YMP/CC-0013

U.S. DEPARTMENT OF ENERGY

OCRWM

YUCCA MOUNTAIN

YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT

PROJECT CCB CONTROLLED DOCUMENT

EXPLORATORY SHAFT FACILITY DESIGN REQUIREMENTS

VOLUME 1

CHANGES TO THIS DOCUMENT REQUIRE PREPARATION AND APPROVAL OF A CHANGE REQUEST IN ACCORDANCE WITH PROJECT AP-3.3Q

DEPARTMENT OF ENERGY · UNITED STATES OF AMERICA

UNITED STATES DEPARTMENT OF ENERGY
YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT OFFICE

YMP/CC-0013

U.S. DEPARTMENT OF ENERGY

OCRWM

YUCCA MOUNTAIN

YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT

PROJECT CCB CONTROLLED DOCUMENT

EXPLORATORY SHAFT FACILITY DESIGN REQUIREMENTS

VOLUME 2

CHANGES TO THIS DOCUMENT REQUIRE PREPARATION AND APPROVAL OF A CHANGE REQUEST IN ACCORDANCE WITH PROJECT AP-3.3Q

UNITED STATES DEPARTMENT OF ENERGY
YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT OFFICE

EXPLORATORY SHAFT FACILITY DESIGN REQUIREMENTS
VOLUME 1

EXPLORATORY SHAFT FACILITY DESIGN REQUIREMENTS
VOLUME 2

YMP/CC-0013

U.S. DEPARTMENT OF ENERGY

OCRWM

YUCCA MOUNTAIN

YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT

Document No. YMP/CC-0013
Revision 5/31/91
CI No. N/A
Date 5/31/91
WBS No. 1.2.1 thru 1.2.7
QA YES

PROJECT CCB CONTROLLED DOCUMENT

EXPLORATORY SHAFT FACILITY DESIGN REQUIREMENTS

CHANGES TO THIS DOCUMENT REQUIRE PREPARATION AND APPROVAL OF A CHANGE REQUEST IN ACCORDANCE WITH PROJECT AP-3.3Q

DEPARTMENT OF ENERGY · UNITED STATES OF AMERICA

UNITED STATES DEPARTMENT OF ENERGY
YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT OFFICE

INFORMATION COPY

Y-AD-057
9/90

YUCCA MOUNTAIN PROJECT
CHANGE DIRECTIVE (CD)

1 CR No. 91-068
Page 1 of 2

SECTION I. IDENTIFICATION

2 Title of Change:

Revision of Exploratory Shaft Facility Design Requirements (ESFDR) Document

3 Change Classification:

☐ Class 1 ☐ Class 3
☒ Class 2

SECTION II. DISPOSITION

4 CR Disposition:

☒ Approved ☐ Disapproved
☐ Approved with Conditions

5 Conditions: *(if applicable)*

None

(See Change Documentation Continuation Page ___)

6 Implementation Direction: *(if applicable)*

1. This Change Request (CR) is Approved for CCB control as the Exploratory Shaft Facility Design Requirements Document and is assigned Controlled Document Number YMP/CC-0013, Revision 5/31/91. A date revision is being given to this document to accommodate the dynamic changes anticipated to this document.

2. The CCB Secretary shall ensure that the Cover Page and the Title Page for Document YMP/CC-0013, Revision 5/31/91, are prepared.

(See Change Documentation Continuation Page 2)

SECTION III. CONCURRENCE

7 Quality Assurance Organization Concurrence

Name: D. G. Horton Org.: PQA
(print) (print)
Signature: [signature] for DG HORTON Date: 5/31/91

8 Disposition Authority

Name: M. B. Blanchard Title: CCB Chrprsn
(print) (print)
Signature: [signature] Date: 5/31/91
For M.B. Blanchard

9 Effective Date:

5/31/91

6 Implementation Direction (continued)

3. The Document Originator shall provide a Print Ready Copy of YMP/CC-0013, Revision 5/31/91, to the CCB Secretary. The Document Number and Revision Number will be identified on each page of the Publication Ready Document YMP/CC-0013. The Document Originator shall also provide a Document Change Notice (DCN) identifying changes made to Revision 5/31/91 of document YMP/CC-0013.

4. The CCB Secretary shall ensure that YMP/CC-0013, Revision 5/31/91, is prepared in accordance with this Change Directive (CD). The CCB Secretary shall prepare a Controlled Document Issuance Authorization (CDIA) to transmit this CD and YMP/CC-0013, Revision 5/31/91, to the Project Document Control Center (DCC) in accordance with AP-1.5Q.

5. Per AP-3.3Q, each Project Participant and Project Office Division Director will complete an Affected Document Notice (ADN) as notification of completion of implementation planning for this CD.

6. The CCB Secretary shall ensure that the Configuration Information System (CIS) and the CCB Document Register are updated to reflect this Approved addition of Document YMP/CC-0013, Revision 5/31/91.

7. Any changes to Document YMP/CC-0013, Revision 5/31/91, will require submittal of a CR to the Project CCB.

8. Upon release of YMP/CC-0013, Revision 5/31/91, all Project Participants will be required to use YMP/CC-0013, Revision 5/31/91, in performing duties applicable to this document.

Y-AD-059
9/90

YUCCA MOUNTAIN PROJECT
DOCUMENT CHANGE NOTICE (DCN) RECORD

1 Document Title:

Exploratory Shaft Facility Design Requirements (ESFDR)

2 Document Number:
YMP/CC-0013

The document identified in Blocks 1 and 2 has been changed. The changed pages attached to this DCN are identified in Block 7 opposite the latest DCN number in Block 3. The original issue of this document as modified by all applicable DCN's constitutes the current version of the document identified in Blocks 1 and 2.

3 DCN NO.	4 CR NO.	5 DOCUMENT Rev./ICN #	6 CR TITLE	7 AFFECTED PAGES	CHANGE	ADD	DELETE	8 DATE
001	91/068	5/31/91*	Revision to ESFDR Document					5/31/91
			Minor editorial changes	Marked by bar	X			
			Supplement Appendix B w/Testing Requirements	Appendix B		X		
			Appendix C				X	

*NOTE: Submitted as YMP/CC-0013, Rev. 1. Change Control Board approved as date revision to accommodate dynamic changes to the document.

 YMP CC-0013, Rev. 5.31.91

YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT

EXPLORATORY STUDIES FACILITY (ESF)

DESIGN REQUIREMENTS

(ESFDR)

VOLUME I

Prepared by Yucca Mountain Site Characterization Project (YMP) Participants as part of the Civilian Radioactive Waste Management Program. The YMP is managed by the Yucca Mountain Site Characterization Project Office (YMPO) of the U.S. Department of Energy, Office of Civilian Radioactive Waste Management.

Compiled by:
Sandia National Laboratories
with support from
Technical and Management Support Services Contractor
101 Convention Center Drive, Suite 407
Las Vegas, Nevada 89109

Prepared for:

U.S. Department of Energy
Yucca Mountain Site Characterization Project Office
P.O. Box 98608
Las Vegas, Nevada 89193-8608

 YMP CC-0013, Rev. 5 31 91

SUBMITTALS AND APPROVALS

This Exploratory Studies Facility Design Requirements (ESFDR) document for the YMP has been prepared and submitted by the Sandia National Laboratories (SNL), with support from the Technical and Management Support Services Contractor (T&MSS), and with YMPO approval by:

Date : 5/20/91

E. H. Petrie, Acting Director
Yucca Mountain Engineering and
Development Division
Yucca Mountain Site Characterization
Project Office

for DGHORTON Date : 5/30/91

D. G. Horton, Director
Yucca Mountain Quality Assurance Division

Date : 5/31/91

C. P. Gertz, Yucca Mountain Site
Characterization Project Manager
Yucca Mountain Site Characterization
Project Office;
Associate Director
Office of Geologic Disposal

The technical content of this document was developed by various Participants who remain responsible for the technical adequacy of the data they provided. Unless otherwise noted, all included data are considered to be "best available," and are adequate for the resumption of ESF design studies. Specific authorization for use of the data to finalize design packages for construction must be obtained from the YMPO.

Sandia National Laboratories (SNL) has primary responsibility for assuring that the technical data other than that indicated as "best available" are developed in accordance with YMP procedures.

YMP CC-0013, Rev. 5/31/91

TABLE OF CONTENTS

VOLUME 1

TABLE OF CONTENTS (continued)

LIST OF FIGURES

YMP CC-0013, Rev. 5 31 91

TABLE OF CONTENTS

VOLUME 2

APPENDICES

YMP CC-0013, Rev. 5/31/91

BACKGROUND

In accordance with the Nuclear Waste Policy Act (NWPA), Public Law 97-425, January 7, 1983, the Office of Civilian Radioactive Waste Management (OCRWM) of the U.S. Department of Energy (DOE) was charged with identifying and nominating at least five sites for submission to the President as being suitable for further study in selection of the first high-level radioactive waste repository site.

As required by Section 112 of the NWPA, each nomination was accompanied by an Environmental Assessment (EA) that included an evaluation of the effects of site characterization activities. Site characterization is defined in the NWPA as the following:

> "...activities, whether in the laboratory or in the field, undertaken to establish the geologic condition and the ranges of the parameters of a candidate site relevant to the location of a repository, including borings, surface excavations, excavations of exploratory shafts, limited subsurface lateral excavations and borings, and in situ testing needed to evaluate the suitability of a candidate site for the location of a repository, but not including preliminary borings and geophysical testing needed to assess whether site characterization should be undertaken."

The DOE recommended three of the five sites to the President for characterization. Presidential approval of the Yucca Mountain site, in Nevada, occurred on May 28, 1986. On December 22, 1987, the Nuclear Waste Policy Act Amendments (NWPAA) identified Yucca Mountain as the site to be characterized.

Evaluation of the suitability of Yucca Mountain as a geologic repository is the responsibility of the YMPO, which is managed by the Office of Civilian Radioactive Waste Management (OCRWM) Office of Geologic Disposal. The Exploratory Studies Facility (ESF) is one aspect of the site characterization process which will provide the necessary data for a number of suitability analyses. An exploratory facility is allowed by the Code of Federal Regulations, Title 10, Part 60 (10 CFR 60) for the conduct of in situ exploration and testing at the depths at which wastes would be emplaced. This testing must be well underway prior to submittal of a license application for authorization to construct a repository. The in situ testing is required to establish and confirm geologic conditions and the ranges of parameters relevant to the demonstration of the adequacy of the site, in accordance with the requirements of 10 CFR 60.

PRIMARY GUIDELINES

The primary guidelines for the YMP ESF are as follows:

- All ESF workings will be restricted to the unsaturated zone. The candidate host rock will be a section of the welded interior of the Topopah Spring Member of the Paintbrush Tuff. The design of the ESF will consider the need to obtain significant and unique information about site properties during underground shaft and/or ramp construction.

YMP CC-0013, Rev. 5 31 91

- The ESF will be constructed with the necessary and adequate facilities and so that the ESF testing will focus on the information necessary to support the site characterization program and license application.

- Construction of the ESF will provide access for detailed studies of the potential host rock as well as the overlying and underlying geologic strata.

The ESF Design Requirements (ESFDR) document provides the functional requirements, performance criteria, constraints, and assumptions for all systems and subsystems within the scope of the ESF. The applicable guidance and requirements contained in the ESF document hierarchy were utilized and incorporated into the ESFDR. For example, the flowdown from the higher documents consist of the Waste Management System Requirements, Volume IV (WMSR IV, an OCRWM document) into the System Requirements (SR) and on into the ESFDR. The ESFDR also has requirement inputs from the Site Characterization Program Baseline (SCPB) (see Appendix B) plus interface requirements from the Repository Design Requirements (RDR) (see Appendix A.1). Additionally, the ESFDR incorporates the input and the concerns of the NRC and the Nuclear Waste Technical Review Board (NWTRB) which includes, but is not limited to, three concerns that were expressed by the NRC regarding the acceptability of ESF Title I Design as it pertains to the Site Characterization Plan and the start of new characterization activities at the Yucca Mountain Site. The three NRC concerns are:

1. The ESF design, construction, and operations should not compromise the ability of the site to isolate waste.

2. The ESF design, construction, and operations should not compromise the ability to characterize the site.

3. The ESF design, construction, and operations should provide representative data.

It is the responsibility of each YMP Participant to comply with all applicable higher level requirements as identified in this document for design and construction of the ESF.

The ESFDR translates the OCRWM requirements into the site specific requirements, from which the YMP Participants' responsibilities are assigned to ensure that all of the design criteria, requirements, and responsibilities are met.

EXPLANATION OF ESFDR VOLUME 1 NOTATIONS AND ORGANIZATION

The structure of the ESFDR follows the applicable guidance of the Office of Civilian Radioactive Waste Management (OCRWM) DOE/RW/0051, REV. 1, Systems Engineering Management Plan. This document requires that the site specific design requirements document (ESFDR) include the following:

YMP CC-0013, Rev. 5-31-91

- DEFINITION OF SUBSYSTEM ELEMENTS.
- APPLICABLE REGULATIONS, CODES, AND SPECIFICATIONS. (This category is shown as APPLICABLE REGULATIONS, CODES, STANDARDS, AND DOE ORDERS in the ESFDR.)
- FUNCTIONAL REQUIREMENTS.
- PERFORMANCE CRITERIA.
- INTERFACE CONTROL REQUIREMENTS.
- CONSTRAINTS.
- ASSUMPTIONS.

This document conforms to this outline within each subsystem section.

Each section of the ESFDR contains the following structure and information: (Section titles are shown in all capital letters for emphasis.)

The DEFINITION OF SUBSYSTEM ELEMENTS division is further divided into two parts, Definition and Boundaries and Interfaces. The definition identifies the general purpose of the section. The boundaries and interfaces identify the complementary sections of the ESFDR which may affect the satisfaction of the requirements in the section of interest.

The APPLICABLE REGULATIONS, CODES, STANDARDS AND DOE ORDERS division identifies those regulatory documents associated with the subject of the section. This division is only found in the primary part of the sections; subsections do not contain this division.

The FUNCTIONAL REQUIREMENTS (FR) division contains definitions of what the subsystem, identified in the section, must accomplish. These FRs are listed in numeric order as statements of purpose.

The PERFORMANCE CRITERIA (PC) division contains criteria statements on how well a specific subsystem must perform its functional requirement and, in some cases, the means for evaluating its performance. These criteria are listed in numeric-alphabetic order as a means of identifying the functional requirement to which they are subordinate. As an example, performance criteria 1a through 1f would be subordinate to Functional Requirement 1. Letters are not used for a single performance criteria.

The INTERFACE CONTROL REQUIREMENTS (IR) division either documents or identifies the source documentation of the external, site, waste package, repository, and internal physical interfaces of the subject subsystem. This division is only found in the primary sections; subsections do not contain this division.

The CONSTRAINTS (C) division contains statements on the limitations that are placed on the subsystem by the design process, interrelated subsystems, and/or environmental conditions within which the subsystem must function. The constraints are listed in alphabetic order.

The ASSUMPTIONS (A) division contains site specific condition statements which may limit the design or needs of the subsystem to a certain alternative, action, route, or piece of equipment. The assumptions are listed in numeric order.

YMP CC-0013, Rev. 5-31-91

Each subsystem statement, whether FR, PC, C, or A, is followed by a bracketed citation which identifies the source of authority for the statement. Specific examples of these citations and their meanings are as follows:

- [10 CFR 60.123]--This citation identifies the statement's source is Paragraph 123 of 10 CFR Part 60.
- [SR3.B]--This citation identifies a quote of Constraint B in Section 3.0 of the Yucca Mountain Mined Geologic Disposal System Requirements (SR-ESF) Document developed to support ESF.
- [SRY.E]--This citation identifies a quote of Constraint E in Section YMMGDS of the Yucca Mountain Mined Geologic Disposal System Requirements (SR-ESF) Document developed to support ESF.
- [6.0FR1]--This citation identifies the statement derived from a higher level statement in section 1.2.6.0 of the ESFDR, Functional Requirement 1.

Any reference made to State regulations will mean State of Nevada unless otherwise noted.

Each PC subsystem statement citation is followed by a series of capital letters in brackets. Each letter identifies the functional system allocation of the associated statement. The definition of each letter code used is as follows:

D--Development activity: ESF construction related tasks and functions.

O--Operations activity: ESF operations related tasks and functions.

W--Waste containment and waste isolation: ESF tasks and functions that may affect nuclear waste isolation capability of the repository.

S--Safety: ESF operational and public safety related tasks and functions.

P--Performance confirmation: ESF performance confirmation related tasks and functions.

M--Maintenance: ESF maintenance tasks and functions.

T--Testing: ESF testing related tasks and functions.

I--Training (instruction): ESF personnel training related tasks and functions.

10 CFR 60 REQUIREMENTS

Appendix E of the WMSR Volume IV lists requirements from 10 CFR 60 which, according to the Nuclear Regulatory Commission (NRC) staff, must be considered in the ESF design. These include requirements which are not applicable to shafts and ramps, but which have been included as a DOE management decision. All requirements have been considered in the sense that nothing in this document

YMP CC-0013, Rev. 5 31 91

would later preclude the DOE's complying with the requirements. However, some of the listed 10 CFR 60 requirements do not directly influence the ESF design and consequently do not appear in the ESFDR. These requirements fall into five categories:

1. The 10 CFR 60 requirements that regulate the handling and control of radioactive material do not appear in the ESFDR because it is anticipated that radioactive waste will not be used during ESF testing. These requirements are:

   - 10 CFR 60.111(a), Protection against radiation exposures and releases of radioactive material

   - 10 CFR 60.131, General design criteria for the geologic repository operations area (a) Radiological protection

   - 10 CFR 60.143, Monitoring and testing waste packages

   Should the DOE decide to transport radioactive waste to the ESF and test it, the above requirements plus others from 10 CFR 71, Section 113 of the NWPA, and appropriate state regulations will be added to the ESFDR.

2. Similarly, the 10 CFR 60 requirements for structures systems and components that protect the public's radiological health and safety do not appear in the ESFDR because such structures would not be needed where there is no radioactive material. These requirements are:

   - 10 CFR 60.21, Content of License Application. This includes the Safety Analysis Report.

   - 10 CFR 60.131, General design criteria for the geologic repository operations area. (b) Structures, systems, and components important to safety.

   - 10 CFR 60.133(g), Underground Facility Ventilation (ventilation when radioactive particles are present underground).

   - 10 CFR 60.133(h), Engineered Barriers (none will be present).

3. The administrative requirements of 10 CFR 60 do not appear in the ESFDR because they are covered elsewhere and are not relevant to the ESF design. These requirements are:

   - 10 CFR 60.4, Communications and records. (b) Retention of records.

   - 10 CFR 60.16, Site characterization plan required (These requirements have been satisfied)

   - 10 CFR 60.17, Contents of the Site Characterization Plan (These requirements have been satisfied)

YMP CC-0013, Rev. 5-31-91

- 10 CFR Part 60.24(a), Updating of application and environmental report

- 10 CFR 60.151, Quality Assurance Applicability

- 10 CFR 60.152, Quality Assurance Implementation

4. The following 10 CFR 60 requirements do not appear in the ESFDR simply because they cannot be evaluated or implemented at this time.

- 10 CFR 60.111(b), Retrievability of Waste

- 10 CFR 60.112, Performance Objective of Geologic Repository after Permanent Closure

- 10 CFR 60.113(a), Performance Objectives of Engineered Barrier Systems

- 10 CFR 60.113(a)(2), Requirements for the minimum groundwater travel time to the accessible environment

- 10 CFR 60.113(b),(2),(3) and (4), Factors that may persuade the Commission to specify or approve some other radionuclide release rate, containment period or groundwater travel time.

- 10 CFR 60.122, Siting Criteria (The ESFDR uses 10 CFR 60.122(c)(1), to constrain drainage and surface water impoundments.

- 10 CFR 60.133(c), Retrieval of Waste

5. Finally, the ESFDR has been revised to eliminate all requirements applicable to the actual Performance Confirmation Program because these belong in the SCPB. The ESFDR now contains only Performance Confirmation Plans (PCPs) design requirements and allows this interface to be maintained. These requirements are:

- 10 CFR 60.133(e)(1), Underground openings (design is to support the retrievability option).

- 10 CFR 60.140, Performance Confirmation Program (PCP), General requirements

- 10 CFR 60.141, Performance Confirmation Program (PCP), Confirmation of geotechnical and design parameters

- 10 CFR 60.142, Performance Confirmation Program (PCP), Design Testing

The remaining 10 CFR 60 requirements are quoted and cited throughout the ESFDR serving as performance criteria or constraints. The quotes and citations enable one to trace the flow of 10 CFR 60 requirements from one document to another. Any deviation from verbatim 10 CFR 60 quotes will be indicated by the new text change being enclosed within brackets.

Beneath some 10 CFR 60 requirements, the ESFDR provides sub-tier requirements, criteria or constraints that orient a Part 60 provision to the circumstances to which it will be applied. These sub-tier statements elaborate on 10 CFR 60, but many do not transform the regulation into a numerical criterion nor do they add much detail. Moreover, in some cases a 10 CFR 60 requirement stands alone without a sub-tier supplement.

DESIGN ACCEPTABILITY ANALYSIS (DAA)

These Exploratory Studies Facility Design Requirements (ESFDR) do not provide the detail that the NRC staff desires. For the most part, the ESFDR, much like the Design Acceptability Analysis, considers the applicable 10 CFR 60 requirements qualitatively. The NRC staff, however, objected to the DAA because:

> "The approach adopted in the DAA raises questions about completeness and rigor of the design acceptability analysis, as <u>detailed design criteria</u> were not developed for <u>all</u> applicable requirements." (NRC, 1989, page 4-98, emphasis added).

The DAA is affected by the 10 CFR 60 considerations discussed above under 10 CFR 60 Requirements. Therefore, these 10 CFR 60 considerations apply to the DAA in that they may not be considered applicable for use in the ESF at this time (See Appendix K for more information).

It is believed the above consideration of 10 CFR 60 requirements adequately deals with the NRC's objection, and this will allow the NRC staff to reconsider their objection and accept the ESFDR even though "detailed design criteria ... for all applicable [10 CFR 60] requirements" have not been developed.

UNDERGROUND TESTING SUPPORT

The title of Section 1.2.6.8 was changed from Underground Tests to Underground Test Support to more accurately reflect the nature of the requirements contained in the section. Requirements applicable to the development of the test program and to the development and execution of individual tests were deleted because they belong in the SCPB. Section 1.2.6.8 now contains only facility design and support requirements for testing.

The Integrated Data System (IDS) will not be designed from requirements in the ESFDR but will be designed using its own set of design requirements. The IDS will require ESF facility support. This will require an interface during ESF design. The title and content of Section 1.2.6.8.1 was revised to reflect this.

EXPLANATION OF ESFDR VOLUME 2 NOTATIONS AND ORGANIZATION

The ESFDR Volume 2 contains Volume 1 support information arranged as appendices A through K. The contents of individual appendices are as follows:

- Appendix A.1--This appendix contains general descriptions of the repository/ESF interfaces. This appendix identifies the need for

YMP CC-0013, Rev. 5/31/91

modifications and redesigns of the ESF accesses to satisfy the functional requirements of the repository underground facility. The appendix cannot be detailed or specific at this time since the ESF configuration is yet to be determined. However, it mentions Option #30 (modified) from the ESF Alternatives Study (AS) as YMPO's choice to resume ESF design. Appropriate generic text describe the Repository/ESF interface relationship. This appendix will continue to be developed and expanded to support the interface relationship as directed by DOE.

- Appendix A.2--This appendix contains drawings that show interfaces between the ESF and repository.

- Appendix A.3--This appendix contains sealing requirements imposed upon the ESF by the repository.

- Appendix A.4--This appendix contains thermal loads to be used for ESF design.

- Appendix A-5--This appendix contains seismic loads to be used for ESF design.

- Appendix B--This appendix contains general descriptions and requirements of the underground tests to be performed in the ESF and the requirements of the Integrated Data System (IDS). The tests are divided into two categories: (1) the suite of tests that will be recommended in any option being considered by the ESF Alternatives Study; (2) the suite of tests that are dependent on the configuration and location of the ESF. These will be addressed when an option has been approved. A list of the tests described is contained in the table at the beginning of the appendix.

- Appendix C--This appendix will list drilling requirements for the ESF.

- Appendix D--This appendix is reserved for future use.

- Appendix E--This appendix contains a listing of some known regulations, codes, standards, and DOE Orders which are applicable to the ESF.

- Appendix F--This appendix contains cross reference listings which allows the reader to determine the relationships between the ESFDR and 10 CFR 60. The listing of 10 CFR 60 contains all of those shown in WMSR Appendix E.

- Appendix G--This appendix contains the logic tree whose purpose is to map graphically the systems, functions and requirements for the ESF.

- Appendix H--This appendix contains the ESF Responsibility Matrix whose purpose is to identify the YMP Participant(s) responsible for designing and implementing per any given requirement in Volume 1 and those Participants who will provide support to the responsible Participant. Those requirements that have not been verified for traceability to a reference authority will have a NV in column 3.

YMP CC-0013, Rev. 5/31/91

Those requirements that require qualification will have a TBD (to be determined) in column 3. Those requirements that have bounds, conditions or values that must be verified will be designated with a TBV (to be verified) in column 3. Requirements listed as TBD are to be sufficiently qualified by the organizations listed to remove the TBD. Requirements with values listed as TBV are to be verified by the organizations listed.

- Appendix I--This appendix contains a listing of information related to ESF performance assessment requirements and the current status of the performance assessment related requirements included in Volume I of the ESFDR.

- Appendix J--This appendix contains the relevant environmental requirements associated with the support of ESF design.

- Appendix K--This appendix contains the requirements developed by the DAA and shows the location of a corresponding statement in the ESFDR.

YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT QUALITY ASSURANCE

All activities associated with the ESF shall be performed to applicable Quality Assurance requirements, and specific approved Quality Assurance Grading Report criteria for ESF items and activities. The basic Quality Assurance policy is established by the YMP Quality Assurance Requirements Document (DOE/RW 0214) and shall be implemented to provide assurance of quality in all phases of the ESF YMP. The latest revision of DOE/RW 0214 includes all Quality Assurance elements identified in the Code of Federal Regulations, Title 10, Part 50, Appendix B, and requires that each participating organization develop Quality Assurance program plans and procedures for all YMP activities.

ESFDR QUALITY ASSURANCE

The review and approval of this document was performed in accordance with QA programs that meet the requirements of 10 CFR 60, Subpart G. The review and approval process was performed in accordance with Sandia National Laboratories Procedure DOP 3-13, "Independent Technical and Management Reviews of Documents," and YMP Quality Management Procedures QMP-06-04, "YMPO Document Development, Review, Approval, and Revision Process." The assignment of quality assurance criteria to individual items and activities described in this document will be accomplished by Quality Assurance grading for specific items and activities. This document does not assign quality assurance criteria. All revisions of the ESFDR for resumption of design shall be performed under QA controls in accordance with DOE/RW 0214 criteria. The ESFDR is expected to be revised on an as-needed basis. Indicated changes, if any, resulting from program redirection or WMSR Vol. IV changes will be incorporated during the revisions.

ESFDR REQUIREMENTS TO BE VERIFIED/VALIDATED

Section

Some of the requirements contained in 1.2.6.0 through 1.2.6.9 and the Appendices may need to be verified or validated. Reference Appendix H and the explanation

 YMP CC-0013, Rev. 5 31 91

of the contents of Appendix H contained in this introduction for additional information.

ESFDR NUMERIC VALUES

The numeric values and units shown in this document are as they appear in the source material. Conversion to any other system or format is left to the user. The principal source of data in this document is the controlled Reference Information Base (RIB), DOE 1989, YMP Reference Information Base, latest issue YMP/CC-0002.

ESFDR VALUES STATED AS GOALS

Performance criteria and constraints expressed as goals are included to provide the designer insight into the importance of parameters that are significant in satisfying the requirements specified in 10 CFR 60. In the design process, it is expected that analyses will be performed to test the validity of these goals. If such analyses predict that the identified goals cannot be met with reasonably available technology, it will be necessary to evaluate the predicted values to ensure that they are acceptable from the repository performance perspective. If the predicted values are acceptable, associated ESFDR goals will be revised accordingly.

CHANGE PROCESS

All changes to this document must have concurrence of the YMPO. Changes required to this document will be evaluated to determine the area(s) of responsibility. Changes which are the responsibility of the Participant organizations will be completed by the responsible Participants.

ESFDR ORGANIZATION DIAGRAM

- **EXPLORATORY STUDIES FACILITY 1260**
  - **SITE(S) 1.2.6.1**
    - MAIN SITE(S) 12611
    - AUXILIARY SITE(S) 12612
    - ACCESS ROADS 12613
    - SITE DRAINAGE 12614
  - **SURFACE UTILITIES 1.2.6.2**
    - POWER SYSTEM 12621
    - WATER SYSTEM 12622
    - SANITARY SYSTEM 12623
    - COMMUNICATIONS SYSTEM 12624
    - SURFACE WASTE-WATER SYSTEM 12625
    - COMPRESSED AIR SYSTEM 12626
    - SOLID WASTE DISPOSAL SYSTEM 12627
  - **SURFACE FACILITIES 1.2.6.3**
    - VENTILATION SYSTEM 12631
    - TEST SUPPORT FACILITIES 12632
    - SITES PREPARATION FOR SURFACE STRUCTURES 12633
    - PARKING AREAS 12634
    - STORAGE FACILITIES 12635
    - SHOP 12636
    - WAREHOUSE 12637
    - OTHER TEMPORARY STRUCTURES 12638
    - COMMUNICATIONS/DATA BUILDING(S) 12639
  - **SHAFT ACCESS 1.2.6.4**
    - COLLAR 12641
    - LINING 12642
    - STATIONS 12643
    - FURNISHINGS 12644
    - HOIST SYSTEMS 12645
    - SUMP 12646
  - **RAMP ACCESS 1.2.6.5**
    - PORTAL 12651
    - LINING 12652
    - STATION 12653
    - RAMP FURNISHINGS 12654
    - 12655 (NOT USED)
    - SUMP 12656
  - **UNDERGROUND EXCAVATIONS 1.2.6.6**
    - OPERATIONS SUPPORT AREAS 12661
    - TEST AREAS 12662
  - **UNDERGROUND SUPPORT SYSTEMS 1.2.6.7**
    - POWER DISTRIBUTION SYSTEM 12671
    - 12672 (NOT USED)
    - LIGHTING SYSTEMS 12673
    - VENTILATION DISTR SYSTEMS 12674
    - WATER DISTRIBUTION SYSTEMS 12675
    - UNDERGROUND WASTEWATER COLLECTION SYSTEM 12676
    - COMPRESSED AIR DISTR SYSTEM 12677
    - FIRE PROTECTION SYSTEM 12678
    - MUCK AND MATERIAL HANDLING SYSTEMS 12679
    - SANITARY FACILITIES 126710
    - MONITORING AND WARNING SYSTEMS 126711
  - **UNDERGROUND TEST SUPPORT 1.2.6.8**
    - INTEGRATED DATA SYSTEM SUPPORT 12681
    - TEST SUPPORT 12682
  - **ESF DECOMMISSIONING AND CLOSURE 1.2.6.9**
    - SURFACE FACILITIES 12691
    - ACCESSES & UNDERGROUND FACILITIES 12692

Figure 1

ESFBS 009/5 31 91

YMP/CC-0013, Rev. 5/31/91

 YMP CC-0013, Rev. 5 31 91

1.2.6.0 EXPLORATORY STUDIES FACILITY
(Generic Physical Subsystem Account Code: 4.0.0)

Subparts are
- 1.2.6.1 ESF Site(s)
- 1.2.6.2 Surface Utilities
- 1.2.6.3 Surface Facilities
- 1.2.6.4 Shaft Access
- 1.2.6.5 Ramp Access
- 1.2.6.6 Underground Excavations
- 1.2.6.7 Underground Support Systems
- 1.2.6.8 Underground Test Support
- 1.2.6.9 ESF Decommissioning and Closure

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The Exploratory Studies Facility (ESF) is defined as those systems, subsystems, and components used for in situ site characterization, early repository construction, and performance confirmation testing of the Yucca Mountain site for a repository. The ESF is defined as the surface and underground facilities (including accesses and connecting drifts) and supporting systems required to support site characterization testing at depth. The underground limits for ESF (the designated test area) use will be defined in the ESF-Repository interface drawings to be contained in ESFDR Appendix A.2. The main test level (MTL) is defined as the ESF development within the planned repository horizon, which currently is the TSw2 rock unit within the Topopah Member of the Paintbrush Tuff. The MTL is contained within the designated test area. Radioactive wastes will not be handled or stored at the ESF surface facilities unless specifically requested by the Nuclear Regulatory Commission for the purpose of site characterization testing.

Boundaries and Interfaces

Specific boundaries and interfaces between participating organizations' designs are identified in the YMP Interface Control Document(s). Boundaries and interfaces internal to a participating organizations design shall be controlled by the procedures of that organization. Full compliance of the ESF design with the requirements and criteria of Section 1.2.6.0 necessitates an evaluation and understanding by the designer of the boundary and interface impacts of the requirements and criteria throughout this document in accordance with approved YMP procedures.

APPLICABLE REGULATIONS, CODES, STANDARDS, AND DOE ORDERS

It is the responsibility of the Design Organization (DO) to identify which specific portions of regulations, codes, standards, and DOE orders apply. General references to some of these can be found in each section of this document. The latest edition or revision in effect at the time of initiation of an ESF design phase shall be used. Subsequent revisions of a regulation, code, standard, or DOE Order during a design phase shall be

evaluated using the applicable YMP-approved change control process to determine the expected impacts of the revision on the design process and when implementation of the revision shall be invoked. ESFDR Appendix E contains a listing of some additional commonly used regulations, codes, standards, and DOE orders. ESFDR Appendix J contains a listing of environmental-related requirements that apply to ESF activities.

In the event of conflicts or duplications among the radiological requirements listed in the Yucca Mountain Regulatory Compliance Plan (YMP/90-33, September 1990), the requirement holding the highest authority shall prevail. In general, Public Laws are the most authoritative, followed by the Code of Federal Regulations, YMP Positions, and NRC guidance. DOE Orders are the least authoritative.

Written requests for any necessary waivers shall be made to the YMP Project Manager of the YMPO, or his designee in accordance with AP-7.2, "Process for Requesting Exemptions from DOE Orders."

FUNCTIONAL REQUIREMENTS

1. Provide facilities for in situ site characterization for the Mined Geologic Disposal System and support in situ site characterization as required by DOE/OCRWM milestones and the Site Characterization Plan. [SRY.E and SR3.B]

2. Provide for the incorporation of the ESF into the future repository. [SR3.C and E]

PERFORMANCE CRITERIA

1a. The location of the ESF shall be representative of the features and conditions expected at the potential repository site. (D) [SR3.C and E]

1b. The thickness, lateral extent, physical and chemical properties, and composition of the host rock for the ESF shall be representative of the potential repository site. (D) [SR3.C and E]

1c. Drill core and/or the results of geologic and geophysical investigations shall be used to establish and confirm specific location of, and design the ESF shafts and/or ramps, and underground openings. (D,O,T) [SR3.C and E]

1d. Underground openings shall be developed to meet the needs of in situ site characterization including basic needs for the initially planned tests and an allowance for uncertainties in the test plans and underground conditions. [TBD] (D,O,P) [SR3.B]

   i. All major systems for ventilation, utilities, emergency egress, rock handling, personnel support, and others shall be analyzed to determine the need for the uncertainty allowance. If it can be

 YMP CC-0013, Rev. 5 31 91

demonstrated that critical parts of the allowance would require excessive costs, or have schedule, test disruption, or other program impacts if designed, procured, and/or constructed later (after the basic test plan needs are completed), consideration shall be given to designing, procuring, and/or constructing these critical items as part of the initial facility. (D,O,P,T)

ii. This uncertainty allowance shall be incorporated in the site specific design requirements documents as a percentage over and above the requirements for the basic test area needs. (D)

iii. All allowances for uncertainty of the major ESF systems are to be determined as soon as possible after the start of Title II. [TBD] (D,O,T)

1e. The ESF shall be designed and constructed so that, to the extent practicable, breakdowns during construction and operations will not adversely affect schedule or budget (D,O) [SR3.B and E]

1f. All geotechnical information used to locate, and design the accesses and underground features (including seismic criteria) shall be consistent with information contained in the Reference Information Base (RIB), YMP controlled documents, or standard reference information (e.g., standard handbooks). Records of the ESF design, construction, operation and in-situ testing shall be maintained sufficient to satisfy the requirements of 10 CFR 60.72. (T) [SR3.C]

1g. The ESF design shall conform to applicable Federal, State, and local codes and standards pertaining to natural hazards and foundation stability, such as the requirements specified in DOE Order 6430.1A, General Design Criteria. (D) [SRY.D]

1h. A minimum of two accesses shall be incorporated into the underground ESF to ensure adequate alternative routes of egress. [SRY.C]

1i. The centerline coordinate locations for the selected accesses shall be defined by the Nevada Coordinate System and listed in the RIB. [SRY.F and G] .

1j. Sufficient facilities shall be provided which alert on-site personnel of possibly dangerous environmental and safety situations. Appendix J identifies the environmental requirements that apply to ESF activities. [SRY.C]

i. Alarm systems shall indicate when the various monitored conditions exceed specified limits. Redundant systems shall be installed as required by applicable regulations, and shall include either whole systems or critical components within the system, to the extent practical. (S)

ii. Detection equipment for fires and explosions shall meet the requirements of DOE Order 5480.7 DOE Order 6430.1A, Division 15,

YMP CC-0013, Rev. 5 31 91

Mechanical; and any other applicable local, State of Nevada, and Federal regulations. (S)

1k. The ESF shall consist of the following: ESF site, surface utilities, surface facilities, shaft access, ramp access, underground excavations, underground support systems, underground test support, and provisions for decommissioning and closure. [SR3.B, C, D and E]

2a. ESF permanent structures, systems, and components that will be incorporated into the repository shall be designed and constructed with the same criteria, standards, and quality assurance as required for a repository, to the extent known at the time of ESF design. (D,O,W) [SRY.D, E, F, G, and H]

2b. The items listed below are the "ESF permanent systems, structures, and components" which shall be designed, procured, and constructed so they can be incorporated into a repository: [SR3.C and E]

i. Underground Opening(s)--space created by mining or drilling, including those zones within the rock altered by that process.

ii. Shaft and Ramp Lining(s)--all permanent components placed between the inside limits of the shaft and ramp and the accessible extent of the underground opening.

iii. Ground Support--any means used to reinforce rock and/or control the movement of rock except for items of support which may be removed or replaced if the ESF is incorporated into the repository.

iv. Operational Seal(s)--any engineered structure including the material placed in an underground opening and/or the peripheral rock for the purpose of controlling the flow of water and/or gas during the life of the ESF and through the pre-closure phase of the repository if the the site is approved.

The above items shall be designed to have a maintainable life of 100 years. (D,O,W)

2c. The design life for ESF systems, components, and structures shall be as follows: [SR3.C and E]

i. Drainage ponds and rock storage liners shall be designed and constructed for a maintainable 25-year life.

ii. Shaft collars and ramp portals shall be designed and constructed for a maintainable 100-year life. (O,S,M)

iii. Site preparation for shaft collars and ramp portals shall be designed and constructed for a maintainable 100-year life. (D,O,M)

YMP CC-0013, Rev. 5-31-91

iv. Permanent shaft and ramp structures, systems, and components shall be designed and constructed for a maintainable 100-year life. (O,S,M)

v. Permanent ESF structures, systems and components shall be designed and constructed for a 100-year maintainable life.

vi. The maintainable design life for those nonpermanent ESF structures, systems, and components that are necessary for initial repository construction shall be 15 years. (D,O,M)

2d. The ESF shall be designed, constructed, and operated so that the ESF does not preclude the MGDS's ability to meet the requirements of 10 CFR 60. Compliance with 10 CFR 60 will be demonstrated at the time of repository license application. (D,O,W) [SR3.E]

2e. The design of the ESF underground facility shall provide for control of water or gas intrusion. [10 CFR 60.133(d)] [SR3.E]

2f. Design and construction methods shall demonstrate that the potential repository can be licensed and constructed. [SR3.C and E]

i. ESF accesses and other underground excavations shall be designed and constructed with reasonably available technology similar to or corresponding with the techniques planned for the potential repository. (D,O,T)

a. Reasonably available technology to be used at the ESF site shall be technology that exists and has been demonstrated, or for which the results of any requisite development, demonstration, or confirmatory testing will be available prior to its application to the ESF. (D,O,T)

INTERFACE CONTROL REQUIREMENTS

1. The basic interface control requirements are established by the YMP Administrative Procedure AP-5.19Q, Interface Control. This procedure is applicable to all work performed by participating organizations and contractors during the engineering phases for the ESF. [TBD] [SRY.H]

2. ESF design, construction, and operations shall be coordinated with surface-based testing design, construction, and operations.

CONSTRAINTS

A. Applicability of State and local regulations shall be determined by DOE in consultation with State and local officials, as stated in the final Environmental Assessments, Mission Plan and NWPA, as amended. [SRY.A]

B. To the extent practicable and consistent with procurement regulations, surplus government equipment shall be considered for fulfilling the

YMP CC-0013, Rev. 5 31 91

requirements of the ESF facilities, support services, and equipment. [SRY.A]

C. The program of site characterization activities shall be conducted in accordance with the following: [SR3.C]

(1) Investigations to obtain the required information shall be conducted in such a manner as to limit adverse effects on the long-term performance of the geologic repository to the extent practical. [10 CFR 60.15(c)(1)]

(2) The number of exploratory boreholes and shafts [and ramps] shall be limited to the extent practical consistent with obtaining the information needed for site characterization. [10 CFR 60.15(c)(2)]

(3) To the extent practical, exploratory boreholes and shafts [and ramps] in the geologic repository operations area shall be located where shafts [and ramps] are planned for underground facility construction and operation or where large unexcavated pillars are planned. [10 CFR 60.15(c)(3)]

(4) Subsurface exploratory drilling, excavation, and in situ testing before and during construction shall be planned and coordinated with geologic repository operations area design and construction. [10 CFR 60.15(c)(4)]

i. Underground ESF construction shall not adversely affect in-situ site characterization.

ii. All ESF activities shall be monitored frequently for the purpose of assessing the effects of those activities on the future suitability of the site for a repository.

iii. All substances and tracers intended to be added to water and compressed air to be used underground for such purposes as drilling and dust control shall first be reviewed for potential to affect site characterization testing, repository testing or monitoring, and waste isolation. They may be added only following review and approval. (See Test 2.2.29, ESFDR, Appendix B.)

iv. The use of hydrocarbons and solvents underground shall comply with criteria to be determined by performance assessment. [TBD]

v. Precautions shall be taken to avoid and/or control spills of hydrocarbons, solvents, and cementitious materials. Spills which do occur shall be cleaned up to the extent practicable. Spilled and contaminated material (including soil) shall be disposed of in accordance with Federal and State requirements. Specifically, this means the following regarding cleanup:

Liquid spills-- all puddles and all soil that are nearly saturated with the spilled material shall be removed.

Powder spills-- all spilled material shall be removed. Final cleanup from solid surfaces shall be by sweeping; final cleanup from soil surfaces shall include removal of soil in contact with the spilled material.

vi. Testing instrumentation shall be removed, to the extent practicable, following its final use.

vii. To the extent practicable, drilling with water into known large-aperture fractures shall be avoided.

viii. ESF items and activities shall not affect overall system performance objectives for the MGDS as required by 10 CFR 60.112.

D. DOE shall perform, or permit the Commission to perform, such tests as the Commission deems appropriate or necessary for the administration of the regulations in this part [Part 60]. These may include tests of: (1) radioactive waste, (2) the geologic repository including its structures, systems, and components, (3) radiation detection and monitoring instruments, and (4) other equipment and devices used in connection with the receipt, handling, or storage of radioactive waste. [10 CFR 60.74(a)] [SR3.E]

The tests required under this section shall include a performance confirmation program carried out in accordance with Subpart F of this part [Part 60]. [10 CFR 60.74(b)] [SR3.E]

E. Sections [10 CFR] 60.131 through [10 CFR] 60.134 specify minimum criteria for the design of the geologic repository operations area. These design criteria are not intended to be exhaustive, however. Omissions in § § [10 CFR] 60.131 through 60.134 do not relieve DOE from any obligation to provide such safety features in a specific facility needed to achieve the performance objectives. All design bases must be consistent with the results of site characterization activities. [10 CFR 60.130] [SRY.F]

i. Design basis events for the ESF shall be those natural, credible disruptive events likely to occur at the ESF site during both pre-closure and post-closure periods. Natural, credible disruptive events shall be identified by the DO and reviewed and approved by the YMPO. Analysis shall conform to procedures for determining items important to safety and items important to waste isolation. The magnitude, duration, and severity used for each of these design basis events shall be as described in the RIB.

ii. Design basis accidents and operational occurrences for the ESF shall be those credible disruptive events likely to occur at the ESF site during pre-closure construction, operations, and testing. An initial comprehensive list of construction, operations and testing related credible disruptive events shall be identified by the DO and reviewed and approved by the YMPO. Analysis shall conform to procedures for determining items important to safety and items important to waste isolation.

YMP CC-0013, Rev. 5 31 91

The magnitude, duration, and severity used for each of these events shall be developed by the responsible DO and included in their design basis documentation.

F. Responsible DO and PI shall develop a list of potentially hazardous substances whose use shall be controlled on the surface and underground. The list shall contain information on maximum allowable quantities and the basis of determination. [SRY.B and C; SR3.F]

G. To the extent that DOE is not subject to the Federal Mine Safety and Health Act of 1977, as to the construction and operation of the geologic repository operations area, the design of the geologic repository operations area shall nevertheless include such provisions for worker protection as may be necessary to provide reasonable assurance that all structures, systems, and components important to safety can perform their intended functions. Any deviation from relevant design requirements in 30 CFR, Chapter I, Subchapters D, E [Subchapters D and E cover Parts 18-36 in the current version], and N will give rise to rebuttable presumption that this requirement has not been met. [10 CFR 60.131(b)(9)] [SR3.E]

   i. If the subsurface facility is classified as a gassy mine, then appropriate requirements of 30 CFR Part 57 in effect at the time of design shall be applicable.

H. (a) Seals for shafts [and ramps] and boreholes shall be designed so that following permanent closure they do not become pathways that compromise the geologic repository's ability to meet the performance objectives for the period following permanent closure. (b) Materials and placement methods for seals shall be selected to reduce, to the extent practicable: (1) The potential for creating a preferential pathway for groundwater to contact the waste packages or (2) for radionuclide migration through existing pathways. [10 CFR 60.134] [SR3.E]

I. The ESF shall be located, designed, constructed, operated, and decommissioned in a manner that complies with the environmental requirements in ESFDR Appendix J. [SRY.B]

J. ESF construction and operations shall comply with State and local requirements for permitting that may be stipulated by NRS Chapter 618, Construction and Operating Permit for New Elevators, and Boiler and Pressure Vessel Operating Permit; and NRS Chapters 278, 439.200, 444, 445, and 446, Permit to Construct a Campsite (for construction activities). [SRY.C]

K. The ESF shall be located, designed, constructed, operated, and decommissioned in a manner that protects the health and safety of the workers and the public. This is as specified in 40 CFR 191 and as implemented by NRC in 10 CFR 20 and 10 CFR 60; 29 CFR 1910 and 29 CFR 1926; 30 CFR 57; DOE Orders 5400.3, 5480.4, and 5480.11; and other radiological and non-radiological standards mandated in DOE/RW-0119, OCRWM Safety Plan.

YMP CC-0013, Rev. 5/31/91

L. Facilities and utilities shall accommodate the number of personnel during the ESF construction, operation, and testing phases. An ESF population study to determine the number of such personnel shall be performed by the DO and approved by the YMPO. [TBD]

M. The design shall incorporate operability assessments which include reliability, availability, and maintainability (RAM) analysis. RAM analysis shall identify and mitigate operational problems in design. These analyses shall allocate systems performance objectives to subsystems and components. (SR1.PC1)

ASSUMPTIONS

None.

YMP CC-0013, Rev. 5/31/91

1.2.6.1 ESF SITE(S)
(Generic Physical Subsystem Account Code: 4.1.0)

Subparts are 1.2.6.1.1 Main Site(s)
1.2.6.1.2 Auxiliary Site(s)
1.2.6.1.3 Access Roads
1.2.6.1.4 Site Drainage

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The ESF site is defined as the surface systems, subsystems and components located on Government-owned land necessary for the development of the surface and underground facilities and supporting systems required to support site characterization testing at depth. Site systems, subsystems, and components are composed of general civil improvements and comprise the main site(s), auxiliary site(s), access roads, and a drainage system(s).

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization's designs are identified in the YMP Interface Control Document(s). Full compliance of the ESF design with the requirements and criteria of Section 1.2.6.1 necessitates an evaluation and understanding, by the designer, of the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.2 SURFACE UTILITIES
1.2.6.2.1 Power System
1.2.6.2.2 Water System
1.2.6.2.3 Sanitary System
1.2.6.2.4 Communications System
1.2.6.2.5 Surface Wastewater System
1.2.6.2.6 Compressed Air System
1.2.6.3 SURFACE FACILITIES
1.2.6.3.1 Ventilation System
1.2.6.3.2 Test Support Facilities
1.2.6.3.3 Site Preparation for Surface Structures
1.2.6.3.4 Parking Areas
1.2.6.3.5 Storage Facilities
1.2.6.3.6 Shop
1.2.6.3.7 Warehouse
1.2.6.3.8 Other Temporary Structures
1.2.6.3.9 Communications/Data Building(s)
1.2.6.4 SHAFT ACCESS
1.2.6.4.1 Collar
1.2.6.5 RAMP ACCESS
1.2.6.5.1 Portal
1.2.6.6 UNDERGROUND EXCAVATIONS
1.2.6.7 UNDERGROUND SUPPORT SYSTEMS
1.2.6.9 ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.1 Surface Facilities

YMP CC-0013, Rev. 5/31/91

APPLICABLE REGULATIONS, CODES, STANDARDS, AND DOE ORDERS

The design shall be in accordance with:

1. DOE 6430.1A, Division 1 General Requirements (except for the seismic requirements in 111-2.7, earthquake loads); Division 2 Site and Civil Engineering; Division 3 Concrete; and Division 5 Metals. For surface structures design seismic requirements, refer to UCRL - 15910, Draft (Rev. 4).

2. State of Nevada, Department of Transportation, Road Design Division, Design Manual, Parts 1 and 2 (for roadways only).

3. State of Nevada, Department of Transportation, Standard Specifications for Road and Bridge Construction.

4. 30 CFR Part 57.

5. 29 CFR Part 1910.

6. DOE 5480.4.

In addition, see Section 1.2.6.0, Applicable Regulations, Codes, Standards, and DOE Orders.

FUNCTIONAL REQUIREMENTS

1. Provide and prepare surface locations to support the ESF activities. [6.0FR1]

PERFORMANCE CRITERIA

1a. Sites shall be surveyed and locations identified in sufficient detail for construction needs and to allow the conduct of an environmental analysis and assessment (archaeological, biological and soil pre-activity surveys, etc.). [6.0PC1k]

1b. Shaft and shaft-collar and ramp and ramp-portal areas shall be located and/or graded to protect them, and prevent water inflow to the underground facilities, from the probable maximum flood. [6.0PC2e] (D,O,S)

1c. The area within the fenced boundaries shall be cleared of unusable roads, utilities, and structures that interfere with the ESF. [6.0PC1k] (D)

1d. Roads, building sites, utility corridors, and rock-storage areas shall be cleared, graded, and stabilized. Topsoil shall be stored in an environmentally acceptable manner. (D) [6.0PC1k]

1e. The site layout shall be able to accommodate future expansion. (D) [6.0PC1k]

1f. Construct new roads and relocate or refurbish existing roads. Include provisions for road access to the site, as required. [6.0PC1k]

1g. All storm-water runoff shall be controlled in an environmentally acceptable manner. [6.0PC1k] (D,C,M)

1h. Locate borrow areas as close to the ESF as practical. [6.0PC1k]

INTERFACE CONTROL REQUIREMENTS

1. The ESF designers shall interface with repository requirements developers and designers on ESF site location and layout, and on permanent ESF structures, systems, and components, and shall make available all design information pertaining to the permanent ESF components during formal program design technical assessments and reviews, or when such information is formally requested by the repository designers through DOE or their designated representative.

See Section 1.2.6.0, Interface Control Requirements.

CONSTRAINTS

A. In accordance with 10 CFR 60.15(c)(1), the location, design, construction, and operation of the main site and auxiliary sites shall incorporate aspects specifically directed at limiting the potential for adverse effects on the long term performance of the repository. [TBD] [6.0PC2d]

B. The ground at each site shall be restored to a contour compatible with its initial condition. This shall be done after all use for a site is completed and all facilities have been removed. [6.0PC2c]

C. In accordance with 10 CFR 60.133(f) [6.0PC2d]:

i. The design and construction of the site civil improvements for the permanent and nonpermanent ESF structures, systems, and components shall not significantly increase the preferential pathways for groundwater or radioactive waste migration to the accessible environment or otherwise significantly reduce the ability of the site to meet the performance objectives as stated in the approved SCP. [TBD]

ii. Foundations for equipment, buildings, and structures shall be constructed using excavation methods such as controlled blasting to limit damage to the underlying rock mass, to the extent that it could affect the adequacy or reliability of information from site characterization. Methods shall be designed by the responsible organization to facilitate investigation and monitoring of such effects during and after construction.

YMP CC-0013, Rev. 5/31/91

iii. The ESF equipment, buildings, and foundations for structures shall be designed and constructed so that their excavation does not lead to creation of pathways that compromise the repository's capability to meet the performance objective of 10 CFR Part 60.112.

D. In accordance with 10 CFR 60.137, the ESF site shall be designed to facilitate appropriate performance confirmation measurement and monitoring to obtain adequate and reliable information about the site. The performance confirmation program shall include measurement and monitoring of the performance of the ESF site to the extent that aspects of the site are part of the geologic setting that could contribute to the waste isolation performance of a repository. [6.0PC2d]

E. In accordance with 10 CFR 60.130, the use of hydrocarbons, solvents, and chemicals shall be controlled during construction and operation of shaft(s)/ramp(s)/surface site(s) to limit adverse chemical changes. [6.0CC]

F. In accordance with 10 CFR 60.133(d) [6.0CC]:

i. The amount of water used in site preparation and operations should be limited to that required for sanitation, dust control, compaction of engineered fill material, and proper equipment operation so as to limit the effects on the containment and isolation capability of the site.

ii. Construction of the shaft(s)/ramp(s) surface sites shall be performed in a manner to avoid blockage of natural surface water drainageways and avoid creation of surface water impoundments that could impact post-closure performance.

iii. Multipurpose boreholes (MPBH) or other surface drilled exploratory boreholes associated with the ESF shall be drilled dry.

iv. Any MPBHs drilled at ESF sites shall incorporate a standpipe or other measures appropriate and adequate for protection against the effects of maximum credible floods during the period when MPBHs are accessible prior to borehole plugging and sealing. The location of the maximum credible flood in relation to MPBHs shall be determined by the DO. [TBD]

v. Excess water shall be removed.

G. The designs for site preparation shall ensure that construction activities disturb only the amount of land necessary to accomplish the YMP. [6.0PC2d]

H. Access to the ESF site shall be controlled by fencing and a gate across the roadway. [6.0PC2d]

 YMP CC-0013, Rev. 5 31 91

I. Flood protection shall be utilized for appropriate surface facilities as applicable. [6.0PC1k]

J. Runoff and erosion during construction and operation and after decommissioning shall be controlled in accordance with applicable State of Nevada and local regulations. [6.0CK]

K. Dust control shall be provided at potential dust-generation areas such as roads and earth-moving sites in order to minimize airborne particulates, as required by applicable Federal, State, and local codes. The current State of Nevada standard for total suspended particulate (TSP) matter is based on the ambient concentration for TSP, which limits TSP to less than 75 micrograms per cubic meter per day [NAC 445.843]. This standard will be replaced with the current EPA standard, based on the fraction of TSP that is less than 10 micrometers in aerodynamic diameter (PM-10). This new standard will limit PM-10 particulates to less than 33 micrograms per cubic meter per day. [40 CFR 50.6] [6.0CK] (D,O,M)

L. The site systems, subsystems, and components shall incorporate environmental impact considerations with respect to ground disturbance, dust control, etc. (See Section 1.2.6.0, Constraints Item A.). [6.0PC1g, CK] (D,O,M)

M. The sites will be sized and arranged so that temporary facilities to support shaft and ramp construction are incorporated. [6.0PC1k] (D)

N. The ESF shall be designed to operate on a 3-shift-per-day, 7-days-per-week schedule throughout both the ESF construction and operation phases. [6.0PC1k]

O. Water entering the ESF shall be managed appropriately, including quantity, location, and water balance. [6.0PC2d, CC]

ASSUMPTIONS

1. Surface characteristics such as topography, meteorological conditions, and flood potential are important factors in the process of designing surface facilities. These factors will be included in the design process.

2. The natural terrain will provide a barrier to vehicle access, but if there are exceptions in any location, access will be controlled by a chain link fence and gates.

3. Excavation using ripping will not measurably damage the underlying rock.

YMP CC-0013, Rev. 5/31/91

1.2.6.1.1 MAIN SITE(S)

(Generic Physical Subsystem Account Code: 4.1.1)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The main site(s), is located on the surface, accommodates structures, systems, and components for direct construction of shaft(s) and/or ramps to provide access to the underground site characterization areas but does not include initial construction and test support facilities.

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the YMP Interface Control Document(s). Full compliance of the ESF design with the requirements and criteria of Section 1.2.6.1.1 necessitates an evaluation and understanding, by the designer, of the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.1.2 Auxiliary Site(s)
1.2.6.1.3 Access Roads
1.2.6.1.4 Site Drainage
1.2.6.2 SURFACE UTILITIES
1.2.6.3 SURFACE FACILITIES
1.2.6.4 SHAFT ACCESS
1.2.6.5 RAMP ACCESS
1.2.6.6 UNDERGROUND EXCAVATIONS
1.2.6.8.2 Test Support
1.2.6.9 ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.1 Surface Facilities

FUNCTIONAL REQUIREMENTS

1. Provide a main site(s) of adequate size and shape to support all anticipated structures, systems, and components that will be located near the accesses. [6.1FR1]

PERFORMANCE CRITERIA

1a. Analysis to determine which items should be included on the main site(s), shall consider the following: [6.1PC1e, CM]

i. Roads (muck haulage and access).
ii. Shaft Access (plus standoff distances).
iii. Ramp Access (plus standoff distances).
iv. Permanent hoist house(s) including ramp hoisting, if needed (plus standoff distances).
v. Headframes and back legs and/or ramp construction facilities.

YMP CC-0013, Rev. 5 31 91

vi. Muck handling facilities.
vii. Ventilation fans (plus standoff distances) as required.
viii. Utilities (power, water, sewage, communications).
ix. Access construction facilities.
x. Parking.
xi. Communications/Data buildings (includes IDS).
xii. Multipurpose boreholes.

1b. The layout of a main site(s) shall facilitate the safe and efficient flow of material and personnel within the working areas. [6.1CM] (D,O)

CONSTRAINTS

A. To the extent practical, exploratory boreholes and shafts in the geologic repository operations area shall be located where accesses are planned for underground facility construction and operation; or where large, unexcavated pillars are planned. [10 CFR 60.15(c)(3)]

B. Buildings shall be so spaced as to allow sufficient room for construction and maintenance of the facilities. [6.1CM] (D,O,M)

ASSUMPTIONS

1. Access to the ESF subsurface may be obtained by ramp(s), shaft(s), or combinations thereof.

YMP CC-0013, Rev. 5 31 91

1.2.6.1.2 AUXILIARY SITE(S)

(Generic Physical Subsystem Account Code: 4.1.2)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The auxiliary site(s) consist of the areas prepared to support the ESF construction and operation. These will include a laydown area and sites for explosives magazine, muck storage, topsoil storage, batch plant, water tank, substation with standby generators, compressors, warehouse (with fenced outdoor storage area), and other areas defined as the design progresses.

Boundaries and Interfaces

Specific boundaries and interfaces between participating organizations' designs are identified in the YMP Interface Control Document(s). Full compliance of the ESF design with the requirements and criteria of Section 1.2.6.1.2 necessitates an evaluation and understanding, by the designer, of the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.1.1 Main Site(s)
1.2.6.1.3 Access Roads
1.2.6.1.4 Site Drainage
1.2.6.2 SURFACE UTILITIES
1.2.6.3 SURFACE FACILITIES
1.2.6.4 SHAFT ACCESS
1.2.6.5 RAMP ACCESS
1.2.6.9 ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.1 Surface Facilities

FUNCTIONAL REQUIREMENTS

1. Provide an auxiliary site(s) of adequate size and shape to support anticipated functions. [6.1FR1]

PERFORMANCE CRITERIA

1a. Analysis to determine which items should be included on the auxiliary sites, shall consider the following: [6.1PC1e, CM]

   i. Construction Utilities

      a. Water.
         Piping.
         Water tanks.
         Booster station.
         Fire protection.

YMP CC-0013, Rev. 5/31/91

b. Power.
  Primary surface power.
  Secondary surface power.
  Substations(s).
  Standby generators (including fuel tanks).

c. Communications.
  Microwave support.
  Communications shelter.
  Telephone support.

d. Sewage.

e. Wastewater disposal.

f. Air compressor system.

ii. Construction surface storage.

a. Borrow material (fill).
b. Chemical and hazardous materials storage (if required).
c. Controlled material storage.
d. Covered material storage.
e. Explosives.
f. Fuel and lubricants.
g. Lay down areas.
h. Muck storage.
i. Surface equipment.
j. Surface transport vehicles.

iii. Construction support facilities.

a. Assembly yard.
b. Batch plant.
c. Shop(s)/warehouse.
d. First aid station.
e. Offices.
f. Change house(s).

iv. Access to other facilities.

a. Roads.

v. Site characterization surface storage.

a. Chemical and hazardous materials storage (if required).
b. Controlled material storage.
c. Covered material storage.
d. Sample storage provided by Sample Management Facility.
e. Spare parts storage.
f. Surface transport vehicles.
g. Top soil storage.

YMP CC-0013, Rev. 5 31 91

vi. Site characterization support facilities.

a. Shop(s)/warehouse.
b. First aid station.
c. Offices.
d. Change house(s).
e. Utilities.

1b. All auxiliary sites shall be designed to handle potential runoff of a 100-year storm unless otherwise specified. The following sites shall be designed to the runoff potential shown:

i. Batch plant site, 10-year storm;

ii. Lower storage site(s), if required, 10-year storm;

iii. USW G-4 borehole site, 10-year storm;

iv. Booster pump building site, 50-year storm;

v. Compressor site, 50-year storm.
[6.1PC1g] (D,O,S,M)

CONSTRAINTS

A. The auxiliary site(s) shall facilitate the safe and efficient flow of material and personnel within and around their respective areas. [6.0FR1]

B. Surface explosives and cap storage magazines shall meet all requirements of 30 CFR 57 Subpart E, 29 CFR 1910.109, applicable State and local regulations, and DOE Orders 5480.4 and 6430.1A. [6.0CO] (D,O,S)

C. The rock-handling system(s) shall be capable of transporting and storing all excavated rock in an environmentally acceptable manner. The storage area shall be capable of supporting the excavation allowance determined under 1.2.6.0 PC1d. [6.1CK, CM] (O)

D. The capacity of surface rock storage [area(s)] shall include allowance for overbreak and swell of broken rock from shafts [and ramps] and underground development. [6.1CM] (O)

ASSUMPTIONS

1. The graded areas for the auxiliary site(s) do not need to be contiguous or on a single level if another arrangement is cost effective (considering construction, operation, and maintenance) or provides for efficient operations.

2. The muck storage site must provide equipment or facilities for dust control when muck storage begins.

YMP CC-0013, Rev. 5/31/91

1.2.6.1.3 ACCESS ROADS
(Generic Physical Subsystem Account Code: 4.1.3)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The access roads are defined as all features needed to provide vehicular access to all surface areas designated as required to support the ESF.

Boundaries and Interfaces

Specific boundaries and interfaces between participating organizations' designs are identified in the YMP Interface Control Document(s). Full compliance of the ESF design with the requirements and criteria of Section 1.2.6.1.3 necessitates an evaluation and understanding, by the designer, of the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.1.1	Main Site(s)
1.2.6.1.2	Auxiliary Site(s)
1.2.6.1.4	Site Drainage
1.2.6.2	SURFACE UTILITIES
1.2.6.3	SURFACE FACILITIES
1.2.6.4	SHAFT ACCESS
1.2.6.5	RAMP ACCESS
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.1	Surface Facilities

FUNCTIONAL REQUIREMENTS

1. Accommodate all anticipated services in a safe and effective manner. [6.1FR1]

PERFORMANCE CRITERIA

1a. Necessary access roads shall meet the requirements of ESF construction and operations. (D,O)

1b. The access roads shall be designed and constructed to ensure that the roads will meet the requirements of all anticipated service during the site characterization phase. This includes site security, safety, and anticipated loads during construction and operation for site characterization. [6.1PC1f] (D,O,S,T)

1c. The access roads shall be designed and constructed with provisions for adequate drainage and flood control during inclement weather without sacrificing the structural integrity or safety of the road. [6.1CI] (D,O,S,M)

 YMP CC-0013, Rev. 5/31/91

1d. Existing roads shall be incorporated into the ESF if this incorporation can be shown to be cost effective and does not reduce the performance of the site or the validity of the investigations. [6.1PC1f] (D,O,M)

CONSTRAINTS

A. Access roads used for hauling heavy loads shall be identified as such and shall not exceed a TBD percent grade that permits safe operation. [6.1PC1f] [TBD]

B. Access roads used by normal vehicle traffic to reach facilities and activity sites shall be identified as such and shall not exceed a TBD percent grade that permits safe operation. [6.1PC1f] [TBD]

C. The design for access roads shall ensure that muck haulage in the vicinity of the main site is separated from personnel access for safety considerations. [6.1PC1f]

D. The design for access roads shall include considerations to minimize dust and other environmental impacts. [6.1CK, CL]

E. The design for access roads shall ensure that the access to the USW G-4 borehole is preserved. [6.1PC1f]

F. The access roads shall ensure and maintain proper provisions for drainage, including protection from runoff water. [6.1PC1g]

G. Access roads will comply with Bureau of Land Management requirements. [6.1CL]

ASSUMPTIONS

None.

YMP CC-0013, Rev. 5 31 91

1.2.6.1.4 SITE DRAINAGE
(Generic Physical Subsystem Account Code: 4.1.4)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The site drainage system is defined by those items and measures utilized to control drainage and runoff water to preclude damage by erosion or flooding.

Boundaries and Interfaces

Specific boundaries and interfaces between participating organizations' designs are identified in the YMP Interface Control Document(s). Full compliance of the ESF design with the requirements and criteria of Section 1.2.6.1.4 necessitates an evaluation and understanding, by the designer, of the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.1.1 Main Site(s)
1.2.6.1.2 Auxiliary Site(s)
1.2.6.1.3 Access Roads
1.2.6.3 SURFACE FACILITIES
1.2.6.4 SHAFT ACCESS
1.2.6.5 RAMP ACCESS
1.2.6.9 ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.1 Surface Facilities

FUNCTIONAL REQUIREMENTS

1. Provide measures to control ESF Site drainage and runoff. [6.1FR1]

PERFORMANCE CRITERIA

1. All storm-water runoff shall be controlled in an environmentally acceptable manner. [6.1PC1g] (D,O,S,M)

CONSTRAINTS

A. In accordance with 10 CFR 60.122(c)(1), drainage shall be controlled to reduce the potential for flooding of the underground facility, whether resulting from the occupancy and modification of flood plains or from the failure of existing or planned man-made surface water impoundments. [6.1CI]

ASSUMPTIONS

None.

YMP CC-0013, Rev. 5 31 91

1.2.6.2 SURFACE UTILITIES
(Generic Physical Subsystem Account Code: 4.2.0)

Subparts are 1.2.6.2.1 Power System
1.2.6.2.2 Water System
1.2.6.2.3 Sanitary System
1.2.6.2.4 Communications System
1.2.6.2.5 Surface Wastewater System
1.2.6.2.6 Compressed Air System
1.2.6.2.7 Solid Waste Disposal System

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The surface utilities are defined as those surface systems, subsystems, structures, and components necessary to meet the needs of Participant organizations in carrying out ESF activities. These include provisions for power, water, sewage, communications, mine wastewater, compressed air and solid waste disposal.

Boundaries and Interfaces

Specific boundaries and interfaces between participating organizations' designs are identified in the YMP Interface Control Document(s). Full compliance of the ESF design with the requirements and criteria of Section 1.2.6.2 necessitates that the designer evaluate and understand the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.1 ESF SITE(S)
1.2.6.1.1 Main Site(s)
1.2.6.1.2 Auxiliary Site(s)
1.2.6.1.3 Access Roads
1.2.6.3 SURFACE FACILITIES
1.2.6.3.1 Ventilation System
1.2.6.3.2 Test Support Facilities
1.2.6.3.3 Sites Preparation for Surface Structures
1.2.6.3.4 Parking Areas
1.2.6.3.5 Storage Facilities
1.2.6.3.6 Shop
1.2.6.3.7 Warehouse
1.2.6.3.8 Other Temporary Structures
1.2.6.3.9 Communications/Data Building(s)
1.2.6.4 SHAFT ACCESS
1.2.6.4.1 Collar
1.2.6.4.4 Furnishings
1.2.6.4.5 Hoist System
1.2.6.5 RAMP ACCESS
1.2.6.5.1 Portal
1.2.6.6 UNDERGROUND EXCAVATIONS
1.2.6.7 UNDERGROUND SUPPORT SYSTEMS
1.2.6.7.1 Power Distribution System

 YMP CC-0013, Rev. 5/31/91

1.2.6.7.3 Lighting System
1.2.6.7.4 Ventilation Distribution System
1.2.6.7.5 Water Distribution System
1.2.6.7.6 Underground Wastewater Collection System
1.2.6.7.7 Compressed Air Distribution System
1.2.6.7.8 Fire Protection System
1.2.6.7.9 Muck and Material Handling Systems
1.2.6.7.10 Sanitary Facilities
1.2.6.7.11 Monitoring and Warning Systems
1.2.6.8 UNDERGROUND TEST SUPPORT
1.2.6.9 ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.1 Surface Facilities
1.2.6.9.2 Accesses and Underground Facilities

APPLICABLE REGULATIONS, CODES, STANDARDS, AND DOE ORDERS

The power system shall be designed in accordance with the following:

Electrical Power

1. DOE 6430.1A, Division 16 Electrical.

2. NFPA-70.

3. ANSI C 2.

Lighting

1. DOE 6430.1A, Division 16 Electrical.

Stand-by Power

1. DOE 6430.1A, Division 16 Electrical

2. NAC Chapter 445, paragraphs .430 through .732.

Uninterruptible Power

1. DOE 6430.1A, Division 16 Electrical.

2. IEEE-485.

3. IEEE-650.

The water system shall be designed in accordance with the following:

1. DOE 6430.1A, Division 2 Site and Civil Engineering and Division 15 Mechanical.

2. NAC Chapter 445, paragraphs .244 through .420.

3. NFPA 20, 22, and 24.

YMP CC-0013, Rev. 5 31 91

The sewage system shall be designed in accordance with the following:

1. DOE 6430.1A, Division 2 Site and Civil Engineering.

2. NAC Chapter 445, paragraph .140 through .241.

The communications system design shall be in accordance with the following:

1. DOE 6430.1A, Division 16 Electrical.

The wastewater system shall be designed in accordance with the following:

1. NAC Chapter 445, paragraph .140 through .241.

2. DOE order 5480.1, Chg. 1, 12-18-80, Chapter XII.

The compressed air system shall be designed in accordance with the following:

1. 30 CFR, Chapter I.

In addition, see Section 1.2.6.0, Applicable Regulations, Codes, Standards, and DOE Orders.

FUNCTIONAL REQUIREMENTS

1. Provide surface utility systems, subsystems, and facilities for the ESF to support site preparation, construction, operations, and testing during site characterization. [6.0FR1]

PERFORMANCE CRITERIA

1a. Necessary utility services, such as power, water, sewage disposal, solid waste disposal and communications system, shall be constructed and made available to meet the requirements of ESF construction and operations. (D,O,S,P,M,T,I) [6.0PC1k]

1b. A suitable system for treating, pumping, and disposing of credible water inflows into the ESF shall be provided. (D,O) [6.0PC1k]

1c. Safety and security lighting shall be available. (D,O,S) [6.0PC1k]

1d. Utilities such as electric power, compressed air, and water systems shall be provided to underground construction, operations, and in situ site characterization areas. [6.0PC1k] (D,O,S,P,M,T,I)

1e. When installed, these surface utility systems shall not unnecessarily restrict foot, vehicular, or shaft collar and/or ramp portal traffic; obstruct ventilation; or cause health and safety concerns. [6.0FR1PC1k] (D,O,S)

YMP CC-0013, Rev. 5 31 91

INTERFACE CONTROL REQUIREMENTS

1. The DO must recognize that interfaces with the telephone system (NTS subcontractor) and the Nevada Test Site (NTS) utility supply will be required. Also see Section 1.2.6.0, Interface Control Requirements.
2. The ESF designers shall interface with repository designers on ESF site location and layout and on permanent ESF structures, systems, and components. The DO shall make available all design information pertaining to the permanent ESF components during formal program design technical assessments and reviews, or when such information is formally requested by the repository designers through DOE or their designated representative.

   See Section 1.2.6.0, Interface Control Requirements.

CONSTRAINTS

A. In accordance with 10 CFR 60.15(c)(1), the design, construction, and operation of the surface utilities, including the wastewater ponds and water handling system, shall incorporate aspects specifically directed at limiting the potential for adverse impacts on the long term performance of the repository, to the extent practical. [6.0PC2d]

B. The offsite utilities shall be considered as extending from the closest tie-in point off the ESF site to its designated point on the ESF site. [6.0PC2d]

C. Water storage tanks shall be located, or protection provided, to preclude water inflow to ESF following a possible tank failure. [6.0 PC2d]

D. Piping shall be designed to preclude or limit possible water inflow to the ESF following a pipe rupture. [6.0 PC2d, CP]

E. Fluids recovered from sanitary uses or construction operations shall be disposed of in such a way as to avoid potential performance impacts. [6.0PC2d]

F. The surface utilities shall be designed and constructed so that they do not affect the capability of the repository to meet the performance objective of 10 CFR 60.112 [6.0PC2d]

ASSUMPTIONS

1. The eventual sites of shaft(s) and/or ramp(s) (if used for access) may be at locations other than those conceptually designed and described in the SCP/CDR.

   a. Some or all of the surface facilities described above (with their supporting equipment) will be needed for each construction location.

YMP CC-0013, Rev. 5-31-91

b. One of the shaft or ramp entries to the ESF may be considered a principal location and may have a full suite of systems and services to be utilized for offices, change rooms, first aid, mine rescue, and other support, with smaller construction support setups at other shaft/ramp locations.

 YMP CC-0013, Rev. 5-31-91

1.2.6.2.1 POWER SYSTEM
(Generic Physical Subsystem Account Code: 4.2.1)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The power system is defined as those systems, subsystems, components, and structures that supply electrical power to the ESF site. These systems include, but are not limited to, the ESF site substation(s), distribution systems, extension of the existing 69-kV overhead power line or other nearest source of power supply, a secondary power line to the booster pump station (if required), surface lighting, a stand-by power generation system, and an uninterruptible power system (UPS).

The subsurface facilities power distribution system shall be as defined in Section 1.2.6.7.1.

Boundaries and Interfaces

Specific boundaries and interfaces between participating organizations' designs are identified in the YMP Interface Control Document(s). Full compliance of the ESF design with the requirements and criteria of Section 1.2.6.2.1 necessitates that the designer evaluate and understand the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.1 ESF SITE(S)
1.2.6.2.2 Water System
1.2.6.2.3 Sanitary System
1.2.6.2.4 Communications System
1.2.6.2.5 Surface Wastewater System
1.2.6.2.6 Compressed Air System
1.2.6.3 SURFACE FACILITIES
1.2.6.3.1 Ventilation System
1.2.6.3.2 Test Support Facilities
1.2.6.3.3 Site Preparation for Surface Structures
1.2.6.3.4 Parking Areas
1.2.6.3.5 Storage Facilities
1.2.6.3.7 Warehouse
1.2.6.3.8 Other Temporary Structures
1.2.6.3.9 Communications/Data Building(s)
1.2.6.4 SHAFT ACCESS
1.2.6.5 RAMP ACCESS
1.2.6.6 UNDERGROUND EXCAVATIONS
1.2.6.7 UNDERGROUND SUPPORT SYSTEM
1.2.6.9 ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.1 Surface Facilities

YMP CC-0013, Rev. 5/31/91

FUNCTIONAL REQUIREMENTS

1. Provide an electrical system consisting of a standard electrical power distribution system, a standby electrical power system, and an uninterruptible electrical power system(s) (UPS) for the ESF. [6.2 FR 1]

PERFORMANCE CRITERIA

1a. Power distribution for the ESF, including the primary and secondary substations, transmission lines, and feeder cables, shall be adequately designed, with sufficient redundancy to meet load requirements at points of usage throughout the operations areas. Suitable switching and protective devices shall be provided in the electrical system to prevent damage to the equipment in case of power failure or faults. Sufficient metering shall be provided to establish the demand and consumption of power. Adequate surge protection and a well-engineered grounding system shall be provided in order to maximize personnel and equipment safety. (D,O,S,P,M,T,I) [6.2PC1a]

1b. Electrical power systems shall provide all of the necessary power, during both normal and peak demands, for the construction and operation of the ESF. (D,O,S,P,M,T,I) [6.2PC1a, 1d]

1c. An overhead power line shall be routed from the nearest suitable power supply to the main substation(s) at the ESF site. (D,O,S,P,M,T,I) [6.2CB]

1d. The design of the electrical system shall include the modifications that are required to accommodate the tie-in of the proposed transmission line between the connection to the nearest suitable existing power supply and the main substation to be located at the ESF site. (D,O,M) [6.2CB]

1e. The main substation(s) at the ESF site shall be designed to accommodate all of the anticipated electrical loads during the construction and operations of the ESF. [6.2PC1a] (D,O,S,P,M,T,I)

1f. The power distribution system shall provide adequate services from the main ESF substation(s) to the surface and subsurface facilities. [6.2PC1a, 1d] (D,O,S,P,M,T,I)

1g. The surface facilities power distribution system shall include the appropriate services to surface-mounted equipment. Surface-mounted equipment (permanent and temporary) includes, but is not limited to:

i. Hoists and controls

ii. Air compressor(s)

iii. Ventilation fans, as required

iv. Communication equipment, as required

YMP CC-0013, Rev. 5 31 91

v. Main water supply pump(s)

vi. Shaft-work-deck winches and miscellaneous motors

vii. Temporary facilities

viii. Shops

ix. Lights

x. Muck discharge transport conveyors

xi. Ventilation air heaters [TBV] [6.2PC1a] (D,O,S,P,M,T,I)

1h. The electrical system shall be designed to withstand windblown dust and other natural phenomena. [6.2PC1a] (D,O,M)

1i. The standby power system shall provide all of the necessary power to systems and subsystems that are required to operate in the event of a power outage based on safety, operational, or security requirements, for the construction and operation of the ESF. This includes those systems essential to evacuation, fire control, flood control, and critical in situ site characterization testing. (D,O,S,P,M,T,I) [6.2PC1a]

i. The standby power system shall include generators, buried fuel tanks, transfer switches, necessary fuel piping, conduit and wire, cutouts, concrete work, and weatherproof enclosures.

ii. The standby power generators shall have sufficient output to provide power for the hoist(s) (to allow for evacuation of all underground personnel within the one-hour time allowed), ventilation, area lighting, and surface computer equipment that would be damaged by a power failure. The allowable delay time TBD between the loss of primary power and the availability of standby power will be dictated by safety considerations of the mining operation. [TBD]

1j. An uninterruptible power system (UPS) shall provide all of the necessary power to systems and subsystems that cannot tolerate a loss of power incident. [6.2PC1a, 1d] (D,O,S,P,M,T,I)

i. An UPS shall be provided to service, as a minimum, the monitoring systems (e.g., fire, smoke, gas), communications systems, data collection systems, and those instruments and tests requiring continuous power. (D,O,S,P,M,T,I)

CONSTRAINTS

A. A utility-provided power supply shall be available as soon as possible but no later than the start of shaft and ramp construction. [6.2PC1a]

YMP CC-0013, Rev. 5/31/91

B. The minimal critical standby power requirements shall be determined by analysis. [6.2PC1a]

C. The normal supply of electrical power shall be provided by the main substation(s) to be constructed at the ESF site. Power for the main substation(s) shall be supplied from a connection to the nearest suitable existing power supply. [6.2C3]

D. The design shall incorporate existing YMP transformers and switchgear as much as practicable. [6.2PC1a]

E. Temporary power shall be available to support site preparation and additional work needing power prior to the supply of power to permanent facilities. [6.2PC1a]

F. An UPS shall consist of standby batteries and inverters. [6.2PC1a]

G. The interconnection buss between the standby power and the main power distribution system shall be designed such that the generating capacity of the standby system can be increased without modification to the interconnection buss. [6.2PC1a]

ASSUMPTIONS

None.

YMP CC-0013, Rev. 5 31 91

1.2.6.2.2 WATER SYSTEM
(Generic Physical Subsystem Account Code: 4.2.2)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The water system is defined as those systems, subsystems, and components that supply and distribute the potable and process water for the ESF.

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the YMP Interface Control Document(s). Full compliance of the ESF design with the requirements and criteria of Section 1.2.6.2.2 necessitates that the designer evaluate and understand the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.1	ESF SITE(S)
1.2.6.2.1	Power System
1.2.6.2.3	Sanitary System
1.2.6.2.4	Communication System
1.2.6.2.5	Surface Wastewater Systems
1.2.6.2.6	Compressed Air System
1.2.6.3	SURFACE FACILITIES
1.2.6.3.4	Parking Areas
1.2.6.4	SHAFT ACCESS
1.2.6.5	RAMP ACCESS
1.2.6.6	UNDERGROUND EXCAVATIONS
1.2.6.7	UNDERGROUND SUPPORT SYSTEMS
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.1	Surface Facilities
1.2.6.9.2	Accesses and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. Provide a water supply, storage, and distribution system for the ESF. [6.2FR1]

PERFORMANCE CRITERIA

1a. The water supply, storage, and distribution systems, subsystems, and components shall be adequately sized with sufficient capacity to supply and distribute potable water and non-potable water in accordance with all anticipated needs and services for the construction, operation, and testing for the ESF. [6.2PC1a, 1d] (D,O,S,P,M,T)

1b. The water system will supply water to the storage tank in addition to any services (tie-ins) to any suitable existing water main. [6.2PC1a] (D,O,M)

 YMP CC-0013, Rev. 5-31-91

1c. The water supply, storage, and distribution systems and subsystems shall have the capability to meet the needs of fire protection during construction and operations under routine emergency and maximum credible firewater demand conditions. [6.2PC1a] (D,O,S,P,M,T)

1d. A water tank shall have adequate volume for peak usage capacity and fire protection. [6.2PC1a] (D,O,S,P,M,T)

1e. The pumping systems shall include the provisions for both manual and automatic operations. [6.2PC1a] (D,O,M)

1f. The design for the water system shall provide adequate resistance to water hammer and other destructive events as well as protective devices to prevent loss of water into the site. [6.2CD] (D,O,M)

1g. The potable water system shall provide water to the surface facilities and have adequate treatment systems to ensure that water quality is appropriate for its intended use. [6.2PC1a] (D,O,S,M)

1h. The nonpotable water system shall provide water to the underground for construction, operation, and testing. [6.2PC1d] (O)

1i. Backflow protection shall be provided to ensure separation of potable and nonpotable water systems. [6.2PC1a, 1d] (D,O)

CONSTRAINTS

A. When practical, a single water storage and distribution system shall be employed for fire, industrial, and personnel needs. [6.2PC1a]

B. The route of the water line shall be adequately marked to minimize the possibility of damage from future construction activities. [6.2CD]

C. Nonpotable water lines shall be clearly marked to prevent consumption of nonpotable water by personnel. [6.2PC1a]

D. All water used during operation and construction of the ESF shall be provided with chemical tracers. All tracers and substances added shall be approved by the ESF test manager to ensure that they will not significantly compromise site characterization testing, repository testing, or waste isolation. [6.2PC1a]

E. The water systems and subsystems shall ensure that all of the water flows are metered, and that addition of tracers to the water systems and subsystems can be accomplished, as required, for the site characterization testing. Permanent records of water use shall be maintained. [6.2PC1a]

F. Tracers added to the water system shall be of a composition and concentration such that potable water will remain potable. [6.2PC1a]

YMP CC-0013, Rev. 5-31-91

i. Tracers added to the water system shall be of a composition and concentration compatible with the sanitary waste disposal system. (D,C,M,P,T)

3. The water supply shall not detract from the performance of the site as described in 10 CFR 60. [6.2CA, CF]

ASSUMPTIONS

1. A booster pumping station may be necessary to provide the flow requirements to the ESF.

YMP CC-0013, Rev. 5 31 91

1.2.6.2.3 SANITARY SYSTEM
(Generic Physical Subsystem Account Code: 4.2.3)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The sanitary system is defined as those systems, subsystems, and components that provide for the collection and disposal of sanitary sewage for the support of ESF operations and in situ site characterization.

Boundaries and Interfaces

Specific boundaries and interfaces between participating organizations' designs are identified in the YMP Interface Control Document(s). Full compliance of the ESF design with the requirements and criteria of Section 1.2.6.2.3 necessitates that the designer evaluate and understand, the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.1	ESF SITE(S)
1.2.6.2.1	Power System
1.2.6.2.2	Water System
1.2.6.2.4	Communications System
1.2.6.2.5	Surface Wastewater Systems
1.2.6.2.6	Compressed Air System
1.2.6.3	SURFACE FACILITIES
1.2.6.3.4	Parking Areas
1.2.6.7	UNDERGROUND SUPPORT SYSTEMS
1.2.6.7.10	Sanitary Facilities
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.1	Surface Facilities

FUNCTIONAL REQUIREMENTS

1. Provide a sanitary system for the collection and disposal of sanitary sewage during ESF activities. [6.2FR1]

PERFORMANCE CRITERIA

1a. Sewage effluent discharges shall not adversely affect site characterization activities. [6.2PC1a] (D,O,M,P,T)

1b. The sanitary system shall accommodate ESF construction, operations, and in situ site characterization. [6.2PC1a] (D,O,M,P,T)

1c. The sanitary waste disposal system shall accommodate the sewage for operations and testing personnel [TBD] at the ESF. [6.2PC1a] [TBD] (D,O,M,P,T)

YMP CC-0013, Rev. 5 31 91

CONSTRAINTS

A. Sanitary systems shall utilize an acceptable method of disposal, consistent with State or local codes, such as septic tanks or offsite disposal. These systems shall be reviewed with respect to impacts on testing. [6.2PC1a]

B. Sanitary wastes shall be disposed of by means of collection piping from all buildings and trailers to a sanitary waste disposal system located beyond the perimeter of the proposed repository subsurface facility at a distance to be determined by performance assessment. The sanitary system shall be designed to prevent interference with site characterization activities. [6.2CA, CF] [TBD]

C. The sanitary system shall not detract from the ability of the site to meet the performance objectives as stated in 10 CFR 60. [6.2CA, CF]

ASSUMPTIONS

None.

YMP CC-0013, Rev. 5 31 91

1.2.6.2.4 COMMUNICATIONS SYSTEM
(Generic Physical Subsystem Account Code: 4.2.4)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The communications system is defined as those systems, subsystems, and components that provide equipment and services for linking the surface areas, the underground areas and the facilities with each other and with all outside commercial communications systems.

Boundaries and Interfaces

Specific boundaries and interfaces between participating organizations' designs are identified in the YMP Interface Control Document(s). Full compliance of the ESF design with the requirements and criteria of Section 1.2.6.2.4 necessitates that the designer evaluate and understand the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.1	ESF SITE(S)
1.2.6.2.1	Power System
1.2.6.2.2	Water System
1.2.6.2.3	Sanitary System
1.2.6.2.5	Surface Wastewater System
1.2.6.2.6	Compressed Air System
1.2.6.3	SURFACE FACILITIES
1.2.6.3.9	Communications/Data Building(s)
1.2.6.4	SHAFT ACCESS
1.2.6.4.3	Stations
1.2.6.4.5	Hoist System
1.2.6.5	RAMP ACCESS
1.2.6.5.3	Station
1.2.6.5.5	Material Handling System
1.2.6.6	UNDERGROUND EXCAVATIONS
1.2.6.7	UNDERGROUND SUPPORT SYSTEMS
1.2.6.7.1	Power distribution System
1.2.6.7.8	Fire Protection System
1.2.6.7.11	Monitoring and Warning System
1.2.6.8	UNDERGROUND TESTS
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.1	Surface Facilities
1.2.6.9.2	Accesses and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. Provide a communications link within and external to the ESF during construction and operation. [6.2FR1]

PERFORMANCE CRITERIA

1a. A hoist call-response signaling system and a battery powered telephone system shall be provided for installation in each shaft station, shaft collars, bottom of shaft, and hoist operator's station. [6.2PC1a] (D,O,S,P,M,T)

1b. A communications system shall be provided between the shaft cage and the hoist operator's station. [6.2PC1a] (D,O,S,P,M,T)

1c. Effective communications capability in and between the surface and the underground facilities (ramps, shafts, and underground openings) shall be established and suitable safety alarm systems shall be provided where required. Closed-circuit television monitoring shall be provided for primary hoisting at critical locations. [6.2PC1a] (D,O,S,P,M,T)

1d. The system shall provide communications to NTS law enforcement, medical fire-fighting, or emergency agencies in the local Nye County area. [6.2PC1a] (D,O,S,P,M,T)

1e. The communication system shall provide adequate facilities for the transfer of data, via modem or other computer interface, from the ESF site to the outside communications network. [6.2PC1a] (D,O,S,P,M,T)

1f. A public address system shall be provided for emergency announcements and general paging. This system shall have adequate speakers on the surface and in the underground to meet safety requirements and serve as an emergency notification system. Access should be from various points, but to include, as a minimum, the control center, each shaft collar and ramp portal, and the telephone system. [6.2PC1a] (D,O,S,P,M,T)

1g. Battery powered phones shall be installed in all refuge stations, shops, and loading pockets. [6.2PC1a] (D,O)

CONSTRAINTS

A. The design shall ensure that at least one telephone shall be located in each building and trailer and each hoist operator station. These phones shall be capable of reaching offsite emergency numbers. [6.2PC1a]

B. The ESF FM radio system shall be installed and integrated with the NTS FM radio system to provide communications to security and maintenance personnel and serve as a backup communication system. [6.2PC1a]

C. An intercom system shall have provisions for a multichannel connection as required in Appendix B. [6.2PC1a]

D. The communications system for the underground areas shall be tied into the hoisting system control room(s). [6.2PC1a]

 YMP CC-0013, Rev. 5 31 91

E. A telephone link shall be available to permit communication between any underground mine pager phone and the surface commercial telephone network except for phones that require dedicated communications. [6.2PC1a]

F. Phone jacks and phone service shall be provided as required for communication service as indicated in Appendix B. [6.2PC1a]

G. All electrical power wiring must be kept physically separated from data and communications wiring to prevent induced interference. [6.2PC1a]

H. The underground test areas shall have limited-access commercial service, with shaft and ramp cabling provided. [6.2PC1a]

I. There shall be a phone jack in each intercom station. [6.2PC1a]

J. Inductive and radio communication systems in accesses/stations shall be restrictive to prevent "stray currents" from initiating premature detonation when blasting. [6.2PC1a]

ASSUMPTIONS

1. The NTS subcontractor for telephone communications will provide the equipment for the telephone system, including the surface data transmission system.

YMP CC-0013, Rev. 5-31-91

1.2.6.2.5 SURFACE WASTEWATER SYSTEM
(Generic Physical Subsystem Account Code: 4.2.5)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The surface wastewater system is defined as those systems, subsystems, and components that provide equipment for collection, transfer, treatment, and disposal of liquid non-sanitary wastes generated underground in the ESF during construction and operations.

Boundaries and Interfaces

Specific boundaries and interfaces between participating organizations' designs are identified in the YMP Interface Control Document(s). Full compliance of the ESF design with the requirements and criteria of Section 1.2.6.2.5 necessitates that the designer evaluate and understand the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.1	ESF SITE(S)
1.2.6.2.1	Power System
1.2.6.2.2	Water System
1.2.6.2.3	Sanitary System
1.2.6.3	SURFACE FACILITIES
1.2.6.4	SHAFT ACCESS
1.2.6.4.1	Collar
1.2.6.4.6	Sump
1.2.6.5	RAMP ACCESS
1.2.6.5.1	Portal
1.2.6.5.6	Sump
1.2.6.7	UNDERGROUND SUPPORT SYSTEMS
1.2.6.7.6	Underground Wastewater Collection System
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.1	Surface Facilities

FUNCTIONAL REQUIREMENTS

1. Provide a surface wastewater system for collection, transfer, treatment, and disposal of non-sanitary underground water. [6.2FR1]

PERFORMANCE CRITERIA

1. A suitable surface wastewater system shall be provided for collection, transfer, pumping, treatment, and disposing of expected water and credible water inflows. The Underground Wastewater Collection System, 1.2.6.7.6, shall be designed to collect and pump all wastewater to the Surface Wastewater System, 1.2.6.2.5. The Surface Wastewater System, 1.2.6.2.5, shall receive underground wastewater and pump it off the repository block in such a manner as to limit adverse effects on the

YMP CC-0013, Rev. 5 31 91

long-term performance of the geologic repository to the extent practical. [TBD] [6.2PC1b, CA, CE, CF] (D,O,S,M,T)

CONSTRAINTS

A. Liquid wastes that cannot be disposed on the ESF site in an environmentally acceptable manner shall be removed from the site for disposal in an appropriate facility or location. [6.2PC1a] [TBD]

B. The surface wastewater collection system shall discharge to a wastewater pond consistent with location constraints to be determined by performance assessment. The surface wastewater system shall be designed, operated, and maintained in such a way as to prevent interference with the site characterization activities. [6.2CA, CE, CF] [TBD]

C. The surface wastewater system shall not detract from the ability of the site to meet the performance objectives as stated in 10 CFR 60. [6.2CA, CE, CF]

ASSUMPTIONS

None.

YMP CC-0013, Rev. 5-31-91

1.2.6.2.6 COMPRESSED AIR SYSTEM
(Generic Physical Subsystem Account Code: 4.2.6)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The compressed air system is defined as those systems, subsystems, and components that provide the production and distribution of compressed air throughout the ESF. The compressed air system supplies compressed air to the compressed air distribution system (1.2.6.7.7).

Boundaries and Interfaces

Specific boundaries and interfaces between participating organizations' designs are identified in the YMP Interface Control Document(s). Full compliance of the ESF design with the requirements and criteria of Section 1.2.6.2.6 necessitates that the designer evaluate and understand the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.1	ESF SITE(S)
1.2.6.2.1	Power System
1.2.6.2.2	Water System
1.2.6.2.3	Sanitary System
1.2.6.2.4	Communications System
1.2.6.2.5	Surface Wastewater Systems
1.2.6.3	SURFACE FACILITIES
1.2.6.4	SHAFT ACCESS
1.2.6.4.1	Collar
1.2.6.5	RAMP ACCESS
1.2.6.5.1	Portal
1.2.6.6	UNDERGROUND EXCAVATIONS
1.2.6.7	UNDERGROUND SUPPORT SYSTEMS
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.1	Surface Facilities
1.2.6.9.2	Accesses and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. Provide compressed air production and distribution. [6.2FR1]

PERFORMANCE CRITERIA

1a. The compressed air system shall provide compressed air throughout the designated areas of the ESF with the flow rates and pressures to support construction and operations of the facilities, site characterization testing requirements, and drilling requirements including additional drift excavation. [6.2PC1d] (D,O,M,P,T)

YMP CC-0013, Rev. 5/31/91

1b. Compressed air shall be conditioned as required and maintained at a quantity to meet drilling and test apparatus requirements. Suitable filtering shall be provided where oil-free air is required. [6.0FR1] (D,C,M,P,T) [6.2PC1d]

1c. The design shall include an air compressor(s) sized to meet the requirements of the ESF construction, testing, and operations. The design shall consider modularity of the system to accommodate variable loads and system maintenance. [6.2PC1d] (D,O,M,P,T)

1d. All compressed air used during operation and construction of the ESF shall be provided with chemical tracers unless exempted by the ESF Test Manager. All tracers and substances added shall be approved per 1.2.6.0, Constraint Ciii. [6.2PC1d]

CONSTRAINTS

A. As an energy conservation measure, designers will examine the use of electrical and/or electrohydraulic drives for underground construction equipment as an alternative to compressed air wherever possible and feasible. [6.2PC1d]

ASSUMPTIONS

None.

YMP CC-0013, Rev. 5-31-91

1.2.6.2.7 SOLID WASTE DISPOSAL SYSTEM

(TBD)

YMP CC-0013, Rev. 5/31/91

1.2.6.3 SURFACE FACILITIES
(Generic Physical Subsystem Account Code: 4.3.0)

Subparts are		
	1.2.6.3.1	Ventilation System
	1.2.6.3.2	Test Support Facilities
	1.2.6.3.3	Site Preparation for Surface Structures
	1.2.6.3.4	Parking Areas
	1.2.6.3.5	Storage Facilities
	1.2.6.3.6	Shop
	1.2.6.3.7	Warehouse
	1.2.6.3.8	Other Temporary Structures
	1.2.6.3.9	Communications/Data Building(s)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The surface facilities include all the temporary and permanent facilities, systems, and services for the surface buildings and temporary structures that are required for the support of ESF operations and in situ site characterization.

Boundaries and Interfaces

Specific boundaries and interfaces between participating organizations' designs are identified in the YMP Interface Control Document(s). Full compliance of the ESF design with the requirements and criteria of Section 1.2.6.3 necessitates an evaluation and understanding, by the designer, of the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.1	ESF SITE(S)
1.2.6.1.1	Main Site(s)
1.2.6.1.2	Auxiliary Site(s)
1.2.6.1.3	Access Roads
1.2.6.1.4	Site Drainage
1.2.6.2	SURFACE UTILITIES
1.2.6.2.1	Power System
1.2.6.2.2	Water System
1.2.6.2.3	Sanitary System
1.2.6.2.4	Communications System
1.2.6.2.5	Surface Wastewater System
1.2.6.2.6	Compressed Air System
1.2.6.4	SHAFT ACCESS
1.2.6.4.1	Collar
1.2.6.4.4	Furnishings
1.2.6.5	RAMP ACCESS
1.2.6.5.1	Portal
1.2.6.6	UNDERGROUND EXCAVATIONS
1.2.6.7	UNDERGROUND SUPPORT SYSTEMS
1.2.6.7.11	Monitoring and Warning Systems
1.2.6.8	UNDERGROUND TEST SUPPORT
1.2.6.8.1	Integrated Data System (IDS) Support

YMP CC-0013, Rev. 5-31-91

APPLICABLE REGULATIONS, CODES, STANDARDS, AND DOE ORDERS

The designs shall be in accordance with:

1. DOE 6430.1A, except for seismic requirements 0111-2.7 Earthquake Loads.

2. DOE Order 5480.7

In addition, see Section 1.2.6.0, Applicable Regulations, Codes, Standards, and DOE Orders.

FUNCTIONAL REQUIREMENTS

1. Provide surface buildings and/or supporting facilities for the ESF operations. [6.0FR1]

2. Provide dust control and/or collection facilities. [6.0FR1]

3. Provide onsite transportation facilities for personnel, equipment, materials, and rock. [6.0FR1]

PERFORMANCE CRITERIA

1a. Surface facilities shall support the following:

i. Administration.
ii. Operations and engineering staff.
iii. Training/Underground safety.
iv. Visitors.
v. Environmental monitoring, health and safety.
vi. Security.
vii. Storage/warehouse.
viii. Shop/maintenance.
ix. Fire/emergency (and associated vehicles).
x. Change room.
xi. Laboratory (as required).
xii. Sleeping quarters (as required).
xiii. Mine ventilation fans, filters, cooling, and enclosures (as required).
xiv. Compressed air.
xv. Computer control system/Data collection systems.
xvi. Drill pads and mud ponds (as required).
xvii. Shaft collars and ramp portals.
xviii. Surface mobile equipment (as required).

xix. Standby power.
xx. Treatment of underground water.
xxi. Communications. [6.0PC1k]

1b. Surface facilities shall support the administration of records, including those of construction, operations, site characterization, security, permitting, personnel, personnel training and certification, visitors, compliance with regulations, safety, and other necessary records. (D,O,S,P,M,T,I) [6.0PC1k]

1c. Security facilities shall protect the ESF in accordance with applicable DOE Orders. (O) [6.0CP]

1d. During ESF construction, temporary visitor facilities shall be approved by the DOE. During ESF testing, facilities shall support a minimum capacity of 50 visitors on the surface and 10 visitors underground at any one time. (D,O) [6.0PC1k]

1e. Surface facilities shall combine functions when the combinations are cost effective and practicable. Similar functions (e.g., communications and computer control system) shall be combined wherever practicable. (D,O,M) [6.0PC1k]

1f. Surface explosives and cap storage magazines, if required, shall be provided that meet all requirements of 30 CFR 57 Subpart E, applicable State of Nevada and local regulations, and DOE Orders 5480.4 and 6430.1A. (S) [6.0CP]

1g. The surface facilities and their locations shall (a) facilitate the flow of material and personnel within the ESF site and (b) support adequate ESF site security, including controlled access and emergency response. (D,O,S,M) [6.0PC1k,CP]

1h. The facilities shall be complete with Heating, Ventilation and Air Conditioning (HVAC), compressed air, plumbing and sanitary facilities, lighting, communications, and fire protection systems as required for appropriate coverage. (D,O,S,P,M,T,I) [6.0PC1k]

1i. The surface facilities shall be located away from potential dust generating areas to the extent practicable. (D,O,M) [6.0PC1k,CP]

2a. Dust control/collection facilities at potential surface dust-generation areas such as rock-handling transfer points (includes the muck storage pile) and processing areas shall control airborne particulates as required by applicable Federal, State, and local regulations. (D,O) [6.0CN]

2b. Monitoring of the dust content in air at potential dust generating areas, such as rock handling transfer points and processing areas shall be conducted periodically. (O) [6.0PC1k, CN, CP]

3. Transportation facilities shall be of sufficient size to sustain ESF construction, operations, and testing. (D,O,S,P,M,T,I) [6.0PC1k]

YMP CC-0013, Rev. 5/31/91

INTERFACE CONTROL REQUIREMENTS

1. The ESF designers shall interface with repository designers on ESF site location and layout and on permanent ESF structures, systems, and components, and shall make available all design information pertaining to the permanent ESF components during formal program design technical assessments and reviews, or when such information is formally requested by the repository designers through DOE or their designated representative.

   See Section 1.2.6.0, Interface Control Requirements.

CONSTRAINTS

A. To the extent practicable and economical, modular, relocatable, or portable structures shall be considered for surface facilities. [6.0PC1k]

B. Each inhabited structure shall have restrooms, water heating, space heating, and air conditioning, as required for the intended use. [6.0PC1k]

C. Structures exceeding 200 ft in height shall meet the safety provisions implemented under the Federal Aviation Act (49 U.S.C. 1501). [6.0CP]

D. The general layout of the surface facilities shall be designed to minimize environmental impacts to the site. [6.0CN]

E. The constructor shall furnish, as necessary, temporary construction support facilities (e.g., change houses(s) office, shop, warehouse and storage, and first aid) during the initial stages of access construction. [6.0CP, PC1k]

ASSUMPTIONS

1. The eventual sites of shaft(s) and/or ramp(s) (if used for access) may be at locations other than those conceptually designed and described in the SCP-CDR.

   a. Some or all of the surface facilities described above (with their supporting equipment) will be needed for each construction location.

   b. One of the shaft or ramp entries to the ESF may be considered a principal location and may have a full suite of systems and services to be utilized for offices, change rooms, first aid, mine rescue, and other support, with smaller construction support setups at other shaft/ramp locations.

YMP CC-0013, Rev. 5 31 91

1.2.6.3.1 VENTILATION SYSTEM
(Generic Physical Subsystem Account Code: 4.3.1)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The ventilation system consists of those surface systems, subsystems, and components that supply fresh air, conditioned if required, to the ventilation distribution system (1.2.6.7.4), which in turn supplies fresh air to, and removes exhaust air from, the ESF underground areas.

Boundaries and Interfaces

Specific boundaries and interfaces between participating organizations' designs are identified in the YMP Interface Control Document(s). Full compliance of the ESF design with the requirements and criteria of Section 1.2.6.3.1 necessitates an evaluation and understanding, by the designer, of the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.1	ESF SITE(S)
1.2.6.2	SURFACE UTILITIES
1.2.6.2.1	Power System
1.2.6.3.9	Communications/Data Building(s)
1.2.6.4	SHAFT ACCESS
1.2.6.5	RAMP ACCESS
1.2.6.6	UNDERGROUND EXCAVATIONS
1.2.6.7	UNDERGROUND SUPPORT SYSTEMS
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.1	Surface Facilities
1.2.6.9.2	Accesses and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. Provide a ventilation system to supply ventilation air to and exhaust ventilation from the subsurface workings to meet the needs of construction and operation of the underground site characterization and testing program. [6.3FR1]

PERFORMANCE CRITERIA

1a. The ventilation system shall supply and exhaust adequate quantities of air to and from underground working areas such that operator safety, health and productivity requirements are maintained. (D,O,S,P,M,T,I) [6.3PC1a]

1b. All main ventilation system(s) shall contain safety features in accordance with 30 CFR 57 Subpart G, and if the repository is classified as gassy, the system shall comply with 30 CFR 57 Subpart T. (S) [6.0CP]

YMP CC-0013, Rev. 5-31-91

1c. Anticipated noise levels, and noise reduction measures needed to provide personnel protection and enable required voice communications, shall be considered in the design specifications established for fan location and installation. (D,O,S,M) [6.3PC1a]

1d. The ventilation fan system shall have electrical back-up power to retain full operational function when primary power is lost. A reduced level necessary to support critical activities will be acceptable since mining operations will be stopped during a power outage. (D,O,S,P,M,T,I) [6.3PC1a]

1e. The ventilation system shall minimize leakage to the extent practicable. (D,O,S,P,M,T,I) [6.3PC1a]

CONSTRAINTS

A. The ventilation system shall be capable of supporting additional excavations beyond those planned as indicated by the uncertainty allowance. [6.3PC1a]

B. The ventilation system shall be designed to handle the required volumes of air in order to cope with the in situ natural and induced heat sources. The system shall provide air cooling power equal to or greater than 260 W/m^2 of personnel skin surface area. [6.3PC1a]

C. The ventilation system for the ESF and (subject to construction authorization) the initial repository development shall not preclude design consideration being given to an underground location for the primary booster fan(s). [6.3PC1a]

D. Monitoring of ventilation air shall comply with requirements of section 1.2.6.7.11 of this ESFDR [6.3PC1a]

ASSUMPTIONS

1. If the criteria of 30 CFR 57.22003 are applied to the ESF, it will be classified as a non-gassy mine, i.e., Category VI.

YMP CC-0013, Rev. 5/31/91

1.2.6.3.2 TEST SUPPORT FACILITIES
(Generic Physical Subsystem Account Code: 4.3.2)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The test support facilities are defined as those surface facilities that accommodate the Principal Investigators' (PIs') testing apparatus for equipment assembly, check out, and repair. This may involve the use of temporary structures.

Boundaries and Interfaces

Specific boundaries and interfaces between participating organizations' designs are identified in the YMP Interface Control Document(s). Full compliance of the ESF design with the requirements and criteria of Section 1.2.6.3.2 necessitates an evaluation and understanding, by the designer, of the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.1	ESF SITE(S)
1.2.6.2	SURFACE UTILITIES
1.2.6.2.1	Power System
1.2.6.3.3	Site Preparation for Surface Structures
1.2.6.3.4	Parking Areas
1.2.6.3.5	Storage Facilities
1.2.6.3.6	Shop
1.2.6.3.7	Warehouse
1.2.6.3.8	Other Temporary Structures
1.2.6.6	UNDERGROUND EXCAVATIONS
1.2.6.6.2	Test Areas
1.2.6.8	UNDERGROUND TEST SUPPORT
1.2.6.8.1	Integrated Data System (IDS) Support
1.2.6.8.2	Tests
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.1	Surface Facilities

FUNCTIONAL REQUIREMENTS

1. Provide test support facilities to meet the operational requirements of the PIs. (D,O,S,P,M,T,I) [TBD] [6.3FR1]

PERFORMANCE CRITERIA

1. Provide the necessary area(s) where the test apparatus, for use in the ESF site characterization testing under the direction of the PIs, can be assembled, stored, repaired, tested, and disassembled. [6.3PC1a]

YMP CC-0013, Rev. 5-31-91

CONSTRAINTS

None.

ASSUMPTIONS

None.

YMP CC-0013, Rev. 5-31-91

1.2.6.3.3 SITE PREPARATION FOR SURFACE STRUCTURES
(Generic Physical Subsystem Account Code: 4.3.3)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

Sites developed under 1.2.6.1 are to be prepared to receive surface structures by providing for necessary utilities at the sites. This includes all of the facilities, systems, and services required by the structures during construction and operation of the ESF. Surface structures to be provided for include all those covered by 1.2.6.3.

Boundaries and Interfaces

Specific boundaries and interfaces between participating organizations' designs are identified in the YMP Interface Control Document(s). Full compliance of the ESF design with the requirements and criteria of Section 1.2.6.3.3 necessitates an evaluation and understanding, by the designer, of the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.1	ESF SITE(S)
1.2.6.2	SURFACE UTILITIES
1.2.6.2.1	Power System
1.2.6.2.2	Water System
1.2.6.2.3	Sanitary System
1.2.6.3.2	Test Support Facilities
1.2.6.3.4	Parking Areas
1.2.6.3.5	Storage Facilities
1.2.6.3.6	Shop
1.2.6.3.7	Warehouse
1.2.6.3.8	Other Temporary Structures
1.2.6.3.9	Communications/Data Building(s)
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.1	Surface Facilities

FUNCTIONAL REQUIREMENTS

1. Provide sites having the required services for surface structures. [6.3FR1]

PERFORMANCE CRITERIA

1a. Each site shall be furnished with available utility services appropriate to the structure. As a minimum, services included shall be power, water, fire protection, communications, sanitary waste, and parking allowances. (D,O,S,M) [6.3PC1a]

1b. Each temporary structure site shall be designed and constructed to accommodate water drainage. (D,O,M) [6.3PC1a]

YMP CC-0013, Rev. 5 31 91

CONSTRAINTS

None.

ASSUMPTIONS

None.

 YMP CC-0013, Rev. 5/31/91

1.2.6.3.4 PARKING AREAS
(Generic Physical Subsystem Account Code: 4.3.4)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

Parking areas are defined as all space and allowances for vehicle parking required to support construction, operation, and testing in the ESF.

Boundaries and Interfaces

Specific boundaries and interfaces between participating organizations' designs are identified in the YMP Interface Control Document(s). Full compliance of the ESF design with the requirements and criteria of Section 1.2.6.3.4 necessitates an evaluation and understanding, by the designer, of the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.1	ESF SITE(S)
1.2.6.2	SURFACE UTILITIES
1.2.6.3.2	Test Support Facilities
1.2.6.3.3	Site Preparation for Surface Structures
1.2.6.3.5	Storage Facilities
1.2.6.3.6	Shop
1.2.6.3.7	Warehouse
1.2.6.3.8	Other Temporary Structures
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.1	Surface Facilities

FUNCTIONAL REQUIREMENTS

1. Provide parking areas to support ESF construction, operation, and underground site characterization activities. [6.3FR1]

PERFORMANCE CRITERIA

1a. As a minimum, the parking areas shall accommodate the following:

i. Automobiles.
ii. Vans.
iii. Buses.
iv. Haulage trucks.
v. Tractor trailers (18 wheel and larger).
vi. Emergency vehicles (ambulance and underground rescue truck.) [6.3PC1a]

1b. The parking areas shall be designed and constructed to ensure that each space is adequate for parking and that the designated areas can accommodate water runoff control. (D,O,M) [6.3PC1a]

YMP CC-0013, Rev. 5 31 91

1c. The parking areas shall be designed and constructed to ensure ease of access while limiting the amount of surface area required. (D,O,M) [6.3PC1a]

1d. All parking areas shall be located to ensure personnel safety and to prevent interference to the ESF construction and operational activities. (D,O,S,M) [6.3PC1a, 1c]

1e. Dedicated parking for emergency vehicles shall be located such that they can be quickly accessed. (O) [6.3PC1a, 1g]

CONSTRAINTS

A. As a minimum, all parking areas shall be designed and constructed utilizing a compacted gravel base and surface. [6.3PC1a]

B. Access from the working areas of the ESF to general parking areas shall be controlled to prevent unauthorized removal of material and property. [6.3PC1c, 1g]

ASSUMPTIONS

None.

YMP CC-0013, Rev. 5-31-91

1.2.6.3.5 STORAGE FACILITIES
(Generic Physical Subsystem Account Code: 4.3.5)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The storage facilities are defined as all areas, structures, and supporting services to store equipment, supplies, and vehicles in a yard-type environment.

Boundaries and Interfaces

Specific boundaries and interfaces between participating organizations' designs are identified in the YMP Interface Control Document(s). Full compliance of the ESF design with the requirements and criteria of Section 1.2.6.3.5 necessitates an evaluation and understanding, by the designer, of the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.1	ESF SITE(S)
1.2.6.2	SURFACE UTILITIES
1.2.6.2.1	Power System
1.2.6.3.2	Test Support Facilities
1.2.6.3.4	Parking Areas
1.2.6.3.6	Shop
1.2.6.3.7	Warehouse
1.2.6.3.8	Other Temporary Structures
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.1	Surface Facilities

FUNCTIONAL REQUIREMENTS

1. Provide storage for the anticipated equipment, supplies, and vehicles that will be used during construction and operation of the ESF. [6.3FR1]

PERFORMANCE CRITERIA

1a. Space and facilities shall support the functions of purchasing, storing, and dispensing equipment and materials, and shall be sized to accommodate the inventory needed for ESF operations and in-situ site characterization. Storage facilities shall, as a minimum, accommodate the following:

i. General equipment
ii. Pipe and pipe racks
iii. Sheet steel and steel shapes
iv. Lumber
v. Cement and admixtures
vi. Coarse and fine aggregate

YMP CC-0013, Rev. 5 31 91

vii. Reinforcing steel
vii. Wire and cable reels
ix. Gas bottles
x. Drilling rigs/construction equipment
xi. Heavy Construction Equipment [6.3PC1a]

1b. The material storage facilities, except for facilities for aggregates and such items that pose a low security risk, shall be capable of being secured (fence, gates, and lockups) and integrated with the overall site security. (D,O,M) [6.3PC1c, 1g]

1c. The storage facilities shall have provisions for adequate, but minimal, protection from the environment for designated stored equipment and supplies. (D,O,M) [6.3PC1a]

CONSTRAINTS

A. Provisions shall be made for the separate storage of private and DOE equipment. [6.3PC1a]

B. Provisions shall be made for the separate storage of test equipment and construction/drilling equipment. [6.3PC1a]

ASSUMPTIONS

None.

YMP CC-0013, Rev. 5-31-91

1.2.6.3.6 SHOP
(Generic Physical Subsystem Account Code: 4.3.6)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The shop is defined as all of the facilities, systems, and services for the routine maintenance and repair of the construction and testing equipment designated for the ESF, and of the ground maintenance equipment.

Boundaries and Interfaces

Specific boundaries and interfaces between participating organizations' designs are identified in the YMP Interface Control Document(s). Full compliance of the ESF design with the requirements and criteria of Section 1.2.6.3.6 necessitates an evaluation and understanding, by the designer, of the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.1	ESF SITE(S)
1.2.6.2	SURFACE UTILITIES
1.2.6.3.2	Test Support Facilities
1.2.6.3.3	Site Preparation for Surface Structures
1.2.6.3.4	Parking Areas
1.2.6.3.5	Storage Facilities
1.2.6.3.7	Warehouse
1.2.6.3.8	Other Temporary Structures
1.2.6.6	UNDERGROUND EXCAVATIONS
1.2.6.7	UNDERGROUND SUPPORT SYSTEMS
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.1	Surface Facilities

FUNCTIONAL REQUIREMENTS

1. Provide shop facilities and equipment for the routine maintenance, inspection, and repair of the ESF equipment, systems, structures, and components. [6.3FR1]

PERFORMANCE CRITERIA

1a. Shop facilities shall support the maintenance of roads, structures, grounds, and buildings. (D,O,M) [6.3PC1a]

1b. Shop facilities and equipment shall accommodate the following types of activities and services: routine equipment maintenance and repair, maintenance equipment storage, and operations spare parts storage. (D,O,M) [6.3PC1a]

1c. Shop facilities shall meet the operational requirements as defined by the users. (D,O,S,P,M,T,I) [6.3PC1a]

YMP CC-0013, Rev. 5 31 91

1d. The shop shall include cranes and shop machinery which are consistent with maintenance needs. (D,O,M) [6.3PC1a]

1e. The shop shall provide for routine electrical generator repair and maintenance. [6.3PC1a]

CONSTRAINTS

A. The shop shall be designed and constructed as a prefabricated metal building. [6.3CA]

B. As a minimum, the shop shall have separate restrooms for men and women, an office, a bay, storage space for maintenance supplies, and locker/change space. The need for multiple bays shall be determined by analysis. [6.3PC1a]

C. The shop shall be insulated and heated. In addition, the office area and restrooms shall be air conditioned. [6.3PC1h, CB]

D. The shop facility shall include a concrete wash pad with suitable controls to assure that wash water enters the proper sewage system and is treated accordingly. [6.3PC1a, 1h]

E. The shop shall provide for separate storage of chemicals and flammable materials. [6.3PC1a]

ASSUMPTIONS

1. Non-routine maintenance of equipment which cannot be performed in the proposed facilities will be performed offsite.

 YMP CC-0013, Rev. 5 31 91

1.2.6.3.7 WAREHOUSE
(Generic Physical Subsystem Account Code: 4.3.7)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The warehouse is defined as all the facilities, systems, and services for the safe storage and dispensing of ESF materials that require indoor storage and are not stored in the open areas provided under 1.2.6.3.5, Storage Facilities.

Boundaries and Interfaces

Specific boundaries and interfaces between participating organizations' designs are identified in the YMP Interface Control Document(s). Full compliance of the ESF design with the requirements and criteria of Section 1.2.6.3.7 necessitates an evaluation and understanding, by the designer, of the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.1	ESF SITE(S)
1.2.6.2	SURFACE UTILITIES
1.2.6.2.1	Power System
1.2.6.3.2	Test Support Facilities
1.2.6.3.3	Site Preparation for Surface Structures
1.2.6.3.4	Parking Areas
1.2.6.3.5	Storage Facilities
1.2.6.3.6	Shop
1.2.6.3.8	Other Temporary Facilities
1.2.6.4	SHAFT ACCESS
1.2.6.5	RAMP ACCESS
1.2.6.6	UNDERGROUND EXCAVATIONS
1.2.6.7	UNDERGROUND SUPPORT SYSTEMS
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.1	Surface Facilities
1.2.6.9.2	Accesses and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. Provide facilities for general warehousing in support of the ESF construction and operations. [6.3FR1]

PERFORMANCE CRITERIA

1a. Space and equipment to support the functions of receiving, storing, and dispensing equipment and materials, shall sufficiently accommodate the inventory needed for ESF operations and site characterization. (D,O,P,M,T) [6.3PC1a]

 YMP CC-0013, Rev. 5/31/91

1b. Temporary warehouse space shall be provided to support initial access construction and hoist and hoist house construction by the contractor. (C) [6.3PC1a, 1g, CE]

CONSTRAINTS

A. The warehouse may be designed and constructed as a prefabricated metal building. [6.3CA]

B. The warehouse shall contain restrooms and offices. [6.3PC1h, CB]

C. The warehouse shall be insulated and heated. In addition, the office areas and restrooms shall be air conditioned. [6.3PC1h, CB]

D. Storage of critical components shall be under controlled access. [6.3PC1c, 1g]

E. The warehouse shall provide a chemical storage area which will comply with applicable Federal, State of Nevada, and local requirements. [6.3PC1a, 1g]

ASSUMPTIONS

None.

YMP CC-0013, Rev. 5 31 91

1.2.6.3.8 OTHER TEMPORARY STRUCTURES
(Generic Physical Subsystem Account Code: 4.3.8)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The other temporary structures are defined as the systems and services that will be utilized for the offices, change rooms, first aid and mine rescue apparatus center, security offices, and space required to support ESF construction, scientific, operations, and maintenance personnel for the site characterization program, including site preparation.

Boundaries and Interfaces

Specific boundaries and interfaces between participating organizations' designs are identified in the YMP Interface Control Document(s). Full compliance of the ESF design with the requirements and criteria of Section 1.2.6.3.8 necessitates an evaluation and understanding, by the designer, of the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.1 ESF SITE(S)
1.2.6.2 SURFACE UTILITIES
1.2.6.2.1 Power System
1.2.6.3.2 Test Support Facilities
1.2.6.3.3 Site Preparation for Surface Structures
1.2.6.3.4 Parking Areas
1.2.6.3.5 Storage Facilities
1.2.6.3.6 Shop
1.2.6.3.7 Warehouse
1.2.6.9 ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.1 Surface Facilities

FUNCTIONAL REQUIREMENTS

1. Provide temporary structures and their supporting equipment to support the ESF. [6.3FR1]

PERFORMANCE CRITERIA

1a. Temporary structures and their supporting equipment provided under this section shall accommodate the following:

i. Offices.
ii. Change rooms.
iii. First aid and underground rescue apparatus center.
iv. Scientific and test support personnel.
v. Temporary IDS.
vi. Construction support functions, including training. [6.3PC1d]

1b. A change room facility shall be established of sufficient size to provide all necessary personnel and underground visitors with a place to bathe, change, and dry clothes. Separate change room facilities shall be provided for men and women. (D,O,S,P,M,T,I) [6.3PC1a, 1d, CE, CF]

1c. Sufficient personnel office space, as defined by the users, shall be provided for test support functions, and for scientific, maintenance, and construction personnel. [6.3PC1a] (D,O,S,P,M,T,I)

1d. Overhead baskets and locker facilities in the change room facility shall be sized to accommodate the ESF underground personnel for operations, maintenance, and underground testing. [6.3PC1a, 1d, CE, CF] (D,O,S,P,M,T,I)

1e. A sufficient number of trailers shall be provided for test support functions. [6.3PC1a]

CONSTRAINTS

A. Office spaces shall be based on a minimum of 100 square feet per office and a maximum per DOE Order 6430.1A. [6.3PC1a]

B. Each first aid structure shall provide at least 200 square feet for the first aid facility, plus 50 square feet for storage. [6.3PC1a]

ASSUMPTIONS

1. Trailers may be provided for office spaces.

2. A single trailer may be provided for each first aid center.

 YMP CC-0013, Rev. 5 31 91

1.2.6.3.9 COMMUNICATIONS/DATA BUILDING(S)
(Generic Physical Subsystem Account Code: 4.3.9)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The communications/data building(s) shall provide for all the facilities, systems, and services for the communications, data collection, and transmissions that are required to support construction and testing.

Boundaries and Interfaces

Specific boundaries and interfaces between participating organizations' designs are identified in the YMP Interface Control Document(s). Full compliance of the ESF design with the requirements and criteria of Section 1.2.6.3.9 necessitates an evaluation and understanding, by the designer, of the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.1	ESF SITE(S)
1.2.6.2	SURFACE UTILITIES
1.2.6.2.1	Power System
1.2.6.2.4	Communications System
1.2.6.3.1	Ventilation System
1.2.6.7	UNDERGROUND SUPPORT SYSTEMS
1.2.6.7.11	Monitoring and Warning Systems
1.2.6.8	UNDERGROUND TEST SUPPORT
1.2.6.8.1	Integrated Data System (IDS) Support
1.2.6.8.2	Test Support
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.1	Surface Facilities

FUNCTIONAL REQUIREMENTS

1. Provide a communications/data building(s) for the communications data collection and transmission equipment during the ESF operation and underground site characterization. [6.3FR1]

PERFORMANCE CRITERIA

1a. The building(s) shall be designed to meet the operational requirements as defined by users. [6.3PC1a] (D,O,S,P,M,T,I)

1b. The space within the building(s) shall be adequate to house the equipment. [6.3PC1a]

1c. The areas for housing IDS systems, as a minimum, shall be equipped as follows:

YMP CC-0013, Rev. 5/31/91

i. Expandable power distribution system.
ii. Raised flooring.
iii. Acoustical treatment to reduce noise.
iv. Power failure lighting.
v. Interior air cleaning/filtering.
vi. Air Conditioning as required.
vii. UPS of 120/208 VAC, capacity as required. [6.3PC1a] (D)

1d. Facilities required for IDS equipment shall be provided with a heating/ventilating/air conditioning (HVAC) system to maintain nominal temperature and humidity as required by the equipment specifications. [6.3PC1h, CB] (T,P)

CONSTRAINTS

A. Provision shall be made adjacent to the communications building for a microwave transmission tower. [6.3PC1a]

ASSUMPTIONS

None.

YMP CC-0013, Rev. 5-31-91

1.2.6.4 SHAFT ACCESS
(Generic Physical Subsystem Account Code: 4.4.1.0)

Subparts are 1.2.6.4.1 Collar
1.2.6.4.2 Lining
1.2.6.4.3 Stations
1.2.6.4.4 Furnishings
1.2.6.4.5 Hoist System
1.2.6.4.6 Sump

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

A shaft access is defined as those systems, subsystems, and components which are comprised of: a) the vertical engineered openings within a circular zone, whose radius is defined as the sum of the radius of the finished shaft, the lining thickness, and a nominal 5 feet beyond the lining, that connect the surface with the targeted horizons; b) the stations within a zone being a nominal 5 feet beyond the excavated surface [TBV]. The system provides safe and controlled access to the targeted horizons for personnel, equipment, underground service systems, and includes the materials required for the development of the underground drifts and excavations, as well as underground and in-shaft testing operations. A shaft, if used, may serve as a primary location for surface to the proposed repository horizon testing and test access.

Boundaries and Interfaces

Specific boundaries and interfaces between participating organizations' designs are identified in the YMP Interface Control Document(s). Full compliance of the ESF design with requirements and criteria of Section 1.2.6.4 necessitates an evaluation and understanding, by the designer, of the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.1 ESF SITE(S)
1.2.6.1.1 Main Site(s)
1.2.6.1.2 Auxiliary Site(s)
1.2.6.1.3 Access Roads
1.2.6.1.4 Site Drainage
1.2.6.2 SURFACE UTILITIES
1.2.6.2.1 Power System
1.2.6.2.2 Water System
1.2.6.2.4 Communications System
1.2.6.2.5 Surface Wastewater System
1.2.6.2.6 Compressed Air System
1.2.6.3 SURFACE FACILITIES
1.2.6.3.1 Ventilation System
1.2.6.3.7 Warehouse
1.2.6.5 RAMP ACCESS
1.2.6.5.3 Station
1.2.6.6 UNDERGROUND EXCAVATIONS

YMP CC-0013, Rev. 5/31/91

1.2.6.6.1	Operations Support Areas
1.2.6.6.2	Test Areas
1.2.6.7	UNDERGROUND SUPPORT SYSTEMS
1.2.6.7.1	Power Distribution System
1.2.6.7.3	Lighting System
1.2.6.7.4	Distribution System
1.2.6.7.5	Water Distribution System
1.2.6.7.6	Underground Wastewater Collection System
1.2.6.7.7	Compressed Air Distribution Systems
1.2.6.7.8	Fire Protection System
1.2.6.7.9	Muck and Material Handling Systems
1.2.6.7.10	Sanitary Facilities
1.2.6.7.11	Monitoring and Warning Systems
1.2.6.8	UNDERGROUND TEST SUPPORT
1.2.6.8.1	Integrated Data System (IDS) Support
1.2.6.8.2	Test Support
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.2	Accesses and Underground Facilities

APPLICABLE REGULATIONS, CODES, STANDARDS, AND DOE ORDERS

See Section 1.2.6.0, Applicable Regulations, Codes, Standards, and DOE Orders.

FUNCTIONAL REQUIREMENTS

1. Provide underground openings for in situ site characterization and access to other underground excavations for the performance and support of in situ site characterization. [6.0FR1]

2. Provide for the incorporation of the ESF into the future repository. [6.0FR2]

PERFORMANCE CRITERIA

1a. Unless the Commission determines with respect to the site described in the application that it is not necessary, site characterization shall include a program of in situ exploration and testing at the depths that wastes would be emplaced. [10 CFR 60.15(b)] [6.0PC1k]

   i. Shaft design and construction shall provide access for site characterization activities to be performed at the planned waste emplacement horizon.

   ii. For planning purposes, the breakout for the main test level shall conform with the RIB data. [TBD]

   iii. Selection of the horizon for the main test level shall be based on evaluation of stratigraphic information sources available during construction (e.g., from the MPBH activity, geologic mapping of the shafts, and a probe corehole drilled ahead of the

YMP CC-0013, Rev. 5 31 91

shaft face in portions of the shaft) with respect to explicit horizon criteria.

iv. The flexibility to construct the shaft into, and/or drift into, the Calico Hills formation shall be maintained, without adversely affecting other testing that may be ongoing. Such flexibility shall consider aspects of hoisting capacity, underground utilities, ground support, and muck handling. [TBD]

1b. The number of exploratory boreholes and shafts shall be limited to the extent practical consistent with obtaining the information needed for site characterization. [10 CFR 60.15(c)(2)] [6.0PC2d]

1c. Shafts shall be designed to meet testing requirements. [6.0PC1d]

i. Shaft design shall have the flexibility needed to ensure that the location, orientation, geometry, and configuration of each planned test can be modified, as necessary, to meet specific test location acceptance criteria for each test in a shaft, in response to actual site conditions encountered during construction.

ii. The configuration of a shaft shall be adequate to support site characterization testing and future testing that may be reasonably expected for site characterization. This shall include an allowance to accommodate site specific conditions encountered in the shaft without adversely affecting testing that is planned or ongoing.

iii. For planning purposes, the breakout for an upper demonstration breakout room shall be at an elevation given in the RIB. [TBD]

iv. Shaft design and construction shall provide for design and construction testing, performance confirmation testing, and in situ site characterization testing to the extent necessary. (D,O,P,T) [TBD]

1d. Shaft operations shall not adversely affect site characterization. [6.0PC1d]

i. Excess water shall be removed to preclude interference with tests. [TBD]

ii. Appropriate gravity drainage and/or pumping systems shall be incorporated into the shaft for draining water away from testing and other working areas to suitable collection point(s) for further treatment and/or disposal. (O,S,P,T)

iii. The amount of water used in the construction and operation of the shaft shall be limited to preclude interference with tests. [TBD]

iv. Methods for dust control and cleaning of walls in the underground portion of the ESF shall be designed to limit adverse effects on

YMP CC-0013, Rev. 5 31 91

the adequacy and reliability of information from site characterization.

v. Construction methods shall be designed and implemented so that the effects of fluids, gases, or other materials used do not adversely affect the adequacy or reliability of information from site characterization.

vi. Fluids and materials planned for use in a shaft shall be evaluated with respect to intended use and possible effects on site characterization or other testing, and appropriate controls shall be implemented.

vii. Fluids, gases, and other materials used in shaft construction and operations, and/or injected into the rock mass, shall be appropriately tagged. Selection of tracers shall consider, but not be limited to: (1) the possible future need to account for the mobility and disposition of all such materials as part of site characterization, and (2) the effects of tracers on site characterization. [TBD]

viii. The use of blasting agents and explosives shall be controlled so that in situ site characterization is not adversely affected.

ix. The chemical content of the blasting agents and explosives shall be evaluated during their selection process and the chemical content of the blasts sampled, recorded, and the data used as necessary to preclude adverse effects on in situ site characterization. [TBD]

x. The location of openings for rock handling shall be selected to minimize effects on testing. (D,S)

xi. Shaft instrumentation shall be protected from physical damage. (O,T)

xii. Location of a shaft relative to any other access shall be such that testing in either access will not be adversely affected by activities in the other. [TBD]

1e. Shafts and shaft operations shall meet specified personnel movement requirements. [6.0PC1d]

1f. Shafts shall meet equipment requirements. [6.0PC1d]

i. Surface rock and materials handling equipment and facilities shall meet specified rates for excavation, rock removal, and backfilling of excavation, and the design of the facilities shall meet applicable requirements of DOE Orders 5480.4 and 6430.1A. (D,O)

ii. Necessary shaft facilities and equipment required for handling excavated rock, materials, equipment, and supplies shall support

YMP CC-0013, Rev. 5 31 91

construction, operations, and in situ site characterization testing. (D,O,S,T,)

1g. Shafts shall meet utility requirements. [6.0PC1d,1k,CM]

1h. Shafts shall meet ventilation requirements. [6.0PC1d,1k,CM]

i. The size, shape, and construction of a shaft shall be adequate to supply and/or exhaust the required volumes of air for underground construction, operations, and in situ site characterization. (D,O,P,T)

ii. A shaft and its furnishings shall be designed to minimize air resistance to the extent practicable.

1i. Shafts shall meet safety requirements. [6.0 CM]

i. A shaft shall provide safe access between the ESF surface and the underground portion of the ESF to meet the needs of underground site characterization testing.

ii. A shaft shall be excavated, supported, and structurally lined using methods and materials based upon currently available shaft construction technology for the shaft diameter and depth under consideration. (D,O,S) [TBD]

iii. The accesses (shafts, ramps) shall be separated to maintain reasonable distances for power and instrument cabling and water piping as well as to provide for redundancy in waste water discharge.

1j. Shafts shall meet all access requirements. [6.0PC1d]

i. Subsurface openings shall be designed and constructed such that they remain stable during operating periods and retrieval periods to meet personnel, equipment, and ventilation access requirements. (D,O)

ii. Support facilities, utilities, and equipment shall be designed and constructed to accommodate the selected shaft excavation method. (D,S)

2a. Investigations to obtain the required information shall be conducted in such a manner as to limit adverse effects on the long-term performance of the geologic repository to the extent practical. [10 CFR 60.15(c)(1)] [6.0PC2d]

i. The design, construction, and operation of a shaft shall incorporate aspects specifically directed at limiting the potential for adverse impacts on the long term performance of the repository. (O,W,S)

ii. All materials or substances to be used underground shall first be reviewed for potential effects on engineered barriers and waste

YMP CC-0013, Rev. 5-31-91

isolation. They may be used only following review and approval (TBD), and only in those areas where use has been approved, and subject to whatever controls are established. Such materials or substances include, but are limited to, the following [TBD]:

a. Concrete and other cementitious materials, such as shotcrete and grout.

b. Ground support materials, including chemical/resin anchorages.

c. Water (pH and organic content) and any additives to water for identification (tracers) or construction, operation, or testing.

d. Hydrocarbons and solvents.

e. Organic materials.

f. Explosives and blasting ancillaries, including the introduction of pressurized drilling water into the rock, and the chemical residues that are the products of blasting.

iii. To the extent feasible or practical, lining and grouting material selection shall consider material chemistry and take into account potential chemical interactions with groundwater that could affect waste package corrosion and radionuclide solubility. [TBD]

iv. A materials control program shall be implemented to enable establishment of limits on the inventory of materials left after decommissioning. [TBD]

v. A shaft shall be designed with construction controls that enable flexibility in closure, such as the location of seals, so that a seismic event is unlikely to compromise the ability of the facility to isolate wastes. [TBD]

2b. **To the extent practical, exploratory boreholes and shafts in the geologic repository operations area shall be located where shafts are planned for underground facility construction and operation or where large unexcavated pillars are planned. [10 CFR 60.15(c)(3)] [6.0PC2d]**

i. **ESF shafts shall be located, to the extent practicable, where shafts are planned for the repository facility.**

ii. **Borehole alignments and locations shall be monitored, surveyed, and the results included on all underground working maps. [TBD]**

iii. **The centerline coordinate location of the shafts shall be as listed in the RIB, and defined by the Nevada Coordinate System. [TBD]**

iv. The nominal finished inside diameter of the shafts shall be as listed in the RIB. [TBD]

2c. Sections [10 CFR] 60.131 through [10 CFR] 60.134 specify minimum criteria for the design of the geologic repository operations area. These design criteria are not intended to be exhaustive, however. Omissions in § § [10 CFR] 60.131 through 60.134 do not relieve DOE from any obligation to provide such safety features in a specific facility needed to achieve the performance objectives. All design bases must be consistent with the results of site characterization activities. [10 CFR 60.130] [6.0PC2d,CE]

2d. The orientation, geometry, layout, and depth of the underground facility, and the design of any engineered barriers that are part of the underground facility shall contribute to the containment and isolation of radionuclides. [10 CFR 60.133(a)(1)] [6.0PC2d]

i. Rock support and other structural anchoring materials shall be compatible with waste isolation. (O,W,S) [TBD]

ii. Rock support and other structural anchoring materials shall neither interfere with radionuclide containment nor enhance radionuclide migration. (O,W,S) [TBD]

iii. Shaft configuration (shaft location, shaft diameter, shaft separation, and shaft depth) shall contribute to or not detract from the isolation capability of the site. [TBD]

iv. The locations of openings for handling muck shall be selected to minimize effects on the integrity of any other openings.

v. ESFDR Appendix A.1 will show the interface between the ESF and the repository conceptual design. New or revised drawings will be prepared to show future design changes (if any) as they are approved. (TBD)

2e. The underground facility shall be designed so that the effects of credible disruptive events during the period of operations, such as flooding, fires and explosions, will not spread through the facility. [10 CFR 60.133(a)(2)] [6.0PC2d]

i. A shaft shall be designed so that the effects of credible disruptive events (e.g., flooding, fires, and explosions) shall not spread through the facility.

ii. A shaft collar shall be designed to prevent significant water inflow from a flooding event during site characterization and the planned period of repository operation, such that testing in the underground portion of the ESF and waste emplacement are not adversely affected. [TBD]

2f. The underground facility shall be designed with sufficient flexibility to allow adjustments where necessary to accommodate specific site

 YMP CC-0013, Rev. 5/31/91

conditions identified through in situ monitoring, testing, or excavation. [10 CFR 60.133(b)] [6.0PC2d]

2g. The design of the underground facility shall provide for control of water or gas intrusion. [10 CFR 60.133(d)] [6.0PC2d]

i. The amount of water used in construction and operations shall be limited to that required for dust control and proper equipment operation so as to limit the effects on the containment and isolation capability of the site. The maximum quantity of water (based on use during construction) shall not exceed 15 gallons per ton of rock excavated.

ii. Water use in shaft construction shall be generally consistent with repository design goals to limit the increase in average percent saturation of the repository horizon to less than [TBD] percent and to limit the increase in local percent saturation to less than [TBD] percent in waste emplacement areas. [TBD]

iii. Water entering the ESF shall be managed appropriately, including quantity, location, and water balance. [TBD]

iv. Operational seals shall be provided where necessary to control the intrusion of water into the facility. [TBD]

2h. Openings in the underground facility shall be designed to reduce the potential for deleterious rock movement or fracturing of overlying or surrounding rock. [10 CFR 60.133(e)(2)] [6.0PC2d]

i. Shaft structures shall be designed and constructed to withstand the effects of seismic events. Seismic criteria to be used to design the shaft are in the RIB.

ii. An adequate distance between accesses shall be provided to limit potential mechanical and hydrological interference between the accesses and to reduce the potential for deleterious rock movement so they do not impact the capability to reliably and adequately characterize the site. [TBD]

iii. The openings for rock handling shall be constructed in such a way as to minimize effects on the integrity of any other openings. (O,D,W,S)

2i. The design of the underground facility shall incorporate excavation methods that will limit the potential for creating a preferential pathway for groundwater to contact the waste packages or radionuclide migration to the accessible environment. [10 CFR 60.133(f)] [6.0PC2d]

i. Techniques used for shaft excavation shall control overbreak of rock and minimize disturbance to the integrity of the adjoining rock mass. (D,O)

YMP CC-0013, Rev. 5-31-91

ii. A shaft shall be designed to provide stability and to minimize the potential for deleterious rock movement or fracturing that may create a pathway for radionuclide migration or could impact the capability to reliably and adequately characterize the site. (C,W,S)

iii. The following are design goals relating to shaft stability. These design goals may be modified pending information obtained during site characterization or from future analyses:

a. In areas not affected by thermal load, diametrical closure rate decreasing at all times after construction. [TBD]

b. In areas affected by thermal load, closure rate no greater than three times that predicted by thermoelastic models. [TBD]

c. In accesses not lined with concrete, no rockfalls greater than a size of [TBD].

d. Access shall be maintainable. [TBD]

iv. Mechanical excavation methods shall be used when feasible and practical; however, in those circumstances where drill and blast excavation may be determined to be more effective (safety, ease of construction, readily available technology, schedule, or cost), the design of blasting rounds shall:

a. Limit the disturbance of the surrounding rock mass.

b. Provide fragmentation of tuff into sizes compatible with removal equipment.

c. Provide flexible blasting techniques to compensate for changes in the lithophysal content of the tuff and in local joint patterns.

d. Provide methods to control sudden inflows of water.

v. The magnitude and extent of blast-induced changes in permeability shall be limited by blast control.

Limitations on blast-induced changes and excavation overbreak are as follows. The limitations are design goals which may be changed based on results of site characterization or future analyses.

a. Blast-induced changes to the average in situ permeability of the rock beyond a dimension (into the rock) equal to one half of the maximum opening dimension shall be less than one order of magnitude. [TBD]

b. Excavation overbreak is to average less than 12 inches. This overbreak limit is additive to the dimensional

tolerances applied to the location and runout of the drill holes used for excavation explosives. This limit may be exceeded for short intervals where blast designs are being adjusted.

vi. Drill and blast specifications should include controls related to types and amounts of explosives, shot patterns, and hole depth in order to limit the magnitude and extent of blast-induced permeability. [TBD]

vii. If drill and blast construction techniques are used, then controlled blasting will be utilized to limit overbreak and damage to the surrounding rock mass which could affect the adequacy or reliability of information from site characterization. The methods shall be designed to provide for the requirements of specific site characterization tests, such as limitations on the extent of excavation-induced damage, or the type of ground support that may be installed. The methods shall be designed to facilitate investigation and monitoring of excavation effects during and after construction. [TBD]

viii. The shaft construction method shall be selected, consistent with other goals of site characterization, to limit impacts on isolation.

2j. The underground facility shall be designed so that the performance objectives will be met taking into account the predicted thermal and thermomechanical response of the host rock, and surrounding strata, groundwater system. [10 CFR 60.133(i)] [6.0PC2d]

i. The subsurface facilities shall be designed considering the predicted thermal and thermomechanical response of the host rock, surrounding strata, and groundwater system so that the performance objectives of the repository can be met.

ii. The predicted loads imposed on a shaft by heating of the repository waste disposal formation are defined in ESFDR Appendix A.4. These loads shall be considered in the analyses performed to predict the long-term response of the shaft.

iii. The shaft lining shall withstand pressures exerted along its length and around the entire perimeter under anticipated conditions, including reaction to thermally-induced stresses resulting from thermal loads. The provisions (TBD) for thermally induced stresses can be installed at a later date. [TBD]

2k. Seals for shafts and boreholes shall be designed so that following permanent closure they do not become pathways that compromise the geologic repository's ability to meet the performance objectives of the period following permanent closure. [10 CFR 60.134(a)] [6.0PC2d]

Materials and placement methods for seals shall be selected to reduce to the extent practicable: (1) The potential for creating a preferential pathway for groundwater to contact the waste packages or

 YMP CC-0013, Rev. 8 31 91

(2) for radionuclide migration through existing pathways. [10 CFR 60.134(b)] [6.0PC2d]

i. Access design and construction shall allow for future sealing in shafts, declines, or drifts in order to ensure that they do not become preferential pathways for groundwater or radioactive waste migration. In addition, techniques used to seal aquifers during access construction should not preclude use, or reduce the effectiveness, of future access seals.

ii. To prevent complications of seal evaluations and emplacement and limit chemical alteration in future seal environments, no pressure grouting shall take place during the construction period of the shaft at locations of potential seal testing or emplacement. Specifically, no pressure grouting shall be performed within 50 feet of the original ground surface and within 50 feet (above and below) the contact of the Pah Canyon and Topopah Spring tuffs, or below the main test level.

iii. Design, construction, and materials used in the construction of a shaft (e.g., epoxies and lean grouts need to be evaluated prior to use) shall not significantly interfere with or prevent the eventual installation of the features required to effect postclosure repository sealing. Specific banned items and activities are to be determined at the direction of the YMPO. The major areas in which these limitations apply are as follows:

a. Immediately below the shaft collar structure in the area where an anchor to bedrock seal installation is planned to be installed at the time of shaft closure.

b. At the interface between the nonwelded tuff (PTn) and the Topopah Spring tuff (TSw).

c. In the extension of the shaft below the Main ESF Test Level.

Note: The above limitations are not intended to apply to the locations of the radial borehole tests.

iv. Pressure grouting during or after construction shall not be permitted in a zone extending 50 feet above and below locations planned for installation of anchor to bedrock seals or below the main test level.

v. Materials and placement methods for shaft and borehole seals shall be selected to reduce, to the extent practicable, the potential for creating preferential pathways for groundwater to contact the waste packages or to reduce radionuclide migration through existing pathways.

INTERFACE CONTROL REQUIREMENTS

i. The ESF designers shall interface with repository designers on ESF site location and layout and on permanent ESF structures, systems, and components, and shall make available all design information pertaining to the permanent ESF components during formal program design technical assessments and reviews, or when such information is formally requested by the repository designers through DOE or their designated representatives.

See Section 1.2.6.0, Interface Control Requirements.

CONSTRAINTS

A. DOE shall perform, or permit the Commission to perform, such tests as the Commission deems appropriate or necessary for the administration of the regulations in this part [Part 60]. These may include tests of: (1) Radioactive waste, (2) the geologic repository including its structures, systems, and components, (3) radiation detection and monitoring instruments, and (4) other equipment and devices used in connection with the receipt, handling, or storage of radioactive waste. [10 CFR 60.74(a)] [6.0CD]

The tests required under this section shall include a performance confirmation program carried out in accordance with Subpart F of this part [Part 60]. [10 CFR 60.74(b)] [6.0CD]

i. The structures, systems, components and operation of the shaft shall be designed to accommodate additional testing as may be required by the NRC for site characterization and performance confirmation. [TBD]

B. The geologic repository operations area shall be designed so as to permit implementation of a performance confirmation program that meets the requirements of Subpart F of this part [Part 60]. [10 CFR 60.137] [6.0PC2d]

i. The underground excavations shall be designed to accommodate the performance confirmation tests required by 10 CFR 60.141 and 10 CFR 60.142, and taking into account any potentially adverse impacts these excavations could have on the waste isolation capabilities of the site.

ii. The configuration of a shaft shall be adequate to support performance confirmation testing, and future testing that may be reasonably expected for performance confirmation. This shall include an allowance to accommodate site specific conditions encountered in the shaft without adversely affecting testing that is planned or ongoing. [TBD]

iii. The accesses to the ESF underground facility shall be designed to facilitate performance confirmation testing to obtain adequate and reliable information about the site, during and after

 YMP CC-0013, Rev. 5 31 91

construction, as required for the geologic repository by 10 CFR 60, Subpart F.

ASSUMPTIONS

None

YMP CC-0013, Rev. 8-31-91

1.2.6.4.1 COLLAR
(Generic Physical Subsystem Account Code: 4.4.1.1)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The shaft collar is defined as the foundation at the uppermost portion of the shaft used to support the headframe and shaft construction activities.

Boundaries and Interfaces

Specific boundaries and interfaces between participating organizations' designs are identified in the YMP Interface Control Document(s). Full compliance of the ESF design with requirements and criteria of Section 1.2.6.4.1 necessitates an evaluation and understanding, by the designer, of the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.1	ESF SITE(S)
1.2.6.2	SURFACE UTILITIES
1.2.6.2.5	Surface Wastewater System
1.2.6.3	SURFACE FACILITIES
1.2.6.4	SHAFT ACCESS
1.2.6.4.2	Lining
1.2.6.4.4	Furnishings
1.2.6.4.5	Hoist System
1.2.6.6	UNDERGROUND EXCAVATIONS
1.2.6.7	UNDERGROUND SUPPORT SYSTEMS
1.2.6.8	UNDERGROUND TEST SUPPORT
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.2	Accesses and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. Provide an adequate foundation for the headframe and accommodate penetrations and structural mountings. [6.4FR1]

PERFORMANCE CRITERIA

1a. Collar shall provide support for the headframe and hoisting system over the entire range of hoisting system functions, operations, and requirements. (D,O,S) [6.4PC1]

1b. Collar shall provide support for shaft construction equipment and construction stages over the range of conditions encountered during construction. (D,S) [6.4PC1]

 YMP CC-0013, Rev. 5 31 91

CONSTRAINTS

A. The surface elevation above mean sea level at the shaft collar shall be as contained in the RIB. [6.4PC2b] [TBD]

B. The shaft collar shall be founded in rock. [6.4PC1i,1j]

ASSUMPTIONS

None

YMP CC-0013, Rev. 5/31/91

1.2.6.4.2 LINING
(Generic Physical Subsystem Account Code: 4.4.1.2)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The lining is defined as those components (e.g., concrete) which are provided to maintain the integrity of the intended opening.

Boundaries and Interfaces

Specific boundaries and interfaces between participating organizations' designs are identified in the YMP Interface Control Document(s). Full compliance of the ESF design with requirements and criteria of Section 1.2.6.4.2 necessitates an evaluation and understanding, by the designer, of the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.4	SHAFT ACCESS
1.2.6.4.1	Collar
1.2.6.4.3	Stations
1.2.6.4.4	Furnishings
1.2.6.4.5	Hoist System
1.2.6.4.6	Sump
1.2.6.6	UNDERGROUND EXCAVATIONS
1.2.6.7	UNDERGROUND SUPPORT SYSTEMS
1.2.6.8	UNDERGROUND TEST SUPPORT
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.2	Accesses and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. Provide structural and mechanical integrity for the shaft and provide mounting for conveyance guide supports, utilities, and shaft instrumentation during construction and operations. [6.4FR1]

PERFORMANCE CRITERIA

1a. The shaft lining shall provide adequate bearing support for the structural mounting of the conveyance system guide supports under both static and dynamic operational loading conditions. (D,O,S) [6.4PC1f]

1b. The lining shall include provisions for shaft instrumentation penetrations and data collection units. (O,S,M,T) [TBD] [6.4PC1c]

1c. All concrete activities shall conform to the applicable American Concrete institute (ACI) standards for furnishing, delivery, and placement of structural concrete. (D) [6.4PC1f]

YMP CC-0013, Rev. 5 31 91

1d. All forming and reinforcements utilized shall conform to applicable ACI and ASTM standards. (D) [6.4PC1f]

CONSTRAINTS

A. The shaft lining shall be protected from damage due to blasting and other activities. To protect the lining from blasting damage, the minimum distance between the shaft bottom and the lining shall be determined by the contractor with concurrence from the design organization and the YMPO. [6.4PC2i]

B. The shaft lining placement shall be coordinated with science needs such as testing and mapping. [6.4PC1c]

C. The capability to enhance postclosure performance by removing shaft linings shall be retained. [6.4PC2e]

ASSUMPTIONS

None

YMP CC-0013, Rev. 5/31/91

1.2.6.4.3 STATIONS
(Generic Physical Subsystem Account Code: 1.4.1.3)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The stations are defined as the initial underground openings at predetermined horizons adjacent to the shaft.

Boundaries and Interfaces

Specific boundaries and interfaces between participating organizations' designs are identified in the YMP Interface Control Document(s). Full compliance of the ESF design with requirements and criteria of Section 1.2.6.4.3 necessitates an evaluation and understanding, by the designer, of the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.2	SURFACE UTILITIES
1.2.6.2.4	Communication System
1.2.6.4	SHAFT ACCESS
1.2.6.4.2	Lining
1.2.6.4.4	Furnishings
1.2.6.4.5	Hoist System
1.2.6.4.6	Sump
1.2.6.5	RAMP ACCESS
1.2.6.5.3	Stations
1.2.6.6	UNDERGROUND EXCAVATIONS
1.2.6.7	UNDERGROUND SUPPORT SYSTEMS
1.2.6.8	UNDERGROUND TEST SUPPORT
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.2	Accesses and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. Provide excavated space of adequate size and appropriate geometry to provide support for underground construction and site characterization testing activities. [6.4FR1]

PERFORMANCE CRITERIA

1a. The shaft stations shall allow sufficient room for unloading of personnel and materials. (D,O,S,M,T) [6.4PC1e,1f]

1b. The shaft stations shall accommodate devices (e.g., forklift) for handling heavy and large materials. (O,S,M,T) [6.4PC1f]

1c. The design of the stations shall ensure unobstructed access to both sides of the shaft conveyance, complete with a protected walkway. (O,S) [6.4PC1e]

YMP CC-0013, Rev. 5/31/91

1d. The stations shall be provided with landings complete with safety devices that shall include as a minimum: signals, clear areas, barriers, gates. (O,S) [6.4PC1e,1i]

1e. The design of the stations shall ensure appropriate transitions of utilities through the shaft stations to the continuation of the shaft below as required. (D,O,S) [6.4PC1g]

1f. The design of the stations shall ensure, if applicable, an adequate means of handling excavated rock. (D,S) [6.4PC1f]

1g. The design of the stations shall ensure adequate unobstructed room for ventilation air flow. (D,O,S) [6.4PC1h]

1h. The design of the shaft stations shall consider the physical characteristics of the material and equipment. (D) [6.4PC1f]

CONSTRAINTS

None

ASSUMPTIONS

None.

 YMP CC-0013, Rev. 5-31-91

1.2.6.4.4 FURNISHINGS
(Generic Physical Subsystem Account Code: 4.4.1.4)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The furnishings are defined as those structural steel sets consisting of buntons attached to fabricated brackets, which are fixed to the shaft wall or to other structural members. Also included are the shaft guides; fixed guide brackets and backers; conveyance chairs; crash beams; various enclosures or blockouts required to support instrumentation and cabling; and utility brackets to facilitate installation of shaft utilities such as electrical power, communications, compressed air, water, and wastewater removal.

Boundaries and Interfaces

Specific boundaries and interfaces between participating organizations' designs are identified in the YMP Interface Control Document(s). Full compliance of the ESF design with requirements and criteria of Section 1.2.6.4.4 necessitates an evaluation and understanding, by the designer, of the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.2	SURFACE UTILITIES
1.2.6.3	SURFACE FACILITIES
1.2.6.3.1	Ventilation System
1.2.6.4	SHAFT ACCESS
1.2.6.4.1	Collar
1.2.6.4.2	Lining
1.2.6.4.3	Stations
1.2.6.4.5	Hoist System
1.2.6.4.6	Sump
1.2.6.6	UNDERGROUND EXCAVATIONS
1.2.6.7	UNDERGROUND SUPPORT SYSTEMS
1.2.6.8	UNDERGROUND TEST SUPPORT
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.2	Accesses and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. Provide for structural support and guides for the operation of the hoist conveyance, the alternate access, underground utility lines, and the necessary services (e.g., pipe, conduit, wiring, ventilation ducting) between surface and subsurface utility systems in the shaft during shaft construction, operation, and site characterization activities. [6.4FR1]

YMP/CC-0013, Rev. 5 31 91

PERFORMANCE CRITERIA

1a. The in-shaft structural steel supports shall be designed and constructed to carry the conveyance guides and absorb the maximum forces imposed on the conveyance when at rest and in motion. (D,O,S) [6.4PC1i]

1b. The brackets, buntons, and attachments shall be designed to allow for final alignment of the sets and guides for the hoist conveyance to be used during ESF operation. (D,O,S) [6.4PC1f]

1c. All furnishings shall be designed and constructed to allow readily performed inspection and maintenance. (M,T,) [6.4PC1c,1g,1i]

1d. Operational shaft guides shall be fixed and positioned to extend up to the underside of the crash beams. (D,O,S) [6.4PC1f,1i]

1e. Shaft furnishings shall be designed and constructed to facilitate shaft sinking equipment and operations, in-shaft site characterization testing and personnel activities. (D,O,S,M,T) [6.0PC1c,1e,1f,1i]

1f. Furnishings shall provide for mounting the following utilities and cables in the shaft:

i. Electrical power.
ii. Compressed air.
iii. Water.
iv. Communications.
v. Underground instrumentation.
vi. Instrumentation and IDS cabling.
vii. Underground wastewater handling system.
viii. Provision for ventilation.
(D,O,S,M,T) [6.4PC1g]

CONSTRAINTS

A. Activities associated with installation, operation, maintenance, and removal of furnishings shall be conducted in a manner that limits, to the extent practicable, adverse effects on the long term performance of the geologic repository. [6.4PC2d]

B. All brackets shall be designed and constructed to provide adequate strength and isolation for all cables and other devices. [6.4PC1g]

C. All shaft furnishings shall be designed to be removed in a manner that will leave the shaft lining free of appendages that would restrict ventilation airflow. Removal will occur at the time the shaft is converted for use as a repository ventilation air supply. [6.4PC1h]

ASSUMPTIONS

None.

 YMP CC-0013, Rev. 5 31 91

1.2.6.4.5 HOIST SYSTEM
(Generic Physical Subsystem Account Code: 4.4.1.5)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The hoist system is defined as those systems and components for the transportation of personnel and equipment between the surface and subsurface to meet the needs of shaft construction and underground site characterization testing. The hoist system includes the rope winding equipment (hoist), conveyance, headframe, rope, dumping system, and hoist house.

The hoist house is defined as those facilities to accommodate the hoist(s); the necessary equipment and instrumentation for the hoist, air compressor system, control room, electrical and motor control centers, and an area for repairs and lay down.

Boundaries and Interfaces

Specific boundaries and interfaces between participating organizations' designs are identified in the YMP Interface Control Document(s). Full compliance of the ESF design with requirements and criteria of Section 1.2.6.4.5 necessitates an evaluation and understanding, by the designer, of the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.2	SURFACE UTILITIES
1.2.6.2.4	Communications System
1.2.6.2.5	Surface Wastewater Systems
1.2.6.4	SHAFT ACCESS
1.2.6.4.1	Collar
1.2.6.4.2	Lining
1.2.6.4.3	Stations
1.2.6.4.4	Furnishings
1.2.6.4.6	Sump
1.2.6.5	RAMP ACCESS
1.2.6.5.5	Material Handling System
1.2.6.6	UNDERGROUND EXCAVATIONS
1.2.6.7	UNDERGROUND SUPPORT SYSTEMS
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.2	Accesses and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. Provide for the transport and support of personnel, materials, and construction equipment and serve as the emergency egress from the underground during shaft and underground construction (excavation) and underground testing. [6.4FR1]

YMP CC-0013, Rev. 5 31 91

PERFORMANCE CRITERIA

1a. Construction hoists may be used if more economical. (D,O,S,M) [6.4PC1f]

1b. The hoisting system capacities shall be consistent with the requirements of ESF construction, operation, and underground site characterization needs. (D,O,S,P,M,T) [6.4PC1c,1e,1f,1g,1h,1i]

1c. The hoisting conveyance shall be designed to permit the inspection of shaft performance monitoring instrumentation, as well as other shaft inspection and maintenance activities. (O,S,P,M,T) [6.4PC1c,1f,1g,1i]

1d. The headframe shall elevate the hoist sheaves sufficiently above the collar level to provide room for normal conveyance unloading and over-travel allowances. (D,O,S) [6.4PC1f]

1e. A hoist foundation shall be provided to accommodate the hoist dimensions and mounting details, independent of the hoist house foundation. (O,S) [6.4PC1f]

1f. The headframe shall provide sufficient facilities for dumping buckets during shaft construction. (D,S) [6.4PC1f]

1g. The headframe shall be designed and constructed to serve subsurface construction and underground test operations. (D,S,T) [6.4PC1c,1e,1f]

1h. Clearances in the headframe directly above the collar shall be designed to accommodate the rigging of all anticipated underground equipment. (D,O,S,M) [6.4PC1f]

1i. The hoisting systems (emergency egress systems) shall be designed and constructed for the evacuation of all underground personnel to safety within one hour. (S) [30 CFR 57.11050(b)] [6.4PC1e,1f,1i]

1j. Area floodlighting, obstruction lighting, and lightning protection shall be provided atop the shaft headframe. (D,O,S) [6.4PC1i]

CONSTRAINTS

A. The hoisting and/or transport system shall incorporate fail-safe devices and be designed with adequate safety factors as per applicable requirements of 30 CFR 57 Subpart R (if vertical hoisting is used) and State of Nevada and local regulations. (S) [6.4PC1i]

B. The hoist shall be designed to accommodate the uncertainty allowance (see Section 1.2.6.0, Performance Criteria 1d.) [6.4PC1c]

C. The hoist house control and operator's room shall be complete with a heating and air conditioning system. [6.4PC1e]

D. The hoisting system shall be designed, constructed, tested, operated, and maintained in conformance with applicable regulations. [6.4PC1i]

 YMP CC-0013, Rev. 5 31 91

E. The hoist shall be designed with an independent power feeder from the primary switchgear and a dedicated standby power feeder. [6.4PC1i]

F. The primary fire protection for hoist electrical gear shall not be a water flow or spray design. [6.4PC1i]

G. The sinking bucket, if used, shall be replaced with an enclosed conveyance for transporting non-shaft sinking personnel (i.e., visitors). [6.4PC1e,ii]

H. The hoist shall not convey radioactive waste unless specifically requested by the Nuclear Regulatory Commission for the purpose of site characterization testing. [6.4CA]

I. The capacity of the personnel hoisting system shall be maintained to provide emergency egress during initial repository construction until this function can be assumed by repository facilities. [6.4PC2b]

ASSUMPTIONS

None.

YMP CC-0013, Rev. 5-31-91

1.2.6.4.6 SUMP
(Generic Physical Subsystem Account Code: 4.4.1.6)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The sump is defined as the area at the bottom of the shaft, below the adjacent horizontal excavation, that contains, collects and transfers underground wastewater to the underground wastewater collection system.

Boundaries and Interfaces

Specific boundaries and interfaces between participating organizations' designs are identified in the YMP Interface Control Document(s). Full compliance of the ESF design with requirements and criteria of Section 1.2.6.4.6 necessitates an evaluation and understanding, by the designer, of the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.2.5	Surface Wastewater System
1.2.6.4	SHAFT ACCESS
1.2.6.4.2	Lining
1.2.6.4.3	Stations
1.2.6.4.4	Furnishings
1.2.6.4.5	Hoist System
1.2.6.6	UNDERGROUND EXCAVATIONS
1.2.6.7	UNDERGROUND SUPPORT SYSTEMS
1.2.6.7.6	Underground Wastewater Collection System
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.2	Accesses and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. Provide adequate space at the bottom of the shaft to accommodate in-shaft testing, shaft operation, and to collect and transfer wastewater to the underground wastewater collection system. [6.4FR1]

PERFORMANCE CRITERIA

1a. The size and depth of the shaft sump shall be sufficient to accommodate the required operation of the shaft equipment. (D,O,S,M) [6.4PC1f]

1b. The sump shall be equipped with wastewater collection and transfer facilities. (D,O,S) [6.4PC2g]

1c. Provisions shall be made for the cleaning out of the sump [6.4PC2g]

YMP CC-0013, Rev. 5/31/91

CONSTRAINTS

A. The extension of the shaft below the main test level shall provide a minimum water storage capacity of 150 cubic meters after removal of the shaft lining and placement of backfill. (Assume backfill porosity equals 0.3) [TBV] [6.4PC2d]

B. The sump shall not penetrate the Calico Hills Formation unless authorization to do so is given by the YMPO. [6.4PC1a]

ASSUMPTIONS

None.

 YMP CC-0013, Rev. 5 31 91

1.2.6.5 RAMP ACCESS
(Generic Physical Subsystem Account Code: 4.4.2)

Subparts are

1.2.6.5.1	Portal
1.2.6.5.2	Lining
1.2.6.5.3	Station
1.2.6.5.4	Ramp Furnishings
1.2.6.5.5	(This number not used)
1.2.6.5.6	Sump

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

A ramp access is defined as those systems, subsystems, and components which are comprised of: a) engineered openings within a zone being a nominal 5 feet beyond the excavated surface, that connects the ground surface with the targeted repository horizon; b) the station within a zone being a nominal 5 feet beyond the excavated surface [TBV]. The system provides safe and controlled access to the targeted horizons for personnel, equipment, underground service systems, and materials required for development of the underground drifts and excavations, as well as underground testing operations. A ramp access, if used, may serve as the primary muck removal opening for test area development and may include site characterization testing activities. [TBV]

Boundaries and Interfaces

Specific boundaries and interfaces between participating organizations' designs are identified in the YMP Interface Control Document(s). Full compliance of the Exploratory Shaft Facility (ESF) design with requirements and criteria of Section 1.2.6.5, necessitates an evaluation and understanding, by the designer, of the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.1	ESF Site(s)
1.2.6.1.1	Main Site(s)
1.2.6.1.2	Auxiliary Site(s)
1.2.6.1.3	Access Roads
1.2.6.1.4	Site Drainage
1.2.6.2	SURFACE UTILITIES
1.2.6.2.1	Power System
1.2.6.2.2	Water System
1.2.6.2.4	Communications System
1.2.6.2.5	Surface Wastewater System
1.2.6.2.6	Compressed Air System
1.2.6.3	SURFACE FACILITIES
1.2.6.3.1	Ventilation System
1.2.6.3.7	Warehouse
1.2.6.4	SHAFT ACCESS
1.2.6.4.3	Stations
1.2.6.4.5	Hoist System

YMP CC-0013, Rev. 5/31/91

1.2.6.6	UNDERGROUND EXCAVATIONS
1.2.6.6.1	Operations Support Areas
1.2.6.6.2	Test Areas
1.2.6.7	UNDERGROUND SUPPORT SYSTEMS
1.2.6.7.1	Power Distribution System
1.2.6.7.3	Lighting System
1.2.6.7.4	Ventilation Distribution System
1.2.6.7.5	Water Distribution System
1.2.6.7.6	Underground Wastewater Collection System
1.2.6.7.7	Compressed Air Distribution System
1.2.6.7.8	Fire Protection System
1.2.6.7.9	Muck and Material Handling Systems
1.2.6.7.10	Sanitary Facilities
1.2.6.7.11	Monitoring and Warning Systems
1.2.6.8	UNDERGROUND TEST SUPPORT
1.2.6.8.1	Integrated Data System (IDS) Support
1.2.6.8.2	Test Support
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.2	Accesses and Underground Facilities

APPLICABLE REGULATIONS, CODES, AND DOE ORDERS

See Section 1.2.6.0, Applicable Regulations, Codes, and DOE Orders.

FUNCTIONAL REQUIREMENTS

1. Provide underground openings for in situ site characterization, and access to other underground excavations for the performance and support of in situ site characterization. [6.0FR1]

2. Provide for the incorporation of the ESF into the future repository. [6.0FR2]

PERFORMANCE CRITERIA

1a. Unless the Commission determines with respect to the site described in the application that it is not necessary, site characterization shall include a program of in situ exploration and testing at the depths that wastes would be emplaced. [10 CFR 60.15(b)] [6.0PC1k]

   i. Ramp design and construction shall provide access for site characterization activities to be performed at the planned waste emplacement horizon.

   ii. For planning purposes, the breakout for the main test level shall be at an elevation identified in the RIB [TBD]

   iii. Selection of the horizon for the main test level shall be based on evaluation of stratigraphic information sources available during construction (e.g., from the geologic mapping of the ramp,

YMP CC-0013, Rev. 5 31 91

and a probe hole drilled ahead of the ramp face in portions of the ramp) with respect to explicit horizon criteria.

1b. The number of exploratory boreholes and shall be limited to the extent practical consistent with obtaining the information needed for site characterization. [10 CFR 60.15(c)(2)] [6.0PC2d]

1c. Ramps shall be designed to meet testing requirements. [6.0PC1d]

i. Ramp design shall have the flexibility needed to ensure that the location, orientation, geometry, and configuration of each planned test can be modified, as necessary, to meet specific test location acceptance criteria for each test in a ramp, in response to actual site conditions encountered during construction.

ii. The configuration of a ramp shall be adequate to support site characterization testing, and future testing that may be reasonably expected for site characterization. This shall include an allowance to accommodate site specific conditions encountered in the ramp without adversely affecting testing that is planned or ongoing.

iii. Ramp design and construction shall provide for design and construction testing, performance confirmation testing, and in situ site characterization testing to the extent necessary. (D,C,P,T)

iv. The ramp roadway shall be designed to permit the inspection of ramp performance monitoring instrumentation, as well as inspection and maintenance activities.

v. Routes for the material handling system shall be selected to avoid active test areas wherever possible.

1d. Ramp operations shall not adversely affect site characterization. [6.0PC1d]

i. Excess water shall be removed to preclude interference with tests. [TBD]

ii. Appropriate gravity drainage and/or pumping systems shall be incorporated into the ramp for draining water away from testing and other working areas to suitable collection point(s) for further treatment and/or disposal. (O,S,P,T)

iii. The amount of water used in the construction and operation of the ramp shall be limited to preclude interference with tests. [TBD]

iv. Methods for dust control and cleaning of walls in the underground portion of the ESF shall be designed to limit adverse effects on the adequacy and reliability of information from site characterization.

v. Construction methods shall be designed and implemented so that the effects of fluids, gases, or other materials used do not adversely affect the adequacy or reliability of information from site characterization.

vi. Fluids and materials planned for use in a ramp shall be evaluated with respect to intended use and possible effects on site characterization or other testing, and appropriate controls shall be implemented.

vii. Fluids, gases, and other materials used in ramp construction and operations, and/or injected into the rock mass, shall be appropriately tagged. Selection of tracers shall consider, but not be limited to: (1) the possible future need to account for the mobility and disposition of all such materials as part of site characterization, and (2) the effects of tracers on site characterization. [TBD]

viii. The use of blasting agents and explosives shall be controlled so that in situ site characterization is not adversely affected.

ix. The chemical content of the blasting agents and explosives shall be evaluated during their selection process and the chemical content of the blasts sampled, recorded, and the data used as necessary to preclude adverse effects on in situ site characterization. [TBD]

x. The location of openings for rock handling shall be selected to minimize effects on testing. (D,S)

xi. Ramp instrumentation shall be protected from physical damage. (O,T)

xii. Location of accesses relative to each other shall be such that testing in either access will not be adversely affected by activities in the other. [TBD]

1e. Ramps and ramp operations shall meet specified personnel movement requirements. [6.0PC1d]

1f. Ramps shall meet equipment requirements. [6.0PC1d]

i. A ramp shall serve as the primary rock removal and construction support access. The DO may assign the primary rock removal function to another access. (D,O,S)

ii. Surface rock and materials handling equipment and facilities shall be compatible to meet specified rates for excavation, rock removal, and backfilling of excavation; and the design of the facilities shall meet applicable requirements of DOE Orders 5480.4. and 6430.1A (D,O)

iii. The ramp roadway shall be designed to sustain impact and heavy moving loads from equipment and material transport.

YMP CC-0013, Rev. 5/31/91

iv. The ramp and ramp roadway shall be provided with adequate width and clearance to permit the largest piece of equipment to be transported to and from the underground facility and to minimize the interference with underground site characterization to the extent practicable.

v. The ramp and ramp roadway shall be designed to provide an acceptable slope suitable for excavation, safe vehicular traffic, and material handling equipment requirements.

1g. Ramps shall meet utility requirements. [6.0PC1d,1k,CM]

1h. Ramps shall meet ventilation requirements. [6.0PC1d,1k,CM]

i. The size, shape, and construction of a ramp shall be adequate to supply and/or exhaust the required volumes of air for underground construction, operations, and in situ site characterization.
ii. A ramp and its furnishings shall be designed to minimize air resistance to the extent practicable.

1i. Ramps shall meet safety requirements. [6.0CM]

i. A ramp shall provide safe access between the ESF surface and the candidate repository horizon to meet the needs of site characterization testing, emergency egress, ventilation intake and exhaust, major muck handling, fuel transfer, and primary transport of heavy equipment.

ii. A ramp shall serve as the emergency egress from the underground during the ESF construction and underground testing and shall be capable of evacuating all underground personnel to safety within one hour.

iii. A ramp shall be designed and constructed such that it meets emergency-egress and ventilation requirements.

iv. A ramp shall be excavated, supported, and lined using methods and materials based upon currently available ramp construction technology for the ramp diameter and depth under consideration. (D,O,S) [TBD]

v. The accesses shall be separated to maintain reasonable distances for power and instrument cabling and water piping as well as to provide for redundancy in wastewater discharge.

1j. Ramps shall meet all access requirements. [6.0PC1d]

i. Subsurface openings shall be designed and constructed such that they remain stable during operating periods and retrieval periods to meet personnel, equipment, and ventilation access requirements. (D,O)

YMP CC-0013, Rev. 5/31/91

ii. Support facilities, utilities, and equipment shall be designed and constructed to accommodate ramp excavation techniques used(i.e., tunnel boring machines and/or drill and blast). (D,S)

2a. Investigations to obtain the required information shall be conducted in such a manner as to limit adverse effects on the long-term performance of the geologic repository to the extent practical. [10 CFR 60.15(c)(1)] [6.0PC2d]

i. The design, construction, and operation of the ramp shall incorporate aspects specifically directed at limiting the potential for adverse impacts on the long term performance of the repository. (O,W,S)

ii. All materials or substances to be used underground shall first be reviewed for potential effects on engineered barriers and waste isolation. They may be used only following review and approval (TBD), and only in those areas where use has been approved, and subject to whatever controls are established. Such materials or substances include, but are limited to, the following [TBD]:

a. Concrete and other cementitious materials, such as shotcrete and grout.

b. Ground support materials, including chemical/resin anchorages.

c. Water (pH and organic content) and any additives to water for identification (tracers) or construction, operation, or testing.

d. hydrocarbons and solvents.

e. Organic materials.

f. Explosives and blasting ancillaries, including the introduction of pressurized drilling water into the rock, and the chemical residues that are the products of blasting.

iii. To the extent feasible or practical, lining and grouting material selection shall consider material chemistry and take into account potential chemical interactions with groundwater that could effect waste package corrosion and radionuclide solubility. [TBD]

iv. A materials control program shall be implemented to enable establishment of limits on the inventory of materials left after decommissioning. [TBD]

v. A ramp shall be designed with construction controls that enable flexibility in closure, such as the location of seals, so that a

YMP CC-0013, Rev. 5 31 91

seismic event is unlikely to compromise the ability of the facility to isolate wastes. [TBD]

2b. To the extent practical, exploratory boreholes and ramps in the geologic repository operations area shall be located where [accesses] are planned for underground facility construction and operation or where large unexcavated pillars are planned. [10 CFR 60.15(c)(3)] [6.0PC2d]

i. Ramps shall be located, to the extent practicable, where accesses are planned for the repository facility.

ii. Borehole alignments and locations shall be monitored, surveyed, and the results included on all underground working maps. [TBD]

iii. The portal coordinate location of a ramp shall be as listed in the RIB and defined by the Nevada Coordinate System. [TBD]

iv. The nominal finished inside diameter of a ramp shall be as listed in the RIB. [TBD]

2c. Sections [10 CFR] 60.131 through [10 CFR] 60.134 specify minimum criteria for the design of the geologic repository operations area. These design criteria are not intended to be exhaustive, however. Omissions in § § [10 CFR] 60.131 through 60.134 do not relieve DOE from any obligation to provide such safety features in a specific facility needed to achieve the performance objectives. All design bases must be consistent with the results of site characterization activities. [10 CFR 60.130] [6.0PC2d,CE]

2d. The orientation, geometry, layout, and depth of the underground facility, and the design of any engineered barriers that are part of the underground facility shall contribute to the containment and isolation of radionuclides. [10 CFR 60.133(a)(1)] [6.0PC2d]

i. Rock support and other structural anchoring materials shall be compatible with waste isolation. [TBD]

ii. Rock support and other structural anchoring materials shall neither interfere with radionuclide containment nor enhance radionuclide migration. (O,W,S) [TBD]

iii. Ramp configuration (access location, access size, access separation, and access depth) shall contribute to or not detract from the isolation capability of the site. [TBD]

iv. The locations of openings for handling muck shall be selected to minimize effects on the integrity of any other openings.

v. ESFDR Appendix A.1 will show the interface between the ESF and the repository conceptual design. New or revised drawings will be prepared to show future design changes (if any) as they are approved. (TBD)

YMP CC-0013, Rev. 5-31-91

2e. The underground facility shall be designed so that the effects of credible disruptive events during the period of operations, such as flooding, fires and explosions, will not spread through the facility. [10 CFR 60.133(a)(2)] [6.0PC2d]

i. A ramp shall be designed so that the effects of credible disruptive events (e.g., flooding, fires, and explosions) shall not spread through the facility.

ii. A ramp portal shall be designed to prevent significant water inflow from a flooding event during site characterization and the planned period of repository operation, such that testing in the underground portion of the ESF and waste emplacement are not adversely affected. [TBD]

2f. The underground facility shall be designed with sufficient flexibility to allow adjustments where necessary to accommodate specific site conditions identified through in situ monitoring, testing, or excavation. [10 CFR 60.133(b)] [6.0PC2d]

2g. The design of the underground facility shall provide for control of water or gas intrusion. [10 CFR 60.133(d)] [6.0PC2d]

i. The drainage plan for underground work shall be consistent with repository operations and postclosure sealing concerns. Drainage in the dedicated test area shall be as defined on Drawing [TBD] in ESFDR Appendix A.2. Drainage in long drifts shall be compatible with repository grades. [TBD]

ii. The amount of water used in construction and operations, shall be limited to that required for dust control and proper equipment operation so as to limit the effects on the containment and isolation capability of the site. The maximum quantity of water (based on use during construction) shall not exceed 15 gallons per ton of rock excavated.

iii. Water use in ramp construction shall be generally consistent with repository design goals to limit the increase in average percent saturation of the repository horizon to less than [TBD] percent, and limit the increase in the local percent saturation to less than [TBD] percent in waste emplacement areas.

iv. Water entering the ESF shall be managed appropriately, including quantity, location, and water balance. [TBD]

v. Operational seals shall be provided where necessary to control the intrusion of water into the facility. [TBD]

2h. Openings in the underground facility shall be designed to reduce the potential for deleterious rock movement or fracturing of overlying or surrounding rock. [10 CFR 60.133(e)(2)] [6.0PC2d]

 YMP CC-0013, Rev. 5 31 91

i. Ramp structures shall be designed and constructed to withstand the effects of seismic events. Seismic criteria to be used to design the ramp are in the RIB.

ii. An adequate distance between accesses shall be provided to limit potential mechanical and hydrological interference between the two accesses and to reduce the potential for deleterious rock movement so they do not impact the capability to reliably and adequately characterize the site. [TBD]

iii. The openings for rock handling shall be constructed in such a way as to minimize effects on the integrity of any other openings. (C,D,W,S)

2i. The design of the underground facility shall incorporate excavation methods that will limit the potential for creating a preferential pathway for groundwater to contact the waste packages or radionuclide migration to the accessible environment. [10 CFR 60.133(f)] [6.0PC2d]

i. Techniques used for ramp excavation shall control overbreak of rock and minimize disturbance to the integrity of the adjoining rock mass.

ii. A ramp shall be designed to provide stability and to minimize the potential for deleterious rock movement or fracturing that may create a pathway for radionuclide migration or could impact the capability to reliably and adequately characterize the site.

iii. The following are design goals relating to ramp stability. These design goals may be modified pending information obtained during site characterization, or from future analysis:

a. In areas not affected by thermal load, diametrical closure rate decreasing at all times after construction. [TBD]

b. In areas affected by thermal load, closure rate no greater than three times that predicted by thermoelastic models. [TBD]

c. In accesses not lined with concrete, no rockfalls greater than a size of [TBD].

d. Access shall be maintainable. [TBD]

iv. Mechanical excavation methods should be used when feasible and practical; however, in those circumstances where drill and blast excavation may be determined to be more effective (safety, ease of construction, readily available technology, schedule, or cost), the design of blasting rounds shall:

a. Limit the disturbance of the surrounding rock mass.

b. Provide fragmentation of tuff into sizes compatible with removal equipment.

 YMP CC-0013, Rev. 5/31/91

c. Provide flexible blasting techniques to compensate for changes in the lithophysal content of the tuff and in local joint patterns.

d. Provide methods to control sudden inflows of water.

v. The magnitude and extent of blast-induced changes in permeability shall be limited by blast control.

Limitations on blast-induced changes and excavation overbreak are as follows. The limitations are design goals which may be changed based on results of site characterization or future analyses.

a. Blast-induced changes to the average in situ permeability of the rock beyond a dimension (into the rock) equal to one half of the maximum opening dimension shall be less than one order of magnitude. [TBV]

b. Excavation overbreak is to average less than 12 inches. This overbreak limit is additive to the dimensional tolerances applied to the location and runout of the drill holes used for excavation explosives. This limit may be exceeded for short intervals where blast designs are being adjusted.

vi. Drill and blast specifications shall include controls related to types and amounts of explosives, shot patterns, and hole depth in order to limit the magnitude and extent of blast-induced permeability. [TBD]

vii. The typical cross section of an ESF ramp shall be constructed using a tunnel boring machine to limit the damage to the surrounding rock mass which could affect the adequacy or reliability of information from site characterization. Ramp stations and other secondary excavation may be developed by controlled drilling and blasting methods. The excavation methods shall be designed to provide for the requirements of specific site characterization tests, such as limitations on the extent of excavation-induced damage, or the type of ground support that may be installed. The methods shall be designed to facilitate investigation and monitoring of such effects during and after construction. [TBD]

viii. The ramp construction method shall be selected, consistent with other goals of site characterization, to limit impacts on isolation.

2j. The underground facility shall be designed so that the performance objectives will be met taking into account the predicted thermal and thermomechanical response of the host rock, and surrounding strata, groundwater system. [10 CFR 60.133(i)] [6.0PC2d]

i. The subsurface facilities shall be designed considering the predicted thermal and thermomechanical response of the host rock, surrounding strata, and groundwater system so that the performance objectives of the repository can be met.

ii. The predicted loads imposed on a ramp by heating of the repository waste disposal formation are defined in ESFDR Appendix A.4. These loads shall be considered in the analysis performed to predict the long term response of the ramp.

iii. The ramp lining shall withstand pressures exerted along its length and around the entire perimeter under anticipated conditions, including reaction to thermally-induced stresses resulting from thermal loads. The provisions (TBD) for thermally induced stresses can be installed at a later date. [TBD]

2k. Seals for [ramps] and boreholes shall be designed so that following permanent closure they do not become pathways that compromise the geologic repository's ability to meet the performance objectives of the period following permanent closure. [10 CFR 60.134(a)] [6.0PC2d]

Materials and placement methods for seals shall be selected to reduce to the extent practicable: (1) The potential for creating a preferential pathway for groundwater to contact the waste packages or (2) for radionuclide migration through existing pathways. [10 CFR 60.134(b)]

i. Access design and construction shall allow for future sealing in shafts, ramps, or drifts in order to ensure that they do not become preferential pathways for groundwater, or radioactive waste migration. In addition, techniques used to seal aquifers during access construction should not preclude use, or reduce the effectiveness, of future access seals.

ii. To prevent complications of seal evaluations and emplacement and limit chemical alteration in future seal environments, no pressure grouting shall take place during the construction period of the ramp at locations of potential seal testing or emplacement. Specifically, no pressure grouting shall be performed within 50 feet of the original ground surface and within 50 feet (above and below) the contact of the Pah Canyon and Topopah Spring tuffs, or below the main test level.

iii. Design, construction, and materials used in the construction of a ramp (e.g., epoxies and lean grouts need to be evaluated prior to use) shall not significantly interfere with or prevent the eventual installation of the features required to effect post-closure repository sealing. Specific banned items and activities are to be determined at the direction of the YMPO. The major areas in which these limitations apply are as follows:

YMP CC-0013, Rev. 5/31/91

a. Immediately below the ramp portal structure in the area where an anchor to bedrock is planned to be installed at the time of ramp closure.

b. At the interface between the nonwelded tuff (PTn) and the Topopah Spring tuff (TSw).

c. In the extension of the ramp below the main ESF test level.

iv. Pressure grouting during or after construction shall not be permitted in a zone extending 50 feet above and below locations planned for installation of anchor to bedrock seals or below the main test level.

v. Materials and placement methods for ramp and borehole seals shall be selected to reduce, to the extent practicable, the potential for creating preferential pathways for groundwater to contact the waste packages or to reduce radionuclide migration through existing pathways.

INTERFACE CONTROL REQUIREMENTS

1. The ESF designers shall interface with repository designers on ESF site location and layout and on permanent ESF structures, systems, and components, and shall make available all design information pertaining to the permanent ESF components during formal program design technical assessments and reviews, or when such information is formally requested by the repository designers through DOE or their designated representative.

See Section 1.2.6.0, Interface Control Requirements.

CONSTRAINTS

A. DOE shall perform, or permit the Commission to perform, such tests as the Commission deems appropriate or necessary for the administration of the regulations in this part [Part 60]. These may include tests of: (1) Radioactive waste, (2) the geologic repository including its structures, systems, and components, (3) radiation detection and monitoring instruments, and (4) other equipment and devices used in connection with the receipt, handling, or storage of radioactive waste. [10 CFR 60.74(a)] [6.0CD]

The tests required under this section shall include a performance confirmation program carried out in accordance with Subpart F of this part [Part 60]. [10 CFR 60.74(b)] [6.0CD]

i. The structures, systems, components, and operation of the ramp shall be designed to accommodate additional testing as may be required by the NRC for site characterization and performance confirmation. [TBD]

YMP CC-0013, Rev. 5-31-91

B. The geologic repository operations area shall be designed so as to permit implementation of a performance confirmation program that meets the requirements of Subpart F of this part (Part 60). [10 CFR 60.137] [6.0PC2d]

  i. The underground excavations shall be designed to accommodate the performance confirmation tests required by 10 CFR 60.141 and 60.142, and taking into account any potentially adverse impacts these excavations could have on the waste isolation capabilities of the site.

  ii. The configuration of a ramp shall be adequate to support site performance confirmation testing, and future testing that may be reasonably expected for performance confirmation. This shall include an allowance to accommodate site specific conditions encountered in the ramp without adversely affecting testing that is planned or ongoing. [TBD]

  iii. Accesses to the ESF underground facility shall be designed to facilitate performance confirmation testing to obtain adequate and reliable information about the site, during and after construction, as required for the geologic repository by 10 CFR 60, Subpart F.

ASSUMPTIONS

None.

YMP CC-0013, Rev. 5-31-91

1.2.6.5.1 PORTAL
(Generic Physical Subsystem Account Code: 4.4.2.1)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The ramp portal is defined as the rock face and retaining structure at the uppermost portion of the ramp. The structure provides ground and utility support and overhead protection for ingress and egress into the ramp during construction and operations.

Boundaries and Interfaces

Specific boundaries and interfaces between participating organizations' designs are identified in the YMP Interface Control Document(s). Full compliance of the ESF design with requirements and criteria of Section 1.2.6.5.1 necessitates an evaluation and understanding, by the designer, of the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.1	ESF SITE(S)
1.2.6.2	SURFACE UTILITIES
1.2.6.5	RAMP ACCESS
1.2.6.2.5	Surface Wastewater System
1.2.6.2.6	Compressed Air System
1.2.6.3	SURFACE FACILITIES
1.2.6.5.2	Lining
1.2.6.5.4	Ramp Furnishings
1.2.6.6	UNDERGROUND EXCAVATIONS
1.2.6.7	UNDERGROUND SUPPORT SYSTEMS
1.2.6.8	UNDERGROUND TEST SUPPORT
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.2	Accesses and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. Provide adequate protection for ingress and egress and accommodate penetrations and structural mountings. [6.5FR1]

PERFORMANCE CRITERIA

1. The portal shall provide access and support for the materials handling system and equipment over the entire range of the handling system functions, operations, and requirements. (D,O,S) [6.5PC1]

CONSTRAINTS

A. The surface elevation at the portal shall be as identified in the RIB. [TBD] [6.5PC2b]

YMP CC-0013, Rev. 5 31 91

B. The portal shall be founded in rock. [6.5PC11,15]

ASSUMPTIONS

None

YMP CC-0013, Rev. 5-31-91

1.2.6.5.2 LINING
(Generic Physical Subsystem Account Code: 4.4.2.2)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The lining is defined as those components (e.g., concrete) which are provided to maintain the integrity of the intended opening.

Boundaries and Interfaces

Specific boundaries and interfaces between participating organizations' designs are identified in the YMP Interface Control Document(s). Full compliance of the ESF design with requirements and criteria of Section 1.2.6.5.2 necessitates an evaluation and understanding, by the designer, of the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.5	RAMP ACCESS
1.2.6.5.1	Portal
1.2.6.5.3	Station
1.2.6.5.4	Ramp Furnishings
1.2.6.5.6	Sump
1.2.6.6	UNDERGROUND EXCAVATIONS
1.2.6.7	UNDERGROUND SUPPORT SYSTEMS
1.2.6.8	UNDERGROUND TEST SUPPORT
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.2	Accesses and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. Provide structural and mechanical integrity for the ramp and mounting for conveyance supports, utilities, and ramp instrumentation during construction and operations. [6.5FR1]

PERFORMANCE CRITERIA

1a. The need for a ramp lining shall be determined by a combination of analysis and observation during construction. [6.5PC1h,1i,1j,2a]

1b. The ramp lining shall provide adequate bearing support for the structural mounting of conveyance system supports under both static and dynamic operational loading conditions. (D,O,S) [6.5PC1f]

1c. The lining shall include provisions for ramp instrumentation penetrations and data collection units. [6.5PC1c]

1d. All concrete activities shall conform to the applicable ACI standards for furnishing, delivery, and placement of structural concrete. (D) [6.5PC1f]

YMP CC-0013, Rev. 5-31-91

1e. All forming and reinforcements utilized shall conform to applicable ACI and ASTM standards. (D) [6.5PC1f]

CONSTRAINTS

A. The ramp lining shall be protected from damage due to blasting and other construction activities. [6.5PC2i]

B. The ramp lining placement shall be coordinated with science needs such as testing and mapping. [6.5PC1c]

C. The capability to enhance postclosure performance by removing ramp linings shall be retained. [6.5PC2a]

ASSUMPTIONS

None.

YMP CC-0013, Rev. 5-31-91

1.2.6.5.3 STATION
(Generic Physical Subsystem Account Code: 4.4.2.3)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The station is defined as the initial underground opening at the predetermined horizon adjacent to the ramp.

Boundaries and Interfaces

Specific boundaries and interfaces between participating organizations' designs are identified in the YMP Interface Control Document(s). Full compliance of the ESF design with requirements and criteria of Section 1.2.6.5.3 necessitates an evaluation and understanding, by the designer, of the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.2	SURFACE UTILITIES
1.2.6.2.4	Communications System
1.2.6.4	SHAFT ACCESS
1.2.6.4.3	Stations
1.2.6.5	RAMP ACCESS
1.2.6.5.2	Lining
1.2.6.5.4	Ramp Furnishings
1.2.6.5.6	Sump
1.2.6.6	UNDERGROUND EXCAVATIONS
1.2.6.7	UNDERGROUND SUPPORT SYSTEMS
1.2.6.8	UNDERGROUND TEST SUPPORT
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.2	Accesses and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. Provide excavated space of adequate size and appropriate geometry to provide support for underground construction and site characterization testing activities. [6.5FR1]

PERFORMANCE CRITERIA

1a. The ramp station shall allow sufficient room for safe loading/unloading of personnel, materials, and equipment from the ramp, and provide areas for laydown and assembly of equipment, and transition of the utility distribution to the underground workings. (D,O,S,M,T) [6.5PC1e,1f,1g]

1b. The station shall have the capacity to accommodate all rock handling requirements from the Main Test Level. (D,S) [6.5PC1f]

1c. The ramp station shall accommodate devices (e.g., forklift) for handling heavy and large materials. (O,S,M,T) [6.5PC1f]

YMP CC-0013, Rev. 5 31 91

1d. The design of the station shall ensure adequate unobstructed room for ventilation air flow. (D,O,S) [6.5PC1h]

1e. The design of the ramp station shall consider the physical characteristics of the material and equipment. (D) [6.5PC1f]

CONSTRAINTS

None

ASSUMPTIONS

None.

 YMP/CC-0013, Rev. 5/31/91

1.2.6.5.4 RAMP FURNISHINGS
(Generic Physical Subsystem Account Code: 4.4.2.4)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The furnishings are defined as fabricated brackets, which are fixed to the ramp wall or to other structural support members. Utility brackets include provisions to facilitate installation of ventilation and ramp utilities consisting of electrical power, communications, compressed air, water, mine wastewater, etc.

Boundaries and Interfaces

Specific boundaries and interfaces between participating organizations' designs are identified in the YMP Interface Control Document(s). Full compliance of the ESF design with requirements and criteria of Section 1.2.6.5.4 necessitates an evaluation and understanding, by the designer, of the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.2	UTILITIES
1.2.6.3.1	Ventilation System
1.2.6.5	RAMP ACCESS
1.2.6.5.1	Portal
1.2.6.5.2	Lining
1.2.6.5.3	Station
1.2.6.5.6	Sump
1.2.6.6	UNDERGROUND EXCAVATIONS
1.2.6.7	UNDERGROUND SUPPORT SYSTEMS
1.2.6.8	UNDERGROUND TEST SUPPORT
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.2	Accesses and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. Provide for support of underground utility systems and the necessary services (e.g., pipe, conduit, wiring, ventilation ducting) in the ramp during ramp construction, operation, and site characterization activities. [6.5FR1]

PERFORMANCE CRITERIA

1a. All ramp furnishings shall be designed and constructed to allow readily performed inspection and maintenance. (M,T) [6.5PC1c,1g,1i]

1b. Ramp furnishings shall be designed and constructed to facilitate ESF underground layout construction after ramp construction is complete. (D,O,S,M,T) [6.5PC1c]

 YMP/CC-0013, Rev. 5/31/91

1c. Furnishings shall provide for mounting the following utilities and cables in the ramp:

   i. Electrical power.
   ii. Compressed air.
   iii. Water.
   iv. Communications.
   v. Underground instrumentation.
   vi. Instrumentation and IDS Cabling.
   vii. Underground wastewater handling system.
   viii. Provision for ventilation.
   (D,O,S,M,T) [6.5PC1g]

CONSTRAINTS

A. Activities associated with installation, operation, maintenance, and removal of furnishings shall be conducted in a manner that limits, to the extent practicable, adverse effects on the long term performance of the geologic repository. [6.5PC2d]

B. All brackets shall be designed and constructed to provide adequate strength and isolation for all cables and other devices. [6.5PC1g]

C. All ramp furnishings shall be designed to be removed in a manner which will leave the ramp free of appendages that would restrict ventilation airflow. Removal will occur at the time the ramp is converted to serve as a repository ventilation path. [6.5PC1h]

ASSUMPTIONS

None.

YMP/CC-0013, Rev. 5/31/91

THIS PAGE INTENTIONALLY LEFT BLANK

YMP/CC-0013, Rev. 5/31/91

1.2.6.5.6 SUMP
(Generic Physical Subsystem Account Code: 4.4.2.6)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The sump is defined as the area(s) within the ramp that collects and transfers underground wastewater to the underground wastewater collection system.

Boundaries and Interfaces

Specific boundaries and interfaces between participating organizations' designs are identified in the YMP Interface Control Document(s). Full compliance of the ESF design with requirements and criteria of Section 1.2.6.5.6 necessitates an evaluation and understanding, by the designer, of the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.2.5	Surface Wastewater System
1.2.6.5.2	Lining
1.2.6.5.3	Stations
1.2.6.5.4	Ramp Furnishings
1.2.6.6	UNDERGROUND EXCAVATIONS
1.2.6.7	UNDERGROUND SUPPORT SYSTEMS
1.2.6.7.6	Underground Wastewater Collection System
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.2	Accesses and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. Provide adequate space within the ramp to collect and transfer wastewater to the underground wastewater collection system. [6.5FR1]

PERFORMANCE CRITERIA

1a. The sump shall be equipped with underground wastewater collection facilities. (D,O,S) [6.5PC2g]

1b. Provisions shall be made for the cleaning out of the sump area. (S,M) [6.5PC2g]

CONSTRAINTS

None.

ASSUMPTIONS

None.

YMP/CC-0013, Rev. 5/31/91

1.2.6.6 UNDERGROUND EXCAVATIONS
(Generic Physical Subsystem Account Code: 4.5)

Subparts are 1.2.6.6.1 Operations Support Areas
1.2.6.6.2 Test Areas

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The underground excavations are defined as those underground openings that extend more than five feet beyond the accesses and which comprise the excavations at the proposed test levels and the preferred repository horizon(s), based on the needs for underground site characterization. [TBV]

Boundaries and Interfaces

Specific boundaries and interfaces between participating organizations' designs are identified in the YMP Interface Control Document(s). Full compliance of the ESF design with requirements and criteria of Section 1.2.6.6 necessitates an evaluation and understanding, by the designer, of the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.1	ESF SITE(S)
1.2.6.1.1	Main Site(s)
1.2.6.1.2	Auxiliary Site(s)
1.2.6.2	SURFACE UTILITIES
1.2.6.2.1	Power System
1.2.6.2.2	Water System
1.2.6.2.4	Communications System
1.2.6.2.5	Surface Wastewater System
1.2.6.2.6	Compressed Air System
1.2.6.3	SURFACE FACILITIES
1.2.6.3.1	Ventilation System
1.2.6.3.2	Test Support Facilities
1.2.6.3.6	Shop
1.2.6.3.7	Warehouse
1.2.6.4	SHAFT ACCESS
1.2.6.4.1	Collar
1.2.6.4.2	Lining
1.2.6.4.3	Stations
1.2.6.4.4	Furnishings
1.2.6.4.5	Hoist System
1.2.6.4.6	Sump
1.2.6.5	RAMP ACCESS
1.2.6.5.1	Portal
1.2.6.5.2	Lining
1.2.6.5.3	Station
1.2.6.5.4	Ramp Furnishings
1.2.6.5.6	Sump
1.2.6.7	UNDERGROUND SUPPORT SYSTEMS
1.2.6.8	UNDERGROUND TEST SUPPORT

1.2.6.8.1 Integrated Data System (IDS) Support
1.2.6.8.2 Test Support
1.2.6.9 ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.2 Accesses and Underground Facilities

APPLICABLE REGULATIONS, CODES, STANDARDS, AND DOE ORDERS

See Section 1.2.6.0, Applicable Regulations, Codes, Standards and DOE Orders.

FUNCTIONAL REQUIREMENTS

1. Provide underground openings for in situ site characterization and support in situ site characterization. [6.0FR1]

2. Provide for the incorporation of the ESF into the future repository. [6.0FR2]

PERFORMANCE CRITERIA

1a. Unless the Commission determines with respect to the site described in the application that it is not necessary, site characterization shall include a program of in situ exploration and testing at the depths that wastes would be emplaced. [10 CFR 60.15(b)] [6.0PC1k]

i. Develop underground openings in welded high lithophysal/low lithophysal tuff for in situ site characterization construction, operations, and maintenance.

ii. The ESF main test level shall be constructed at the planned repository horizon, which currently is the TSw2 rock unit, although TSw1 can be considered.

iii. The proposed Main Test Level floor shall be within the Topopah Spring Unit Member of the Paintbrush Tuff.

iv. The underground design shall not preclude the ability to access the Calico Hills Formation. [TBD]

1b. The number of exploratory boreholes and [accesses] shall be limited to the extent practical consistent with obtaining the information needed for site characterization. [10 CFR 60.15(c)(2)] [6.0PC2d]

i. The number of connections between the underground excavations developed for the ESF and eventual repository drifting shall be kept to the minimum required to provide personnel safety and functional efficiency.

ii. The area of the ESF underground excavations shall be limited to that necessary for conducting the needed site characterization and performance confirmation tests.

YMP/CC-0013, Rev. 5/31/91

1c. Underground openings shall be designed to meet testing requirements. [6.0PC1d]

i. The testing requirements outlined in ESFDR Appendices B and C shall serve as the basis for the test level development. (O,T)

ii. The design of shaft and ramp breakouts, and the layout of the main test level of the ESF, shall have the flexibility to ensure that the location, orientation, geometry, and configuration of each planned test can be modified, as necessary, to meet specific test location acceptance criteria, in response to actual site conditions encountered during construction.

iii. The ESF underground excavation shall be of adequate size to support site characterization testing and future testing that may be reasonably expected for site characterization. This shall include: (1) an allowance to accommodate site specific conditions encountered in the dedicated test area without adversely affecting testing that is planned or ongoing, and (2) capacity to extend an exploratory drift from the main test level, if necessary, up to approximately 10,000 feet to other parts of the repository block, taking care that planned future repository openings are not adversely impacted by random exploratory drift extensions.

iv. The design of shaft and ramp breakouts and main test level shall have sufficient flexibility to: (1) relocate experiments as necessary to limit interference between tests and aid in ensuring that test location acceptance criteria are met, (2) incorporate additional tests, as needed, in the dedicated test area, (3) allow development and testing in other areas as needed (e.g., southern portion of repository block or Calico Hills Formation), (4) accommodate schedule changes as needed, and (5) limit interference between ESF construction and operation activities and testing activities.

v. A station landing and test drifts shall be constructed as part of the selected access at the Upper Demonstration Breakout Room (DBR) and the Main Test Level.

vi. Provide the specific excavation required for access stations beyond initial breakout, muck storage, refuge chambers, power centers, shop and storage areas, fueling, sanitation, ventilation, utilities, drifts, test levels, test rooms and alcoves, communications, IDS, service, special functions, and other areas as determined by the in situ site characterization program. (D,O,S,P,M,T,I)

vii. The enlarged sections as shown on Drawing [TBD] to investigate the Ghost Dance Fault, the Drill Hole Wash structures, and the suspected imbricate faults shall be driven at full dimension. [TBD]

viii. The enlarged sections in the drifts driven to the Ghost Dance Fault and the suspected imbricate (excluding the enlarged portions on Drawing [TBD] in ESFDR Appendix A.2) fault zone shall be driven initially at the 14 ft by 14 ft cross section and later slashed to the final 21 ft by 14 ft size, if developed by drill and blast methods. (includes the drifting through these geologic features). [TBD]

ix. The enlarged section in the drift driven to the Drill Hole Wash structures (excluding the enlarged portions on Drawing [TBD] in ESFDR Appendix A.2) shall be driven initially at the 14 ft by 14 ft cross section and later slashed to the final 25 ft by 19 ft size, as shown in the drift sections depicted in ESFDR Appendix A.2, if developed by drill and blast methods (includes the drifting through the Drill Hole Wash structures). [TBD]

x. The necessary access openings shall be available for use of their specific purposes within the time frame specified in the schedule. (O)

1d. Underground operations shall not adversely affect site characterization. [6.0PC1d]

i. Instrument cables shall be separated from power cables in drifts to minimize electrical interference. Instrument and IDS trunk cables shall be contained in overhead runs to protect them from damage.

ii. Probe or pilot holes shall be drilled, as appropriate, in advance of drifting to detect and control sudden water and/or gas inrushes into openings. [TBD]

iii. Water intrusion, if any, into the underground openings shall be monitored and controlled by suitable measures such that the effects of expected water inflows (i.e., water, heat, gases) will not endanger worker safety and in situ site characterization. [TBD]

iv. Excess water shall be removed to preclude interference with tests. [TBD]

v. Appropriate gravity drainage and/or pumping systems shall be incorporated in underground openings for draining water away from testing and other working areas to suitable collection point(s) for further treatment and/or disposal.

vi. The amount of water used in construction and operations of the underground facility shall be limited to preclude interference with tests. [TBD]

vii. Methods for dust control and cleaning of walls in the underground portion of the ESF shall be designed to limit adverse effects on the adequacy and reliability of information from site characterization.

YMP/CC-0013, Rev. 5/31/91

viii. Construction methods shall be designed and implemented so that the effects of fluids, gases, or other materials used do not adversely affect the adequacy or reliability of information from site characterization.

ix. Fluids and materials planned for use in the ESF underground facility shall be evaluated with respect to intended use and possible effects on site characterization or other testing, and appropriate controls shall be implemented.

x. Fluids, gases, and other materials used in underground construction and operations, and/or injected into the rock mass, shall be appropriately tagged. Selection of tracers shall consider, but not be limited to: (1) the possible future need to account for the mobility and disposition of all such materials as part of site characterization, and (2) the effects of tracers on site characterization. [TBD]

xi. The presence of combustible materials in the underground facility shall be controlled and limited such that testing in the ESF is not adversely affected.

xii. The use of blasting agents and explosives shall be controlled to preclude adverse effects on in situ site characterization.

xiii. The chemical content of the blasting agents and explosives shall be evaluated during their selection process and the chemical content of the blasts sampled, recorded, and the data used as necessary to preclude adverse effects on in situ site characterization. [TBD]

xiv. The ESF shall be designed so that testing areas are separated from possible repository shop, training, operations, or waste emplacement areas, to limit adverse effects from activities in those areas on future testing, including performance confirmation, in the dedicated test area.

xv. The openings required for handling excavated rock shall be of sufficient size to allow equipment movement in such a way that interference with in situ site characterization is minimized.

xvi. The openings required for rock handling and for support facilities (e.g., maintenance shops, electrical substations, pump stations, refuge chambers, lunch rooms, explosives magazines, and storage facilities for supplies and consumables) shall be located away from in situ site characterization testing to minimize interruptions.

xvii. Dry air coring will be required for some tests. [TBD]

1e. Underground openings and operations shall meet specified personnel movement requirements. [6.0PC1d]

i. During ESF construction, temporary visitor facilities shall be provided as approved by the DOE. During in situ site characterization testing, facilities shall be provided for at least 10 visitors underground at any one time. [TBD]

1f. Underground openings shall meet equipment requirements. [6.0PC1d]

i. The excavation facilities and equipment required for handling excavated rock shall meet the needs of construction and testing activities and shall be capable of supporting the excavation allowances determined under General ESF Requirements Section 1.2.6.0 Performance Criteria 1d. (D,O,S,T)

ii. In the event backfilling is required, underground handling capacity for processing, receiving, transporting, and, where necessary, emplacing backfill material shall be adequate. (O)

iii. Excavated rock processing and storage capacity underground prior to further disposal shall be compatible with the required excavation and handling rates. (O)

1g. Underground openings shall meet utility requirements. [6.0PC1d,1k,CM]

1h. Underground openings shall meet ventilation requirements. [6.0PC1d,1k,CM]

i. The size, shape, and construction of openings shall be adequate to supply and/or exhaust required volumes of air for underground operations and testing during normal and emergency conditions and shall minimize airborne dust during in situ site characterization.

ii. Underground openings shall be designed to minimize air resistance to the extent practicable.

iii. Underground openings shall be designed to handle required volumes of air in order to cope with potential high temperatures from rock or waste-package simulation tests with heaters.

iv. The ESF shall be designed so as not to preclude separate ventilation of repository excavation and waste emplacement.

1i. Underground openings shall meet safety requirements. [6.0CM]

i. The extent of drifting on the main test level prior to connection of the accesses shall be determined by a safety analysis. The emphasis of the safety analysis shall be on early excavation of the long drifts.

ii. The maintenance, refueling, and equipment storage areas shall be designed and located to minimize the fire and safety risks.

 YMP/CC-0013, Rev. 5/31/91

iii. A refuge chamber(s) shall be provided with sufficient capacity and facilities to accommodate personnel underground.

2a. Investigations to obtain the required information shall be conducted in such a manner as to limit adverse effects on the long-term performance of the geologic repository to the extent practical. [10 CFR 60.15(c)(1)] [6.0PC2d]

i. The design, construction, and operation of the main test level shall incorporate aspects specifically directed at limiting the potential for adverse impacts on the long term performance of the repository. [TBD]

ii. All materials or substances to be used underground shall first be reviewed for potential effects on engineered barriers and waste isolation. They may be used only following review and approval (TBD), and only in those areas where use has been approved, and subject to whatever controls are established. Such materials or substances include, but are limited to, the following [TBD]:

a. Concrete and other cementitious materials, such as shotcrete and grout.

b. Ground support materials, including chemical/resin anchorages.

c. Water (pH and organic content) and any additives to water for identification (tracers) or construction, operation, or testing.

d. hydrocarbons and solvents.

e. Organic materials.

f. Explosives and blasting ancillaries, including the introduction of pressurized drilling water into the rock, and the chemical residues that are the products of blasting.

iii. A materials control program shall be implemented to enable establishment of limits on the inventory of materials left after decommissioning. [TBD]

iv. The underground excavation shall be designed with construction controls that permit flexibility in closure, such as the location of seals, so that a seismic event is unlikely to compromise the ability of the facility to isolate wastes. [TBD]

2b. To the extent practical, exploratory boreholes and accesses in the geologic repository operations area shall be located where accesses are planned for underground facility construction and operation or where large unexcavated pillars are planned. [10 CFR 60.15(c)(3)] [6.0PC2d]

YMP/CC-0013, Rev. 5/31/91

i. Exploratory boreholes drilled from the ground surface may intersect openings within the ESF dedicated testing areas which are to be defined in ESFDR Appendix A.2. The number of boreholes should be kept to the minimum required to perform the experiments needed. The location of any such boreholes must be identified on the "as-built" maps of the ESF.

ii. In areas outside the ESF dedicated testing areas which are to be defined ESFDR Appendix A.2, no portion of an exploratory borehole drilled from the ground surface shall be located within 15 m of any underground opening. [TBV]

iii. Horizontal boreholes, drilled from the Main Test Level for installation of experiments or instrumentation systems, that penetrate areas where waste could eventually be stored, shall not be permitted unless performance evaluations have been completed and approved indicating such holes shall be acceptable. Unless alternate constraints are approved, all such horizontal holes are subject to the following restrictions:

a. The holes shall be collared no less than 3 feet above the floor of the drift or alcove from which they are drilled.

b. The holes shall be biased upward from the collar sufficiently to assure that any liquid that may enter the hole will drain toward the hole collar.

c. All borehole alignments and locations shall be monitored, surveyed, and included on all underground as-built maps.

2c. Subsurface exploratory drilling, excavation, and in situ testing before and during construction shall be planned and coordinated with geologic repository operations area design and construction. [10 CFR 60.15(c)(4)] [6.0PC2d]

i. Location of the underground facility shall stay within the conceptual perimeter drift boundary, except as needed to characterize areas outside that boundary, taking into account any potential impacts on the waste isolation capabilities of the site.

ii. The facilities constructed to support the experimental program on the Main Test Level of the ESF, with the exception of the drifts driven laterally to investigate geological features, shall be within the boundary defined in ESFDR Appendix A.2. No drifting shall be closer than 75 feet from this boundary. Small diameter boreholes are exempted, provided they meet the requirements pertaining to boreholes stated in 1.2.6.6PC2b. [TBV]

 YMP/CC-0013, Rev. 5/31/91

iii. The line, grade, cross sections, and other features of the drift driven on the main test level to investigate the Drill Hole Wash structures shall be as shown on Drawings [TBD] in ESFDR Appendix A.2. [TBD]

iv. The line, grade, cross sections, and other features of the drift driven on the main test level to investigate the suspected imbricate fault zone shall be as shown on Drawings [TBD] in ESFDR Appendix A.2. [TBD]

v. The line, grade, cross sections, and other features of the drift driven on the main test level to investigate the Ghost Dance Fault shall be as shown on Drawing [TBD] in ESFDR Appendix A.2. [TBD]

vi. The Dedicated Test Area and the Dedicated Shop Area openings, as defined in ESFDR Appendix A.2, shall be maintained for future use during repository operation (future uses include utilization as waste emplacement support shops, ventilation airways, access to performance confirmation areas, etc.).

vii. The future repository access drift shown crossing the ESF Dedicated Shop Area which are to be shown on Drawing [TBD] in ESFDR Appendix A.2 may be incorporated into the design of the ESF support shop facility. [TBD]

viii. The long exploratory drifts laterally extended from the central portion of the ESF on the Main Test Level shall be constructed in locations that will permit them to be used to support repository operations.

ix. The ESF shall be designed to be consistent with the repository design goal to limit the extraction ratio to less than 30 percent unless otherwise governed by test requirements. [TBV]

x. Appendix A.2 will show the interface between the ESF and the repository conceptual design. New or revised drawings will be prepared to show future design changes (if any) as they are approved. (TBD)

2d. Sections [10 CFR] 60.131 through [10 CFR] 60.134 specify minimum criteria for the design of the geologic repository operations area. These design criteria are not intended to be exhaustive, however. Omissions in § § [10 CFR] 60.131 through 60.134 do not relieve DOE from any obligation to provide such safety features in a specific facility needed to achieve the performance objectives. All design bases must be consistent with the results of site characterization activities. [10 CFR 60.130] [6.0PC2d,CE]

2e. The orientation, geometry, layout, and depth of the underground facility, and the design of any engineered barriers that are part of the underground facility shall contribute to the containment and isolation of radionuclides. [10 CFR 60.133(a)(1)] [6.0PC2d]

i. Overburden shall be greater than 200m for the main test level of the ESF.

ii. The spacing between adjacent ESF drifts shall be a minimum of two drift diameters (using the maximum diameter of either opening and considering the closest proximity of any part of each opening) consistent with obtaining reliable and adequate information from site characterization, except where required otherwise by specific test requirements. [TBV]

iii. The location of openings for handling muck shall be selected to minimize effects on the integrity of any other openings.

iv. Rock support and other structural anchoring materials shall be compatible with waste isolation and shall neither interfere with radionuclide containment, nor enhance radionuclide migration. [TBD]

v. The underground facility configuration (drift locations, orientation, geometry, and sizes) shall contribute to or not detract from the isolation capability of the site.

2f. The underground facility shall be designed so that the effects of credible disruptive events during the period of operations, such as flooding, fires and explosions, will not spread through the facility. [10 CFR 60.133(a)(2)] [6.0PC2d]

i. The ESF shall be designed so that the effects of credible disruptive events (e.g., flooding, fires, and explosions) shall not spread through the facility.

ii. Materials shall be selected such that effects of fire do not produce geochemical effects that impact waste isolation capabilities of the site. [TBD]

iii. The underground facility shall be designed such that effects of fire, which could produce geochemical effects that adversely affect future repository operations, shall not spread.

iv. The drainage plan for underground work shall be consistent with repository operations and postclosure sealing concerns, be designed to control and limit the impact of a credible flood on testing in the ESF, and not impact the capability to characterize the site.

2g. The underground facility shall be designed with sufficient flexibility to allow adjustments where necessary to accommodate specific site conditions identified through in situ monitoring, testing, or excavation. [10 CFR 60.133(b)] [6.0PC2d]

YMP/CC-0013, Rev. 5/31/91

i. Probe or pilot holes shall be drilled, if required, in advance of drifting to detect and provide for control of possible anomalous geological conditions which may affect ESF development or ability to obtain data for site characterization. (D) [TBD]

ii. The ESF shall be designed so as not to interfere with the flexibility of the repository to accommodate specific site conditions.

iii. A contingency plan shall be established for underground excavation to accommodate unexpected or site specific conditions that may be encountered, such as highly fractured zones, lithophysae-rich zones, perched water, or pathways for significant water movement.

2h. The design of the underground facility shall provide for control of water or gas intrusion. [10 CFR 60.133(d)] [6.0PC2d]

i. Facilities for plugging or grouting water inflow areas shall be available if water is known to exist in the vicinity of subsurface workings.

ii. The drainage plan for the ESF and long exploratory drifts shall be consistent with repository operations and postclosure sealing concerns. Specifically, drainage in the dedicated test area, as defined in ESFDR Appendix A.2, shall be toward the nearest shaft (or ramp, if no shaft is readily available) and drainage in long drifts shall be compatible with repository grades.

iii. The general drainage design for the Main Test Level shall preclude water entering the lateral exploratory drifts or the dedicated ESF support area as defined on Drawing [TBD] (ESFDR Appendix A) from flowing into the Dedicated Testing Area defined on the same drawing. Construction provisions to ensure this preferential drainage pattern after closure are shown on Drawing [TBD] in ESFDR Appendix A.2. [TBD]

iv. The amount of water used in construction and operations shall be limited to that required for dust control and proper equipment operation so as to limit the effects on the containment and isolation capability of the site. The maximum quantity of water (based on use during construction) will not exceed 15 gallons per ton of rock excavated.

v. Water used in construction and operations shall not adversely impact the repository design goals to limit the increase in average percent saturation of the repository horizon to less than TBD percent and to limit increase in the local percent saturation to less than TBD percent in areas of waste emplacement. [TBD]

vi. Water entering the ESF shall be managed appropriately, including quantity, location, and water balance. [TBD]

vii. Operational seals shall be provided where necessary to control the intrusion of water into the facility. [TBD]

2i. Openings in the underground facility shall be designed to reduce the potential for deleterious rock movement or fracturing of overlying or surrounding rock. [10 CFR 60.133(e)(2)] [6.0PC2d]

i. Underground excavated areas shall be designed for safe and maintainable ground support and control where required. (S,M)

ii. Facilities and equipment shall be available to deal effectively with subsurface ground control including emergencies such as rock falls, rock bursts, and squeezing and swelling rock.

iii. Underground structures shall be designed and constructed to withstand the effects of seismic events. Seismic criteria to be used to design the underground excavations are in the RIB.

iv. The main test level of the ESF shall be designed to limit overall response to excavation, including rock fall, considering all planned drifts and future drifting that may be performed in the dedicated test area, consistent with obtaining adequate and reliable information from site characterization.

v. The design of underground openings and their supports in the ESF shall utilize pillar and opening geometries that limit stress concentration, changes in rock mass permeability, and changes in rock mass deformability to levels consistent with acquiring adequate and reliable information from site characterization.

2j. The design of the underground facility shall incorporate excavation methods that will limit the potential for creating a preferential pathway for groundwater to contact the waste packages or radionuclide migration to the accessible environment. [10 CFR 60.133(f)] [6.0PC2d]

i. Excavation techniques shall control overbreak of rock and minimize disturbance to the integrity of the adjoining rock mass.

ii. Underground openings shall be designed to provide stability and to minimize the potential for deleterious rock movement or fracturing that may create a pathway for radionuclide migration or could impact the capability to reliably and adequately characterize the site.

iii. The following are design goals relating to underground opening stability. These design goals may be modified pending information obtained during site characterization or from future analyses:

a. In areas not affected by thermal load, closure rate decreasing at all times after construction [rate TBD].

 YMP/CC-0013, Rev. 5/31/91

b. In areas affected by thermal load, closure rate no greater than three times that predicted by theoretical thermoelastic models [rate TBD].

c. In openings not lined with concrete, no rockfalls greater than a size of [TBD].

d. Opening shall be maintainable [TBD].

iv. Conventional drill and blast excavation may not be the final preferred method of excavation for the emplacement drifts. Alternately, the construction of test alcoves and other short drifts in the ESF facility may not be amenable to the use of mechanical excavation methods. The use of the term "mechanical excavation" is open to interpretation. The following paragraph includes definitions and elaborates on the above:

Mechanical excavation methods with machines that break the rock with disc cutters or picks (e.g., Tunnel Boring Machines, Roadheaders, or variations of these machines) should be used when feasible and practical. However, controlled drill-and-blast excavation may be used in circumstances where it is determined to be more effective (maneuverability, flexibility, cost, and schedule), and provided that pressurized drill water usage and the chemical by-products of blasting do not disturb site characteristics related to waste isolation.

v. Mechanical excavation methods should be used when feasible and practical; however, in those circumstances where drill and blast excavation may be determined to be more effective (safety, ease of construction, readily available technology, schedule, or cost), the design of blasting rounds shall:

a. Limit the disturbance of the surrounding rock mass.

b. Provide fragmentation of tuff into sizes compatible with removal equipment.

c. Provide flexible blasting techniques to compensate for changes in the lithophysal content of the tuff and in local joint patterns.

d. Provide methods to control sudden inflows of water.

vi. The magnitude and extent of blast-induced changes in permeability shall be limited by blast control.

Limitations on blast-induced changes and excavation overbreak are as follows. The limitations are design goals which may be changed based on results of site characterization or future analyses.

a. Blast-induced changes to the average in situ permeability of the rock beyond a dimension (into the rock) equal to one

YMP/CC-0013, Rev. 5/31/91

half of the maximum opening dimension shall be less than one order of magnitude. [TBV]

b. Excavation overbreak is to average less than 12 inches. This overbreak limit is additive to the dimensional tolerances applied to the location and runout of the drill holes used for excavation explosives. This limit may be exceeded for short intervals where blast designs are being adjusted.

vii. Mechanical excavation methods may be used if technically feasible and economically justified.

viii. The design, construction, and operation of the underground excavation shall incorporate aspects specifically directed at limiting, to the extent practicable, adverse effects on the repository long term performance.

ix. If drill and blast methods are used, specifications shall include controls related to types and amounts of explosives, shot patterns, and hole depth in order to limit the magnitude and extent of blast-induced permeability. [TBD]

x. If the shaft or ramp breakouts and main test level of the ESF are constructed using controlled drilling and blasting methods to limit overbreak and damage to the surrounding rock mass, the methods shall be designed to provide for the requirements of specific site characterization tests, such as limitations on the extent of excavation-induced damage, or the type of ground support that may be installed. The methods shall be designed to facilitate investigation and monitoring of excavation effects during and after construction. [TBD]

2k. The underground facility shall be designed so that the performance objectives will be met taking into account the predicted thermal and thermomechanical response of the host rock, and surrounding strata, groundwater system. [10 CFR 60.133(i)] [6.0PC2d]

i. The subsurface facilities shall be designed considering the predicted thermal and thermomechanical response of the host rock, surrounding strata, and groundwater system so that the performance objectives of the repository can be met.

ii. The predicted loads imposed on the underground excavations by the heating of the repository waste disposal formation are defined in ESFDR Appendix A.4. These loads shall be considered in the analyses performed to predict the long-term response of the underground excavations.

iii. The ESF shall be designed such that the thermal and thermomechanical effects of ESF operations and testing do not produce failure of intact rock, nor gross rock mass failure, along potential pathways from the repository to the accessible

YMP/CC-0013, Rev. 5/31/91

environment and do not significantly increase the saturation of the host rock in the waste emplacement area. [TBD]

iv. The underground excavation support system shall be designed to withstand pressures under anticipated conditions, including reaction to thermally induced stresses resulting from thermal loads.

v. The ESF shall be designed so that the thermal effects of ESF testing do not result in temperatures in excess of 115°C in either the TSw3 or CHn units, compatible with the performance measure for the repository listed in Table 8.3.2.2-4 in Volume VI, Part B, of the Site Characterization Plan for the Yucca Mountain Site.

21. Seals for shafts and boreholes shall be designed so that following permanent closure they do not become pathways that compromise the geologic repository's ability to meet the performance objectives of the period following permanent closure. [10 CFR 60.134(a)] [6.0PC2d]

Materials and placement methods for seals shall be selected to reduce to the extent practicable: (1) The potential for creating a preferential pathway for groundwater to contact the waste packages or (2) for radionuclide migration through existing pathways. [10 CFR 60.134(b)] [6.0PC2d]

i. Access design and construction shall allow for future sealing in shafts, ramps, declines, or drifts in order to ensure that they do not become preferential pathways for groundwater or radioactive waste migration. In addition, techniques used to seal aquifers during access construction should not preclude use, or reduce the effectiveness, of future access seals.

ii. Any fill or other construction materials used in the floors of the drifting within the ESF in areas that may adversely impact implementation of post-closure sealing shall be removable.

iii. The 150-foot long, full-sized portion of the drift driven (Drawing [TBD]) toward the Ghost Dance Fault shall be driven consistent with the requirements imposed by the sealing program. See note on Drawing [TBD].

iv. The Exploratory Shaft Underground Facility operational seals shall be designed, consistent with other goals of site characterization, to limit impacts on isolation. If the seals are determined to be important to waste isolation, a comparative evaluation of alternatives shall be performed.

v. Operational seals shall be provided where necessary to control the spread of water through the facility. [10 CFR 60.134(a)(2)]

vi. Grouting during ESF construction shall have the following limitations:

 YMP/CC-0013, Rev. 5/31/91

a. Pressure grouting is not permitted during or after construction in the ESF dedicated test area connection drifts and access station drifts for a distance of 50 feet from the panel access drift as shown in ESFDR Appendix A.2.

b. In the drift driven to investigate the Drill Hole Wash structure, no pressure grouting is to be performed during or after construction in the fault or within the limits of the enlarged drift (approximately 150 ft.) driven through the fault (see Drawing [TBD] in ESFDR Appendix A.2). [TBD]

c. No pressure grouting is to be performed in the 150-ft long full-sized portion of the drift driven (Drawing [TBD]) toward the Ghost Dance Fault. [TBD]

d. In the drift driven to investigate the Ghost Dance fault, no pressure grouting is to be performed during or after construction in the fault or within the limits of the enlarged drift (approximately 126 ft.) driven through the fault (see Drawing [TBD] in ESFDR Appendix A.2). [TBD]

INTERFACE CONTROL REQUIREMENTS

1. The ESF designers shall interface with repository designers on ESF site location and layout and on permanent ESF structures, systems, and components, and shall make available all design information pertaining to the permanent ESF components during formal program design technical assessments and reviews, or when such information is formally requested by the repository designers through DOE or their designated representative.

   See Section 1.2.6.0, Interface Control Requirements.

CONSTRAINTS

A. DOE shall perform, or permit the Commission to perform, such tests as the Commission deems appropriate or necessary for the administration of the regulations in this part [Part 60]. These may include tests of: (1) Radioactive waste, (2) the geologic repository including its structures, systems, and components, (3) radiation detection and monitoring instruments, and (4) other equipment and devices used in connection with the receipt, handling, or storage of radioactive waste. [10 CFR 60.74(a)] [6.0CD]

   The tests required under this section shall include a performance confirmation program carried out in accordance with Subpart F of this part [Part 60]. [10 CFR 60.74(b)] [6.0CD]

   i. The structures, systems, components, and operation of the dedicated test area shall be designed to accommodate such additional testing as may be required by the NRC for site characterization and performance confirmation without disruption of, or interference with, testing in progress or planned testing. [TBD]

 YMP/CC-0013, Rev. 5/31/91

ii. The area set aside for future site characterization and performance confirmation testing shall be representative of the overall designated test area with respect to rock characteristics and control. This determination shall be based on reasonable interpretation of available information on the variability of host rock characteristics throughout the ESF site area.

B. The geologic repository operations area shall be designed so as to permit implementation of a performance confirmation program that meets the requirements of Subpart F of this part [Part 60]. [10 CFR 60.137] [6.0PC2d]

i. The underground excavations shall be designed to accommodate the performance confirmation tests required by 60.141 and 60.142, and taking into account any potentially adverse impacts these excavations could have on the waste isolation capabilities of the site.

ii. The ESF underground excavation shall be of adequate size to support performance confirmation testing and future testing that may be reasonably expected for performance confirmation. This shall include an allowance to accommodate site specific conditions encountered in the dedicated test area [TBD].

iii. The access breakouts and main test level of the ESF shall be designed to permit performance confirmation testing to obtain adequate and reliable information about the site, during and after construction, as required for the geologic repository by 10 CFR 60, Subpart F.

ASSUMPTIONS

1. Mucking will be accomplished by using rubber-tired, diesel-powered equipment and/or conveyor belts.

 YMP/CC-0013, Rev. 5/31/91

1.2.6.6.1 OPERATIONS SUPPORT AREAS
(Generic Physical Subsystem Account Code: 4.5.1)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The operations support areas are defined as the following underground openings: drift(s); refuge room(s); operations administration area; underground shop(s); lunch room(s); storage facility(ies); maintenance shop(s); areas for power distribution, fuel storage, and equipment storage; and other underground openings, not including 1.2.6.6.2 Test Areas.

Boundaries and Interfaces

Specific boundaries and interfaces between participating organizations' designs are identified in the YMP Interface Control Document(s). Full compliance of the ESF design with requirements and criteria of Section 1.2.6.6.1 necessitates an evaluation and understanding, by the designer, of the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.4	SHAFT ACCESS
1.2.6.5	RAMP ACCESS
1.2.6.6	UNDERGROUND EXCAVATIONS
1.2.6.6.2	Test Areas
1.2.6.7	UNDERGROUND SUPPORT SYSTEMS
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.2	Accesses and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. Provide excavated space of adequate size and appropriate geometry to support underground site characterization test activities on multiple levels. [6.6FR1]

PERFORMANCE CRITERIA

1a. Operations support areas shall include facilities for the administration and maintenance of ESF underground systems, structures, and components, as well as space for underground testing equipment and instrumentation, equipment storage, power distribution, fuel storage and distribution, and lunch room. [6.6PC1c,1e,1f,1g]

1b. Openings for operating equipment shall be sized and equipment positioned to provide adequate clearance for maintenance, inspection, and repair or replacement. (D,O,M) [6.6PC1f]

1c. Underground maintenance facilities shall be designed and sized to maintain subsurface equipment, instrumentation, and systems. (D,O,M) [6.6PC1f]

 IMP/CC-0013, Rev. 5/31/91

CONSTRAINTS

A. The maintenance areas/facilities shall be separated into a construction maintenance area and an underground test maintenance area. [6.6PC1c,1f]

B. Fuel storage areas shall comply with applicable Federal, State of Nevada, and local requirements. [6.6PC1i]

ASSUMPTIONS

None.

YMP/CC-0013, Rev. 5/31/91

1.2.6.6.2 TEST AREAS
(Generic Physical Subsystem Account Code: 4.5.2)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The test areas are defined as those openings excavated off the ESF access stations at the Upper Demonstration Breakout Room, the Main Test Level, and other areas as required for conducting underground site characterization tests at the potential repository horizon and the other geologic horizon(s).

Boundaries and Interfaces

Specific boundaries and interfaces between participating organizations' designs are identified in the YMP Interface Control Document(s). Full compliance of the ESF design with requirements and criteria of Section 1.2.6.6.2 necessitates an evaluation and understanding, by the designer, of the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.3.2	Test Support Facilities
1.2.6.4	SHAFT ACCESS
1.2.6.5	RAMP ACCESS
1.2.6.6	UNDERGROUND EXCAVATIONS
1.2.6.6.1	Operations Support Areas
1.2.6.7	UNDERGROUND SUPPORT SYSTEMS
1.2.6.8	UNDERGROUND TEST SUPPORT
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.2	Accesses and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. Provide excavated space of adequate size, appropriate layout, and appropriate opening geometry to conduct the necessary underground site characterization test activities and house the necessary construction and testing support equipment. [6.6FR1]

PERFORMANCE CRITERIA

1. Areas shall be provided for the storage of testing support equipment such as forms, scaffolds, cable runs, support structures and utilities. (T) [6.6PC1c]

CONSTRAINTS

A. Test areas shall be separated so they are not affected by the excavation disturbed zone and any thermal, mechanical, chemical, and hydrological interactions. See Appendix B for specifics. [6.6PC1c,1d]

B. To the extent practicable, limit or avoid the use of concrete and cementitious materials in or near geochemical test areas and emplacement holes. [6.6PC1d,2a]

YMP/CC-0013, Rev. 5/31/91

ASSUMPTIONS

None.

 YMP/CC-0013, Rev. 5/31/91

1.2.6.7 UNDERGROUND SUPPORT SYSTEMS
(Generic Physical Subsystem Account Code: 4.6)

Subparts are	1.2.6.7.1	Power Distribution System
	1.2.6.7.2	(This number not used)
	1.2.6.7.3	Lighting System
	1.2.6.7.4	Ventilation Distribution System
	1.2.6.7.5	Water Distribution System
	1.2.6.7.6	Underground Wastewater Collection System
	1.2.6.7.7	Compressed Air Distribution System
	1.2.6.7.8	Fire Protection System
	1.2.6.7.9	Muck and Material Handling Systems
	1.2.6.7.10	Sanitary Facilities
	1.2.6.7.11	Monitoring and Warning Systems

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The underground support systems, subsystems, and components include the utilities and provisions for power, communications, lighting, ventilation, water, underground wastewater removal, compressed air, fire protection, materials and muck handling, sanitation, and safety monitoring and warning required to meet the needs of the underground site characterization testing program during construction and operation.

Boundaries and Interfaces

Specific boundaries and interfaces between participating organizations' designs are identified in the YMP Interface Control Document(s). Full compliance of the ESF design with requirements and criteria of Section 1.2.6.7 necessitates an evaluation and understanding, by the designer, of the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.1	ESF SITE(S)
1.2.6.2	SURFACE UTILITIES
1.2.6.2.1	Power System
1.2.6.2.2	Water System
1.2.6.2.3	Sanitary System
1.2.6.2.4	Communications System
1.2.6.2.5	Surface Wastewater System
1.2.6.2.6	Compressed Air System
1.2.6.3	SURFACE FACILITIES
1.2.6.3.1	Ventilation System
1.2.6.3.6	Shop
1.2.6.3.7	Warehouse
1.2.6.3.9	Communications/Data Building(s)
1.2.6.4	SHAFT ACCESS
1.2.6.4.1	Collar
1.2.6.4.2	Lining
1.2.6.4.3	Stations
1.2.6.4.4	Furnishings

YMP/CC-0013, Rev. 5/31/91

1.2.6.4.5 Hoist System
1.2.6.4.6 Sump
1.2.6.5 RAMP ACCESS
1.2.6.5.1 Portal
1.2.6.5.2 Lining
1.2.6.5.3 Station
1.2.6.5.4 Ramp Furnishings
1.2.6.5.6 Sump
1.2.6.6 UNDERGROUND EXCAVATIONS
1.2.6.6.1 Operations Support Areas
1.2.6.6.2 Test Areas
1.2.6.8 UNDERGROUND TEST SUPPORT
1.2.6.8.1 Integrated Data System (IDS) Support
1.2.6.8.2 Test Support
1.2.6.9 ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.2 Accesses and Underground Facilities

APPLICABLE REGULATIONS, CODES, STANDARDS, AND DOE ORDERS

General

1. 30 CFR, Chapter I.
2. Nevada Administrative Code, Chapter 512.

Electrical

1. DOE 6430.1A, Division 16 Electrical.
2. NFPA-70.
3. ANSI C-2.

Lighting

1. DOE 6430.1A, Division 16 Electrical.

Uninterruptible Power

1. DOE 6430.1A, Division 16 Electrical.
2. IEEE-485.
3. IEEE-650.

Water System

1. DOE 6430.1A, Division 2 Site and Civil Engineering and Division 15-Mechanical.
2. NAC Chapter 445, paragraphs .244 through .420.
3. NFPA 20, 22, and 24.

Underground Wastewater Collection System

1. DOE 6430.1A, Division 2 Site and Civil Engineering.
2. NAC Chapter 445, paragraphs .140 through .241.

YMP/CC-0013, Rev. 5/31/91

Ventilation System and Dust Control

1. American Conference of Governmental Industrial Hygienists, Industrial Ventilation, A Manual of Recommended Practices, 19th Edition.

2. NAC Chapter 512, paragraph .154.

In addition, see Section 1.2.6.0, Applicable Regulations, Codes, Standards, and DOE Orders.

FUNCTIONAL REQUIREMENTS

1. Provide utilities for underground ESF construction, operations, in situ site characterization, and monitoring activities. [6.0FR1,2]

2. Provide facilities and equipment for the installation, operation, and maintenance of the underground services. [6.0FR1]

3. Provide underground transport services for personnel, equipment, and materials. [6.0FR1]

PERFORMANCE CRITERIA

1a. The following underground needs shall be met: power, communications, lighting, ventilation, water, wastewater removal, compressed air, fire protection, sanitation, materials (including supplies and fuel) and muck handling, and safety monitoring and warning. [6.0PC1k]

1b. The utility services shall include minimal backup units for primary power lines, primary pumps, shaft and ramp conveyances, primary ventilation fans, and primary communications and testing equipment to allow testing continuity based upon YMP analysis. [6.0PC1k]

1c. Effective communications capability in and between the surface and the underground facilities shall be established, and suitable safety alarm systems shall be provided where required. Closed-circuit television monitoring shall be provided for primary hoisting and/or material handling at critical locations. [6.0PC1k]

1d. The underground support systems and service facilities shall be capable of supporting the uncertainty allowances as defined in Section 1.2.6.0, Performance Criteria 1d. [6.0PC1k] (D,O,S,P,M,T,I)

1e. The distribution of utilities around the operations area of the Main Test Level shall allow for flexibility in the siting and construction of the final testing locations. [6.0PC1k]

1f. Utilities shall meet the needs of construction, operations, and in situ site characterization. [6.0PC1k]

2a. The service facilities and equipment required for maintaining and installing underground services shall be provided to support ESF operation and in situ site characterization and shall be capable of

YMP/CC-0013, Rev. 5/31/91

supporting the excavation allowances defined in Section 1.2.6.0, Performance Criteria 1d. [6.0PC1k]

2b. Cranes, lifting equipment, and shop machinery shall be consistent with maintenance needs. [6.0PC1k] (M)

3a. The underground transport facilities shall be sufficiently sized to sustain construction, operations, and testing. [6.0PC1k]

3b. The transport system(s) shall be designed with appropriate safety features, as required by YMP analysis and applicable Federal, State of Nevada, and local regulations. [6.0PC1k,CM]

INTERFACE CONTROL REQUIREMENTS

1. The ESF designers shall interface with repository designers on ESF site location and layout and on permanent ESF structures, systems, and components, and shall make available all design information pertaining to the permanent ESF components during formal program design technical assessments and reviews, or when such information is formally requested by the repository designers through DOE or their designated representative.

   See Section 1.2.6.0, Interface Control Requirements.

CONSTRAINTS

A. Utility systems (i.e., electric power, air, water, etc.), when installed, shall not restrict foot, vehicular, or shaft and ramp conveyance traffic; obstruct ventilation; or cause safety hazards. [6.0CM]

B. Investigations to obtain the required information shall be conducted in such a manner as to limit adverse effects on the long-term performance of the geologic repository to the extent practical. [10 CFR 60.15(c)(1)] [6.0PC2d]

   i. **The design of the underground utilities shall incorporate aspects specifically directed at limiting, to the extent practicable, adverse effects on the repository's long term performance , and construction and operation of the underground utilities shall be performed in a manner that limits, to the extent practicable, adverse effects on the repository's long term performance.**

C. DOE shall **perform,** or **permit** the **Commission** to **perform,** such tests as the Commission **deems appropriate or necessary for the administration** of the regulations in this part [Part 60]. **These may include** tests of: (1) Radioactive waste, (2) the geologic repository including its structures, systems, and components, (3) radiation detection and monitoring instruments, and (4) other equipment and devices used in connection with the receipt, handling, or storage of radioactive waste. [10 CFR 60.74(a)] [6.0PC2d]

 YMP/CC-0013, Rev. 5/31/91

i. The structures, systems, components, and operation of the shaft and ramp breakouts and main test level of the ESF shall be designed to accommodate additional tests that may be required by the NRC for site characterization and performance confirmation. [NEV]

D. The underground facility shall be designed so that the effects of credible disruptive events during the period of operations, such as flooding, fires and explosions, will not spread through the facility. [10 CFR 60.133(a)(2)] [6.0PC2d]

i. Utility systems, including the water distribution and underground wastewater collection systems, shall be designed so that, in the event of seismic activity, safe operation is ensured.

ii. The underground utility system shall be designed to control and limit the impact of utility system failures caused by credible disruptive events such as fire, explosion, or seismic events, on site characterization and other testing.

E. The underground facility shall be designed with sufficient flexibility to allow adjustments where necessary to accommodate specific site conditions identified through in situ monitoring, testing, or excavation. [10 CFR 60.133(b)] [6.0PC2d]

i. Underground utilities for the ESF shall be designed to accommodate expansion of the main test level for additional testing and exploratory drifting from the main test level, if necessary, up to approximately 10,000 feet to other parts of the repository block. [TBD]

ii. The underground utilities for the ESF shall not preclude monitoring and investigation of in situ conditions, and shall be designed to accommodate site specific conditions, construction, and operation of the ESF.

iii. The design of the underground utilities shall provide the flexibility needed to support the uncertainty in the design of the shafts and ramps, shaft and ramp breakouts, and the layout of the main test level of the ESF. [TBD]

F. The design of the underground facility shall provide for control of water or gas intrusion. [10 CFR 60.133(d)] [6.0PC2d]

i. Appropriate gravity drainage and/or pumping systems shall be incorporated into the shaft, ramp, and underground facilities for draining water away from testing and other working areas to suitable collection point(s) for further treatment and/or disposal.

ii. Structures, systems, and components shall be provided for effective water and ground control.

IMP/CC-0015, Rev. 5/31/91

iii. The design of the ESF underground utility system, including ventilation, shall facilitate monitoring of moisture influx to the ESF from the rock mass and from ventilation, and moisture efflux from underground water removal and ventilation exhaust to limit possible impacts on the capability to adequately characterize the site.

G. The geologic repository operations area shall be designed so as to permit implementation of a performance confirmation program that meets the requirements of Subpart F of this part [Part 60]. [10 CFR 60.137] [6.0PC2d]

i. The design of underground utilities for the ESF shall be capable of supporting the performance confirmation testing.

H. To the extent practicable, underground support (utility) systems and associated hardware (hangers, brackets, etc.) shall be removed following final use. [6.0PC2d]

I. In the selection of equipment that will require maintenance, consideration shall be given to the availability and cost of replacement materials and parts, and the need for equipment manufacturer's technical services. [6.0PC1e]

J. Piping shall be designed to preclude or limit water inflow into the ESF following a pipe rupture. [6.0PC2d,CP]

K. All joints in fluid-carrying columns shall be sealed and proof-tested. [6.0PC2d,CP]

ASSUMPTIONS

None.

 YMP/CC-0013, Rev. 5/31/91

1.2.6.7.1 POWER DISTRIBUTION SYSTEM
(Generic Physical Subsystem Account Code: 4.6.1)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The power distribution system for the underground is defined as the systems, subsystems, and components that distribute electrical power to underground systems.

Boundaries and Interfaces

Specific boundaries and interfaces between participating organizations' designs are identified in the YMP Interface Control Document(s). Full compliance of the ESF design with requirements and criteria of Section 1.2.6.7.1 necessitates an evaluation and understanding, by the designer, of the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.2	SURFACE UTILITIES
1.2.6.2.4	Communications System
1.2.6.4	SHAFT ACCESS
1.2.6.5	RAMP ACCESS
1.2.6.7.3	Lighting System
1.2.6.7.4	Ventilation Distribution System
1.2.6.7.5	Water Distribution System
1.2.6.7.6	Underground Wastewater Collection System
1.2.6.7.7	Compressed Air Distribution System
1.2.6.7.8	Fire Protection System
1.2.6.7.9	Muck and Material Handling Systems
1.2.6.7.10	Sanitary Facilities
1.2.6.7.11	Monitoring and Warning Systems
1.2.6.8	UNDERGROUND TEST SUPPORT
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.2	Accesses and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. Distribute electrical power to underground systems. [6.0FR1]

PERFORMANCE CRITERIA

1a. The underground electrical system shall be sized to accommodate all of the normal and peak demands for construction, operation, and site characterization requirements of the subsurface facility. [6.7PC1a,1f]

1b. Underground power distribution for the ESF, including the transformers, and primary and secondary feeder cables, shall be adequately designed with sufficient redundancy to meet the load requirements at points of usage for the construction and operations areas of the facility. (D,O) [6.7PC1a,1f]

 YMP/CC-0013, Rev. 5/31/91

1c. Stand-by power to the underground systems shall provide all of the necessary power to systems and subsystems that are required to operate in the event of a power outage based on safety or operational requirements for the construction and operation of the ESF. [6.7PC1b]

1d. An underground Uninterrupted Power System (UPS) shall ensure continuity of power to the Integrated Data System (IDS), sensor systems, safety instruments and controls, communications, and all systems and subsystems that cannot tolerate a power interruption (See ESFDR Appendix B). [6.7PC1b] (O,P,T)

CONSTRAINTS

A. The underground power distribution system shall have one primary power feed (steel or wire armored) and a second alternate power feed (steel or wire armored). One power feed shall be installed in each access, as necessary, and adequate switching shall be provided. [6.7PC1a]

B. Underground feeders shall have a ground check circuit to continuously monitor the grounding circuit to ensure continuity. [6.0FR1]

C. Underground substations supplying power to 480 volt, three phase loads shall be resistance grounded. [6.7PC1a]

D. The UPS shall consist of batteries and inverters and shall be in a location separate from the main power distribution center. [6.7PC1b]

E. Utility lines, steel supports, etc., shall be electrically bonded and reliably connected to the surface electrical safety grounding network. [6.7PC1a]

F. The power distribution system shall be shielded so as to minimize interference with testing activities. [6.7PC1f]

ASSUMPTIONS

None.

YMP/CC-0013, Rev. 5/31/91

THIS PAGE INTENTIONALLY LEFT BLANK

 YMP/CC-0013, Rev. 5/31/91

1.2.6.7.3 LIGHTING SYSTEM
(Generic Physical Subsystem Account Code: 4.6.3)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The lighting system is defined as those systems, subsystems, and components that provide for the illumination of the ESF underground areas (shafts, ramps, stations, refuge chamber(s), alcoves, test areas, and shop areas).

Boundaries and Interfaces

Specific boundaries and interfaces between participating organizations' designs are identified in the YMP Interface Control Document(s). Full compliance of the ESF design with requirements and criteria of Section 1.2.6.7.3 necessitates an evaluation and understanding, by the designer, of the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.2	SURFACE UTILITIES
1.2.6.4	SHAFT ACCESS
1.2.6.5	RAMP ACCESS
1.2.6.7.1	Power Distribution System
1.2.6.7.11	Monitoring and Warning Systems
1.2.6.8	UNDERGROUND TEST SUPPORT
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.2	Accesses and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. Provide adequate underground lighting. [6.7PC1a]

PERFORMANCE CRITERIA

1a. Lighting shall be provided at each testing area and alcove, refuge chamber(s), and at the shaft and ramp station areas. Lighting shall also be provided in the mechanical, electrical, and utility shops. [6.7PC1a,1f]

1b. Sufficient electrical capacity shall be provided so that temporary lighting for special needs; i.e., mapping, photography, and temporary work lights near the instrumentation junction boxes, can be accommodated. [6.7PC1a,1f] (O,T)

1c. Adequate exit lighting shall be provided to identify direction of evacuation to refuge chamber(s), and/or shaft and ramp stations. [6.7PC1a,1f]

1d. Emergency lighting with battery backup shall be provided in each shop, testing area, refuge chamber(s), and shaft and ramp station area. [6.7PC1a,1f]

YMP/CC-0013, Rev. 5/31/91

CONSTRAINTS

A. The lighting provided in each testing area shall also be based upon any specific test requirements for that area. [6.7PC1a]

B. The lighting in the shop areas shall be based on the specific maintenance requirements. [6.7PC1a]

C. Lighting fixtures for test areas shall be selected for low electrical noise as applicable. [6.7PC1a]

ASSUMPTIONS

None.

 YMP/CC-0013, Rev. 5/31/91

1.2.6.7.4 VENTILATION DISTRIBUTION SYSTEM
(Generic Physical Subsystem Account Code: 4.6.4)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The underground ventilation distribution system is defined as those systems, subsystems, and components that allow fresh air, conditioned if required, to be supplied to, and exhaust air to be removed from, the underground areas to meet the needs of underground construction and site characterization testing. The ventilation distribution system distributes air supplied by the ventilation system (1.2.6.3.1).

Boundaries and Interfaces

Specific boundaries and interfaces between participating organizations' designs are identified in the YMP Interface Control Document(s). Full compliance of the ESF design with requirements and criteria of Section 1.2.6.7.4 necessitates an evaluation and understanding, by the designer, of the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.2	SURFACE UTILITIES
1.2.6.4	SHAFT ACCESS
1.2.6.4.4	Furnishings
1.2.6.5	RAMP ACCESS
1.2.6.5.4	Ramp Furnishings
1.2.6.7.1	Power Distribution System
1.2.6.7.11	Monitoring and Warning Systems
1.2.6.8	UNDERGROUND TEST SUPPORT
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.2	Accesses and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. Provide a distribution system for ventilation air. [6.7FR1]

PERFORMANCE CRITERIA

1a. Underground ventilation shall dilute and/or remove particulate matter, blasting fumes (if drill-and-blast is used), and other flammable and noxious gases from the working areas, and shall divert polluted air to the exhaust opening(s), all in conformance with applicable Federal, State, and local regulations. [6.7PC1a,1f]

1b. The ventilation distribution system shall meet requirements for operator safety and productivity. [6.7PC1f]

1c. The ventilation distribution system shall provide for ventilating air with special ventilation devices, as required, to control airflow to

 YMP/CC-0013, Rev. 5/31/91

the heated test areas and other specified underground areas during ESF underground construction, operations, and site characterization. [6.7PC1a,1e,1f]

1d. Airflow distribution shall be controlled, as required, to supply air to all underground areas. [6.7PC1a,1e,1f] (O)

1e. The ventilation distribution system shall minimize leakage and undesirable recirculation, to the extent practicable. [6.7PC1a] (D,O,S)

1f. The underground ventilation distribution system shall supply adequate quantities of air of acceptable temperature and humidity in accordance with applicable federal, state, and local regulations to support all underground activities. [6.7PC1a] (D,O,S)

1g. Dust control/collection facilities shall be provided at potential dust-generation areas (e.g., working faces, rock-handling transfer points, processing areas, etc.) underground in order to minimize airborne particulates. [6.7PC1a] (D,O,S)

CONSTRAINTS

A. The ventilation distribution system shall be designed to contribute to the control of the expected high free-silica and zeolite content dust, in conformance with applicable federal, state, and local regulations. (See ESFDR Appendix E.) [6.7PC1a]

B. Personnel working in the shaft and ramp shall not be exposed to ventilation air velocities exceeding those listed in the RIB. [6.7PC1a]

C. Ventilation air velocities in the active underground openings shall not be greater than those listed in the RIB. The ventilation volume shall not be less than the quantity per person as listed in the RIB. [6.7PC1a]

D. The ventilation distribution system shall be designed to provide an air cooling power equal to or greater than 260 W/m^2 of personnel skin surface area. [6.7PC1a]

E. The subsurface data building ventilation system shall be designed to be compatible with the fire protection system. [6.7PC1a]

F. Shaft or ramp heaters, if required, shall conform to standard industry design. [6.7PC1a]

G. Maximum allowable noise levels produced by the underground ventilation distribution system shall allow the understanding of face-to-face and alarm-voice communications. [6.7PC1a]

H. Ventilation capacity, shaft or ramp design, and air velocities in the shaft or ramp shall be optimized with respect to safety, design objectives, and cost. [6.7PC1a]

YMP/CC-0013, Rev. 5/31/91

I. The ventilation distribution system shall be maintained to support initial repository construction until this function can be assumed by repository facilities. [6.7PC1a]

ASSUMPTIONS

1. Auxiliary fans may be allowed, if required, during the construction and operation of the ESF to supplement the normal ventilation system.

 YMP/CC-0013, Rev. 5/31/91

1.2.6.7.5 WATER DISTRIBUTION SYSTEM
(Generic Physical Subsystem Account Code: 4.6.5)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The water distribution system is defined as the systems, subsystems, and components that distribute water within the underground facility.

Boundaries and Interfaces

Specific boundaries and interfaces between participating organizations' designs are identified in the YMP Interface Control Document(s). Full compliance of the ESF design with requirements and criteria of Section 1.2.6.7.5 necessitates an evaluation and understanding, by the designer, of the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.2	SURFACE UTILITIES
1.2.6.4	SHAFT ACCESS
1.2.6.5	RAMP ACCESS
1.2.6.6	UNDERGROUND EXCAVATIONS
1.2.6.7.1	Power Distribution System
1.2.6.7.6	Underground Wastewater Collection System
1.2.6.7.8	Fire Protection System
1.2.6.7.11	Monitoring and Warning Systems
1.2.6.8	UNDERGROUND TEST SUPPORT
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.2	Accesses and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. Provide distribution of water underground. [6.7FR1]

PERFORMANCE CRITERIA

1. The underground water distribution system shall be adequately sized, with sufficient capacity for fire protection and for process water throughout the ESF, in accordance with all anticipated needs and services for construction, testing, and operation of the ESF. [6.7PC1a,1e,1f] (D,O,S)

CONSTRAINTS

A. All water used during operation and construction of the ESF shall be provided with chemical tracers as required by testing. [6.7PC1a]

ASSUMPTIONS

1. The water distribution system will not be suitable for drinking purposes (i.e., water will be nonpotable). Bottled water will be provided underground for drinking purposes.

 YMP/CC-0013, Rev. 5/31/91

1.2.6.7.6 UNDERGROUND WASTEWATER COLLECTION SYSTEM
(Generic Physical Subsystem Account Code: 4.6.6)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The underground wastewater collection system is defined as those systems, subsystems, and components that collect, control, and transfer to the surface wastewater system (1.2.6.2.5), the wastewater that flows into the shafts or ramps and underground facilities.

Boundaries and Interfaces

Specific boundaries and interfaces between participating organizations' designs are identified in the YMP Interface Control Document(s). Full compliance of the ESF design with requirements and criteria of Section 1.2.6.7.6 necessitates an evaluation and understanding, by the designer, of the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.2	SURFACE UTILITIES
1.2.6.2.5	Mine Wastewater System
1.2.6.4	SHAFT ACCESS
1.2.6.5	RAMP ACCESS
1.2.6.7.1	Power Distribution System
1.2.6.7.5	Water Distribution System
1.2.6.7.8	Fire Protection System
1.2.6.7.9	Muck and Material Handling Systems
1.2.6.7.11	Monitoring and Warning Systems
1.2.6.8	UNDERGROUND TEST SUPPORT
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.2	Accesses and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. Provide underground water handling and treatment as required. [6.0FR1]

PERFORMANCE CRITERIA

1a. The underground wastewater collection system shall provide for control, handling, collection, treatment (as required), and transfer of wastewater and groundwater inflow to the surface wastewater system. [6.7PC1a]

1b. Gravity drainage, storage, and pumping systems, with adequate capacity and control measures, shall be designed and constructed for the control and transfer of underground water to the surface to ensure worker protection and to preclude adverse effects on in situ site characterization testing or the ability of the site to meet performance objectives. (D,O,S) [6.7PC1a,CB]

i. Water handling and control underground shall be designed for all credible inflows, including inflow from penetration of fault

YMP/CC-0013, Rev. 5/31/91

structures or from perched water horizons, use of fire protection sprinklers, and from water line breakage.

ii. The storage and pumping system shall have the capacity to accommodate a peak rate of 250 gpm or a steady flow of 20 gpm.

iii. Adequate piping shall be provided to carry water from underground pump station(s) to the surface.

iv. Pumping systems with adequate capacity shall be available.

v. The underground wastewater collection system shall have full operating redundancy or shall have storage capacity to allow installation of spares in order to limit possible impacts on the isolation capability of the site.

1c. The underground wastewater collection system shall control standing water and air/water contact surfaces where ventilation air will be flowing in order to control humidity in air and to maintain the quality of the ventilation air being supplied. [6.7PC1a] (D,O,S)

i. Control of humidity in the underground ventilation air shall be facilitated by reducing all underground (shaft, ramp, and test level) air/water contacts to the lowest practical level.

1d. The underground wastewater collection system shall utilize materials of construction that are resistant to erosive and corrosive effects, if economically practicable; otherwise, suitable monitoring and treatment facilities for credible groundwater inflows shall be available to control possible contamination and to prevent damage to pumping/piping systems from erosion or corrosion by waterborne particulates. (D,O,S) [6.7PC1a]

1e. Fluids recovered during construction operations shall be disposed of in such a way to avoid potential for performance impacts. [6.7CB]

1f. The drainage and pumping systems shall accommodate measurement of the water as required. [6.7PC1a]

CONSTRAINTS

A. **The underground wastewater collection system shall be designed to prevent damage caused by water hammer and other destructive events. [6.7CB]**

ASSUMPTIONS

None.

 YMP/CC-0013, Rev. 5/31/91

1.2.6.7.7 COMPRESSED AIR DISTRIBUTION SYSTEM
(Generic Physical Subsystem Account Code: 4.6.7)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The compressed air distribution system is defined as those systems, subsystems, and components that distribute compressed air throughout the underground ESF facility. The compressed air distribution system distributes compressed air from the compressed air system (1.2.6.2.6).

Boundaries and Interfaces

Specific boundaries and interfaces between participating organizations' designs are identified in the YMP Interface Control Document(s). Full compliance of the ESF design with requirements and criteria of Section 1.2.6.7.7 necessitates an evaluation and understanding, by the designer, of the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.2	SURFACE UTILITIES
1.2.6.4	SHAFT ACCESS
1.2.6.5	RAMP ACCESS
1.2.6.6	UNDERGROUND EXCAVATIONS
1.2.6.7.1	Power Distribution System
1.2.6.7.11	Monitoring and Warning Systems
1.2.6.8	UNDERGROUND TEST SUPPORT
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.2	Accesses and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. Distribute compressed air throughout the underground ESF facility. [6.7FR1]

PERFORMANCE CRITERIA

1. Compressed air shall be distributed at a quantity and pressure sufficient to meet underground ESF construction, operations, and site characterization testing requirements. The compressed air distribution system shall also be sufficient to meet drilling requirements during ESF operations to support additional drift excavation. [6.7PC1a,1d,1e,1f,2a] (D,O,T)

CONSTRAINTS

None.

ASSUMPTIONS

None.

 YMP/CC-0013, Rev. 5/31/91

1.2.6.7.8 FIRE PROTECTION SYSTEM
(Generic Physical Subsystem Account Code: 4.6.8)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The fire protection system is defined as the systems, subsystems, and components that provide detection and corrective response, as required, to extinguish fire(s) within the underground facilities.

Boundaries and Interfaces

Specific boundaries and interfaces between participating organizations' designs are identified in the YMP Interface Control Document(s). Full compliance of the ESF design with requirements and criteria of Section 1.2.6.7.8 necessitates an evaluation and understanding, by the designer, of the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.2	SURFACE UTILITIES
1.2.6.2.4	Communication System
1.2.6.4	SHAFT ACCESS
1.2.6.5	RAMP ACCESS
1.2.6.7.1	Power Distribution System
1.2.6.7.5	Water Distribution System
1.2.6.7.6	Underground Wastewater Collection System
1.2.6.7.11	Monitoring and Warning Systems
1.2.6.8	UNDERGROUND TEST SUPPORT
1.2.6.8.1	Integrated Data System (IDS) Support
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.2	Accesses and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. Provide for the detection, warning, and suppression of fires in the ESF underground. [6.0FR1]

PERFORMANCE CRITERIA

1a. The underground portion of the ESF shall incorporate a fire protection system to control and limit the impact of credible fires in the ESF. [6.7PC1a,1e,1f,CB]

1b. The fire suppression system shall be capable of operating automatically and/or manually. [6.7PC1a] (D,O,S)

1c. Portable extinguishers shall be located in the subsurface areas. [6.7PC1a] (D,O,S)

CONSTRAINTS

A. Fire suppression agents shall be selected for their compatibility with their intended use. These agents shall be approved for use based on

 YMP/CC-0013, Rev. 5/31/91

their impacts on underground safety (i.e., they do not produce adverse geochemical effects), the in situ site characterization testing program, and performance objectives as stated in 10 CFR 60.
[6.7PC1a,1e,1f,CB,CG]

B. As a minimum, fire hose outlets shall be located at all shaft or ramp stations. [6.7PC1a]

C. A fire protection system shall be provided for the subsurface data building and IDS facility. [6.7PC1a]

ASSUMPTIONS

None.

 YMP/CC-0013, Rev. 5/31/91

1.2.6.7.9 MUCK AND MATERIAL HANDLING SYSTEMS
(Generic Physical Subsystem Account Code: 4.6.9)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The muck and material handling systems are defined as those systems, subsystems, structures, equipment, and components that transport excavated rock (muck), materials (including supplies and fuel), and equipment between the surface and subsurface to meet the needs of construction and underground site characterization testing. This includes any transferring at a shaft or ramp station. The material handling system systems includes material handling equipment, loading and unloading stations, transfer point structures, and buildings to accommodate all the necessary equipment and instrumentation, hydraulic power units, air compressor system, control room, electrical and motor centers, and an area for repairs and laydown. The muck handling system includes the muck pockets, skip loaders, bottom cleanout systems, and the appropriate conveyances.

Boundaries and Interfaces

Specific boundaries and interfaces between participating organizations' designs are identified in the YMP Interface Control Document(s). Full compliance of the ESF design with requirements and criteria of Section 1.2.6.7.9 necessitates an evaluation and understanding, by the designer, of the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.2	SURFACE UTILITIES
1.2.6.4	SHAFT ACCESS
1.2.6.5	RAMP ACCESS
1.2.6.5.3	Station
1.2.6.5.4	Ramp Furnishings
1.2.6.6	UNDERGROUND EXCAVATIONS
1.2.6.7.1	Power Distribution System
1.2.6.7.6	Underground Wastewater Collection System
1.2.6.7.11	Monitoring and Warning Systems
1.2.6.8	UNDERGROUND TEST SUPPORT
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.2	Accesses and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. Provide for transport of excavated rock, materials, and equipment between the surface and subsurface. [6.7FR1]

PERFORMANCE CRITERIA

1a. The muck handling system shall provide for collecting excavated rock at the shaft or ramp station, surge capacity, measuring, and loading the rock into a skip for movement. [6.7PC1a]

YMP/CC-0013, Rev. 5/31/91

1b. Muck and material handling systems shall be sized and designed for ESF construction and underground site characterization needs and shall minimize the spillage of excavated rock during handling. These systems shall provide capabilities for gathering and removing spillage from the shaft or ramp bottom. [6.7PC1a,1e,1f] (D,O,S)

1c. Sufficient flexibility and redundancy for sustaining production shall be built into the muck handling system to cope with problems/breakdowns (e.g., equipment failure, material handling problems, etc.) in the underground development and operations activities. [6.7PC1a,3a]

CONSTRAINTS

A. The muck handling system design shall accommodate handling of oversize material at the transfer points. [6.7PC1a]

B. The conveyors and/or transport system shall incorporate fail-safe devices, and be designed with adequate safety factors as per applicable requirements of 30 CFR 57, and State of Nevada and local regulations. (S) [6.7PC3b]

C. The muck and material handling systems shall be designed with a separate and independent power distribution system. [6.7PC3b]

D. The muck and material handling systems shall be designed, installed, tested, operated, and maintained in conformance with applicable regulations. [6.7PC1a,3a]

E. The muck and material handling systems shall be maintained to support initial repository construction until this function can be assumed by repository facilities. [6.7PC3a]

ASSUMPTIONS

None.

YMP/CC-0013, Rev. 5/31/91

1.2.6.7.10 SANITARY FACILITIES
(Generic Physical Subsystem Account Code: 4.6.10)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The sanitary facilities are defined as the system that provides for human waste collection within the underground facilities.

Boundaries and Interfaces

Specific boundaries and interfaces between participating organizations' designs are identified in the YMP Interface Control Document(s). Full compliance of the ESF design with requirements and criteria of Section 1.2.6.7.10 necessitates an evaluation and understanding, by the designer, of the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.2	SURFACE UTILITIES
1.2.6.2.3	Sanitary System
1.2.6.4	SHAFT ACCESS
1.2.6.5	RAMP ACCESS
1.2.6.6	UNDERGROUND EXCAVATIONS
1.2.6.7.1	Power Distribution System
1.2.6.7.11	Monitoring and Warning Systems
1.2.6.8	UNDERGROUND TEST SUPPORT
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.2	Accesses and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. Provide sanitary facilities at convenient locations throughout the underground facilities for the underground work force. [6.7FR1]

PERFORMANCE CRITERIA

1a. Dry chemical, portable type toilets shall be provided underground to accommodate the collection of wastes from a maximum occupancy underground, per shift. [6.7PC1a] (D,O)

1b. The portable toilets shall be sized to be compatible with the conveyance equipment. [6.7PC1a]

1c. Toilet facilities shall be located at convenient, noninterfering locations relative to operations, site characterization testing, and monitoring. [6.7PC1a,1e,1f]

CONSTRAINTS

None.

YMP/CC-0013, Rev. 5/31/91

ASSUMPTIONS

None.

 YMP/CC-0013, Rev. 5/31/91

1.2.6.7.11 MONITORING AND WARNING SYSTEMS
(Generic Physical Subsystem Account Code: 4.6.11)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The monitoring and warning systems are defined as those systems required to monitor underground conditions (noise, dust, toxic and flammable gases, radon/radon daughters) and to alert onsite personnel of possible dangerous situations so as to ensure a safe and healthful working environment.

Boundaries and Interfaces

Specific boundaries and interfaces between participating organizations' designs are identified in the YMP Interface Control Document(s). Full compliance of the ESF design with requirements and criteria of Section 1.2.6.7.11 necessitates an evaluation and understanding, by the designer, of the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.2 SURFACE UTILITIES
1.2.6.2.4 Communications System
1.2.6.3 SURFACE FACILITIES
1.2.6.3.9 Communications/Data Building(s)
1.2.6.4 SHAFT ACCESS
1.2.6.4.6 Sump
1.2.6.5 RAMP ACCESS
1.2.6.6 UNDERGROUND EXCAVATIONS
1.2.6.7.1 Power Distribution System
1.2.6.7.3 Lighting System
1.2.6.7.4 Ventilation Distribution System
1.2.6.7.5 Water Distribution System
1.2.6.7.6 Underground Wastewater Collection System
1.2.6.7.7 Compressed Air Distribution System
1.2.6.7.8 Fire Protection System
1.2.6.7.9 Muck and Material Handling Systems
1.2.6.7.10 Sanitary Facilities
1.2.6.8 UNDERGROUND TEST SUPPORT
1.2.6.9 ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.2 Accesses and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. Monitor the underground air for conditions dangerous to personnel and warn of such conditions. [6.7FR1]

PERFORMANCE CRITERIA

1a. An alarm system shall give warning of hazardous conditions by indicating when the monitored condition(s) exceed predetermined limits and shall notify the responsible personnel on surface and all underground personnel of such hazardous conditions. [6.7PC1a,1c] (D,O,S)

YMP/CC-0013, Rev. 5/31/91

1b. A life safety alarm system shall be provided between the underground and surface. [6.7PC1a,1c] (D,O,S)

1c. The central surface control room for the monitoring of the underground systems shall provide a central location for facility instrument readouts, alarms, equipment status, and automatic and/or manual override equipment controls. Monitor/control of the following equipment shall be incorporated into the design of the control room: water supply pumps, primary fans and doors, Monitoring and Warning System, and underground wastewater collection system. [6.7PC1a,1c] (D,O,S)

1d. The air quality monitoring system shall have the capability to sample, measure, and analyze physical and chemical conditions consistent with the requirements of applicable Federal, State, and local regulations. [6.7PC1a]

1e. The underground ventilation system shall be monitored, as a minimum, for noise, dust, radon daughters, ammonia, nitrogen dioxide, nitrous oxides, sulfur dioxide, hydrogen sulfide, methane, oxygen, carbon monoxide, carbon dioxide, temperature, humidity, and air velocity and volume flow, as required by applicable federal, state and local regulations. [6.7PC1a,1c]

   i. Concentrations of radon daughters in underground work areas shall be monitored in accordance with 30 CFR 57.5037. [6.7PC1a,1c] (O)

1f. The underground ventilation system shall be continuously monitored for environmental conditions (such as temperature, humidity, and volume) as required by the Testing Program. [6.7PC1a,1c] (D,O,S,P,M,T,I)

CONSTRAINTS

A. Redundant components for all systems which monitor potential life threatening conditions shall be installed in accordance with applicable federal, state, and local regulations. [6.7PC1]

B. The ventilation monitoring systems for site characterization shall be separate and independent from the monitoring systems required for industrial hygiene and life safety support systems wherever this is feasible. [6.7PC1a,1c]

ASSUMPTIONS

None.

YMP/CC-0013, Rev. 5/31/91

1.2.6.8 UNDERGROUND TEST SUPPORT
(Generic Physical Subsystem Account Code: 4.7)

Subparts are 1.2.6.8.1 Integrated Data System (IDS) Support
1.2.6.8.2 Test Support

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

Underground test support is defined as those activities associated with test equipment including but not limited to installation and maintenance, test execution, test data recording, and test analysis for in situ site characterization to be performed within the Yucca Mountain ESF. The facility requirements for individual underground tests are described in ESFDR Appendix B. Drilling support is summarized in ESFDR Appendix C.

Boundaries and Interfaces

Specific boundaries and interfaces between participating organizations' designs are identified in the YMP Interface Control Document(s). Full compliance of the ESF design with requirements and criteria of Section 1.2.6.8 necessitates an evaluation and understanding, by the designer, of the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.2	SURFACE UTILITIES
1.2.6.2.4	Communications System
1.2.6.3	SURFACE FACILITIES
1.2.6.3.2	Test Support Facilities
1.2.6.3.9	Communications/Data Building(s)
1.2.6.4	SHAFT ACCESS
1.2.6.4.1	Collar
1.2.6.4.2	Lining
1.2.6.4.3	Stations
1.2.6.4.4	Furnishings
1.2.6.5	RAMP ACCESS
1.2.6.5.1	Portal
1.2.6.5.2	Lining
1.2.6.5.3	Station
1.2.6.5.4	Ramp Furnishings
1.2.6.6	UNDERGROUND EXCAVATIONS
1.2.6.6.2	Test Areas
1.2.6.7	UNDERGROUND SUPPORT SYSTEMS
1.2.6.7.1	Power Distribution System
1.2.6.7.3	Lighting System
1.2.6.7.4	Ventilation Distribution System
1.2.6.7.5	Water Distribution System
1.2.6.7.6	Underground Wastewater Collection System
1.2.6.7.7	Compressed Air Distribution System
1.2.6.7.8	Fire Protection System
1.2.6.7.9	Muck and Material Handling Systems
1.2.6.7.10	Sanitary Facilities
1.2.6.7.11	Monitoring and Warning Systems

YMP/CC-0013, Rev. 5/31/91

1.2.6.9 ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.1 Surface Facilities
1.2.6.9.2 Accesses and Underground Facilities

APPLICABLE REGULATIONS, CODES, STANDARDS, AND DOE ORDERS

See Section 1.2.6.0, Applicable Regulations, Codes, Standards, and DOE Orders.

FUNCTIONAL REQUIREMENTS

1. Provide the means for implementing characterization and performance confirmation testing plans. [6.0FR1, FR2]

PERFORMANCE CRITERIA

1a. An uninterruptible power supply system shall be available to ensure continuous operation of equipment and instrumentation related to critical testing as determined by the YMP through analysis. [6.0PC1k]

1b. Where potential gassy mine conditions exist, instrumentation appropriate to the category (30CFR57) shall be provided, as required. [6.0PC1g,CGi]

1c. See ESFDR Appendix B for a summary of the ESF requirements for the IDS and for individual tests. [6.0PC1k] (D)

1d. Testing instrumentation/hardware, cables, computer equipment, and data acquisition and monitoring systems, shall be designed to withstand the expected underground environment. [6.0PC1k] (T,P)

1e. Experiments, tests controls, and monitoring and control systems shall be secure from unauthorized access. [6.0PC1k]

1f. Provide support for an Integrated Data System (IDS) for the acquisition, storage and dissemination of test data. [6.0PC1k]

INTERFACE CONTROL REQUIREMENTS

1. The ESF designers shall interface with repository designers on ESF site location and layout and on permanent ESF structures, systems, and components, and shall make available all design information pertaining to the permanent ESF components during formal program design technical assessments and reviews, or when such information is formally requested by the repository designers through DOE or their designated representative.

 YMP/CC-0013, Rev. 5/31/91

CONSTRAINTS

A. Tests shall be designed and located within the facility to ensure that thermal, mechanical, chemical and hydrological interactions will not endanger the structural stability of the ESF or adversely affect tests conducted in adjacent areas within the ESF. [6.0PC2d]

B. Tests shall be prioritized by DOE through a performance allocation process (see the SCPB).

   i. The above test prioritization shall be the basis for instrumentation design; testing layout; and ventilation, personnel, and utility requirements. [TBD] [6.0PC1k]

C. Full scale testing in the core test panel shall not be allowed until two routes of egress are available. [6.0PC1g,CK]

   i. Tests or parts of tests which can be initiated prior to when the two routes of egress are available shall be determined on the basis of the information contained in ESFDR Appendices B and C. [TBD]

D. To the extent practical, [accesses and] exploratory boreholes in the geologic repository operations area shall be located where [accesses] are planned for underground facility construction and operation or where large unexcavated pillars, are planned. [10 CFR 60.15(c)(3)] [6.0CD]

   i. MPBH boreholes shall be located in pillars, to the extent practicable.

   ii. MPBH boreholes should be surveyed as drilling proceeds and the option to cease drilling may be invoked if insufficient separation from the proposed access location is observed. [TBD]

   iii. Boreholes drilled from the main test level shall not penetrate significantly below the base of the TSw2 host rock, unless the impacts on the waste isolation performance of the site have been evaluated and found to be acceptable. [TBD]

E. The design of the underground facility shall provide for control of water or gas intrusion. [10 CFR 60.133(d)] [6.0PC2f]

   i. Fluids and materials planned for use in testing in the ESF shall be evaluated with respect to intended use and possible effects on site characterization or other testing, and appropriate controls implemented.

   ii. The amount of water used in testing and operations shall be limited so as to limit the effects on the containment and isolation capability of the site. [TBD]

 YMP/CC-0013, Rev. 5/31/91

iii. Water use in testing shall be generally consistent with repository design goals to limit the increase in average percent saturation of the repository horizon to [TBD] percent and to limit increase in the local percent saturation to [TBD] percent in areas of waste emplacement. [TBD]

iv. MPBHs or other surface drilled exploratory boreholes associated with the ESF shall be drilled dry.

v. Fluids recovered during testing operations shall be disposed of in such a way as to avoid potential for performance impacts.

vi. Excess water shall be removed.

vii. Any cleaning of ESF walls to facilitate photogrammetry, mapping, or other testing shall be done using compressed air/mist and control procedures to limit water saturation.

viii. Water entering the ESF shall be managed appropriately, including quantity, location, and water balance. [TBD]

ix. Gaseous products used in characterization shall not produce geochemical effects that impact waste isolation capabilities of the site.

ASSUMPTIONS

1. Planned testing and monitoring may be conducted in the accesses, the Upper Demonstration Breakout Room, the Main Test Level, and the Calico Hills Formation, as directed by DOE.

YMP/CC-0013, Rev. 5/31/91

1.2.6.8.1 INTEGRATED DATA SYSTEM (IDS) SUPPORT
(Generic Physical Subsystem Account Code: 4.7.1)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The Integrated Data System (IDS) is defined as those hardware components and associated computer software necessary to acquire, store and disseminate data collected in connection with testing operations in the ESF. Support for the IDS consists of providing facilities as described in ESFDR Appendix B.

Boundaries and Interfaces

Specific boundaries and interfaces between participating organizations' designs are identified in the YMP Interface Control Document(s). Full compliance of the IDS design with Section 1.2.6.8.1 and the instrumentation and data requirements of the tests in ESFDR Appendix B necessitates an evaluation and understanding, by the designer, of the physical and virtual interface requirements between the IDS, the Users test systems and the facility systems in the following sections:

1.2.6.3	SURFACE FACILITIES
1.2.6.3.2	Test Support Facilities
1.2.6.3.9	Communications/Data Building(s)
1.2.6.4	SHAFT ACCESS
1.2.6.5	RAMP ACCESS
1.2.6.6	UNDERGROUND EXCAVATIONS
1.2.6.7	UNDERGROUND SUPPORT SYSTEMS
1.2.6.7.8	Fire Protection System
1.2.6.8.2	Test Support
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.1	Surface Facilities
1.2.6.9.2	Accesses and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. Provide for the incorporation of an IDS into the ESF. [6.8FR1]

PERFORMANCE CRITERIA

1. Facilities shall be provided, as given in ESFDR Appendix B, to incorporate an IDS into the ESF.

 YMP/CC-0013, Rev. 5/31/91

INTERFACE CONTROL REQUIREMENTS

1. The ESF designers shall interface with IDS and repository designers on ESF site location and layout and on permanent ESF structures, systems, and components, and shall make available all design information pertaining to the permanent ESF components during formal program design technical assessments and reviews, or when such information is formally requested by the IDS or repository designers through DOE or their designated representative.

   See Section 1.2.6.0, Interface Control Requirements.

2. Interface control will be established between the following:

   i. The Facility designers and the IDS designers for the electrical and mechanical cable and terminating requirements between the Instruments and the IDS.

   ii. The IDS designers and the Facility designers for the support requirements for the IDS facility.

CONSTRAINTS

None

ASSUMPTIONS

None

 YMP/CC-0013, Rev. 5/31/91

1.2.6.8.2 TEST SUPPORT
(Generic Physical Subsystem Account Code: 4.7.2)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

Four types of tests will be performed: geologic, geomechanic, near-field and thermally perturbed, and hydrologic and transport phenomena. The geologic tests are defined as the detailed characterization of the geology in the area of the ESF for (1) determining the suitability of the locations of the underground tests, (2) for defining the distribution of the rock characteristics and properties at those locations, and (3) relating the results of ESF hydrological, geomechanical, and geochemical tests to variations in the geologic framework of the site. Facility requirements for these tests are described in ESFDR Appendix B.

The geomechanics tests are defined as the tests required to determine the physical and mechanical properties of the welded tuff. These properties are an integral part of the information needed to evaluate the stability and deformational response of the underground openings. Facility requirements for these tests are described in ESFDR Appendix B.

The near-field and thermally perturbed tests are defined as those tests that are required to investigate the mechanical and hydrologic behavior of the welded Topopah Spring Member tuff under thermally perturbed conditions. These tests are intended to characterize the environmental conditions to be expected in the vicinity of waste-package emplacement holes and to validate models to be used in repository design and performance assessment. These efforts will also establish scaling ratios for correlating laboratory test results with field test results. Facility requirements for these tests are described in ESFDR Appendix B.

The hydrologic and transport phenomena tests are defined as those tests that are required to characterize the hydrologic and transport phenomena of the welded and nonwelded tuff. These properties are an integral part of the information needed to: supplement and complement the surface-based hydrologic information needed to characterize the Yucca Mountain site; and provide information for analyzing fluid flow and the potential for radionuclide transport through unsaturated tuff. Facility requirements for these tests are described in ESFDR Appendix B.

Boundaries and Interfaces

Specific boundaries and interfaces between participating organizations' designs are identified in the YMP Interface Control Document(s). Full compliance of the ESF design with the requirements and criteria of Section 1.2.6.8.2 necessitates an evaluation and understanding, by the designer, of the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.1.1 Main Site(s)
1.2.6.3 SURFACE FACILITIES
1.2.6.3.2 Test Support Facilities

YMP/CC-0013, Rev. 5/31/91

1.2.6.9 ESF DECOMMISSIONING AND CLOSURE
(Generic Physical Subsystem Account Code: 4.8)

Subparts are 1.2.6.9.1 Surface Facilities
1.2.6.9.2 Accesses and Underground Facilities

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

Decommissioning and closure are defined as those activities enacted to place the ESF facilities (systems and subsystems) into a permanently non-operable and safe condition. Requirements in this section apply only if Yucca Mountain is determined to be unsuitable as a repository. For requirements if Yucca Mountain is determined to be suitable, see 1.2.6.0 PC2d.

Boundaries and Interfaces

Specific boundaries and interfaces between participating organizations' designs are identified in the YMP Interface Control Document(s). Full compliance of the ESF design with the requirements and criteria of Section 1.2.6.9 necessitates an evaluation and understanding, by the designer, of the boundary and interface impacts of the requirements and criteria in the following Sections:

1.2.6.1 ESF SITE(S)
1.2.6.1.1 Main Site(s)
1.2.6.1.2 Auxiliary Site(s)
1.2.6.1.3 Access Roads
1.2.6.1.4 Site Drainage
1.2.6.2 SURFACE UTILITIES
1.2.6.2.1 Power System
1.2.6.2.2 Water System
1.2.6.2.3 Sewage System
1.2.6.2.4 Communications System
1.2.6.2.5 Surface Wastewater System
1.2.6.2.6 Compressed Air System
1.2.6.3 SURFACE FACILITIES
1.2.6.3.1 Ventilation System
1.2.6.3.2 Test Support Facilities
1.2.6.3.3 Site Preparation for Structures
1.2.6.3.4 Parking Areas
1.2.6.3.5 Storage Facilities
1.2.6.3.6 Shop
1.2.6.3.7 Warehouse
1.2.6.3.8 Other Temporary Structures
1.2.6.3.9 Communications/Data Building(s)
1.2.6.4 SHAFT ACCESS
1.2.6.4.1 Collar
1.2.6.4.2 Lining
1.2.6.4.3 Stations
1.2.6.4.4 Furnishings
1.2.6.4.5 Hoist System

YMP/CC-0013, Rev. 5/31/91

1.2.6.4.6 Sump
1.2.6.5 RAMP ACCESS
1.2.6.5.1 Portal
1.2.6.5.2 Lining
1.2.6.5.3 Station
1.2.6.5.4 Ramp Furnishings
1.2.6.5.6 Sump
1.2.6.6 UNDERGROUND EXCAVATIONS
1.2.6.6.1 Operations Support Areas
1.2.6.6.2 Test Areas
1.2.6.7 UNDERGROUND SUPPORT SYSTEMS
1.2.6.7.1 Power Distribution System
1.2.6.7.3 Lighting System
1.2.6.7.4 Ventilation Distribution System
1.2.6.7.5 Water Distribution System
1.2.6.7.6 Underground Wastewater Collection System
1.2.6.7.7 Compressed Air Distribution System
1.2.6.7.8 Fire Protection System
1.2.6.7.9 Muck and Material Handling Systems
1.2.6.7.10 Sanitary Facilities
1.2.6.7.11 Monitoring and Warning Systems
1.2.6.8 UNDERGROUND TEST SUPPORT
1.2.6.8.1 Integrated Data System (IDS) Support
1.2.6.8.2 Test Support

APPLICABLE REGULATIONS, CODES, STANDARDS, AND DOE ORDERS

No specific regulation, codes, standards, or DOE Orders have been defined for decommissioning and closure other than those contained in section 1.2.6.0, Applicable Regulations, Codes, Standards, and DOE Orders.

FUNCTIONAL REQUIREMENTS

1. Provide for decommissioning and closure of the ESF.

PERFORMANCE CRITERIA

1a. The ESF shall be designed, constructed, and operated, to not preclude meeting restoration requirements of applicable Federal, BLM, State, and local codes. (D,O,T) [6.0FR1,FR2]

1b. Decommissioning and closure shall be in accordance with the baselined Site Characterization Plan. (D,O)

1c. Repository decommissioning requirements imposed on the ESF are generally shown on drawings in ESFDR Appendix A.3.

INTERFACE CONTROL REQUIREMENTS

None

YMP/CC-0013, Rev. 5/31/91

CONSTRAINTS

None

ASSUMPTIONS

1. Subsequent to the selection process but prior to the actual decommissioning of the ESF facilities, alternative uses may be identified that can influence the range and extent of the actual decommissioning tasks and the designs and plans that are required. These alternative uses may be identified as near-term and/or long-term commitments. The ESF will only be fully decommissioned and closed if no alternative uses can be identified.

2. Systems, subsystems, and facilities may be utilized in other repository programs or salvaged in accordance with the Nuclear Waste Policy Act (NWPA) funding requirements.

 YMP/CC-0013, Rev. 5/31/91

1.2.6.9.1 SURFACE FACILITIES
(Generic Physical Subsystem Account Code: 4.8.1)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The surface facilities includes all of the facilities, systems, and subsystems as defined in previous sections: ESF Site; Surface Utilities; Surface Facilities; Shaft Collar; Shaft Hoist System; Ramp Portal; and Material Handling System.

Boundaries and Interfaces

Specific boundaries and interfaces between participating organizations' designs are identified in the YMP Interface Control Document(s). Full compliance of the ESF design with the requirements and criteria of Section 1.2.6.9.1 necessitates an evaluation and understanding, by the designer, of the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.1	ESF SITE(S)
1.2.6.1.1	Main Site(s)
1.2.6.1.2	Auxiliary Site(s)
1.2.6.1.3	Access Roads
1.2.6.1.4	Site Drainage
1.2.6.2	SURFACE UTILITIES
1.2.6.2.1	Power System
1.2.6.2.2	Water System
1.2.6.2.3	Sewage System
1.2.6.2.4	Communications System
1.2.6.2.5	Surface Wastewater System
1.2.6.2.6	Compressed Air System
1.2.6.3	SURFACE FACILITIES
1.2.6.3.1	Ventilation System
1.2.6.3.2	Test Support Facilities
1.2.6.3.3	Site Preparation for Surface Structures
1.2.6.3.4	Parking Areas
1.2.6.3.5	Storage Facilities
1.2.6.3.6	Shop
1.2.6.3.7	Warehouse
1.2.6.3.8	Other Temporary Structures
1.2.6.3.9	Communications/Data Building(s)
1.2.6.8	UNDERGROUND TEST SUPPORT
1.2.6.8.1	Integrated Data System (IDS) Support
1.2.6.9.2	Accesses and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. Provide for decommissioning and closure of the ESF surface facilities. [6.9FR1]

YMP/CC-0013, Rev. 5/31/91

PERFORMANCE CRITERIA

1a. Near term decommissioning of the surface facilities shall place the facilities in a permanently non-operable, and safe condition. [6.9PC1b, 1c] (O,S)

1b. Permanent decommissioning of the surface facilities shall restore the ESF site and the immediate surrounding areas so it is compatible with its initial condition. (O) [6.9PC1b, 1c]

CONSTRAINTS

A. Facilities shall be removed by the most practical and cost-effective methods: [6.9PC1b, 1c]

   i. Portable and prefabricated buildings shall be emptied of their contents, dismantled, and removed from the site.

   ii. Systems and subsystems such as the hoist equipment (including the headframes) electric generators, electrical and water distribution systems, ventilation equipment, meteorological towers, and communications equipment shall be dismantled and removed from the site.

   iii. Buried water, electrical, and sewage lines may be disconnected below the surface and left in the ground.

B. Any significant adverse environmental impacts associated with the ESF decommissioning shall be minimized through the use of good engineering practices, Reclamation Guidelines, and the Reclamation Implementation Plan (when completed) [reference TBD]. The Reclamation Guidelines and the Reclamation Implementation Plan shall be implemented to the extent practicable. Conformance of the design with the Reclamation Guidelines (and the Reclamation Implementation Plan, when completed) shall be demonstrated during the design review process. [6.9PC1a] [TBD]

ASSUMPTIONS

None

YMP/CC-0013, Rev. 5/31/91

1.2.6.9.2 ACCESSES AND UNDERGROUND FACILITIES
(Generic Physical Subsystem Account Code: 4.8.2)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The accesses and underground facilities includes all of the facilities, systems, and subsystems as described in previous sections: Accesses; Underground Excavations; Underground Utility Systems; and Underground Test Support (excluding Collar, Hoist and Portal Systems).

Boundaries and Interfaces

Specific boundaries and interfaces between participating organizations' designs are identified in the YMP Interface Control Document(s). Full compliance of the ESF design with the requirements and criteria of Section 1.2.6.9.2 necessitates an evaluation and understanding, by the designer, of the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.2	SURFACE UTILITIES
1.2.6.2.4	Communications System
1.2.6.4	SHAFT ACCESS
1.2.6.4.1	Collar
1.2.6.4.2	Lining
1.2.6.4.3	Stations
1.2.6.4.4	Furnishings
1.2.6.4.5	Hoist System
1.2.6.4.6	Sump
1.2.6.5	RAMP ACCESS
1.2.6.5.1	Portal
1.2.6.5.2	Lining
1.2.6.5.3	Station
1.2.6.5.4	Ramp Furnishings
1.2.6.5.6	Sump
1.2.6.6	UNDERGROUND EXCAVATIONS
1.2.6.6.1	Operations Support Areas
1.2.6.6.2	Test Areas
1.2.6.7	UNDERGROUND SUPPORT SYSTEMS
1.2.6.7.1	Power Distribution System
1.2.6.7.3	Lighting System
1.2.6.7.4	Ventilation Distribution System
1.2.6.7.5	Water Distribution System
1.2.6.7.6	Underground Wastewater Collection System
1.2.6.7.7	Compressed Air Distribution System
1.2.6.7.8	Fire Protection System
1.2.6.7.9	Muck and Material Handling Systems
1.2.6.7.10	Sanitary Facilities
1.2.6.7.11	Monitoring and Warning Systems
1.2.6.8	UNDERGROUND TEST SUPPORT
1.2.6.8.1	Integrated Data System (IDS) Support
1.2.6.9.1	Surface Facilities

FUNCTIONAL REQUIREMENTS

1. Provide for decommissioning and closure of the ESF accesses and underground facilities. [6.9FR1]

PERFORMANCE CRITERIA

1. Near term decommissioning of the ESF accesses and underground excavations shall place the facilities, systems, and subsystems in a permanently non-operable and safe condition. (O,S) [6.9PC1b, 1c]

CONSTRAINTS

A. Facilities shall be removed by the most practical and cost-effective methods: [6.9PC1b, 1c]

   i. Horizontal and vertical drillholes extending from the ESF accesses and rooms shall be sealed;

   ii. Subsurface accesses, drifts, and rooms shall be backfilled with the material that was removed during excavation and/or with other suitable engineered material;

   iii. ESF accesses shall be stripped of equipment and structures; and

   iv. ESF access liners may be left in place.

ASSUMPTIONS

None

YMP 00-0013, Rev. 5 31 91

YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT

EXPLORATORY STUDIES FACILITY (ESF)

DESIGN REQUIREMENTS

(ESFDR)

VOLUME II

Prepared by Yucca Mountain Site Characterization Project (YMP) Participants as part of the Civilian Radioactive Waste Management Program. The YMP is managed by the Yucca Mountain Site Characterization Project Office (YMPO) of the U.S. Department of Energy, Office of Civilian Radioactive Waste Management.

Compiled by:
Sandia National Laboratories
with support from
Technical and Management Support Services Contractor
101 Convention Center Drive, Suite 407
Las Vegas, Nevada 89109

Prepared for:

U.S. Department of Energy
Yucca Mountain Site Characterization Project Office
P.O. Box 98608
Las Vegas, Nevada 89193-8608

YMP CC-0013, Rev. 5 31 91

TABLE OF CONTENTS

VOLUME 2

APPENDICES

 YMP CC-0013, Rev. 5 31 91

ESF/REPOSITORY INTERFACE CONSTRAINTS

The reference ESF/Repository configuration to be used for subsequent design of the ESF shall be as follows:

1. Option 30 of the ESF Alternatives Study shall form the basis of configuration. The following modifications shall be considered for enhancement.

   a. The test area at the main test level shall be located in the northeastern part of the repository block.

   b. If it is needed, a shaft shall be designed (in addition to the two ramps of Option 30), the construction of which shall be deferred until it is required. This shaft would facilitate underground operations and acquisition of scientific information about the rock above the Topopah Spring unit within the repository block. This shaft shall serve as the third repository access out of a total of four repository accesses included in Option 30.

2. Rock excavated from the underground facilities shall be deposited at a location on the surface that is not visible from U.S. Highway 95.

3. Design and construction of the ESF main test level shall not preclude construction of the repository emplacement level at the highest elevation possible compatible with the contact between the TSw1 and TSw2.

4. Design and construction of the ESF main test level shall not preclude design and construction of the repository so that waste emplacement drifts do not cross major faults, such as the Ghost Dance Fault.

5. Refer also to YMP MGDS RDR (YMP/CC-0011).

YMP CC-0013, Rev. 5 31 91

APPENDIX A.1

REPOSITORY/EXPLORATORY STUDIES FACILITY (ESF) INTERFACE

REFER TO:

YUCCA MOUNTAIN MINED GEOLOGIC DISPOSAL SYSTEM

REPOSITORY DESIGN REQUIREMENTS

(YMP/CC-0011)

[illegible]

APPENDIX A.2

ESF-REPOSITORY INFERFACE DRAWINGS

[TBD]

YMP CC-0013, Rev. 8 31 91

APPENDIX A.3

ESF SEALING REQUIREMENTS IMPOSED BY REPOSITORY SEALING PLAN

[TBD]

YMP CC-0013, Rev. 5 01 91

APPENDIX A.4

THERMAL DESIGN BASIS LOADS FOR THE ESF

[TBD]

 YMP CC-0013, Rev. 5 01 91

APPENDIX A.5

SEISMIC DESIGN BASIS LOADS FOR THE ESF

[TBD]

YMP CC-0013, Rev. 5 31 91

APPENDIX B

ESF TESTING REQUIREMENTS FOR FACILITY DESIGN

YMP 90-0013, Rev. 5 31 91

APPENDIX B

Exploratory Studies Facility (ESF) Testing Requirements For Facility Design

The information provided in this Appendix is preliminary design input supporting pre-Title II Design Studies for the ESF Reference Design Concept, and is the first phase submittal of test related design information. The information is taken from Test Planning Package 91-5, "Preliminary ESF TPP for Support of Preliminary Title II ESF Design Studies -- First Phase Submittal, Planned ESF Tests - North Ramp Access." The content and format of the information is consistent with the Raytheon Services Nevada (RSN) request for Title I Design testing information (FS-YMP-5197).

Two additional ESFDR Appendix B design phased inputs will be developed for ESF testing in the Calico Hills and the Topopah Spring Main Test Level (including South Ramp Access). The purpose of these phased design inputs is to complete the design requirements for ESF testing prior to Title II Design.

Supporting requirements from the ESFDR, Rev. 0, Appendix B (Sections 2.3 through 2.9) for the above test design inputs, are provided for use in design study activities as preliminary, best available information, for development of the ESF Reference Design Concept. Information provided in TPP 91-5 is the most current and takes precedence over Sections 2.3 through 2.9 if discrepancies occur. Prior to the initiation of Title II Design, the North Ramp, Calico Hills, and the Topopah Spring Main Test Level (including South Ramp Access) test design inputs will be revised based upon prioritized needs to support Design Studies and Phased Title II Design. This will include changes which result from SCPB revisions and selected facility configuration and construction methods. These changes will be submitted as a formal revision of the ESFDR.

YMP CC-0013, Rev. 5 31 91

APPENDIX B

TABLE OF CONTENTS

 YMP CC-0013, Rev. 5 31 91

APPENDIX B

TABLE OF CONTENTS (Cont.)

TEST PLANNING PACKAGE 91-5
PRE-TITLE II DESIGN STUDIES
PLANNED ESF TESTS - NORTH RAMP ACCESS

PLANNED ACTIVITY IN ESF NORTH ACCESS	SCPB STUDY NUMBER	SCPB ACTIVITY NUMBER	SCPB ADDITION ? (2)	PONTENTIAL IMPACT ON CONSTRUCTION ?	ALCOVE NECESSARY ?	SAMPLING ONLY ?	IDS SUPPORTED ?
United States Geological Survey							
Underground Geologic Mapping	8.3.1.4.2.2	8.3.1.4.2.2.4					
Seismic Tomography / Vertical Seismic Profiling in the ESF	8.3.1.4.2.2	8.3.1.4.2.2.5		X			X
Overcore Stress Experiment in the ESF	8.3.1.15.2.1	8.3.1.15.2.1.2			X		
Matrix Hydrologic Properties Testing	8.3.1.2.2.3	8.3.1.2.2.3.1				X	
Intact Fracture Test	8.3.1.2.2.4	8.3.1.2.2.4.1					
Radial Borehole Tests in the ESF	8.3.1.2.2.4	8.3.1.2.2.4.4			X		X
Excavation Effects Test	8.3.1.2.2.4	8.3.1.2.2.4.5		X	X		X
Perched Water Testing in the ESF	8.3.1.2.2.4	8.3.1.2.2.4.7		X (3)			X
Hydrochemistry Tests in the ESF	8.3.1.2.2.4	8.3.1.2.2.4.8			X		
Hydrologic Properties of Major Faults Encountered in the ESF	8.3.1.2.2.4	8.3.1.2.2.4.10		X (3)	X		X
Lawrence Livermore National Laboratory							
Geomechanical Attributes of the Waste Package Environment	8.3.4.2.4.3	UNDEFINED	X		X		X
Repository Horizon Near-Field Hydrologic Properties	8.3.4.2.4.4	8.3.4.2.4.4.1			X		X
Repository Horizon Rock-Water Interaction	8.3.4.2.4.4	8.3.4.2.4.4.2				X	
Sandia National Laboratory							
Access Convergence Test at the ESF	8.3.1.15.1.5	8.3.1.15.1.5.1					X
Demonstration Breakout Rooms	8.3.1.15.1.5	8.3.1.15.1.5.2			X		X
Heater Experiment in TSwl	8.3.1.15.1.6	8.3.1.15.1.6.1			X		X
Plate Loading Tests	8.3.1.15.1.7	8.3.1.15.1.7.1			X		X
Evaluation of Mining Methods	8.3.1.15.1.8	8.3.1.15.1.8.1					X
Monitoring of Ground Support Systems	8.3.1.15.1.8	8.3.1.15.1.8.2					X
Monitoring Drift Stability	8.3.1.15.1.8	8.3.1.15.1.8.3					X
Air Quality and Ventilation Experiment	8.3.1.15.1.8	8.3.1.15.1.8.4					X
Laboratory Tests (Thermal & Mechnical) Using Samples ...	8.3.1.15.1.1,.2,.3,.4	(1)				X	
Development and Demonstration of Required Equipment	8.3.2.5.6	UNDEFINED	X				UNCERTAIN
In Situ Testing of Seals Components	8.3.3.2.2.3	UNDEFINED	X		X		X
Los Alamos National Laboratory							
Chloride and Chlorine-36 Measurements of Percolation at YM	8.3.1.2.2.2	8.3.1.2.2.2.1				X	
Diffusion Test in the ESF	8.3.1.2.2.5	8.3.1.2.2.5.1			X		X
History of Mineralogic and Geochemical Alteration of YM	8.3.1.3.2.2	8.3.1.3.2.2.1				X	
Fracture Mineralogy Studies of the ESF	8.3.1.3.2.1	8.3.1.3.2.1.3				X	
Petrologic Stratigraphy of the Topopah Spring Member	8.3.1.3.2.1	8.3.1.3.2.1.1				X	
Biological Sorption and Transport	8.3.1.3.4.2	UNDEFINED	X			X	

NOTES:
1 SCPB Activities under this identifier are 8.3.1.15.1.1.1, 2, 3, 8.3.1.15.1.2.1, 8.3.1.15.1.3.1, 2, 8.3.1.15.1.4.1, 2
2 Requires addition of activity description in SCPB
3 Pote[illegible] onstruction impact is more attributable to the characteristics of the feature than actual [illegible] conduct

YMP CO-0013, Rev. 5 31 91

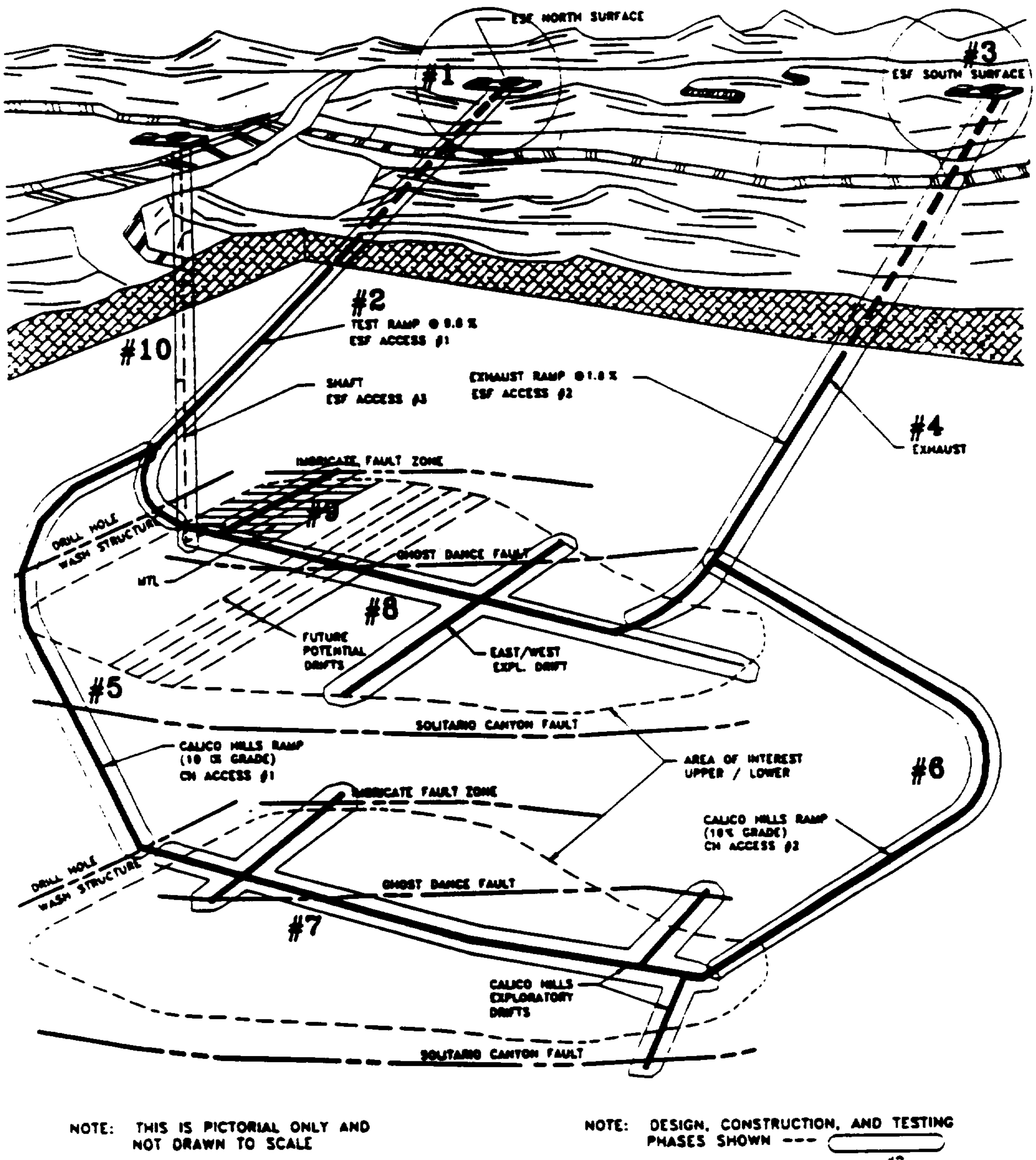


Figure A.

REFERENCE DESIGN CONCEPT
FOR COMMENCING STUDY

YMP 03-0013, Rev. 5 31 91

PRE-TITLE II DESIGN STUDIES
PLANNED ESF TESTS - NORTH RAMP ACCESS

PLANNED ACTIVITY NAME: UNDERGROUND GEOLOGIC MAPPING

SCPB Section 8.3.1.4.2.2.4 (Activity)

Description of Activity

Geologic mapping and photogrammetry will be used to document lithologic and fracture variability throughout the vertical and horizontal extent of the underground excavations, to investigate structural features, and to provide siting data to confirm (or modify) planned test locations within the underground excavations. Geologists will take stereo-photographs of exposed rock surfaces of all openings in the ESF. These photographs will be analyzed off-site using a computer-driven analytical plotter. Detail line surveys will be performed continuously along one wall of each drift or ramp (or at 2-m intervals if in a shaft). Detail line surveys consist of recording the characteristics of each fracture, geologic discontinuity, or feature which intersects a datum line. Regular sampling of the wall rock and fracture infilling will be part of the mapping process.

Location

Geologic mapping will be performed in all ESF openings where items of particular interest such as faults, special contacts, etc. are encountered, special small-scale mapping may be conducted.

Special Room/Alcove Requirements

No special rooms required. Mapping will adjust to the opening configuration.

Interference Envelope

We are trying to design the underground mapping to have minimal interference with both construction and other experimentation. Standoff distances are not applicable to this test.

Constraints/Controls

1. Mapping must be conducted before installation of chain-link or wire mesh.

2. Walls must be cleaned before photography for mapping.

3. Utilities must be confined to the lower left or right quadrants or the invert of the ramp for 250 ft behind the trailing gear of the TBM.

 YMP 00-0013, Rev. 5 31 91

4. Geologists must have access to the entire circumference for sampling and mapping.

Timing/Schedule Requirements

Mapping will begin as soon as construction starts, and will proceed with excavation progress.

ESF Design/Test Support Requirements

Generally, mapping will be done as close to the working face as possible to minimize any deterioration of the rock, or interference from ground support. While the presence of rock bolts and plates will not hinder processing of the photos, rock pans, chain link fabric, or wire mesh must not be installed until the walls have been cleaned and photographed. The walls will be cleaned of all dirt, muck smear, or any other encrusted materials by the use of a high-pressure air-water blowpipe. The air-water mixture of the blowpipe should be adjusted such that little or no free water is present on the walls during cleaning. A tracer will be added to the cleaning water to allow detection of any penetration into the wall rock.

Mapping will be preformed on as much of the exposed rock surface as possible. The location of utilities (fan lines, compressed air line, conveyor, water line, electrical cables) should be arranged in each drift and ramp such that the maximum circumference of the tunnel is visible for mapping. We recommend that the utilities be confined to the lower left or right quadrants or the invert of the ramp if possible. Adequate illumination will be required for inspection of the walls, but strobe lighting for photography will be provided by the mapping team. The strobes require 110v AC power. Mapping will also require surveying support for location of photogrammetry control targets. The accuracy of locations of geologic features depends on the accuracy of the surveyed target locations.

Provision must be made to allow mapping geologists access to all parts of the tunnel circumference. We recommend some type of mapping platform be built, which would be equipped with multiple decks and/or levels, and an apparatus for mounting and aligning the photogrammetric camera for stereophotography of the walls. This platform could also be used for placing and surveying of photogrammetry control points, and hanging of wire mesh or chain line (after completion of a section of mapping).

We expect the maximum advance rate of the TBM to be about 250 ft per day. For this reason, a 250-ft section is required behind the trailing gear in which to conduct mapping. This section must be free of chain link fabric and wire mesh, and as free of obstruction from the utilities as possible. Behind this 250-ft area, miners will be free to install additional roof support, chain link fabric, or arrange utilities however they see fit. If ground conditions require fabric, mesh, or shotcrete closer to the machine than 250 ft, steps will be taken to do mapping as close to the machine as possible.

 YMP CC-1013, Rev. 5 31 91

Collection of various samples will be done concurrent with mapping. Where possible, geologists will use pry bars and hammers to remove samples from the wall. Where smooth walls make traditional sampling difficult, the use of a small drill and hydraulic splitter may be an option. This would require the drilling of a 6-inch to 1-ft deep hole adjacent to a fracture, about 1.25-inch in diameter. The hydraulic splitter would be inserted into the hole and used to split out a sample. Fracture filling minerals will also be sampled by using pry bars and hammers.

A storage and staging trailer or building of at least 200-sq-ft is required on the surface with necessary amenities. A photographic laboratory (light-tight) approximately 8 x 13 ft with necessary amenities and one circuit with 220 V, 30-A circuit.

 YMP 00-0013, Rev. 5 31 91

PRE-TITLE II DESIGN STUDIES
PLANNED ESF TESTS - NORTH RAMP ACCESS

PLANNED ACTIVITY NAME: SEISMIC TOMOGRAPHY/VERTICAL SEISMIC PROFILING AT THE ESF

SCPB Section 8.3.1.4.2.2.5 (Activity)

Description of Activity

The purpose of seismic tomography and vertical seismic profiling activity is to remotely characterize subsurface fracture networks. Tests to be conducted are a) surface to ramp seismic imaging, b) borehole to borehole tomographic imaging, c) ramp to borehole seismic imaging, and d) strong motion seismic monitoring.

Test (a) will be conducted in both the Topopah Springs ramp and the Calico Hills ramp. The zone over which the test will be conducted will be mainly in areas of suspected faulting, fracturing, and perched water which have been identified in the ramps from geologic mapping, surface mapping, or other geophysical or geological studies.

Test (b) will be conducted in both the Topopah Springs and the Calico Hills ramps to determine the behavior of the damage zone, map faults away from the ramps and/or zoned of perched water. The location will be in zones of principle lithology, areas of changing fracture and fault content, and zones of any water inflow.

Test (c) will be conducted if suspected faults or geologic anomalies may be present ahead of the ramps to more accurately define the location and extent of these features that may significantly affect the integrity of the ramps.

Test (d) will be passive monitoring of strong seismic ground motion at points of different lithology and depth along the ramps.

Location

See Activity Description and Sketches 1, 2, and 3.

Special Room/Alcove Requirements

No special rooms or alcoves are needed. It is anticipated that all work can be done from the ramps or from already designed rooms. The exception may be an area required for the strong motion instruments ($1m^3$) when there is no area near a required location available.

YMP 02-0013, Rev. 5 31 91

Interference Envelope

Dry drilling is not needed or wanted, only constraints are space to set up instruments in the ramps to perform the tests and record data during the tests (a few square meters). Ground vibration from other activities should be kept to a minimum.

Constraints Controls

Because the purpose of this test is to measure ground vibration caused by the introduction of energy from a specific source controlled by the seismic-test team, other loud noises or equipment or machinery-induced vibration in or near the facility are not allowed while tests are in progress. No other special constraints are required to include this activity in the ESF testing, and no additional perturbation to natural conditions (stress, temperature, moisture, etc.) will result from this activity (i.e., no significant zone of influence results from this activity) if boreholes are dry-drilled. This test does not require dry-drilled boreholes.

Timing/Schedule Requirements

Test "a", "b", and "c" should be done as the ramps are excavated and anomalies are encountered.

Test "d" instrumentation need not be emplaced until ramp construction is finished.

ESF Design/Test Support Requirements

No special rooms or alcoves are required. It is anticipated that all work can be done from the ramps or from already designed rooms. The exception may be an area required for the strong motion instruments ($1m^3$) when there is no protected area near a required location area. Horizontal boreholes (3.5-inch diameter) will be required for each of the "b" and "c" type tests. The length of the boreholes will be a function of the zone of desired investigation.

For damage zone investigations, the minimum length will be 5 meters. The distance between boreholes will be 1/2 to 1/3 the length. For more extensive "look ahead" or fault zone studies, the length of the boreholes may be up to 100 meters. No IDS support will be required except for one data line for each location of test "d". Temporary lighting and power, 110v/20 amp or 220v/20 amp will be required for test "a", "b", and "c". The length of each test will be from one day to ten days. Test "b" may be repeated to determine temporal changes in the extent of the damage zone.

SURFACE TO RAMP SEISMIC IMAGING TEST
Type "a"

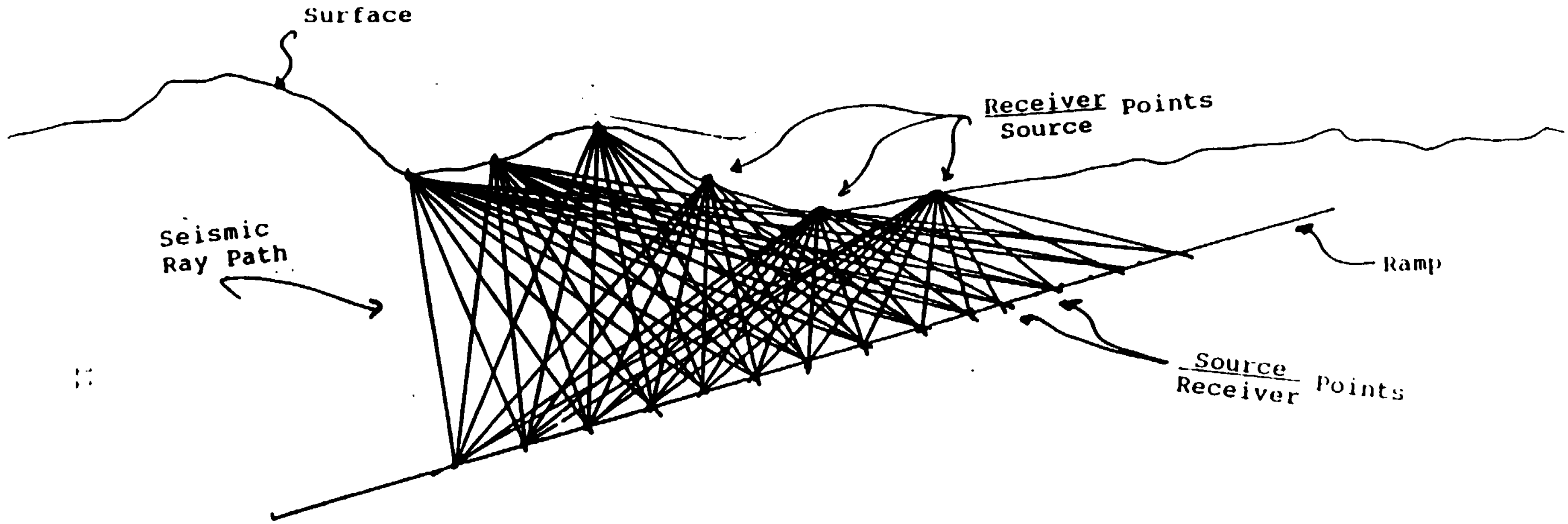


FIGURE 1. SIDE VIEW OF RAMP
(SCPB Section 8.3.1.4.2.2.5)

Note: This is pictorial only and not drawn to scale.

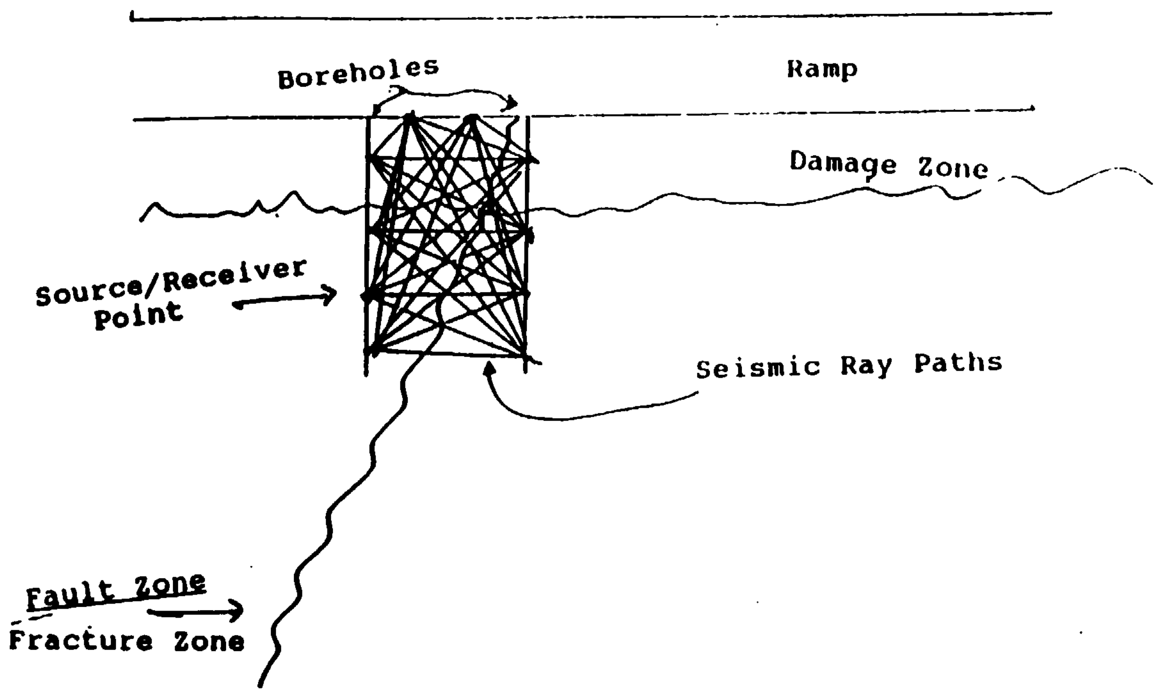


FIGURE 2. PLAN VIEW OF TOMOGRAPHIC IMAGING IN RAMPS TEST
Type "b" (SCPB Section 8.3.1.4.2.2.5)

Note: This is pictorial only and not drawn to scale.

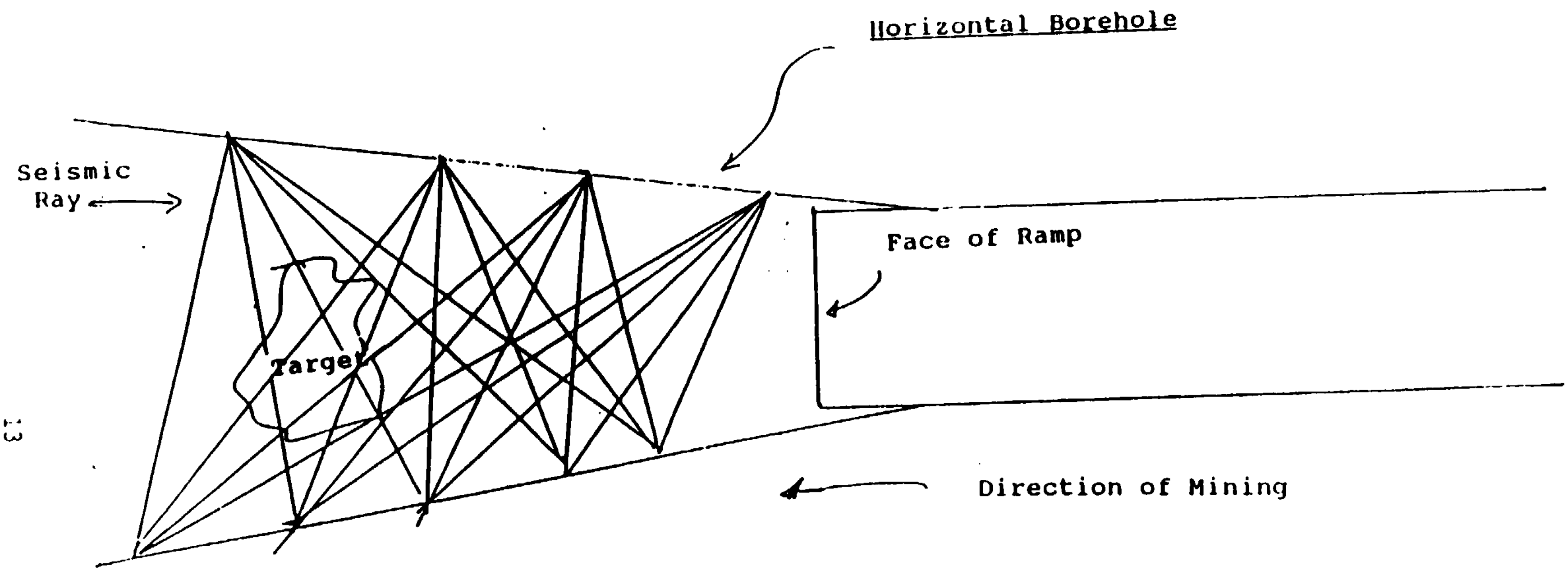


FIGURE 3. PLAN VIEW OF TEST - Type "c"
(SCPB Section 8.3.1.4.2.2.5)

Note: This is pictorial only and not drawn to scale.

PLANNED ACTIVITY NAME: OVERCORE STRESS EXPERIMENT IN THE EXPLORATORY STUDIES FACILITY

SCPB Section 8.3.1.15.2.1.2 (Activity)

Description of Activity

The overcore stress experiments will be performed to determine the in situ state of stress above, within, and below the repository horizon, in that portion of the unsaturated zone penetrated by the ESF, to determine the extent of excavation-induced stress changes, and to relate stress parameters to rock-mass heterogeneities.

Soon after access is available, small-diameter holes will be drilled to prescribed orientations and lengths (longer than three shaft or drift diameters). A stress sensor will then be installed, and the instrumented center hole will be overcored in stages. Stress data will be taken as the instrumentation of each stage is overcored.

The test will be conducted in alcoves constructed from both the north and south ramps in the high lithophysal zone of the upper Topopah Springs welded unit, in alcoves on the main test level (one north end, one south end of block), and in the Calico Hills nonwelded unit at both the north and south ends of the block. The tests in the nonwelded Calico Hills may be either on the Calico Hills test level or from the ramps in the unit. Tests conducted in the Calico Hills unit will include hydrofracture tests conducted with low-volume amounts of water. The Calico Hills test locations should be sited so as to not be near hydrologic tests or other water-sensitive tests.

Location

The test will be conducted in alcoves constructed from both ramps in the high lithophysal zone of the upper Topopah Springs welded unit, in alcoves on the main test level (one north end, one south end of block), and in the Calico Hills nonwelded unit at both the north and south ends of the block. The tests in the nonwelded Calico Hills may be either on the Calico Hills test level or from the ramps in the unit (if applicable).

Special Room/Alcove Requirements

See "Location" statement.

YMP 00-0013, Rev. 5 31 91

Interference Envelope

Test must be conducted at a distance equivalent to at least two opening diameters from the opening. The test must be located at least 50 ft from any heater test or be conducted prior to any heater test within 50 ft distance. If water is used in drilling/coring, any hydrologic tests can be conducted several meters away. Tests conducted in the Calico Hills unit will include hydrofracture tests conducted with low-volume amounts of water. The Calico Hills test locations should be sited so as to not be near hydrologic tests or other water-sensitive tests.

Constraints/Controls

The test should be separated from the nearest thermal test by a minimum of 50 ft or should be completed before the heaters are energized. Flexibility in location of the tests is required because intact segments of core are required. Thus, the location, distribution, orientation and apertures of fractures need to be examined before tests are conducted. No mining, testing, or construction should take place in such a way as to influence the in situ stresses at the bottom of the test holes. Test holes should not be drilled near other instrument holes. Tests will be conducted within the approximately 50-ft-long boreholes extending downward and horizontally from the end of the excavation.

Timing/Schedule Requirements

This test does not require any special timing relative to the ESF construction.

ESF Design/Test Support Requirements

Drilling, including coring will be required. Dry drilling is not required. A mobile rock-testing facility (to be supplied by the test organization) will require an assigned space at the surface and utility hookups.

YMP CC-0013, Rev. 5 31 91

PRE-TITLE II DESIGN STUDIES
PLANNED ESF TESTS - NORTH RAMP ACCESS

PLANNED ACTIVITY NAME: MATRIX HYDROLOGIC PROPERTIES TESTING

SCPB Section 8.3.1.2.2.3.1 (Activity)

Description of Activity

The purpose of the matrix hydrologic properties tests is to develop a comprehensive data base on matrix flux properties in the unsaturated-zone tuffs at Yucca Mountain. This activity includes collecting bulk and/or core samples, taken from the ESF. The samples may be obtained either from core holes drilled for other tests or from core drilled specifically for the collection of core for matrix properties testing. The collected samples will be packaged, labeled, and sent to a laboratory for various analyses.

Location

Various locations along the length of the ramp and other areas in the ESF to adequately characterize the matrix properties of the units. Samples will be required from near contacts; north, south, and middle of the block; and from all lithologic units encountered.

Special Room/Alcove Requirements

Small alcoves, large enough to contain a core rig, may be required in the event that additional coreholes are used to obtain samples for this test.

Interference Envelope

This test requiréd, as much as possible, in situ, samples. The samples should be collected far enough from any wet-drilling operations to insure uncontaminated samples.

Constraints/Controls

Procedures and design shall be developed to minimize the water contamination of any bulk samples. Core holes shall be drilled dry and provide core of HQ size.

Timing/Schedule Requirements

Samples do not need to be collected immediately after excavation, but should be collected as soon as possible. This is important for natural water content samples.

YMP 00-0013, Rev. 5 31 91

ESF Design/Test Support Requirements

Large size (estimated to be large enough not to pass a 1-ft mesh) may be required for some samples. Samples should be collected as soon as possible after excavation of the opening in order to avoid changes in the natural moisture state.

  YMP 00-0013, Rev. 5 31 91

PRE-TITLE II DESIGN STUDIES
PLANNED ESF TESTS - NORTH RAMP ACCESS

PLANNED ACTIVITY NAME: INTACT FRACTURE TEST

SCPB Section 8.3.1.2.2.4.1 (Activity)

Description of Activity

The intact-fracture test will be used to evaluate fluid-flow and chemical transport properties and mechanisms in relatively undisturbed and variably stressed fractures to enhance understanding of physics of low and for flow modeling.

Fracture-sampling locations will be selected on the basis of detailed fracture maps. At about 12 or more locations (to be determined), a small pilot hole will be drilled across a fracture, a rock bolt anchor will be installed, the pilot hole will be overcored, and the sample will be withdrawn. The sample will be packaged, labeled, and transported to an off-site laboratory for intact-fracture analyses.

Location

Sample locations will be chosen by the PI after detailed mapping information is available.

Special Room/Alcove Requirements

An alcove large enough to accommodate a core rig may be required.

Interference Envelope

Suitable sample locations will be chosen by the PI. No interference envelope is defined.

Constraints/Controls

Flexibility in sampling location is required to locate suitable fractures. Drilling and overcoring will be done using dry methods. Because only sample collection will be conducted in the ESF, no other special constraints on the layout are required. No hydrological, chemical, or thermal disturbance is expected from this activity.

YMP CC-0013, Rev. 5 31 91

Timing Schedule Requirements

This test should be done before any lining material is installed in the ESF.

ESF Design Test Support Requirements

Sample locations will be chosen by the PI after mapping information is available. Dry drilling and overcoring will be required. A drilling alcove may be required if in a high traffic area.

YMP 00-0013, Rev. 3 11 91

PRE-TITLE II DESIGN STUDIES
PLANNED ESF TESTS - NORTH RAMP ACCESS

PLANNED ACTIVITY NAME: RADIAL BOREHOLE TESTS IN THE ESF

SCPB Section 8.3.1.2.2.4.4 (Activity)

Description of Activity

The radial borehole tests will investigate vertical and lateral movement of gas, water, and vapor on and across hydrogeologic contacts and within the various units.

Five stratigraphic depths have been tentatively chosen as sites for drilling the "Contact Test Holes" (replace "Short Radial Boreholes) (See Sketch 1). At each depth location, four 50-ft coreholes will be drilled parallel to the contact and each other, using air as the drilling fluid. A drilling and testing alcove will be required at each location. Core will be collected, packaged, labeled, and transported to an off-site laboratory for hydrologic analyses (fracture and matrix properties). The holes will be logged and surveyed for fracture and moisture data. Air-permeability tests in packed-off intervals will be conducted to obtain gas permeability data. Cross-hole permeability tests will be conducted across stratigraphic contacts with both gas and water. Long-term monitoring of matrix water potential, pressure, and temperature will also be conducted; formation gases will be sampled periodically.

Nine stratigraphic depths have been tentatively chosen as sites for drilling the "Anisotropy Test Holes" (replace long radial boreholes) (See Sketch 2). At each location, three 50-ft coreholes will be drilled horizontal, and perpendicular to the ramp. The first location will also serve to conduct limited prototype testing (also see Hydrochemistry Test). Air permeability testing will be conducted in each borehole and between the three boreholes.

Location

See "Description of Activity" and Sketches 1 and 2.

Special Room/Alcove Requirements

Contact Test Alcoves:

- Must allow drilling of 4 - 50 ft deep ODX core holes parallel to the contact and each other.

- Minimum of 20 ft off the ramp

- Holes 1 and 2 will be up to 10 ft apart and 7 ft above the contact.

 YMP 00-0013, Rev. 5 31 91

- Holes 3 and 4 will be up to 10 ft apart and 7 ft below the contact.

- Maximum dimensions are 24 ft wide, 26 ft height, 20 ft deep, these are dependent on the angle the ramp intersects the contact.

Anisotropy Test Alcoves:

- Must allow drilling of 3 - 50 ft deep ODX coreholes in an equilateral triangle with maximum of 15 ft sides.

- Holes will be horizontal and perpendicular to the ramp.

- Dimensions are 24 ft width, 22 ft height, 20 ft off ramp.

- Alcove is perpendicular to ramp.

Interference Envelope

Contact Tests:

- The holes need to be placed such that the stress relief effects of the ramp and alcove are minimized.

- The holes need to be placed such that other tests (excavation effects, fracture tests, etc.) will not interfere.

Anisotropy Tests:

- The holes need to be placed such that stress relief effects of the ramp and alcoves are minimized.

- The holes need to be placed such that other tests will not interfere.

Constraints/Controls

Provision for data collection by the IDS must be available at each location. Both the "contact" boreholes and the "anisotropy" boreholes will be drilled deep enough to be beyond the expected zone of mechanical and hydrologic influence of the openings, but need to be placed such that stress relief effects of the ramp and alcove are minimized. The boreholes also need to be placed so that other tests will not interfere. The "contact" holes will be used to monitor the movement of any construction water from the opening in order to measure the hydrologic zone of influence resulting from shaft construction. These monitoring activities require no special constraints, nor do they alter the hydrologic or geochemical state of the rock mass. However, at the stratigraphic contacts, cross-hole permeability tests will be run with both gas and water. The water injected under low pressure is estimated to influence a zone extending 10 m from the test location.

YMP CC-0013, Rev. 5 31 91

Geochemical effects are not expected to extend beyond the zone of influence resulting from water movement. The air injected for this test will contain a tracer to allow discrimination between the natural gas in pore spaces and the injected air. Since a portion of the hydrochemistry testing is expected to be performed at the same location as the radial borehole test, the use of an air tracer will control the potential interference between these tests. No thermal or mechanical alterations to the rock mass will result from this test.

Timing/Schedule Requirements

Contact and anisotropy testing (Radial Borehole Tests) should be conducted as soon as feasible after excavation.

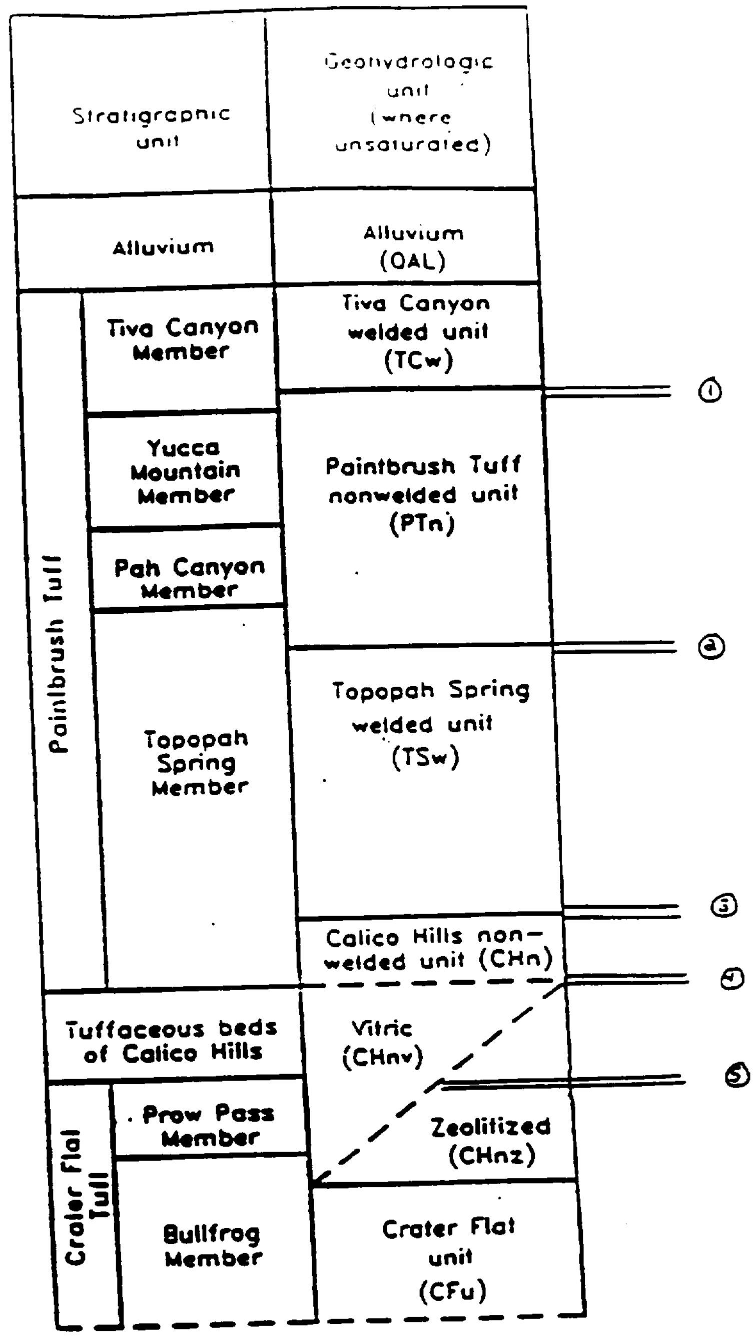
ESF Design/Test Support Requirements

An alcove of approximate dimensions of 26-ft high by 24-ft wide by 20-ft deep is required for each "Contact Location" and 22-ft high by 24-ft wide by 20-ft deep for each "Anisotropy Location". The boreholes will be dry drilled and will require drilling support as well as electricity and compressed air. The facility design and operational constraints shall allow periodic access to the test locations. Access should be provided as soon as feasible after passage of the TBM for both types of locations.

 YMP/CC-0013, Rev. 5/31/91

These sites will require a total of 4 - 50' ODX holes, 2 on each side of the contact.

* We do also reserve the right to test across other interesting contacts that may be encountered in excavation

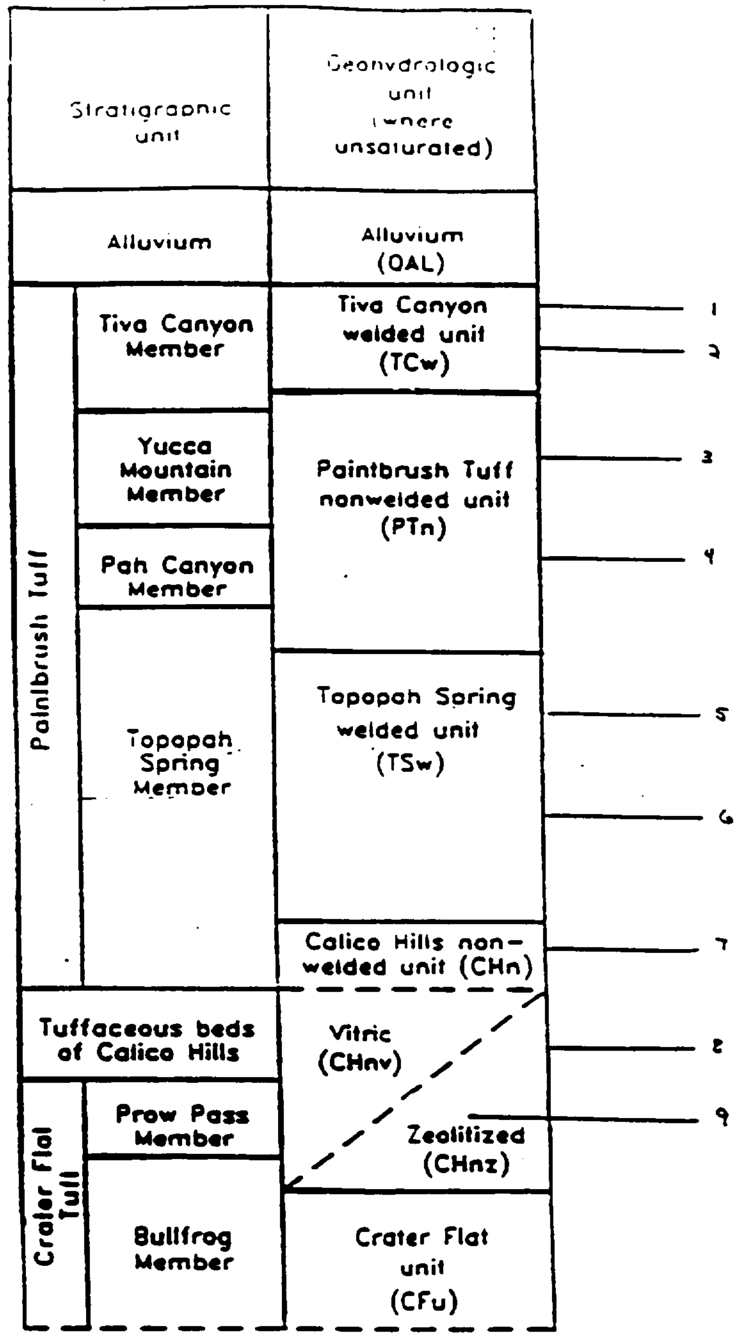


Note: Figure not to scale

Figure 1.2-4. Diagram showing the relation of geohydrologic units to stratigraphic units (modified from Montazer and Wilson, 1984).

SKETCH 1: CONTACT TEST SITES (SCPB Section 8.3.1.2.2.4.4)

YMP/CC-0013, Rev. 5 31 91



Note: Figure not to scale

Figure 1.2-4. Diagram showing the relation of geohydrologic units to stratigraphic units (modified from Montazer and Wilson, 1984).

SKETCH 2: ANISOTROPY TESTING (SCPB Section 8.3.1.2.2.4.4)

YMP 02-0013, Rev. 8 31 91

PRE-TITLE II DESIGN STUDIES
PLANNED ESF TESTS - NORTH RAMP ACCESS

PLANNED ACTIVITY NAME: EXCAVATION EFFECTS TEST

SCPB Section 8.3.1.2.2.4.5 (Activity)

Description of Activity

The excavation effects tests will measure stress changes in the near-field wall-rock as the ESF is excavated, and measure air-permeability changes that result from the stress redistribution.

Currently, the Calico Hills ramp from the main ramp is being considered as a possible location for this test. Other similar locations may be included at a later date. At each test location, multiple small-diameter holes will be drilled parallel or sub-parallel to the unexcavated opening wall but set back selected distances from it. All holes are planned to be air drilled/cored, logged, and surveyed; some of the holes will be instrumented to monitor stress changes and some to monitor permeability changes as the excavation is advanced. Stress and permeability data will be taken in drill holes extended beyond the excavation. Long-term permeability measurements will be made and temperature and moisture data collected. Additional holes may be drilled to handle the instrumentation packages if they are determined to be necessary during prototype testing.

Another possible location for excavation effects type testing is in the engineering boreholes along the ramp alignments. Testing impacts are expected to be minimal, but details are not yet developed.

Location

The configuration and construction methods of the ESF have limited the areas in which this test can be performed. One area in the ESF that could accommodate this test is the area in the north ramp where the shaft to the tuffaceous beds of Calico Hills begins. Boreholes could be drilled and instrumented prior to starting the Calico Hills ramps, and excavation effects data could be collected. A second possible site for the Excavation Effects Test is in the surface-based boreholes drilled in advance of the north ramp.

The site of the test is constrained by the available access to areas proximal to proposed excavations. This test will be conducted in areas that provide this proximity.

Special Room/Alcove Requirements

An alcove large enough to accommodate a core rig. After the boreholes are instrumented, the alcove will house the data acquisition equipment.

YMP 90-0013, Rev. 5 31 91

Interference Envelope

This test must be located adjacent to where a new mined opening is to be excavated.

Constraints/Controls

Flexibility is the only significant constraint identified for this test. It is required for locating drill holes for tests. The instrument holes will be drilled at distances up to 50 ft from the excavation. They will extend as much as 100 ft beyond the excavation creating a zone of potential mechanical interference. All holes will be drilled dry. No thermal, chemical, or hydrological alteration of the rock mass is expected as a result of this activity.

Timing/Schedule Requirements

The test must be performed in conjunction with the excavation of a new opening to allow for the acquisition of the excavation effects data.

ESF Design/Test Support Requirements

Instrument leads at the test location shall be protected from damage. A drilling and testing alcove will be required for this test if conducted underground.

YMP CC-0013, Rev. 5

PRE-TITLE II DESIGN STUDIES
PLANNED ESF TESTS - NORTH RAMP ACCESS

PLANNED ACTIVITY NAME: PERCHED-WATER TESTING IN THE ESF

SCPB Section 8.3.1.2.2.4.7 (Activity)

Description of Activity

The purpose of the perched-water test is to detect the occurrence, and delineate the lateral and vertical extent, of perched-water zones (if encountered) during excavation, to identify perching mechanism(s), and to sample the water for chemical analyses. Because there is significant uncertainty regarding the likelihood of encountering perched water, the perched-water test is categorized as a "contingency test." The form and duration of the testing is dependent upon the nature of any encountered perched-water.

If perched-water is encountered during excavation, one or more small-diameter hole(s) will be drilled to enhance drainage, facilitate collection of water samples, and allow flow and/or pressure measurements to be made. The hole(s) will also be instrumented and sealed during testing to obtain data on hydraulic pressure and water potential over time.

Location

Since the occur and character of the perched-water zones can not be predicted, the actual locations can not be shown. Likewise, the type of facility needed in which to conduct the testing can not be determined at this time.

Special Room/Alcove Requirements

A room large enough to contain a small, underground coring rig may be required if drilling into a perched-water zone becomes necessary. This alcove would be needed to remove the drilling rig out of the main traffic areas in the ESF.

Interference Envelope

The perched-water test is not constrained by any interference envelope. The test will be conducted whenever and wherever perched-water is detected.

YMP 02-0013, Rev. 5 31 91

Constraints/Controls

All boreholes will be drilled dry. Grouting in the ESF will require a chemical tracer to be added to the grout. Because of its nature and location, no special constraints on the layout or operation of the ESF are imposed by this experiment.

Because this activity only involves sampling and drilling of small-diameter holes only, no mechanical, chemical or thermal alteration of the rock mass is expected.

Timing/Schedule Requirements

The perched-water testing should be initiated as soon as possible after it is detected to insure that no data pertaining to the occurrence of perched-water is lost.

ESF Design/Test Support Requirements

All moisture or free water observed in the ESF will be sampled as soon as possible after it is detected to insure that no date pertaining to the occurrence or perched-water is lost. An alcove may be required for drilling any boreholes if access in a main traffic area is a problem. Only normal drilling and other utilities are required.

 YMP 02-0013, Rev. 5 31 91

PRE-TITLE II DESIGN STUDIES
PLANNED ESF TESTS - NORTH RAMP ACCESS

PLANNED ACTIVITY NAME: HYDROCHEMISTRY TESTS IN THE ESF

SCPB Section 8.3.1.2.2.4.8 (Activity)

Description of Activity

The hydrochemistry tests will determine the chemical composition, reactive mechanisms, and age of water and gas in pores, fractures, and perched-water zones within the unsaturated tuffs accessible from the ESF and/or affiliated core holes. The ESF will provide access for the collection of gas, rock and possibly perched-water samples. Two different types of boreholes will be used to obtain gas samples for this test. Boreholes used as part of the Radial Boreholes test will be used for long term gas sampling. In addition, short (1-2 m) boreholes will be used to provide a gas sample at selected locations as soon as possible after mining.

Location

A) In all parts of the ESF (Ramps, Drifts, Shafts, Alcoves, MTL) (See Sketch 1 and generalized North Ramp list)

B) Generalized Locations for UZ Hydrochem Boreholes in North Ramp:

- Tiva Canyon 3 locations long and short boreholes, evenly spaced
- Near Bow Ridge Fault long and short boreholes, both sides
- Bedded and Tiva Canyon contact long and short boreholes, both sides
- Bedded Unit 1 location long and short boreholes
- Bedded and Topopah Springs contact long and short boreholes, both sides
- Topopah Springs 3 locations long and short boreholes, evenly spaced
- Drill Hole Wash structure 2 locations long and short boreholes
- Calico Hills Topopah Springs contact long and short holes, both sides
- Calico Hills nonwelded 2 locations long and short boreholes, evenly spaced
- Calico Hills vitric welded 2 locations long and short boreholes, evenly spaced

 YMP [illegible], Rev. [illegible]

- Calico Hills zeolitized welded 2 locations long and short boreholes, evenly spaced

Special Room/Alcove Requirements

Alcoves needed to set up equipment for two week tests out of traffic areas. Equipment will require about a 6 foot by 8 foot area. Larger sized alcoves needed to house the drill rig during drilling. For most holes we can use the alcove required by the Radial Boreholes test.

Interference Envelope

Borehole sampling locations need to be about 13 feet from ramps or drifts. Pumping of boreholes could effect various pneumatic tests if held during the same time period within about 10 to 15 meters.

Constraints Controls

Tracer specifications must take into account requirements of other tests, specifically, no chloride tracers or chlorination prior to the completion of CL36 sample collection.

Timing Schedule Requirements

As soon as possible after mining, we will require a short 1-2 meter borehole for gas sampling at all locations. The larger/longer boreholes can wait (up to several months), but should be conducted as soon as possible.

ESF Design Test Support Requirements

All water used in the ESF will be traced. All compressed air used in coring or drilling will be tagged with SF_6. Provide suitable space for gas sampling activities and equipment at each Radial Borehole location. Large rock samples (bulk) or core (HQ size) will be required from various locations in the ESF. Core samples shall be dry and bulk shall have minimal disturbance to moisture content. One to two meter long boreholes will be required for gas sampling. Radial boreholes used for gas sampling should be more than 13 ft from ramps or drifts. Access to a location early in the ESF construction for the purpose of conducting prototype testing in order to determine if the short (1-2 m) holes are required at all locations or if the longer Radial Boreholes are sufficient for gas sampling.

YMP 02-1013, Rev. 5 31 91

PRE-TITLE II DESIGN STUDIES
PLANNED ESF TESTS - NORTH RAMP ACCESS

PLANNED ACTIVITY NAME: HYDROLOGIC PROPERTIES OF MAJOR FAULTS ENCOUNTERED IN THE ESF

SCPB Section 8.3.1.2.2.4.10 (Activity)

Description of Activity

This activity is designed to provide hydrologic information in parallel with a portion of Activity 8.3.1.4.2.2.4 (geologic mapping of the exploratory shaft and drifts). All faults encountered in the ESF will be characterized geologically under the geologic mapping activity. Hydraulic properties of major faults encountered in the ESF will be determined in this activity. The major faults or fault zones expected to be tested are the Bow Ridge fault, Ghost Dance fault,a suspected fault in Drill Hole Wash, the Imbricate fault zone, and the Solitario Canyon fault. Other faults will be tested if flow is observed.

On the basis of the identification of major faults by the geologic mapping activity, a hydrologic testing program will be implemented. This program will consist primarily of tests conducted in boreholes drilled through or parallel to fault zones and tests on core collected from the coreholes. The first activity will be the drilling and testing of a geothermal borehole. Sensitive temperature measurements made in the borehole will provide indications of any water movement in the fault zone. Air permeability tests will be conducted between other boreholes to determine the permeability to air of the fault zones. Some boreholes will be instrumented to determine in situ conditions of the rock mass and monitored for any changes in these conditions over time. Other sets of boreholes will be used for cross-hole water-injection tests. All water used for injection will be tagged with a tracer. Core recovered from the holes will be tested to provide a water-content profile across the fault zone. This profile may provide information relative to any recent moisture occurrence in the fault zone.

Locations

1. Bow Ridge Fault
2. Drill Hole Wash Faults (maybe several sites)
3. Ghost Dance Fault
4. Solitario Canyon Fault
5. Imbricate Fault Zone
6. All Major Faults not Previously Identified

Special Room/Alcove Requirements

Alcoves will be required at each ramp crossing of a major fault. Sketch 1 provides a general alcove concept for each test.

Interference Envelope

- The holes need to be placed such that stress relief effects of the ramp and alcove are minimized.

- The holes need to be placed such that other tests will not interfere.

Constraints/Controls

The hydrologic boreholes shall not be drilled until the PI has determined that effects of ventilation in the opening have been detected in the geothermal borehole at that location and drilling of the hydrologic holes can proceed.

Timing/Schedule Requirements

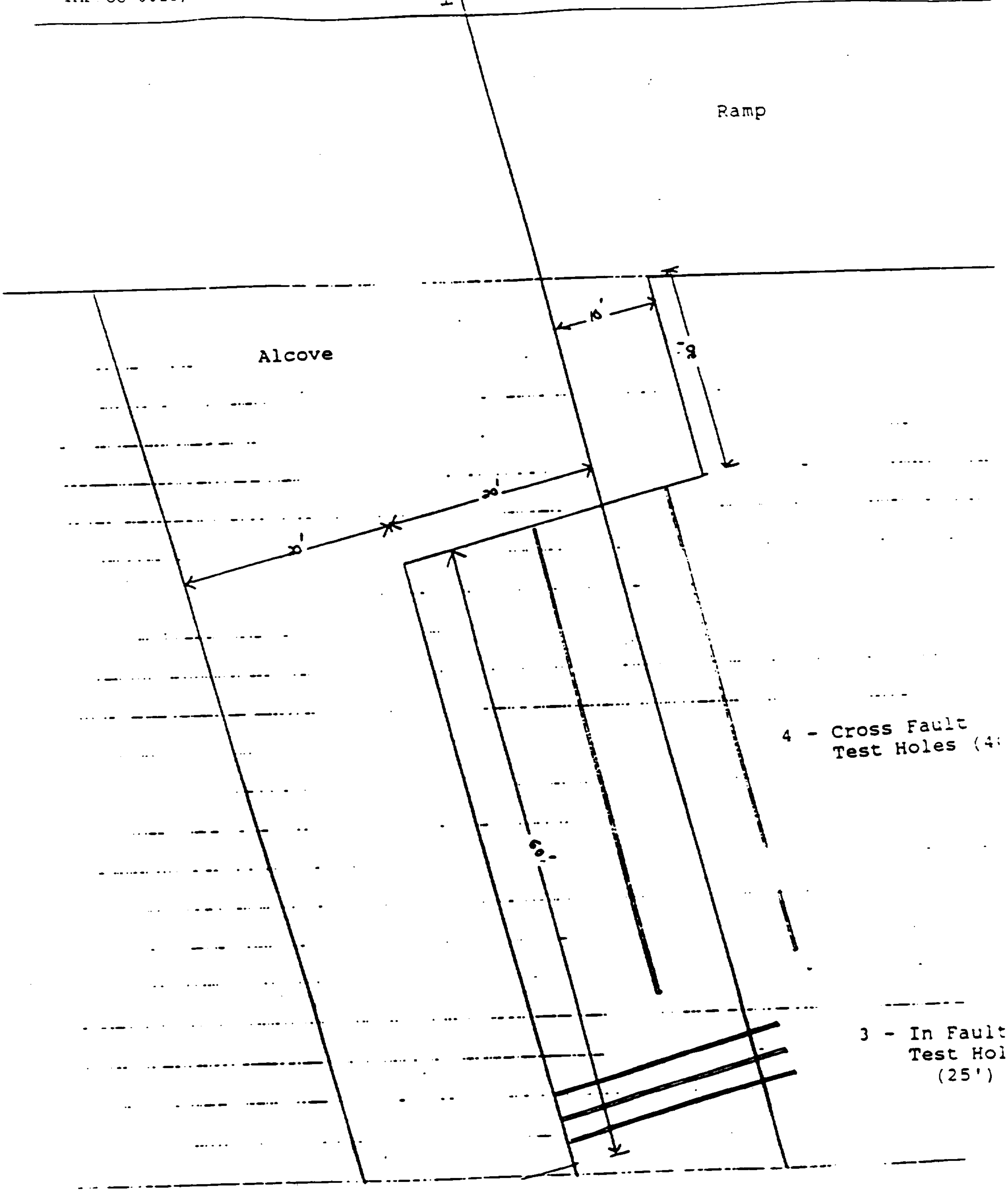
Testing should be conducted as soon as feasible after excavation.

ESF Design/Test Support Requirements

Geothermal holes: one hole will be air cored, near horizontally, at each location at about 45 degrees to the opening as soon after identification of the fault as possible. This borehole should be drilled from the ramp or drift, or a small drilling alcove. It may be necessary to construct a separate drilling alcove for the geothermal borehole. The intent is to have access to the borehole as soon as possible to reduce the effect of air exchange with the surrounding rock mass. These holes will be minimum of 200 ft long.

Hydrologic holes: four "cross-fault" test holes (40 ft) will be air-cored at each location. In addition, three "in fault" test holes (25 ft) will be required at each location. Each location will require access to the IDS. An alcove for hydrologic holes will be required that provides access to both sides of the fault near the ramp or drift, and also run parallel to the fault for approximately 80 to 90 ft with an approximately 20 ft offset.

YMP/CC-0013, Rev. 5/31/91



SKETCH A: MAJOR FAULT TESTS (SCPB Section 8.3.1.2.2.4.10)

 YMP CO-0013, Rev. 5 31 91

PLANNED ACTIVITY NAME: GEOMECHANICAL ATTRIBUTES OF THE WASTE PACKAGE ENVIRONMENT

SCPB Section 8.3.4.2.4.3 (Study)

Description of Activity

A series of heater tests is planned in the North Ramp of the ESF as the prototype of the ESF tests. These tests are designed to characterize the geomechanical response of the rock in the near-field environment to the changing environmental conditions expected to occur over the lifetime of the reposit[illegible]. Some tests will study the effect of a heating/cooling cycle on the stab[illegible]ity of rock blocks formed by excavation of the emplacement hole. Other tests will assess the potential for spalling or other types of borehole breakout that may occur due to the heating/cooling cycle and associated changes in the rock/fracture properties.

For each test, instruments will be installed to measure temperature, stress, and displacement as a function of time and location. Rock cores and blocks will also be obtained before and after the thermal cycles for laboratory determination of thermal-mechanical properties.

The heaters in the test will be cycled through heating and cooling stages and in some cases temperatures and/or stresses may be imposed on the rock which are higher than those expected in the potential repository. The intent of testing at these higher temperatures and stresses will be to accelerate the rate at which rock deformation mechanisms occur. This may serve to bound the estimates of geomechanical deformation over time.

Location

The test will be conducted in the non-lithophysal portion of the Topopah Spring Tuff unit (about 100 feet below the Tiva Canyon unit), away from major faults.

Special Room/Alcove Requirements

An alcove/room will be required that is 40 feet long, twenty feet wide and 15 feet high. In addition, two alcoves, 12'x 12', one each for instrumentation and storage, will be needed.

Interference Envelope

The test area should be at least 30 feet from other activities, and 20 feet from ramp or shaft.

 YMP CC-0013, Rev. 5 31 91

Constraints/Controls

Flexibility to adjust the test locations to avoid fracture zones.

Timing/Schedule Requirements

The test should be initiated at least two years before second phase of the ESF tests which are tied to the License Application Date (LAD).

ESF Design/Test Support Requirements

The layout and the length of the drifts and the borehole layouts must be added to the ESFDR, or provided as test design input, as no tests for this study were included in the old SDRD.

Dry drilling of boreholes up to 30" in diameter.
Slotting of the rock (10'wide x 10'deep x 0.5" to 1" aperature)
Electric power: 2 circuits of 208V, 45 amp., voltage regulated power, several circuits of 120V, 30 amp, UPS instrument power
Compressed Air: 100 psig shop air.
3 Heater holes (4", 12", 30")
Twenty four instrumentation holes for each heater hole.
Ability to obtain cubic block samples 18"x18"x18".
Transporting ability: To move, lift and load at least 1.5 tons.
Surface trailer: A trailer pad of at least 12'x60' at the surface facility of ESF.
The trailer should house office, machine shop, and change rooms.

YMP CC-0013, Rev. 5 31 91

PRE-TITLE II DESIGN STUDIES
PLANNED ESF TESTS - NORTH RAMP ACCESS

PLANNED ACTIVITY NAME: REPOSITORY HORIZON NEAR-FIELD HYDROLOGIC PROPERTIES (EBSFT)

SCPB Section 8.3.4.2.4.4.1 (Activity)

Description of Activity

A series of heater tests and infiltration tests are planned in the North Ramp of the ESF as the prototype tests of the ESF tests. All are designed to investigate moisture movement and saturation conditions in the host rock during heating and cooling periods of waste storage and to investigate the scale effects of the heater hole on the measured parameters. Some tests will measure the parameters during the thermal cycle using ambient moisture as the initial condition. The other tests will include a simulated percolation event to examine the effect of water percolating or diffusion through the rock mass.

For each of the tests, instruments will be installed in the rock mass around the heaters to measure temperature, moisture content, gas and liquid pore pressure, stress change, and displacement as a function of time and location. Various geophysical probes will be used to measure the moisture content in the rock before, during and after thermal cycling. Rock cores will be obtained before and after the thermal cycles for mineralogical and geochemical analyses. Laboratory measurements of hydrologic properties and thermal-mechanical properties will be made on similar samples.

The heaters in the test will be cycled through heating and cooling stages. The duration of the period during which the heater is at maximum power and the initial thermal loading for the heater are based on the criteria that the boiling conditions encompass a sufficiently large volume of rock to include several fractures within the dry hot region. Scoping calculations will be used to determine the initial power of heating and the duration of heating at the maximum power.

Location

The test will be conducted in the non-lithophysal portion of the Topopah Spring Tuff unit (about 100 feet below the Tiva Canyon unit), away from major faults.

YMP 00-0013, Rev. 3

Special Room/Alcove Requirements

Alcove drifts totaling about 900 feet will be required. There are two sets of drift: emplacement drift and instrumentation drift. These two sets of drift will be separated by at least 25 feet vertically. In addition, two instrument alcoves 12'x12' each and two storage alcoves 12'x12' each will be needed.

Interference Envelope

The test area should be at least 30 feet from other activity, and 50 feet from ramp or shaft.

Constraints/Controls

1. A minimum of 25 feet vertical separation between the emplacement drift and the instrument drift.
2. The width of the emplacement drift be at least 20 feet.
3. At least 16" vertical and horizontal clearance at the collar of all instrument boreholes.
4. Flexibility to adjust the test locations to avoid fracture zones.
5. No rock bolts are allowed within a region of the test region plus 5 feet.
6. The heights of the instrumentation drift be sufficient to provide for drilling of an array of boreholes that extends at least 15 feet vertically.

Timing/Schedule Requirements

The test should be initiated at least two years before second phase of the ESF tests which are tied to LAD.

ESF Design/Test Support Requirements

The layout and the length of the drifts are different from that in the ESFDR, and will require either ESFDR revision, or test design input. The borehole layouts are generally the same as in the ESFDR.

Dry drilling of boreholes up to 30" in diameter.
IDS
Electric power: 3 circuits of 208V, 45 amp voltage-regulated power; several circuits of 120V, 30 amp UPS instrument power
Compressed Air: 150 scfm, 100 psig for air permeability measurement
Five Heater holes (4", 12", and 30" in diameter).
Twenty four instrumentation holes for each heater hole.
At least two horizontal holes for the infiltration tests.

YMP 02-1113, Rev. 5 31 91

Transporting ability: To move, lift, and load at least 1.5 tons.
Infiltration water: Un-tracered un-chlorinated J-13 water, about 500 gal/week.
Surface trailer: A trailer pad of at least 12'x 60' at the surface facility of ESF. The trailer should house office, machine shop, and change rooms.

 YMP CC-0013, Rev. 5 31 91

PLANNED ACTIVITY NAME: REPOSITORY HORIZON ROCK-WATER INTERACTION

SCPB Section 8.3.4.2.4.4.2 (Activity)

Description of Activity

This activity is to obtain samples for laboratory test of rock-water interactions at high temperatures. The samples needed are 6 to 8 inch diameter cores or blocks of rock of similar sizes. The rock types to be studied include the lithophysal Topopah Spring tuff at the contact between the Tiva Canyon and Topopah Spring units, the welded Topopah Spring, the Basal Vitrophyre of the Topopah Spring, and the top of the Vitric Calico Hills unit.

Location

Large diameter (6 to 8 in.) cores or blocks of sample from the lithophysal zone of Topopah Spring tuff at the contact of Tiva Canyon and Topopah Spring, Topopah Spring Welded unit, Basal Vitrophyre of Topopah Spring, and the top of Vitric Calico Hills unit.

Special Room/Alcove Requirements

Not required.

Interference Envelope

No.

Constraints/Controls

Dry drill and blast or dry coring to obtain the sample required.

Timing/Schedule Requirements

This test is tied to the LAD.

ESF Design/Test Support Requirements

No general ESF design requirements for this test. For test support, it will be necessary to obtain large diameter cores or blocks of rock sample.

 YMP 02-0013, Rev. 5 31 91

PRE-TITLE II DESIGN STUDIES
PLANNED ESF TESTS - NORTH RAMP ACCESS

PLANNED ACTIVITY NAME: ACCESS CONVERGENCE TEST AT THE EXPLORATORY STUDIES FACILITY

SCPB Section 8.3.1.15.1.5.1 (Activity)

Description of Activity

Access convergence tests are required to monitor rock-mass deformation around the accesses and measure in situ stress at the station where convergence is being measured.

Rock-mass deformation around the access will be monitored at measurement stations using multiple-point borehole extensometers (MPBXs) placed at 120? intervals around the opening. The MPBX's primarily consist of anchors installed at predesigned depth. Movement in the rockmass is recorded as the anchors move. Deformations are measured across the ramp diameter and as a function of distance from the access portal at multiple locations in the access. In addition to MPBX measurements, deformations are measured with rod extensometers at each of the three measurement stations. Extensometer measurements will be made along diameters in the same plane as the MPBXs at 60? from the MPBX heads.

If a liner is used, each station will also include hydraulic pressure cells in the liner to monitor radial stress changes over time as construction continues beyond the test location.

Locations

The tests will be located in each thermal/mechanical unit encountered (one in each unit), preferably more than 100 meters from major thermal/mechanical contacts and faults. At a minimum the tests should be performed with the TSw1, TSw2, and in the Calico Hills.

Special Room/Alcove Requirements

No special room or alcove needed.

Interference Envelope

The tests will sense rock mass displacements on a line approximately 15 meters from and perpendicular to the drift wall, floor, and ceiling. Tests which in any way affect the thermal/mechanical response in this region should be avoided.

YMP 02-1113, Rev. 5 31 91

Constraints Controls

The tests should be installed soon after the excavation passes the proposed test location. No constraint on construction is imposed by this test. Purpose of the test is to obtain deformation, in situ stress and stress change due to the excavation activities. However, it is not necessary that the stations be instrumented immediately after face has been exposed. No drilling will be allowed near the MPBX and pressure cell stations.

Timing/Schedule Requirements

The test instrumentation should be installed as close to the working face as possible.

ESF Design/Test Support Requirements

Standard underground facilities for water, air, electricity for drilling will be used for these tests. No special experimental needs are identified.

YMP CC-0013, Rev. 5-31-91

PRE-TITLE II DESIGN STUDIES
PLANNED ESF TESTS - NORTH RAMP ACCESS

PLANNED ACTIVITY NAME: DEMONSTRATION BREAKOUT ROOMS

SCPB Section 8.3.1.15.1.5.2 (Activity)

Description of Activity

These tests will be used to demonstrate constructability and stability of the underground openings in the upper lithophysal zone of the Topopah Spring member (TSw1) in the upper demonstration breakout room (UDBR) and in welded fractured tuff (TSw2) on the main test level at lower demonstration breakout room (LDBR).

Location

The tests will be located in the high lithophysal zone encountered in the north ramp.

Special Room/Alcove Requirements

The test itself consists of mining a separate room off the main access.

The size of the DBR openings will be consistent with the maximum width planned for repository openings. The excavation techniques for the DBRs should be similar to the excavation techniques to be used for the repository openings. This test will evaluate mining techniques and rock support requirements. Rock mass response will also be measured in the DBR excavations by using extensometers and convergence anchors.

Interference Envelope

The test will sense rock mass displacements on a line approximately 15 meters from and perpendicular to the drift wall, floor, and ceiling. Tests which in any way affect the thermal/mechanical response in this region should be avoided.

Constraints/Controls

Flexibility in the orientation of the rooms is required to insure that desired alignment relative to local geological features, such as the prevailing joint structure, is achieved. Adequate flexibility must exist to rotate the rooms depending on the geology of the test location. Other constraints include a requirement that no other mining be performed within a

YMP CC-1113, Rev. 5 31 91

distance of approximately 50 ft from the deepest MultiPoint Borehole Extensometer (MPBX) anchors installed in the walls of the opening while the test is in progress.

Timing Schedule Requirements

The test should be performed (its mining) before major excavation are performed in the MTL. No impact to construction of the ramp.

ESF Design/Test Support Requirements

Standard underground facilities for water, air, and electricity for drilling will be used for this test. The instrument heads will be placed in a recess at the walls of the excavation. No other special experimental needs.

YMP 02-1013, Rev. 5 31 91

PRE-TITLE II DESIGN STUDIES
PLANNED ESF TESTS - NORTH RAMP ACCESS

PLANNED ACTIVITY NAME: HEATER EXPERIMENT IN TSw1

SCPB Section 8.3.1.15.1.6.1 (Activity)

Description of Activity

The heater experiment measures thermomechanical and thermally induced hydrologic responses in high-lithophysal rock to verify scaling relationships needed for repository design and performance calculations.

Location

The test will be located in the high lithophysal zone encountered in the north ramp (preferably in the UDBR).

Special Room/Alcove Requirements

The test will be conducted in a separate room in the TSw1 away from contacts and faults. It is preferable to use the demonstration breakout room described in Activity 8.3.1.15.1.5.2.

Interference Envelope

In the upper demonstration breakout room (UDBR), a heater-emplacement hole will be drilled approximately 8 feet (2.4 m) into the drift floor. Several instrumentation holes parallel to the heater hole will be drilled and then heater and instruments (multiple point borehole extensometers (MPBX) and thermocouples) will be installed. In a borehole near the heater, neutron logs will be run before, during, and after the heating cycle to monitor moisture content changes. After the heater is started, the rock response to thermal loading, heat flow, and moisture changes will be monitored. Because test is short and affects only a small volume of rock, no special constraints are required.

Constraints/Controls

Sufficient flexibility should be provided to locate the test so that other activities in the UDBR are not adversely affected: this test should be located about 10 m away from the next nearest test, and in an area of low traffic. Heat from this test cannot be allowed to interfere with other tests.

YMP CC-0011, Rev. 5 31 91

Timing Schedule Requirements

The test should be performed in a timely manner as it will help assess the viability of storing waste in, or in the vicinity of, high lithophysal rock.

ESF Design/Test Support Requirements

Standard underground facilities for water, air, and electricity for drilling will be used for this test. The instrument heads will be placed in a recess at the walls of the excavation. No other special experimental needs.

 YMP 03-0013, Rev. 5 31 91

PRE-TITLE II DESIGN STUDIES
PLANNED ESF TESTS - NORTH RAMP ACCESS

PLANNED ACTIVITY NAME: PLATE LOADING TESTS

SCPB Section 8.3.1.15.1.7.1 (Activity)

Description of Activity

The plate loading test loads parallel, diametrically opposed surfaces of rock for the purpose of deformation measurements.
Experimental results can be used to calculate rock mass modulus and interpret the depth of the disturbed zone. This test will follow ISRM and ASTM standard testing procedures.

Location

The tests will be conducted in each of the thermal/mechanical units encountered in the ramp. Most tests should be away from thermal/mechanical contacts; some test locations proximal to faults will be acceptable.

Special Room/Alcove Requirements

The tests will be conducted in alcoves extending from the access. The alcoves will be approximately 15 ft wide by 6 ft tall by 60 ft long. Five or more tests may be performed in each alcove. Surfaces in the vicinity of the test should be relatively free of blast damage.

Interference Envelope

The test should be 10 meters from the nearest test which altered the thermal/mechanical properties of the rock.

Constraints/Controls

Testing impedes traffic, therefore, test alcoves should be provided out of the way.

Timing/Schedule Requirements

The test should be performed in a timely manner as it will provide input to facility design.

YMP CC-0013, Rev. 5 31 91

ESF Design/Test Support Requirements

Standard underground facilities for water, air, and electricity for drilling will be used for this test. No other special experimental needs.

 YMP 00-0013, Rev. 5 31 91

PRE-TITLE II DESIGN STUDIES
PLANNED ESF TESTS - NORTH RAMP ACCESS

PLANNED ACTIVITY NAME: **EVALUATION OF MINING METHODS**

SCPB Section 8.3.1.15.1.8.1 (Activity)

Description of Activity

These tests will monitor and evaluate mining methods for ramp and drift openings, with emphasis on rock responses in a variety of lithologic and structural settings that may be encountered in the long exploratory drifts. This activity will be to develop recommendations for mining in the repository. Mining investigations will include TBM performance measurements, and examination of induced damage, as appropriate.

Location

The tests will be conducted in all of the thermal/mechanical units encountered in the ramp.

Special Room/Alcove Requirements

None required.

Interference Envelope

No special requirements.

Constraints/Controls

This test has no identified constraints.

Timing/Schedule Requirements

As the excavation proceeds.

ESF Design/Test Support Requirements

Standard underground facilities for water, air, and electricity for drilling will be used for this test. No other special experimental needs.

PLANNED ACTIVITY NAME: MONITORING OF GROUND SUPPORT SYSTEMS

SCPB Section 8.3.1.15.1.8.2 (Activity)

Description of Activity

This activity will develop recommendations for a ground support in drifts in the repository, based on evaluations of the ground-support techniques used in the underground excavations, and on experimentation with other ground-support configurations. This activity will be carried out in ramps and on the main test level. The selection, installation, and performance of the support systems used will be monitored. Experimentation with ground supports will include pull tests on rock bolts. Observation of unsupported rock, strength measurements on shotcrete cores, and trails of alternate ground-support configurations from those prescribed for the ESF. The effects of heat on ground support will be considered in the heated room experiment.

Location

The tests will be conducted in all of the thermal/mechanical units encountered in the ramp.

Special Room/Alcove Requirements

No special room/alcove is required.

Interference Envelope

No interference envelope. However, pull tests may temporarily block movement of vehicles in ramp.

Constraints/Controls

None identified for this activity.

Timing/Schedule Requirements

No conflict with facility construction.

ESF Design/Test Support Requirements

Standard underground facilities for water, air, and electricity for drilling will be used for this test. No other special experimental needs.

PLANNED ACTIVITY NAME: MONITORING DRIFT STABILITY

SCPB Section 8.3.1.15.1.8.3 (Activity)

Description of Activity

These tests will monitor drift convergence throughout the ESF, along accesses and in the Calico Hills. This activity involves monitoring drift convergences and drift maintenance activities. Convergence measurement stations will be selected by the Principal Investigator. In the long drifts, convergence measurements will be taken in a continuous manner, if practical. Rock-mass relaxation will be investigated in repository-scale portions of the long drifts using multiple-point borehole extensometers. Rock falls and maintenance activities will be documented.

Location

The tests will be conducted in each of the thermal/mechanical units encountered in the ramp.

Special Room/Alcove Requirements

No special room/alcove is required.

Interference Envelope

No interference envelope.

Constraints/Controls

Field observations of ground conditions will be necessary before final locations of measurement stations can be specified. The design of service hardware in the drifts (such as ventilation ducts, cable trays, etc.) must accommodate these measurements. MPBX's and tape extensometer anchors should be installed as close to the advancing face as possible. Provision for data collection by the IDS must be available prior to beginning this test.

Timing/Schedule Requirements

No conflict with facility construction. It is desirable to install the instrumentation as soon as practical behind the excavation equipment.

YMP 00-0013, Rev. 5 31 91

ESF Design/Test Support Requirements

Standard underground facilities for water, air, and electricity for drilling will be used for this test. No other special experimental needs.

YMP CC-1113, Rev. 5 31 91

PRE-TITLE II DESIGN STUDIES
PLANNED ESF TESTS - NORTH RAMP ACCESS

PLANNED ACTIVITY NAME: AIR QUALITY AND VENTILATION EXPERIMENT

SCPB Section 8.3.1.15.1.8.4 (Activity)

Description of Activity

The purpose of these tests is to assess the impact of site characteristics on ventilation requirements to ensure a safe working environment. This activity consists of (1) measurements of radon emanation; (2) surveys of air-flow and pressure, temperature, and humidity; (3) determinations of air resistance factors; and (4) dust characterization. The radon emanation measurements will be made in a dead-end drift that has been sealed with a bulkhead at equilibrium conditions and at various rates of airflow. Radon concentrations might also be measured in a borehole. The air quality and ventilation measurements are not expected to interfere significantly with other underground activities.

Location

The tests will be conducted throughout the ESF after construction is completed. The end section of the drift to the Ghost Dance Fault will be sealed with a bulkhead to allow measurement of radon gas emanation.

Special Room/Alcove Requirements

No special room/alcove is required.

Interference Envelope

No interference envelope.

Constraints/Controls

This experiment will measure the rate of radon emanation from the TSw2 formation and will be conducted on the main test level. Because this requires only periodic air sampling, no special constraints are required to include this activity in the ESF testing, and no additional perturbation to natural conditions (stress, temperature, moisture, etc.) will result from this activity.

Timing Schedule Requirements

No conflict with facility construction.

YMP CC-0013, Rev. 5 31 91

ESF Design/Test Support Requirements

Standard underground facilities for water, air, and electricity for drilling will be used for this test. No other special experimental needs.

YMP CC-0013, Rev. 5 31 91

PRE-TITLE II DESIGN STUDIES
PLANNED ESF TESTS - NORTH RAMP ACCESS

PLANNED ACTIVITY NAME: LABORATORY TESTS (THERMAL AND MECHANICAL) USING SAMPLES OBTAINED FROM THE EXPLORATORY STUDIES FACILITY

SCPB Sections 8.3.1.15.1.1.1, 8.3.1.15.1.1.2, 8.3.1.15.1.1.3, 8.3.1.15.1.2.1, 8.3.1.15.1.3.1, 8.3.1.15.1.3.2, 8.3.1.15.1.4.1, 8.3.1.15.1.4.2 (Activities)

1. Density and Porosity Characterization (thermal properties)
2. Volumetric Heat Capacity Characterization
3. Thermal Conductivity Characterization
4. Thermal Expansion Characterization
5. Compressive Mechanical Properties of Intact Rock at Baseline Experiment Conditions
6. Effects of Variable Environmental Conditions on Mechanical Properties (intact rock)
7. Mechanical Properties of Fractures at Baseline Experiment Conditions.
8. Effects of Variable Environmental Conditions on Mechanical Properties of Fractures

Description of Activity

The laboratory geoengineering properties test will provide bulk, thermal and mechanical properties data for evaluations of opening stability and related design and performance studies and/or modeling. Data from the laboratory test will also support analyses of the geomechanical and thermomechanical field tests planned in the ESF. The ESF activities are basically the collection, packaging, and labeling of the selected bulk samples or core taken from the shafts or drifts. The laboratory test activities are described individually in SCPB Section 8.3.1.15.1.

Location

The tests require sampling throughout the ESF. The tests are laboratory tests.

Special Room/Alcove Requirements

No special room/alcove is required.

YMP CC-0013, Rev. 5 31 91

Interference Envelope

No interference envelope. Samples should be taken from rock that has not been disturbed by excavation or testing conditions. Dry coring may be required in some cases.

Constraints/Controls

None. Provide capabilities to drill cores or collect samples and transport them to the surface for shipment to laboratories.

Timing/Schedule Requirements

No conflict with facility construction.

ESF Design/Test Support Requirements

Standard underground facilities for water, air, and electricity for drilling will be used for this test. No other special experimental needs. Capability should exist to extract cores of various sizes up to 15 inches in diameter.

 YMP CC-0013, Rev. 5 31 91

PRE-TITLE II DESIGN STUDIES
PLANNED ESF TESTS - NORTH RAMP ACCESS

PLANNED ACTIVITY NAME: **DEVELOPMENT AND DEMONSTRATION OF REQUIRED EQUIPMENT**

SCPB Section 8.3.2.5.6 (Information Need)

Description of Activity

This SCP activity was originally proposed for the purpose of development and demonstration of special equipment. Further specific equipment needs have not been identified to date.

Location

To be determined.

Special Room/Alcove Requirements

To be determined.

Interference Envelope

To be determined interference envelope.

Constraints/Controls

None identified.

Timing/Schedule Requirements

No conflict with facility construction.

ESF Design/Test Support Requirements

Standard underground facilities for water, air, and electricity for drilling will be used for this test. No other special experimental needs are currently identified.

YMP CC-0013, Rev. 5 31 91

PRE-TITLE II DESIGN STUDIES
PLANNED ESF TESTS - NORTH RAMP ACCESS

PLANNED ACTIVITY NAME: IN SITU TESTING OF SEAL COMPONENTS

SCPB Section 8.3.3.2.2.3 (Study)

Description of Activity

Because one of the 'sealing' concepts for the Yucca Mountain Project (YMP) is drainage of water through the highly fractured rock, two areas of characterization are essential: first, characterizing the potential of discrete structural features to introduce water into the ramp, and second, characterizing the ability of the rock mass to drain water by determining the rock mass hydraulic conductivity.

Because of the overall performance of the repository, including the performance of the sealing components, is, in part, tied to the air conductivity of the rock mass above the repository, measurements of air conductivity of discrete features and the bulk rock are necessary. Therefore, part of this activity involves determination of the air conductivity of discrete features and the bulk rock to assess the potential for flow out of the repository. A related test will involve contrasting the modified permeability zone (MPZ) in the main ramp with the MPZ in the parallel 3.1m-diameter drifts.

Finally, the performance of sealing components, primarily backfilled crushed tuff and engineered filter designs, will be evaluated. The primary concern is the migration of fines under various hydrologic conditions and the potential of these fines to migrate into the fractures and reduce the hydraulic conductivity. Tests to support the borehole sealing program will also be performed primarily in the nonwelded and bedded tuffs.

Two categories of tests are necessary in the sealing program:

a. intrinsic permeability characterization of discrete structural features to evaluate water inflow and air outflow,

b. assessment of selected rock mass locations to drain water and leak air, evaluation of sealing component performance, and characterization of the modified permeability zone (MPZ) in the main ramps and in the drifts parallel to the main ramp.

Location

The tests will be conducted in the densely welded Tiva Canyon unit, the bedded tuffs below the Tiva Canyon unit, and in the Topopah Spring unit. Locations for the tests in the north ramp access are provided in Figure 1.

 YMP CC-0013, Rev. 3 11 91

Special Room/Alcove Requirements

The locations for the sealing related tests are defined on Figure 1.

Category A Testing -

- Bow Ridge fault
- Characteristic fault or fracture zone beneath alluvium downgrade from the Bow Ridge fault
- Characteristic fault or fracture zone downgrade from the alluvial area
- Characteristic fault or fracture zones in the Topopah Spring Member (2 locations)

The purpose in characterizing these structural features through air conductivity testing is to provide information that will be used to refine the design requirements for seals. If these structural features do not produce water, an alcove 6.1m x 6.1m x 3.1m (height) should be developed after construction of the main ramp and it should be located approximately 6.1m from the structural feature of interest. There are five potential locations identified in the ramp. These locations are identified in Figure 1.

Note: If water occurs in these typical zones, no alcove is necessary. However, it will be necessary to monitor the inflows for the life of the facility. Quantification of these inflows is as essential for the sealing program as it is for developing a performance assessment model. Because this information has very broad usage, it is not necessary for this information to be acquired under the sealing program. In fact, the intrinsic permeability testing of major structural zones penetrated by the ramp may already be defined by others in the project.

Category B Testing -

- Tiva Canyon densely welded zone
- Middle and lower portion of the bedded tuff zone and the upper portion of the Topopah Spring unit
- a characteristic portion of the densely welded, highly fractured Topopah Spring unit

In each of these areas a 3.1m-diameter drift should be developed parallel to the main ramp and at the same inclination as the main ramp. These drifts should be at least three tunnel diameters from the main ramp. These drifts should also be developed using smooth wall blasting to simulate as closely as possible the conditions in the main ramp.

Interference Envelope

For all testing it is necessary that no water injection in the rock mass occurs prior to the air conductivity testing. The drifts for Category B testing should be at least 3 tunnel diameters away from the main ramp.

YMP CC-0013, Rev. 5 31 91

Constraints/Controls

Exploratory boreholes, currently anticipated to be drilled at 1000 foot spacings along the alignment of the ramps, should not intercept the ramp. If deemed to be necessary, the boreholes should be offset from the ramp, perhaps 3 tunnel diameters.

Dry drilling of core holes in the test areas should be attempted first. The standard project drilling technique will be used first. If this presents unusual difficulties drilling should be performed using air foam.

If the test locations are to have multi-uses, then the floor shall be protected from fines clogging the floor of the drifts by the placement of geomembrane materials or equivalent. This applies only to the three drifts parallel to the main ramp.

In the three, 3.1m-diameter drifts and the alcoves, the contractor shall limit the zone of overbreak through either smooth wall blasting or presplitting.

The initial testing of all areas will use air. Water injection should not occur prior to the air testing.

Because the tests evaluate drainage characteristics, no fluids from underground repository excavation should be disposed of in the test areas.

If the testing of sealing systems is needed under flooding scenarios, then a significant amount of water may be required. If this is required, then a hydrologic zone of influence may result. The impact of this zone of influence may then need to be analyzed.

The floor of the main ramp shall be protected from fines entering the fractures in the floor as soon as practical.

Unless required for safety reasons, no grouting should be performed in the ramp.

All water inflows should be monitored as soon as possible after the inflows are encountered.

Timing/Schedule Requirements

Testing of the rock and the structural features can be performed any time after the development of the main ramp. The only exception to this will be the measurement of water inflows as soon as possible after their occurrence.

ESF Design/Test Support Requirements

The three, 3.1m drifts shall be parallel to the main ramp and be at the same grade as the main ramp.

 YMP 02-0013, Rev. 8 31 91

Excavated rock should be stockpiled according to general stratigraphy, i.e., Tiva Canyon Member welded zones, nonwelded and bedded tuff zones, and the Topopah Spring Member welded zones.

Required Test Support - For both categories of testing standard facilities support, such as electricity, water, and air, will be necessary. In addition the following support is required.

Category A Testing -

Each of the alcoves should be large enough for a drilling machine that can core a distance of approximately 20m. Two horizontal holes will penetrate the fault or fractured zone. The first hole will be drilled perpendicular to the structural feature and one will be drilled to intercept the fault plane at a currently unspecified angle. The intrinsic permeability of the zone upgrade from the fault zone, at the fault zone, and downgrade from the fault zone will be characterized. This testing will involve a data acquisition system and a system to determine the intrinsic permeability of these zones, possibly a guarded-straddle-packer system. Because we intend to determine the permeability through the use of air injection, a uniform supply of compressed air will be necessary.

Category B Testing -

Each of the 3.1m-diameter drifts will require borehole drilling and coring support to characterize the natural fracturing and excavation induced fracturing. In the main ramp the fractures along the same parallel segment as the 3.1m-diameter ramps will also be characterized. The number of the boreholes depends on the nature of the fractured system. Testing similar to the Category A testing will be performed to characterize the fractured rock. Therefore, a uniform compressed air supply will be necessary. Because the bedded tuff drift will also support the borehole sealing activity, it is anticipated that horizontal coring into the bedded tuffs would also be performed. The exact amount of drilling is not currently defined.

Measurement of the air conductivity at a drift scale will also be performed. This will require the pressurization of a segment of the drift and injection of a tracer. Because of the scale of this test, a larger compressed air supply will be necessary. The requirement of the size of the air supply depends on the quality of rock being evaluated. Large-scale testing of the drifts will require construction of temporary bulkheads, constructed possibly of cinder blocks and sealed with gunite.

Testing of seal designs will also be performed in these drifts. This type of testing would require the placement of temporary bulkheads and the placement of backfill through mechanical compaction and pneumatic emplacement. This would require material handling of graded materials to the seal test areas. The first series of tests would be performed in the Tiva Canyon drift. When adequate backfill and filter designs are developed more realistic backfilling operations will be performed in the bedded tuff and Topopah Spring tuff alcoves. Because mechanical compaction and pneumatic emplacement are both being considered to

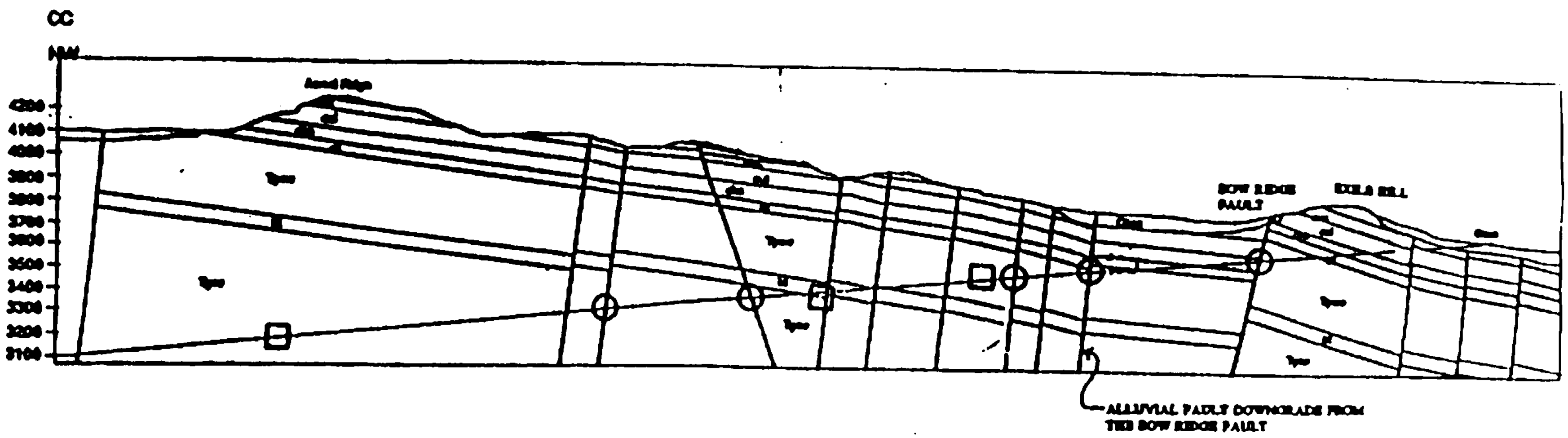
YMP CC-0013, Rev. 5 31 91

backfill drifts and multiple designs may be used to seal the ramps and the underground facility, crushed tuff will be emplaced in the test drifts and removed from the drifts several times. These multiple tests will be required to optimize the backfill and filter designs.

<u>Note:</u> If another underground test facility is defined, some of this seal emplacement testing need not be performed in these drifts. However, the selected designs should be emplaced in each zone to validate the emplaced performance of the backfill and the filters. Part of the test may involve the injection of water into the backfill.

YMP/CC-0013, Rev. 5/31/91

PRELIMINARY DRAFT



O = CATEGORY A TESTING

□ = CATEGORY B TESTING

FIGURE B. (SCPB Section 8.3.3.2.2.3)

YMP CC-0013, Rev. 5 31 91

PRE-TITLE II DESIGN STUDIES
PLANNED ESF TESTS - NORTH RAMP ACCESS

PLANNED ACTIVITY NAME: CHLORIDE AND CHLORINE-36 MEASUREMENT OF PERCOLATION AT YUCCA MOUNTAIN

SCPB Section 8.3.1.2.2.2.1 (Activity)

Description of Activity

These measurements will be made at various depths to determine the rate of water movement downward through the unsaturated-zone tuffs using the chlorine-36/chloride concentration ratio. Large bulk samples from up to 30 locations will be periodically collected, packaged, and labeled for laboratory analysis as described in SCPB Section 8.3.1.2.2.2.1. Because of the requirement to extract pore water to conduct the chlorine-36 test, several hundred pounds of samples may be needed at each sampling location. In the event that perched water is encountered, perched water samples will also be provided to Los Alamos.

Location

This is a sample collecting activity. Along ramps samples will be collected every 100 m. For a vertical shaft, samples will be collected every 30 m. Samples will also be required at contacts, faults, and fracture zones when encountered in either type of excavation. Each sample will consist of 100 to 200 kg of rock that has been loaded and sealed into 208-L (55 gal.) drums. If tunnel boring is conducted dry, then chips can be used.

Special Room/Alcove Requirements

No special room or alcove is required.

Interference Envelope

No identifiable interference envelope, but samples must be collected avoiding any interferences from possible contamination by other sources of chloride and bromide.

Constraints/Controls

Dry construction is the preferred ESF excavation method for this test. If liquids are used then dry drilling will be used to obtain samples.

YMP 02-0013, Rev. 5 31 91

Timing/Schedule Requirements

This test is an ESF sampling activity and can be conducted during facility construction without impact to construction activities.

ESF Design/Test Support Requirements

Design and test support requirements will differ if a tunnel boring machine is used with liquids. In that case, samples will have to be collected by drilling rather than using excavation cuttings. Only other required utility is lights. Sampling locations will have to be surveyed. Sampling should follow completion of geologic mapping activities.

PRE-TITLE II DESIGN STUDIES
PLANNED ESF TESTS - NORTH RAMP ACCESS

PLANNED ACTIVITY NAME: DIFFUSION TESTS IN THE EXPLORATORY STUDIES FACILITY

SCPB Section 8.3.1.2.2.5.1 (Activity)

Description of Activity

The diffusion test in the ESF Topopah Spring North ramp will use a specially constructed alcove in non-welded material. Each test will require boreholes dry-drilled, vertically downward, or subhorizontally in each alcove. Each hole will be approximately 10 cm diameter for the upper 10 meters and about 4 cm diameter for the bottom 45 cm. The bottom of each hole will serve as a source region for the tracer diffusion tests. The core removed from the bottom of each hole will be examined for fractures in order to minimize the possibility of fractures intersecting the source region. In addition, the boreholes will be examined for fractures using a downhole borescope.

About 10 ml of solution containing a suite of tracers will be placed at the bottom of the 4 cm diameter hole. One of the tracers will be bromide. The 10 cm diameter hole will be sealed with an inflatable packer to isolate the bottom of the hole from air pressure and humidity changes in the alcove while diffusion occurs. The hole will then be overcored, and the bottom portion of the core will be sectioned and analyzed for tracer concentration as a function of position.

The results of the diffusion experiments will be used to estimate the effective diffusion coefficients of conservative radionuclides in the unsaturated zone. There will be two sets of experiments performed. The initial experiment (3 months) will be performed to establish the length of time required and the size and type of overcoring needed to effect the transport rate via diffusion through the unsaturated tuff unit. Then a period of one year will be required to conduct a conclusive experiment to be reported in a milestone report.

Location

This test will be conducted in an alcove located near the middle of the non-welded Paintbrush Tuff Unit below the Tiva.

Special Room/Alcove Requirements

An alcove that is 6-m in diameter is required. Drill hole will be located in center of alcove so alcove should have sufficient height to accommodate drilling equipment. Hole will be dry drilled. The diameter of this hole is 10 cm over the first 10 -m and 4 cm over the next 0.45 m.

Interference Envelope

No other test or additional construction within 6 m of this facility.

Constraints/Controls

Construction and drilling should be done dry. Minimize the introduction of chloride and bromide into the alcove.

Timing/Schedule Requirements

This test must be initiated four years prior to the completion of milestone R537 which is titled "Significant Physical Processes Affecting Transport" being conducted under the Retardation Sensitivity Study (WBS 1.2.3.4.1.5.1).

ESF Design/Test Support Requirements

No differences from the ESFDR except the test will be conducted in non-welded tuff.

Utilities include lights, electricity (110 and 220v), and compressed air. Location should be surveyed and geologic mapping should be completed prior to test initiation.

PLANNED ACTIVITY NAME: HISTORY OF MINERALOGIC AND GEOCHEMICAL ALTERATION OF YUCCA MOUNTAIN

SCPB Section 8.3.1.3.2.1.1 (Activity)

Description of Activity

This study will include petrologic analysis of alteration sequences and structures. Mineral growth sequences will be studied using an electron microprobe. Ages of alteration events will be estimated using potassium-argon dating of clays and zeolites and electron spin resonance dating of quartz and calcite.

Samples will be collected from the bottom of the Topopah Spring Member and the Calico Hills. The underground samples will provide large oriented samples of alteration products. Any natural gels found in the ESF will be sampled.

Location

Samples will be collected from the lower Topopah Spring and throughout the Calico Hills unit. Samples of any gels encountered will be collected at any location in the facility.

Special Room/Alcove Requirements

No special room or alcove is needed.

Interference Envelope

There is no interference of other tests on this test. Samples can be collected at any location (shafts/ramps) that has been identified by geologist.

Constraints/Controls

There are no special constraints required by this test.

Timing/Schedule Requirements

Test is sampling so can be conducted following excavation. Gels must be sampled as soon as possible after exposure by excavation.

ESF Design/Test Support Requirements

This test is listed in the ESFDR under Mineralogy and Petrology sampling. Requirements will change depending on the excavation method.

Drilling may be required to collect samples. Geologic mapping should be complete and sample locations surveyed prior to sample collection.

 YMP 00-0013, Rev. 5 31 91

PLANNED ACTIVITY NAME: FRACTURE MINERALOGY STUDIES OF THE EXPLORATORY STUDIES FACILITY

SCPB Section 8.3.1.3.2.1.3 (Activity)

Description of Activity

The fracture mineralogy studies will be conducted to determine mineralogic variability throughout the Exploratory Studies Facility (ESF) to establish the time and conditions of fracture mineralogy deposition alteration, and to identify fracture-coating mineral types, sorptive characteristics, and health hazard potential of fibrous zeolites.

In addition to mineralogic sampling by drilling cores and collecting samples from walls and at the face in the ESF drifts, samples may be collected on the surface from the muck removed. The samples will be packaged and labeled for shipment to a Los Alamos laboratory for detailed analyses, including age determinations. The site parameters gathered by this activity are presented in Table 2.1.

Location

Study will be conducted throughout the facility where fractures are located.

Special Room Alcove Requirements

No special room or alcove is needed.

Interference Envelope

There is no interference from other tests on this test.

Constraints/Controls

Constraints are clean walls and ability to obtain core when requested. Sampling sites will need to be surveyed.

Timing/Schedule Requirements

This is basically sample collection and it does not have to be performed until geologic mapping has been completed and drilling equipment is available.

YMP 00-0013, Rev. 5 31 91

ESF Design/Test Support Requirements

This test is listed in the ESFDR under Mineralogy and Petrology sampling. Requirements will change depending on the excavation methods.

Depending on excavation technique, drilling may be required to obtain samples for characterization.

PRE-TITLE II DESIGN STUDIES
PLANNED ESF TESTS - NORTH RAMP ACCESS

PLANNED ACTIVITY NAME: BIOLOGICAL SORPTION AND TRANSPORT

SCPB Section 8.3.1.3.4.2 (Study)

Description of Activity

Underground operations will introduce microorganisms into the environment. This study will address the effects of these organisms on retardation (either positive or negative) of radionuclides. This study will determine the growth of microorganisms in fluids used in excavation and drilling, evaluate the influence of microorganisms on actinide mobility, and determine binding constants of microorganisms to actinides. Indigenous populations must be characterized as well as introduced organisms.

Microorganisms will be cultured from samples collected by drilling and from the ESF. These organisms will then be cultured in the presence of fluids expected to be introduced to examine growth. These microorganisms will also be used to examine actinide sorption characteristics.

Location

Test is sampling for microbial populations throughout the facility within all units and at contacts.

Special Room/Alcove Requirements

No special room or alcove.

Interference Envelope

Samples must be collected in a manner to avoid any contamination by biological sources. Either drill and blast or mechanical excavation methods can be used given that sufficiently large sizes of muck can be collected so that a 100-gm sample can be collected aseptically.

Constraints/Controls

Ability to collect aseptic samples. This activity is sample collection. Samples will be identified by the principal investigator. No constraints are imposed by this activity on either construction or other testing activities. Samples must be of sufficient size to minimize contamination so that 100-gm of material can be collected aseptically. Either fluid used in excavation or chemicals used in blasting are not expected to affect samples if they are of sufficient size so that coring can be employed to obtain aseptic sample.

YMP CC-0013, Rev. 5 31 91

Timing/Schedule Requirements

This is a sampling activity so no impact on construction is expected.

ESF Design/Test Support Requirements

This test is not currently listed in the ESFDR. All test and facility requirements will be developed. Samples will have to be collected aseptically.

Samples must be of sufficient size so the aseptic techniques can be used.

YMP 00-0013, Rev. 5 31 91

PLANNED ACTIVITY NAME: PETROLOGIC STRATIGRAPHY OF THE TOPOPAH SPRING MEMBER

SCPB Section 8.3.1.3.2.1.1 (Activity)

Description of Activity

The goal for this activity is to determine the petrologic variability within the devitrified Topopah Spring Member at Yucca Mountain, and to define the stratigraphic distribution of this variability using samples taken from locations throughout the TS member in the ESF. Studies of the distribution of phenocyst and rock matrix textures in this member have been shown to be useful for defining stratigraphic position. Analysis will be conducted with X-ray diffraction. Chemical analyses will also be used to determine variability.

Location

This test will be conducted throughout the Topopah Spring Member in the ESF.

Special Room/Alcove Requirements

No special room or alcove is needed.

Interference Envelope

No interference envelope. Geologic mapping should be completed prior to this test.

Constraints/Controls

There are no constraints imposed by this activity.

Timing/Schedule Requirements

This test is sample collection so it should not interfere with construction.

YMP CC-0011, Rev. 5 31 91

ESF Design/Test Support Requirements

This test was listed in the ESFDR under Mineralogy and Petrology sampling. Requirements will change depending on the excavation method. No special requirements are imposed on the design of the ESF. Ability must exist to obtain oriented samples and to transport samples to the surface.

Drilling may be required to obtain samples for laboratory analyses.

YMP 00-0013, Rev. 5 31 91

PRE-TITLE II DESIGN STUDIES
PLANNED ESF TESTS - NORTH RAMP ACCESS

INTEGRATED DATA SYSTEM (IDS) NORTH RAMP FACILITY REQUIREMENTS

An analysis of the information with regard to test support requirements from Lawrence Livermore National Laboratory, Los Alamos National Laboratory, Sandia, and United States Geological Survey indicate that IDS will require alcove space as a part of the Exploratory Studies Facility development. The alcoves are projected to be approximately 10'0" X 10'0" minimum and will be located in the immediate vicinity of the IDS test supported. An extension of the test alcove is acceptable.

Firm locations and quantities of alcoves will be provided during the development of Title II design.

 YMP CC-0013, Rev. 5 31 91

2.3 Scientific Manpower Requirements for Testing

2.3.1 Definition of Test

This testing integration study defines the recommended planning and design assumptions for on-site scientific manpower requirements to support ESF testing.

2.3.2 Functional Requirements

1. Provide the system design sufficient flexibility to accommodate ESF testing requirements.

2.3.3 Performance Criteria

1. The ESF should be designed to accommodate a nominal scientific workforce of 100 persons.

2. Peak scientific manpower, during day shift in the first few months as the MTL test areas first become available, is estimated to be 120 people.

2.3.4 Assumptions

1. The analysis was based on a network of 670 test activities with resource loading. This network contained input from 19 PIs. The judgments and assumptions are discussed in a Los Alamos letter dated July 12, 1988

YMP [illegible], Rev. [illegible]

(ESD-WX4-7/88-7). Subsequent revision by the PIs allowed the recommended peak scientific manpower to be reduced to 120 people.

2. This manpower estimate does not include

   A. Drilling crews

   B. Cable plant installation

   C. Construction activities

   D. Official visitors

YMP CC-0013, Rev. 5 31 91

2.4 Laboratory/Office/Storage Space Requirements

2.4.1 Functional Requirements

1. Provide adequate space at the ESF, surface and underground, for each testing organization to be able to satisfactorily perform the following tests.
   - Min/Pet Sampling Test (LANL)
   - Hydrologic Properties Sampling Test (USGS-Hyd)
   - Chlorine-36 Test (LANL)
   - Geoengineering Laboratory Samples Test (SNL)
   - Diffusion Test (LANL)
   - Overcore Stress Test (USGS-Mech)

2. Provide adequate space at the ESF, surface and underground, for each testing organization to be able to satisfactorily perform the following tests.
   - Demonstration Breakout Room Test (UDBR and MTL)(SNL)
   - Plate Loading Test (SNL)
   - TSw1 Heater Test (SNL)
   - Sequential Drift Mining Test (SNL)
   - Horizontal Boring Machine Test (SNL)
   - Excavation Effects Test (UDBR and MTL)(USGS-Hyd)
   - Intact Fracture Test (USGS-Hyd)
   - Equipment Development Test (SNL)

3. Provide adequate space at the ESF, surface and underground, for each testing organization to be able to satisfactorily perform the following tests.

YMP CC-0013, Rev. 5 31 91

- Underground Geologic Mapping Test (USGS-Geo)
- Vertical Seismic Profiling Test (LBL)
- Shaft Convergence Test (SNL)
- Radial Borehole Test (USGS-Hyd)
- Perched Water Test (USGS-Hyd)
- Hydrochemistry Test (USGS-Hyd)

2.4.1 4. Provide adequate space at the ESF, surface and underground, for each testing organization to be able to satisfactorily perform the following tests.

- Evaluation of Mining Methods Test (SNL)
- Monitoring of Ground Support Systems Test (SNL)
- Monitoring Drift Stability Test (SNL)
- Air Quality and Ventilation Test (SNL)

5. Provide adequate space at the ESF, surface and underground for each testing organization to be able to satisfactorily perform the following tests.

- Canister Scale Heater Test (SNL)
- Yucca Mountain Heated Block Test (SNL)
- Thermal Stress Measurements Test (SNL)
- Rock Mass Response Test (SNL)

6. Provide adequate space at the ESF, surface and underground for each testing organization to be able to satisfactorily perform the following tests.

- Infiltration Test (USGS-Hyd)
- Bulk Permeability Test (USGS-Hyd)
- Calico Hills Test (USGS-Hyd)

YMP 00-0013, Rev. 5 31 91

2.4.1 7. Provide adequate space at the ESF, surface and underground for each testing organization to be able to satisfactorily perform the following tests.

- Heated Room Test (SNL)
- Engineered Barrier Design Test (LLNL)

2.4.2 Performance Criteria

1a. 150 sq ft of office space and limited storage space at the ESF (surface) will be provided.

1b. 150 sq ft of storage space for three rock collection bins. This space will be located near the ES-1 shaft, and will be common to the sample collection point at the ES-1 collar.

1c. An alcove 10 ft x 10 ft x 16 ft will be provided at the MTL and the CHDR to perform the drilling for the Diffusion Test (see performance Criteria 6c.)

1d. Storage space for four nitrogen bottles will be provided in the Diffusion Test alcove.

1e. Adequate space will be provided in the drifts at the MTL and CHDR to perform overcoring for the Overcore Stress Test.

1f. 1000 sq ft of space will be provided at the auxiliary pad for two semi-trailer units. (purpose?)

YMP 00-0013, Rev. 3 31 91

2a. 200 sq ft of office space and limited storage space at the ESF (surface) will be provided.

2b. The Demonstration Breakout Room will require an area 25 ft wide x 19 ft high x 150 ft long at both the UDBR and MTL. The 150 ft length begins at the corner of any opening perpendicular to the DBR drift and extends without any alcoves or openings within the drift for 150 ft.

2c. A DAS will be provided for the SNL tests at the UDBR and the DBR at the MTL. It will require an area 17 ft wide x 14 ft high x 26 ft long.

2d. Space for the TSw1 Heater Test will be provided at the UDBR. At this time, no additional excavation is needed.

2e. Space for the Plate Loading Tests will be provided at the UDBR and MTL. Approximately 15 plate loading tests will be performed in the ESF, and no additional excavation is planned at this time.

2f. Space for the Excavation Effect Test will be provided at the UDBR and MTL. No additional excavation is planned at this time.

2g. A DAS will be provided for the Excavation Effects Test at the UDBR. Dimensions for the DAS are 17 ft wide x 14 ft high x 26 ft long.

YMP 00-0013, Rev. 5 31 91

2h. Space for the Equipment Development Test will be provided at the MTL. No additional excavation is required at this time.

2i. Three drifts will be excavated for the Sequential Drift Mining Test. Two instrumentation drifts will be 16 ft wide x 14 ft high x 180 ft long. The third (center) drift will be 25 ft wide x 10 ft high x 180 ft long.

2j. Two DAS alcoves are required for the Sequential Drift Mining Test. Each DAS alcove will be 17 ft wide x 12 ft high x 26 ft long.

2k. An organization computer alcove is also required for the Sequential Drift Mining Test. This alcove is 20 ft width x 12 ft high x 25 ft long.

2l. Space for the Intact Fracture Test will be needed in the shaft for drilling purposes.

3a. 100 sq ft of office space, storage space and lab lay down area at the ESF (surface) will be provided.

3b. An alcove will be excavated at the MTL for storing equipment and supplies. This alcove will be constructed to afford no access to unauthorized personnel. The minimum dimensions will be 16 ft wide x 10 ft high x 20 ft long.

3c. Alcoves will be excavated in the shaft rib at depths of 70.86 m (232.48 ft), 190.86 m (626.20

ft) and 310.86 m (1019.92 ft) for the shaft convergence data collection units. The units are 4 ft wide x 8 ft high x 4 ft deep. (Shaft Convergence Test 1 and 2 can share the data collection units with Radial Borehole Test 7.)

3d. Alcoves for the Short Radial Boreholes will be excavated in the shaft rib at depths of 28.35 m (93 ft), 34.44 m (113 ft), 79.55 m (261 ft), 85.64 m (281 ft), 120.69 m (396 ft), 243.22 m (798 ft), for the Radial Borehole Test data collection units. The units are 4 ft wide x 8 ft high x 4 ft deep (see performance criteria 3c). The alcove should be constructed to accommodate a shelf 4 ft wide x 3 ft high x 4 ft deep. Total alcove dimensions will be 4 ft wide x 8 ft high x 4 ft deep.

3e. The Hydrochemistry Test will require an alcove at the UDBR and MTL. The dimensions of this alcove are 10 ft wide x 10 ft high x 8 ft long.

4a. 100 sq ft of office space and limited storage space at the ESF (surface) will be provided.

4b. No additional excavation will be required for the Evaluation of Mining Methods Test, Monitoring of Ground Support Systems Test, and Air Quality and Ventilation Test.

 YMP CC-0013, Rev.

4c. Space will be provided at the end of the Ghost Dance Fault drift to perform the Air Quality and Ventilation Drift. This portion of the drift will be sealed by a bulk head.

5a. 100 sq ft of office space and limited storage space at the ESF (surface) will be provided.

5b. An alcove at the MTL will be required for the Canister Scale Heater Test. The dimensions of this alcove are 14 ft wide x 14 ft high x 25 feet deep.

5c. An alcove at the MTL will be required for the Heated Block Test. The dimensions of this alcove are 27 ft wide x 14 ft high x 27 ft deep.

5d. A DAS alcove will be needed for the Canister Scale Heater Test and the Heated Block Test. The dimensions for this alcove are 25 ft wide x 12 ft high x 21 ft long.

5e. An organizational computer alcove will be required. The dimensions for this alcove are 20 ft wide x 12 ft high x 25 ft long.

5f. Space for the Thermal Stress Measurements Test will be provided. No additional excavation is required for this test.

5g. Space for the Rock Mass Response Test will be required at five locations throughout the MTL. No additional excavation is required for this test.

 YMP CC-0013, Rev. 5 31 91

6a. 100 sq ft of office space and limited storage space at the ESF (surface) will be provided.

6b. Space for the Infiltration Test will be provided. Dimensions for this test will TBD.

6c. A DAS alcove is needed for this test. Dimensions for this alcove are 17 ft wide x 12 ft high x 46 ft long. This DAS will be shared with the Diffusion Test.

6d. Space for the Bulk Permeability Test will be provided. The Bulk Permeability Test is composed of four separate drill rooms, two at each end of service drift four, and two whose locations and dimensions will be determined at a later date.

6e. A DAS alcove will be required for each separate Bulk Permeability Test. Dimensions for each of these alcoves are 17 ft wide x 12 ft high x 46 ft long.

7a. 500 sq ft of office space and limited storage space at the ESF (surface) will be provided.

7b. Space for the Heated Room Test will be required. No additional excavation for this test is needed.

7c. The Heated Room Test will require an organizational computer alcove. Dimensions for this alcove are 20 ft wide x 12 ft high x 25 ft long.

7d. The Heated Room Test will require a DAS alcove.

 YMP 00-0013, Rev. 5 31 91

The dimensions for this alcove are 17 ft wide x 12 ft high x 26 ft deep.

7e. 200 sq ft of space will be provided on the surface at the auxiliary pad for a machine shop trailer.

7f. The Engineered Barrier System Field Tests will require subsurface storage space and alcoves for organizational computers as shown in Figures B-2.33-A to 2.33-C. The dimensions for each storage alcove and each computer alcove are 15 ft by 15 ft in horizontal dimensions and a minimum height of 8 ft.

7g. The Engineered Barrier Test requires two DAS alcoves. The dimensions for these alcoves are 17 ft wide x 12 ft high x 26 ft long.

7h. The Engineered Barrier System Field Test is composed of drifts as defined in Figures 2.33-A to 2.33-C. The instrumentation drift which parallel the test drift are connected to the MTL by ramps.

Constraints

None

YMP CC-0013, Rev. 5 31 91

2.5 Electrical Power Requirements for ESF Testing

Location: **Shaft**

Test Name	Volts	Phase	Watts	Use
Shaft Wall Mapping	120	Single	600	Lights
Min/Pet Sampling				
Vertical Seismic Profiling (1)	120	Single	300	Instrumentation
Shaft Convergence (1) (2)	120	Single	300	Instrumentation
Hydrologic Properties Samples (1)				
Radial Boreholes (1) (3)	120	Single	300	Instrumentation
	120	Single	150	Logging
Perched Water (1)	120	Single	300	Instrumentation
Hydrochemistry				
Chlorine-36 (1)				

YMP CC-0013, Rev. 5 31 91

2.5 Electrical Power Requirements for ESF Testing

Location: Upper Demonstration Breakout Room

Test Name	Volts	Phase	Watts	Use
Drift Wall Mapping	120	Single	600	Lights
Min/Pet Sampling				
Vertical Seismic Profiling (4)	120	Single	300	Instrumentation
Upper Demonstration Breakout Room	120	Single	1200	Lights
TSw1 Heater Test	120 120 208	Single Single Triple	300 600 1200	Instrumentation Lights Heater
Overcore Stress	120	Single	600	TV Borehole Camera
Hydrologic Properties Samples (4)				
Excavation Effects	120	Single	600	Instrumentation
Plate Loading	120 120	Single Single	600 300	Lights Instrumentation

YMP CC-0013, Rev. 5 31 91

2.5 Electrical Power Requirements for ESF Testing

Location: **Main Test Level**

Test Name	Volts	Phase	Watts	Use
Drift Wall Mapping	120	Single	600	Lights
Min/Pet Sampling				
Vertical Seismic Profiling (4)	120	Single	300	Instrumentation
Demonstration Breakout Room	120	Single	1200	Lights
	120	Single	300	Instrumentation
Sequential Drift Mining	120	Single	2400	Lights
	120	Single	600	Instrumentation
Canister Scale Heater	120	Single	600	Lights
	120	Single	300	Instrumentation
	208	Triple	5000	Heater
Heated Block	120	Single	600	Lights
	120	Single	300	Instrumentation
	480	Triple	14000	Heaters
Thermal Stress	120	Single	600	Lights
	220	Single	300	Instrumentation
	480	Triple	24000	Heaters
Heated Room	120	Single	600	Lights
	120	Single	300	Instrumentation
	480	Triple	96000	Heaters

YMP CC-0013, Rev. 5-31-91

2.5 Electrical Power Requirements for ESF Testing

Location: **Main Test Level**

Test Name	Volts	Phase	Watts	Use
Horizontal Boring	480	Triple	10000	Power to Machines
Plate Loading (5)	120	Single	2400	Lights
	120	Single	600	Instrumentation
Rock Mass Response	120	Single	600	Lights
	120	Single	300	Instrumentation
Evaluation of Mining Methods				
Ground Support				
Monitoring Drift Stability (6)	120	Single	900	Instrumentation
Air Quality & Ventilation (7)	120	Single	300	Instrumentation
Overcore Stress	120	Single	150	TV Borehole Camera
Hydrologic Properties Samples (4)	120	Single	1200	Lights
	120	Single	300	Instrumentation
Infiltration Test	120	Single	1200	Lights
	120	Single	300	Instrumentation
Excavation Effects	120	Single	600	Instrumentation
Hydrochemistry Test	12	Direct Current	1000	20 Peristaltic Pumps @ 50 Watts Each

 YMP CC-0013, Rev. 5-31-91

2.5 Electrical Power Requirements for ESF Testing

Location: **Main Test Level**

Test Name	Volts	Phase	Watts	Use
Diffusion Test (8)	120	Single	600	Lights
	120	Single	300	Instrumentation
Engineered Barrier Design	120	Single	65000	Instrumentation (UPS Power)
	120	Single	65000	Misc. Equipment
	208	Triple	28000	Heater (Voltage Regulated Standby)
	208	Triple	56000	Guard Heaters (Standby Power)
	208	Triple	25000	Misc. Equipment

YMP CC-0013, Rev. 5 31 91

2.5 Electrical Power Requirements for ESF Testing

Footnotes and Clarification Notes

1. The lights for shaft wall mapping can be used.
2. Shaft Convergence Test has three locations in ES-1.
3. Radial Boreholes Test has eight locations in ES-1.
4. The lights for Drift Wall Mapping can be used.
5. Plate Loading is in DBR and drifts A, B, C of the Sequential Drift Mining Test.
6. Location is in all three long drifts.
7. Location is at the end of one of the long drifts.
8. Many tests that will be repeated in the Calico Hills unit (if testing is done in that horizon) will have power requirements that can be assumed to be the same as the corresponding test at other locations in the ESF.
9. Unless otherwise defined, normal lighting values from design handbooks for laboratories and offices are acceptable in the testing alcoves.
10. Where no requirements for a specific test have been stated, this is intended to imply that no "special" requirements for power have been identified for that test.

YMP CC-0013, Rev. 5/31/91

2.6 Water System Design Requirements For ESF Testing

2.6.1 Definition of Study

This testing integration study defines the water system requirements to support ESF testing.

2.6.2 Functional Requirement

1. Provide the system design with sufficient flexibility to accommodate ESF testing requirements.

2.6.3 Performance Criteria

1. Each test location will have water provided.

2. All water will be tagged with a suitable tracer as defined in the Hydrochemistry Test requirements (2.3.29).

3. All water use in or around the ESF for each activity will be monitored and appropriate quantity records will be provided to the Test Manager's Office.

4. The Engineered Barrier System Field Test has a special requirement for up to 500 gal/week of pristine J-13 water (no tracers).

 YMP CC-0013, Rev. 5 31 91

2.6.4 Constraints

1. Unless otherwise defined, a supply line capable of providing an intermittent flow rate of 10 gpm to each test area is required.

2. The water supply for each test shall be provided to an access coupling and an isolation valve near each test location.

3. A monitoring system will be installed to monitor water in/water out of the ESF.

4. Water leakage will be kept to a minimum and will be contained to the maximum extent possible.

5. No chlorine may be added to the water used in underground construction until a performance assessment evaluation has been made to determine if such chlorine could be detrimental to waste package materials.

2.6.5 Assumptions

1. Standard mine plant water is acceptable.

2. The test organization will be responsible for the distribution system downstream from the isolation valve.

YMP CC-0013, Rev. 5 31 91

2.6.5 3. Each organization will be responsible for adding a tracer to its respective test (if needed) subject to tracer limitations necessitated by other tests.

4. Standards for water meter accuracy conforming to American Water Works Association standard C700-77 will be adequate.

5. Water metering will be required, as a minimum, at each tracer injection location (Reference 2.2.29).

6. Water usage quantity records will be collected and handled using procedures developed by the project and approved by the Test Manager. It is anticipated that a "best effort" criterion will apply.

 YMP CC-0013, Rev. 5/31/91

2.7 Compressed Air System Design Requirements for ESF Testing

2.7.1 Definition of Test

This testing integration study defines the compressed air system requirements to support ESF testing.

2.7.2 Functional Requirements

1. The functional design requirement is to provide the flexibility in the compressed air system to accommodate ESF testing requirements.

2.7.3 Performance Criteria

1. Each test location will have compressed air provided.

2. All compressed air will be tagged with SF6 tracer to a nominal concentration of 20 parts per trillion.

2.7.4 Constraints

1. Provision will be made to prevent the introduction of liquid water from the compressed air supply into tests that are sensitive to water, such as the Diffusion Test, the Bulk Permeability Test, the Engineered Barrier System Field Tests, and the Radial Borehole Test.

YMP/CC-0013, Rev. 5 31 91

2.7.5 Interfaces

1. The compressed air supply for each test shall be provided to an access coupling and an isolation valve near each test location.

2.7.6 Assumptions

1. Standard mine plant compressed air is suitable for all test areas.

2. The test organization will be responsible for the distribution downstream from the isolation valve.

YMP CC-0013, Rev. 5 31 91

2.8 Common Sampling Design Requirements in the ESF

2.8.1 Definition of Study

Sample collection requirements occur whenever coring is required and as a part of four specific tests: 1) Mineralogy Petrology Sampling (2.2.2), 2) Hydrologic Properties Samples (2.2.21), 3) Chlorine 36 Test (2.2.31), and 4) Geoengineering Laboratory Samples (2.2.34). Control and collection procedures will be developed by the PIs and the Sample Management Facility staff.

2.8.2 Functional Requirements

1. The functional design requirement is to provide a system design and construction specifications with sufficient flexibility to accommodate ESF sample collection requirements.

2.8.3 Performance Criteria

1. Sample collection will be required to satisfy the Performance Criteria, Constraints and Assumptions contained in following specific test requirements:

YMP/CC-0013, Rev. 5 31 91

- Mineralogy Petrology Sampling (2.2.2)
- Hydrologic Properties Samples (2.2.21)
- Chlorine 36 Test (2.2.31)
- Geoengineering Laboratory Samples (2.2.34)

2. Core samples from coring operations (reference Appendix C of the ESF SDRD) in the ESF will be handled and controlled using procedures developed by the PIs and the Sample Management Facility staff.

2.8.4 Constraints

2.8.5 Assumptions

2.9 Communications System Design Requirements for ESF Testing

2.9.1 Definition of Study

This testing integration study defines the communication system requirements to support ESF Testing.

2.9.2 Functional Requirements

1. The functional design requirement is to provide intercom and telephone service to all locations and tests given in the attached Summary ESF Communication Requirements.

2.9.3 Performance Criteria

1. Permanent intercom stations must be provided in each of the major IDS equipment enclosures. This includes the IDS Surface Facility, the Interim IDS surface enclosure, the Upper and Lower Demonstration Breakout Room IDS Data Acquisition Stations, the Main Test Level Alcove DAS and all the IDS Data Acquisition Stations distributed on the Main Test Level.

2. Permanent intercom stations must be provided in each of the organizational computer enclosures and individual test alcoves.

YMP CC-0013, Rev. 5 31 91

2.9.3 3. Plug-in intercom connections must be provided adjacent to other IDS components including:

* Each In-shaft Data Acquisition Station
* Each Zone Box associated with the sensor used to generate Site Characterization Data.

4. The intercom system must be flexible enough to allow additional plug-in and permanent stations to be added as the need arises.

5. The intercom system must provide the following capabilities:

* Point-to-point conversation between any two stations.
* Full duplex conversational mode.
* Simultaneous multiple conversations. For example, Station A must be able to converse with Station B while Station C converses with Station D. Each of these conversations must be totally independent of the other.
* A master broadcast mode which allows a station to transmit and receive messages to all other stations on the intercom network.
* Audible and visual signals to indicate when a station is being called.

YMP CC-0013, Rev. 5 31 91

2.9.3 6. Multiline telephones will be provided in the surface IDS facility. These telephone sets will include a comm line capability to allow communication with the other stations in the IDS system.

7. Single line telephone sets will be provided in each of the major IDS equipment enclosures including the Interim Surface enclosure, the Upper and Lower Demonstration Breakout Rooms, the Main Test Level IDS Alcove and each of the Main Test Level IDS Data Acquisition Stations. Each of these locations will be provided with a separate number.

8. Single line telephone sets will be provided in each of the Organization Computer enclosures and individual test alcoves.

2.9.4 Constraints

1. The intercom and telephone systems cabling and equipment must be designed such that no detectable electromagnetic signals are induced into the IDS data acquisition equipment or any associated sensor.

2. No data to be used for Site Characterization will be transmitted over the telephone or intercom systems.

YMP/CC-0013, Rev. 5 31 91

2.9.4 3. Both telephone and intercom systems will be powered from uninterruptable power supplies.

4. The intercom system will be designed and constructed to prevent radio-frequency interference that could affect electromagnetic measurements to be made.

2.9.5 Interfaces

1. The IDS telephone units will be connected to the NTS telephone system.

2.9.6 Assumptions

1. The type of cabling or other media used to support the intercom and telephone systems is left to the designer.

2. The features given are considered to provide the minimum level of support for IDS operations. Additional features are acceptable as long as they do not interfere with the basic operational requirements.

3. This study does not address mining operations intercom or telephone requirements. While some of the equipment may have common components, it is beyond the scope of this study to define mining communications requirements.

Summary of ESF Communications Requirements

Test Name	Orgn.	Intercom Station	Telephone	Test Location
Surface Facility	IDS	Permanent	Yes	Surface
Temporary Surface Facility	IDS	Permanent	Yes	Surface
IDS Alcove (DAS #4)	IDS	Permanent	Yes	MTL
Sensor Zone Boxes	IDS	Plug-in	No	Each Box
Fracture Mineralogy Studies in ES-1	LANL	No	No	ES-1
Topopah Spring Stratigraphy Test	LANL	No	No	ES-1
Alteration History Test	LANL	No	No	ES-1
Chloride and Chlorine 36 Test	LANL	No	No	ES-1
Fracture Mineralogy Studies in Drifts	LANL	No	No	Drifts
Diffusion Test	LANL	Permanent	Yes	MTL
Diffusion Test (DAS #6)(used also by Percolation Test)	IDS	Permanent	Yes	MTL
Diffusion Test (Pending)	LANL	Permanent	Yes	Calico Hills
Eng. Barrier Design Test #1 (Vertical)	LLNL	Permanent	Yes	MTL
Eng. Barrier Design Test #2 (Vertical)(see EDBT #1)	LLNL	-	-	MTL
Eng. Barrier Design Test #3 (Vertical)(see EDBT #1)	LLNL	-	-	MTL
Eng. Barrier Design Test (in DAS #9)	IDS	Permanent	Yes	MTL
Shaft Convergence Test #1	SNL	Plug-in	No	ES-1
Shaft Convergence Test #2	SNL	Plug-in	No	ES-1
		Intercom		Test

Test Name	Orgn.	Station	Telephone	Location
Shaft Convergence Test #3	SNL	Plug-in	No	ES-1
Shaft Convergence Test #1 (see SRBT #4 for IDS)	IDS	Plug-in	No	ES-1
Shaft Convergence Test #2 (see SRBT #7 for IDS)	IDS	Plug-in	No	ES-1
Shaft Convergence Test #3	IDS	Plug-in	No	ES-1
Demonstration Breakout Room Test (Upper)	SNL	Permanent	Yes	UBDR
Demonstration Breakout Room Test (Lower)	SNL	Permanent	Yes	LDBR
Demonstration Breakout Room Test (Upper)(in DAS #1)	IDS	Permanent	Yes	UBDR
Demonstration Breakout Room Test (Lower)(in DAS #3)	IDS	Permanent	Yes	LDBR
Sequential Drift Mining Test	SNL	Permanent	Yes	MTL
Sequential Drift Mining Test (in DAS #10 and DAS #11)	IDS	Permanent	Yes	MTL
Heater Experiment in Unit TSw1 (see UDBR Test, SNL)	SNL	-	-	UDBR
Canister Scale Heater Experiment	SNL	Plug-in	No	MTL
Yucca Mountain Heated Block Test	SNL	Plug-in	No	MTL
Thermal Stress Measurement Test (see UDBR Test, SNL)	SNL	-	-	UDBR
Thermal Stress Measurement Test (see LDBR Test, SNL)	SNL	-	-	LDBR
Heated Room Test	SNL	Permanent	Yes	MTL
Heated Room Test (in DAS #7)	IDS	Permanent	Yes	MTL
Development & Demonstration of Required Equipment	SNL	Plug-in	No	MTL

Test Name		Orgn.	Intercom Station	Telephone	Test Location
Plate Loading Tests (UDBR)	] 10 to 20	SNL	Plug-in	No	UDBR
Plate Loading Tests (MTL)	] Unspecified	SNL	Plug-in	No	MTL
Plate Loading Tests (Long Drifts)	] Locations	SNL	Plug-in	No	Long Drifts
Rock Mass Response Experiment #1 (Slot Strength)		SNL	Plug-in	No	LDBR
Rock Mass Response Experiment #2 (Slot Strength)		SNL	Plug-in	No	UDBR
Drift Stability Test		SNL	Plug-in	No	Long Drifts
Ground Support Systems Test		SNL	Plug-in	No	Long Drifts
Mining Methods Test		SNL	Plug-in	No	Long Drifts
Air Quality and Ventilation Test		SNL	Plug-in	No	Long Drifts
Seismic Tomography and Vertical Seismic Profiling		LBNL	Plug-in	No	ES-1
Geologic Mapping of ES-1		USGS	No	No	ES-1
Geologic Mapping of ES-2		USGS	No	No	ES-2
Excavation Effects Test (UDBR)		USGS	Permanent	Yes	UDBR
Excavation Effects Test (MTL)		USGS	Permanent	Yes	MTL
Excavation Effect Test (UDBR)(in DAS #2)		IDS	Permanent	Yes	UDBR
Excavation Effects Test (MTL)(in DAS #16)		IDS	Permanent	Yes	MTL
Matrix Hydrologic Properties Testing		USGS	Plug-in	No	ES-1
Intact Fracture Tests #1		USGS	Plug-in	No	ES-1

Test Name	Orgn.	Intercom Station	Telephone	Test Location
Intact Fracture Tests #2	USGS	Plug-in	No	ES-1
Intact Fracture Tests #3	USGS	Plug-in	No	ES-1
Intact Fracture Tests #4	USGS	Plug-in	No	ES-1
Intact Fracture Tests #5	USGS	Plug-in	No	ES-1
Short Radial Boreholes Test #1	USGS	Plug-in	No	ES-1
Short Radial Boreholes Test #2	USGS	Plug-in	No	ES-1
Short Radial Boreholes Test #3	USGS	Plug-in	No	ES-1
Short Radial Boreholes Test #4	USGS	Plug-in	No	ES-1
Short Radial Boreholes Test #5	USGS	Plug-in	No	ES-1
Short Radial Boreholes Test #6	USGS	Plug-in	No	ES-1
Short Radial Boreholes Test #7	USGS	Plug-in	No	ES-1
Short Radial Boreholes Test #8 (Pending)	USGS	Plug-in	No	ES-1 (CH)
Short Radial Boreholes Test #1	IDS	Plug-in	No	ES-1
Short Radial Boreholes Test #2	IDS	Plug-in	No	ES-1
Short Radial Boreholes Test #3	IDS	Plug-in	No	ES-1
Short Radial Boreholes Test #4 (used also by SCT #1)	IDS	-	-	ES-1
Short Radial Boreholes Test #5	IDS	Plug-in	No	ES-1
Short Radial Boreholes Test #6	IDS	Plug-in	No	ES-1

Test Name	Orgn.	Intercom Station	Telephone	Test Location
Short Radial Boreholes Test #7 (used also by SCT #2)	IDS	-	-	ES-1
Short Radial Boreholes Test #8 (Pending)	IDS	Plug-in	No	ES-1 (CH)
Perched Water Test (if perched water encountered	USGS	No	No	ES-1
Hydrochemistry Test	USGS	No	No	ES-1
Long Radial Boreholes Test #1	USGS	Plug-in	No	ES-1
Long Radial Boreholes Test #2	USGS	Plug-in	No	ES-1
Long Radial Boreholes Test #3	USGS	Plug-in	No	ES-1
Long Radial Boreholes Test #4	USGS	Plug-in	No	ES-1
Long Radial Boreholes Test #5	USGS	Plug-in	No	ES-1
Long Radial Boreholes Test #6	USGS	Plug-in	No	ES-1
Seismic Tomography and Vertical Seismic Profiling	LBNL	Plug-in	No	MTL
Seismic Tomography and Vertical Seismic Profiling	LBNL	Plug-in	No	Long Drifts
Geologic Mapping of Drifts	USGS	No	No	MTL
Geologic Mapping of Drifts (Pending)	USGS	No	No	Calico Hills
Geologic Mapping of Drifts	USGS	No	No	Long Drifts
Overcore Stress Test #1	USGS	No	No	ES-1
Overcore Stress Test #2	USGS	No	No	ES-1
Overcore Stress Test #3	USGS	No	No	ES-1

Test Name	Orgn.	Intercom Station	Telephone	Test Location
Percolation Test	USGS	Plug-in	Yes	MTL
Percolation Test (see Diffusion Test)	IDS	-	-	MTL
Bulk Permeability Test #1 (West)	USGS	Permanent	Yes	MTL
Bulk Permeability Test #2 (North)	USGS	Permanent	Yes	Long Drift
Bulk Permeability Test #3 (East)	USGS	Permanent	Yes	Long Drift
Bulk Permeability Test #4 (South)	USGS	Permanent	Yes	Long Drift
Bulk Permeability Test #1 (West)(in DAS #5)	IDS	Permanent	Yes	MTL
Bulk Permeability Test #2 (North)(in DAS #14)	IDS	Permanent	Yes	Long Drift
Bulk Permeability Test #3 (East)(in DAS #13)	IDS	Permanent	Yes	Long Drift
Bulk Permeability Test #4 (South)(in DAS #10)	IDS	Permanent	Yes	Long Drift
Calico Hills Cross Hole Test (Pending)	USGS	Permanent	Yes	Calico Hills
CH Drillholes at Contact (Pending)(see 1st CH Test)	USGS	-	-	Calico Hills
Calico Hills Drillholes at Ghost Dance Fault (Pending)(see 1st CH Test)	USGS	-	-	Calico Hills
Calico Hills Vertical Hole to Water Table (Pending)(see 1st CH Test)	USGS	-	-	Calico Hills
Calico Hills Cross Hole Test (Pending)(in DAS #15)	IDS	Permanent	Yes	Calico Hills
Perched Water Test (if perched water available)	USGS	No	No	MTL

NOTES: A dash (-) in a column indicates that this item has been previously addressed in another test (see the Test Name for the previous location).

YMP CC-0013, Rev. 5/31/91

APPENDIX C

ESF DRILLING REQUIREMENTS

(TO BE PROVIDED PRIOR TO TITLE II DESIGN)

YMP CC-0013, Rev. 5/31/91

APPENDIX D

(RESERVED FOR FUTURE USE)

YMP CC-0013, Rev. 5/31/91

APPENDIX E

APPLICABLE REGULATIONS, CODES, STANDARDS, AND DOE ORDERS

YMP CC-0013, Rev. 5/31/91

APPLICABLE REGULATIONS, CODES, STANDARDS, AND DOE ORDERS

General

The design and construction of the ESF shall be in accordance with all applicable parts of the following:

CODE OF FEDERAL REGULATIONS (CFR)

- 10 CFR 60, Disposal of High-Level Radioactive Wastes in Geologic Repositories
- 10 CFR 960, General Guidelines for the Recommendation of Sites for the Nuclear Waste Repositories
- 29 CFR 1910, Occupational Safety and Health Standards (OSHA)
- 29 CFR 1926, Safety and Health Regulations for Construction (OSHA)
- 30 CFR CHAPTER I , Mine Safety and Health Administration (MSHA)

U.S. CONGRESS

- Nuclear Waste Policy Act of 1982, Public Law 97-425
- Nuclear Waste Policy Act Amendments of 1987, Public Law 100-203

U.S. DEPARTMENT OF ENERGY (DOE)

- DOE Order 5400, Environmental Quality and Impact (Also refer to ESFDR Appendix J, "Exploratory Shaft Facility Environmental Requirements" which contains ESF-related environmental requirements)
  - DOE Order 5480.1B, Environmental Protection, Safety, and Health Protection Program
  - DOE/NV Order 5480.1B-20, Environmental Safety and Health Program for DOE
  - DOE Order 5480.4, Environmental Protection, Safety, and Health Protection Standards
  - DOE/NV Order 5480.4-17, Environmental Protection, Safety, and Health Protection Standards, July 2, 1986
  - DOE Order 5480.7, Fire Protection
  - DOE Order 5480.9, Construction Safety and Health Program

YMP CC-0013, Rev. 5 31 91

- DOE Order 5480.10, Contractor Industrial Hygiene Program
- DOE/NV Order 5480.10-26, Contractor Industrial Hygiene Program
- DOE Order 5481.1B, Safety Analysis and Review System
- DOE/NV Order 5481.1B-21, Safety Analysis and Review System, January 25, 1988
- DOE Order 5482.1B, Environmental Protection, Safety, and Health Protection Appraisal Program
- DOE/NV Order 5482.1B-19, Environmental, Safety, and Health Appraisal
- DOE Order 5483.1A, 6-22-83, Occupational Safety and Health Program for Government Owned Contractor-Operated Facilities
- DOE Order 5484.1, Environmental Protection, Safety and Health Protection Information Reporting Requirements
- DOE/NV 54XA.1-2, NTS Traffic Regulations (proposed)
- DOE/NV 54XB.1-28, Laser Safety (proposed)

• DOE Order 5900, Energy Information

• DOE Order 6400, Construction and Engineering
  - DOE Order 6430.1A, General Design Criteria

• DOE/RW-0005, Mission Plan for the Civilian Radioactive Waste Management Program

• DOE/AD/06212-1, Site Development Planning Handbook

• DOE/NV/00410-77, Reynolds Electrical and Engineering Company Safety and Health Program Plan, Nevada Nuclear Waste Storage Investigations Exploratory Shaft at Yucca Mountain

• UCRL- 15910, Design Evaluation guidelines for Department of Energy Facilities Subjected to Natural Phenomena Hazards, Draft (Rev. 4), May, 1989.

• DOE/EP 0108, Standard for Fire Protection of DOE Electronic Computer/Data Processing Systems

• DOE/EV 0043, Stand on Fire Protection for Portable Structures

• DOE/EV 0051/1, Electrical Safety Criteria for Research and Development Activities

• DOE/EV 06194-3, DOE Explosive Safety Manual

YMP CC-0013, Rev. 5 31 91

- DOE (U.S. Department of Energy), Site Characterization Program Baseline, YMP/CM-0011, Rev. 0, Las Vegas, NV, February 21, 1991 nze14

STATE OF NEVADA

- Nevada Revised Statutes (NRS) Title 40, Public Health and Safety
  - Chapter 444, Sanitation
  - Chapter 445, Water Controls , Air Pollution
- NRS Title 46, Chapter 512, State of Nevada Health and Safety Standards for Open Pit and Underground Metal and Nonmetal Mines and Sand, Gravel, and Crushed Stone Operations
- Nevada Administrative Code
  - Chapter 444, Hazardous Waste Disposal
  - Chapter 445, Water Pollution Control, Air Pollution
  - Chapter 512,
- Department of Transportation (DH)
  - Standard Specifications for Road and Bridge Construction
  - Standard Plans for Road and Bridge Construction
  - Road Design Division, Design Manual, Parts 1 and 2

<u>Industrial and Professional Society Publications</u>

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (ASSHTO)

- A Policy on Geometric Design f Highways and Streets

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

- Threshold Limit Values and Biological Exposure Indices

AMERICAN CONCRETE INSTITUTE (ACI)

- ACI 301, Specifications for Structural Concrete for Buildings
- ACI 304, Recommended Practice for Measuring, Mixing, Transporting , and Placing Concrete
- ACI 305, Recommended practice for Hot Weather Concreting
- ACI 308, Standard Practice for Curing Concrete

 YMP/CC-0013, Rev. 5/31/91

- ACI 316, Recommended Practice for Construction of Concrete Pavements and Concrete Bases
- ACI 318, Building Code Requirements for Reinforced Concrete
- ACI 318.1, Building Code Requirements for Structural Plain Concrete
- ACI 347, Recommended Practice for Concrete Formwork

PRESTRESSED CONCRETE INSTITUTE

- Standards

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

- Manual of Steel Construction

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

- B31.3, Chemical Plant and and Petroleum Refinery Piping
- C2, National Electrical Safety Code
- ANS-2.3, Standard for Estimating Tornado and Extreme Wind Characteristics at Nuclear Power Sites
- ANS-2.5, Standard for Determining Meteorological Information at Nuclear Power Sites
- ANS-2.8, Standard for determining Design Basis Flooding at Power Reactor Sites

AMERICAN SOCIETY OF CIVIL ENGINEERS

- 7-88, Minimum Design Loads for Buildings and Other Structures

AMERICAN SOCIETY OF HEATING, REFRIGERATING, AND AIR CONDITIONING ENGINEERS (ASHRAE)

- 1985 Handbooks, Fundamentals
- 1988 Handbook, Equipment
- 1987 Handbook, HVAC Systems and Applications
- 1986 Handbook, Refrigeration
- 62, Ventilation for Acceptable Indoor Air Quality
- 90, Energy Conservation in New Building Design

 YMP CC-0013, Rev. 5/31/91

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

- Boiler and Pressure Vessel Code: Section VIII, Division I, Unfired Pressure Vessel Code

AMERICAN SOCIETY OF TESTING MATERIALS (ASTM)

- A184, Standard Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement
- A185, Standard Specification for Steel Welded Wire, Fabric, Plain, for Concrete Reinforcement
- A615, Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
- A775, Standard Specification for Epoxy-Coated Reinforcing Steel Bars
- C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
- D1751, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction
- E488, Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements

AMERICAN WELDING SOCIETY

- AWS D1.1 Structural Welding Code - Steel

DIESEL ENGINE MANUFACTURER ASSOCIATION (DEMA)

- Standard Practices for Stationary Diesel and Gas Engines

INSTRUMENTATION SOCIETY OF AMERICA (ISA)

- Standards and Specifications

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

- 141, Recommended Practice for Electrical Power Distribution for Industrial Plants
- 142, Recommended Practice for Grounding of Industrial and Commercial Power Systems
- 387, Standard Criteria for Diesel-Generator Units Applied as Standby Power Supplies for Nuclear Generating Stations
- 485, Recommended Practice for Sizing Large Lead Storage Batteries for Generating Stations and Substations
- 583, Standard Modular Instrumentation and Digital Interface System

 YMP CC-0013, Rev. 5/31/91

- 595, Standard Serial Highway Interface System
- 650, Qualification of Class 1E Battery Chargers and Inverters for Nuclear Power Generating Stations

INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS

- Uniform Building Code (UBC)
- Uniform Mechanical Code (UMC)
- Uniform Plumbing Code (UPC)

NATIONAL ASSOCIATION OF PLUMBING-HEATING-COOLING CONTRACTORS

- National Standard Plumbing Code

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

- National Fire Codes
- 22, Water Tanks for Private Fire Protection
- 20, Centrifugal Fire Pumps
- 24, Installation of Private Fire Service Mains and Their Appurtenances
- 70, National Electrical Code

YMP CC-0013, Rev. 5 31 91

APPENDIX F.1

CROSS REFERENCE 10 CFR 60 TO ESFDR, VOLUME 1

YMP CC-0013, Rev. 5-31-91

10 CFR 60 Quote	ESFDR Location
10 CFR 60.15(b)	1.2.6.4 PC 1a.
10 CFR 60.15(b)	1.2.6.5 PC 1a.
10 CFR 60.15(b)	1.2.6.6 PC 1a.
10 CFR 60.15(c)(1)	1.2.6.0 C C.(1)
10 CFR 60.15(c)(1)	1.2.6.4 PC 2a.
10 CFR 60.15(c)(1)	1.2.6.5 PC 2a.
10 CFR 60.15(c)(1)	1.2.6.6 PC 2a.
10 CFR 60.15(c)(1)	1.2.6.7 C B.
10 CFR 60.15(c)(2)	1.2.6.0 C C.(2)
10 CFR 60.15(c)(2)	1.2.6.4 PC 1b.
10 CFR 60.15(c)(2)	1.2.6.5 PC 1b.
10 CFR 60.15(c)(2)	1.2.6.6 PC 1b.
10 CFR 60.15(c)(3)	1.2.6.0 C C.(3)
10 CFR 60.15(c)(3)	1.2.6.1.1 C A.
10 CFR 60.15(c)(3)	1.2.6.4 PC 2b.
10 CFR 60.15(c)(3)	1.2.6.5 PC 2b.
10 CFR 60.15(c)(3)	1.2.6.6 PC 2b.
10 CFR 60.15(c)(3)	1.2.6.8 C D.
10 CFR 60.15(c)(4)	1.2.6.0 C C.(4)
10 CFR 60.15(c)(4)	1.2.6.6 PC 2c.
10 CFR 60.74(a)	1.2.6.0 C D.
10 CFR 60.74(a)	1.2.6.4 C A.
10 CFR 60.74(a)	1.2.6.5 C A.
10 CFR 60.74(a)	1.2.6.6 C A.
10 CFR 60.74(a)	1.2.6.7 C C.
10 CFR 60.74(b)	1.2.6.0 C D.[2]
10 CFR 60.74(b)	1.2.6.4 C A.[2]
10 CFR 60.74(b)	1.2.6.5 C A.[2]
10 CFR 60.74(b)	1.2.6.6 C A.[2]
10 CFR 60.130	1.2.6.0 C E.
10 CFR 60.130	1.2.6.4 PC 2c.
10 CFR 60.130	1.2.6.5 PC 2c.
10 CFR 60.130	1.2.6.6 PC 2d.
10 CFR 60.131(b)(9)	1.2.6.0 C G.
10 CFR 60.133(a)(1)	1.2.6.4 PC 2d.
10 CFR 60.133(a)(1)	1.2.6.5 PC 2d.
10 CFR 60.133(a)(1)	1.2.6.6 PC 2e.
10 CFR 60.133(a)(2)	1.2.6.4 PC 2e.
10 CFR 60.133(a)(2)	1.2.6.5 PC 2e.
10 CFR 60.133(a)(2)	1.2.6.6 PC 2f.
10 CFR 60.133(a)(2)	1.2.6.7 C D.
10 CFR 60.133(b)	1.2.6.4 PC 2f.
10 CFR 60.133(b)	1.2.6.5 PC 2f.
10 CFR 60.133(b)	1.2.6.6 PC 2g.
10 CFR 60.133(b)	1.2.6.7 C E.
10 CFR 60.133(d)	1.2.6.0 PC 2e.
10 CFR 60.133(d)	1.2.6.4 PC 2g.
10 CFR 60.133(d)	1.2.6.5 PC 2g.
10 CFR 60.133(d)	1.2.6.6 PC 2h.
10 CFR 60.133(d)	1.2.6.7 C F.
10 CFR 60.133(d)	1.2.6.8 C E.

YMP/CC-0013, Rev. 5/31/91

10 CFR 60 Quote	ESFDR Location
10 CFR 60.133(e)(2)	1.2.6.4 PC 2h.
10 CFR 60.133(e)(2)	1.2.6.5 PC 2h.
10 CFR 60.133(e)(2)	1.2.6.6 PC 2i.
10 CFR 60.133(f)	1.2.6.4 PC 2i.
10 CFR 60.133(f)	1.2.6.5 PC 2i.
10 CFR 60.133(f)	1.2.6.6 PC 2j.
10 CFR 60.133(i)	1.2.6.4 PC 2j.
10 CFR 60.133(i)	1.2.6.5 PC 2j.
10 CFR 60.133(i)	1.2.6.6 PC 2k.
10 CFR 60.134	1.2.6.0 C H.
10 CFR 60.134(a)	1.2.6.4 PC 2l.
10 CFR 60.134(a)	1.2.6.5 PC 2k.
10 CFR 60.134(a)	1.2.6.6 PC 2l.
10 CFR 60.134(a)(2)	1.2.6.6 PC 2l.v
10 CFR 60.134(b)	1.2.6.4 PC 2k.[2]
10 CFR 60.134(b)	1.2.6.5 PC 2k.[2]
10 CFR 60.134(b)	1.2.6.6 PC 2l.[2]
10 CFR 60.137	1.2.6.4 C B.
10 CFR 60.137	1.2.6.5 C B.
10 CFR 60.137	1.2.6.6 C B.
10 CFR 60.137	1.2.6.7 C G.

Sections Not Quoted verbatum

(10 CFR 60.72 "satisfy req")	1.2.6.0 PC 1f.
(10 CFR 60.112 "meet perf obj")	1.2.6.2 C F.
(10 CFR 60.122 "meet req")	1.2.6.1 C C.iii
(10 CFR 60.122 "meet req")	1.2.6.2 C F.
(10 CFR 60.122(c)(1) "in accord")	1.2.6.1.4 C A.
(10 CFR 60.141 and 142 "meet req")	1.2.6.4 C B.i
(10 CFR 60.141 and 142 "meet req")	1.2.6.5 C B.i
(10 CFR 60.141 and 142 "meet req")	1.2.6.6 C B.i

Sections Not Addressed (See ESFDR Introduction)

10 CFR 60.4
10 CFR 60.16
10 CFR 60.17
10 CFR 60.21
10 CFR 60.24(a)
10 CFR 60.111(a)
10 CFR 60.111(b)
10 CFR 60.112
10 CFR 60.113(a)
10 CFR 60.113(b)(2)
10 CFR 60.113(b)(3)
10 CFR 60.113(b)(4)
10 CFR 60.122
10 CFR 60.131(a)
10 CFR 60.131(b)
10 CFR 60.133(c)
10 CFR 60.133(e)(1)

YMP CC-0013, Rev. 5 31 91

Sections Not Addressed (See ESFDR Introduction)

10 CFR 60.133(g)
10 CFR 60.133(h)
10 CFR 60.140
10 CFR 60.141
10 CFR 60.142
10 CFR 60.143
10 CFR 60.151
10 CFR 60.152

YMP CC-0013, Rev. 5/31/91

APPENDIX F.2

CROSS REFERENCE ESFDR, VOLUME 1, TO 10 CFR 60

YMP CC-0013, Rev. 5 31 91

ESFDR Location	10 CFR 60 Quote
1.2.6.0 PC 1f.	(10 CFR 60.72 "satisfy req")
1.2.6.0 PC 2e.	10 CFR 60.133(d)
1.2.6.0 C C.(1)	10 CFR 60.15(c)(1)
1.2.6.0 C C.(2)	10 CFR 60.15(c)(2)
1.2.6.0 C C.(3)	10 CFR 60.15(c)(3)
1.2.6.0 C C.(4)	10 CFR 60.15(c)(4)
1.2.6.0 C D.	10 CFR 60.74(a)
1.2.6.0 C D.[2]	10 CFR 60.74(b)
1.2.6.0 C E.	10 CFR 60.130
1.2.6.0 C G.	10 CFR 60.131(b)(9)
1.2.6.0 C H.	10 CFR 60.134
1.2.6.1 C C.iii	(10 CFR 60.122 "meet req")
1.2.6.1.1 C A	10 CFR 60.15(c)(3)
1.2.6.1.4 C A.	(10 CFR 60.122(c)(1) "in accord")
1.2.6.2 C F.	(10 CFR 60.122 "meet req")
1.2.6.4 PC 1a.	10 CFR 60.15(b)
1.2.6.4 PC 1b.	10 CFR 60.15(c)(2)
1.2.6.4 PC 2a.	10 CFR 60.15(c)(1)
1.2.6.4 PC 2b.	10 CFR 60.15(c)(3)
1.2.6.4 PC 2c.	10 CFR 60.130
1.2.6.4 PC 2d.	10 CFR 60.133(a)(1)
1.2.6.4 PC 2e.	10 CFR 60.133(a)(2)
1.2.6.4 PC 2f.	10 CFR 60.133(b)
1.2.6.4 PC 2g.	10 CFR 60.133(d)
1.2.6.4 PC 2h.	10 CFR 60.133(e)(2)
1.2.6.4 PC 2i.	10 CFR 60.133(f)
1.2.6.4 PC 2j.	10 CFR 60.133(i)
1.2.6.4 PC 2k.	10 CFR 60.134(a)
1.2.6.4 PC 2k.[2]	10 CFR 60.134(b)
1.2.6.4 C A.	10 CFR 60.74(a)
1.2.6.4 C A.[2]	10 CFR 60.74(b)
1.2.6.4 C B.	10 CFR 60.137
1.2.6.4 C B.i	(10 CFR 60.141 and 142 "meet req")
1.2.6.5 PC 1a.	10 CFR 60.15(b)
1.2.6.5 PC 1b.	10 CFR 60.15(c)(2)
1.2.6.5 PC 2a.	10 CFR 60.15(c)(1)
1.2.6.5 PC 2b.	10 CFR 60.15(c)(3)
1.2.6.5 PC 2c.	10 CFR 60.130
1.2.6.5 PC 2d.	10 CFR 60.133(a)(1)
1.2.6.5 PC 2e.	10 CFR 60.133(a)(2)
1.2.6.5 PC 2f.	10 CFR 60.133(b)
1.2.6.5 PC 2g.	10 CFR 60.133(d)
1.2.6.5 PC 2h.	10 CFR 60.133(e)(2)
1.2.6.5 PC 2i.	10 CFR 60.133(f)
1.2.6.5 PC 2j.	10 CFR 60.133(i)
1.2.6.5 PC 2k.	10 CFR 60.134(a)
1.2.6.5 PC 2k.[2]	10 CFR 60.134(b)
1.2.6.5 C A.	10 CFR 60.74(a)
1.2.6.5 C A.[2]	10 CFR 60.74(b)
1.2.6.5 C B.	10 CFR 60.137
1.2.6.5 C B.i	(10 CFR 60.141 and 142 "meet req")

 YMP CC-0013, Rev. 5/31/91

ESFDR Location	10 CFR 60 Quote
1.2.6.6 PC 1a.	10 CFR 60.15(b)
1.2.6.6 PC 1b.	10 CFR 60.15(c)(2)
1.2.6.6 PC 2a.	10 CFR 60.15(c)(1)
1.2.6.6 PC 2b.	10 CFR 60.15(c)(3)
1.2.6.6 PC 2c.	10 CFR 60.15(c)(4)
1.2.6.6 PC 2d.	10 CFR 60.130
1.2.6.6 PC 2e.	10 CFR 60.133(a)(1)
1.2.6.6 PC 2f.	10 CFR 60.133(a)(2)
1.2.6.6 PC 2g.	10 CFR 60.133(b)
1.2.6.6 PC 2h.	10 CFR 60.133(d)
1.2.6.6 PC 2i.	10 CFR 60.133(e)(2)
1.2.6.6 PC 2j.	10 CFR 60.133(f)
1.2.6.6 PC 2k.	10 CFR 60.133(i)
1.2.6.6 PC 2l.	10 CFR 60.134(a)
1.2.6.6 PC 2l.[2]	10 CFR 60.134(b)
1.2.6.6 PC 2l.v	10 CFR 60.134(a)(2)
1.2.6.6 C A.	10 CFR 60.74(a)
1.2.6.6 C A.[2]	10 CFR 60.74(b)
1.2.6.6 C B.	10 CFR 60.137
1.2.6.6 C B.i	(10 CFR 60.141 and 142 "meet req")
1.2.6.7 C B.	10 CFR 60.15(c)(1)
1.2.6.7 C C.	10 CFR 60.74(a)
1.2.6.7 C D.	10 CFR 60.133(a)(2)
1.2.6.7 C E.	10 CFR 60.133(b)
1.2.6.7 C F.	10 CFR 60.133(d)
1.2.6.7 C G.	10 CFR 60.137
1.2.6.8 C D.	10 CFR 60.15(c)(3)
1.2.6.8 C E.	10 CFR 60.133(d)

YMP CC-0013, Rev. 5 31 91

APPENDIX G

ESF SYSTEMS, FUNCTIONS, AND REQUIREMENTS ANALYSIS LOGIC TREE

YMP/CC-0013, Rev. 5 31 91

SYSTEMS, FUNCTIONS, AND REQUIREMENTS ANALYSIS
FOR THE EXPLORATORY STUDIES FACILITY (ESF) AT YUCCA MOUNTAIN

The logic tree shown in this appendix identifies graphically the systems, functions and requirements for the ESF. It may be viewed as an activities tree for the ESF depicting how its mission will be accomplished.

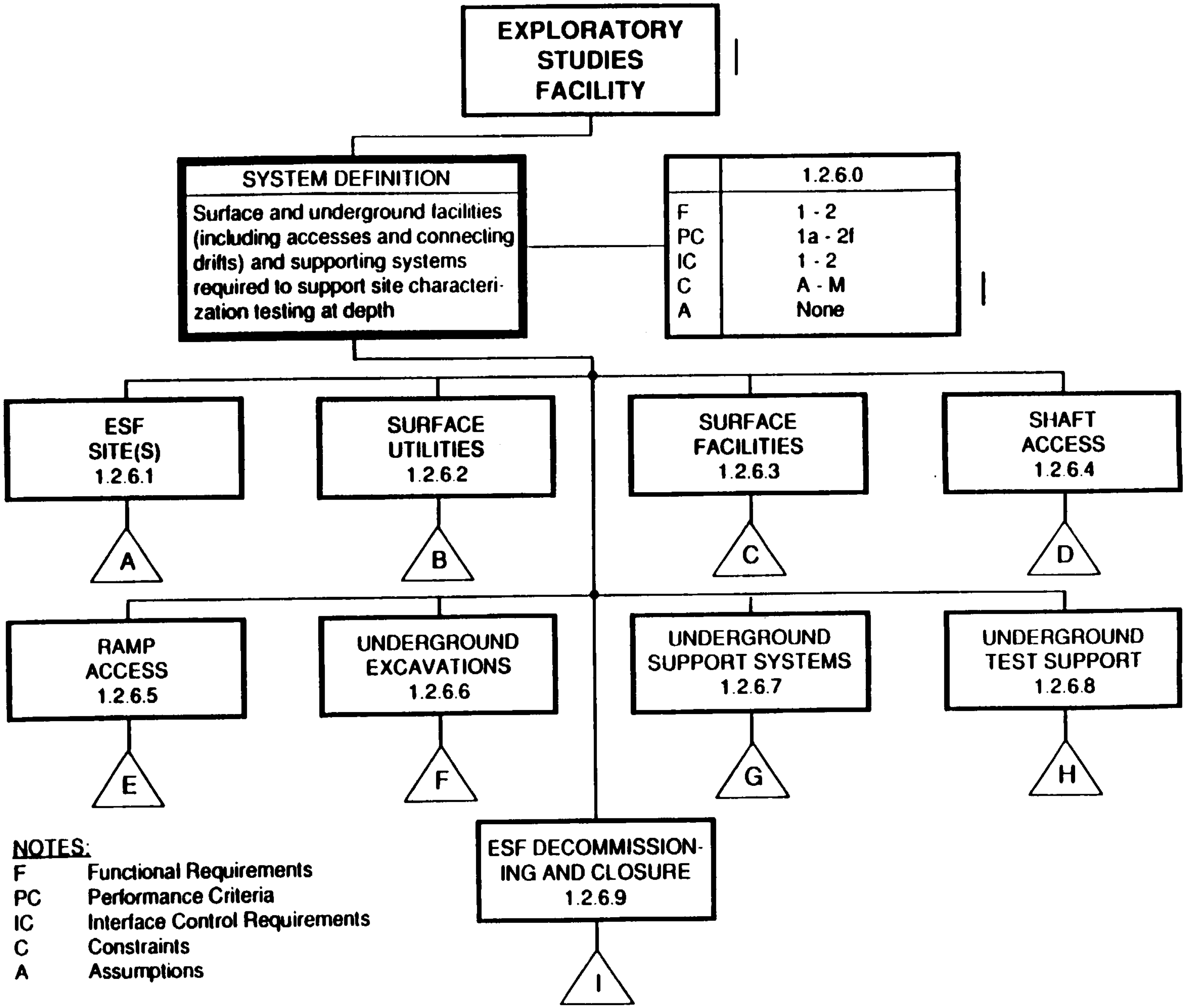
A description of the logic tree is as follows: Each major system is stated in a bold-lined rectangle. Lower-tier subsystems are identified in the rectangles immediately below the superior system. The systems are those identified in the ESFDR document text; i.e., 1.2.6.0 Exploratory Shaft Facility (ESF) identifies the main all-encompassing system, and 1.2.6.1 ESF site(s) identifies a lower-tier or subelement system to 1.2.6.0. Main site(s) (1.2.6.1.1) is yet a lower-tier to 1.2.6.1 and so forth.

Functions and Requirements are shown for each system in the thin-lined rectangle connected to the immediate right of each system rectangle. The functions and requirements are listed in the rectangle and are identified as follows:

F = Functional requirements
PC = Performance Criteria
IC = Interface Control requirements
C = Constraints
A = Assumptions

Definitions of these elements are stated in the ESFDR Introduction.

Numerous triangles containing at least one letter and possibly a number occur throughout the tree. These are "off-page connectors." As one proceeds downward from the top of the tree, an off page connector symbol means that the tree is continued on another page at the corresponding set of alphabet letters.



NOTES:

F	Functional Requirements
PC	Performance Criteria
IC	Interface Control Requirements
C	Constraints
A	Assumptions

MAIN SITE(S)

A1

SYSTEM DEFINITION

Located on the surface, accommodates structures, systems, and components for direct construction of shaft(s) and/or ramps to provide access to the underground site characterization areas but does not include initial construction and test support facilities.

	1.2.6.1.1
F	1
PC	1a - 1b
IC	None
C	A - B
A	1

AUXILIARY SITE(S)

A2

SYSTEM DEFINITION

The Auxiliary Site(s) consist of the areas prepared to support the ESF construction and operation

	1.2.6.1.2
F	1
PC	1a - 1b
IC	None
C	A - D
A	1 - 2

ACCESS ROADS

A3

SYSTEM DEFINITION

All features needed to provide vehicular access to all surface areas designated as required to support the ESF.

	1.2.6.1.3
F	1
PC	1a - 1d
IC	None
C	A - G
A	None

SITE DRAINAGE

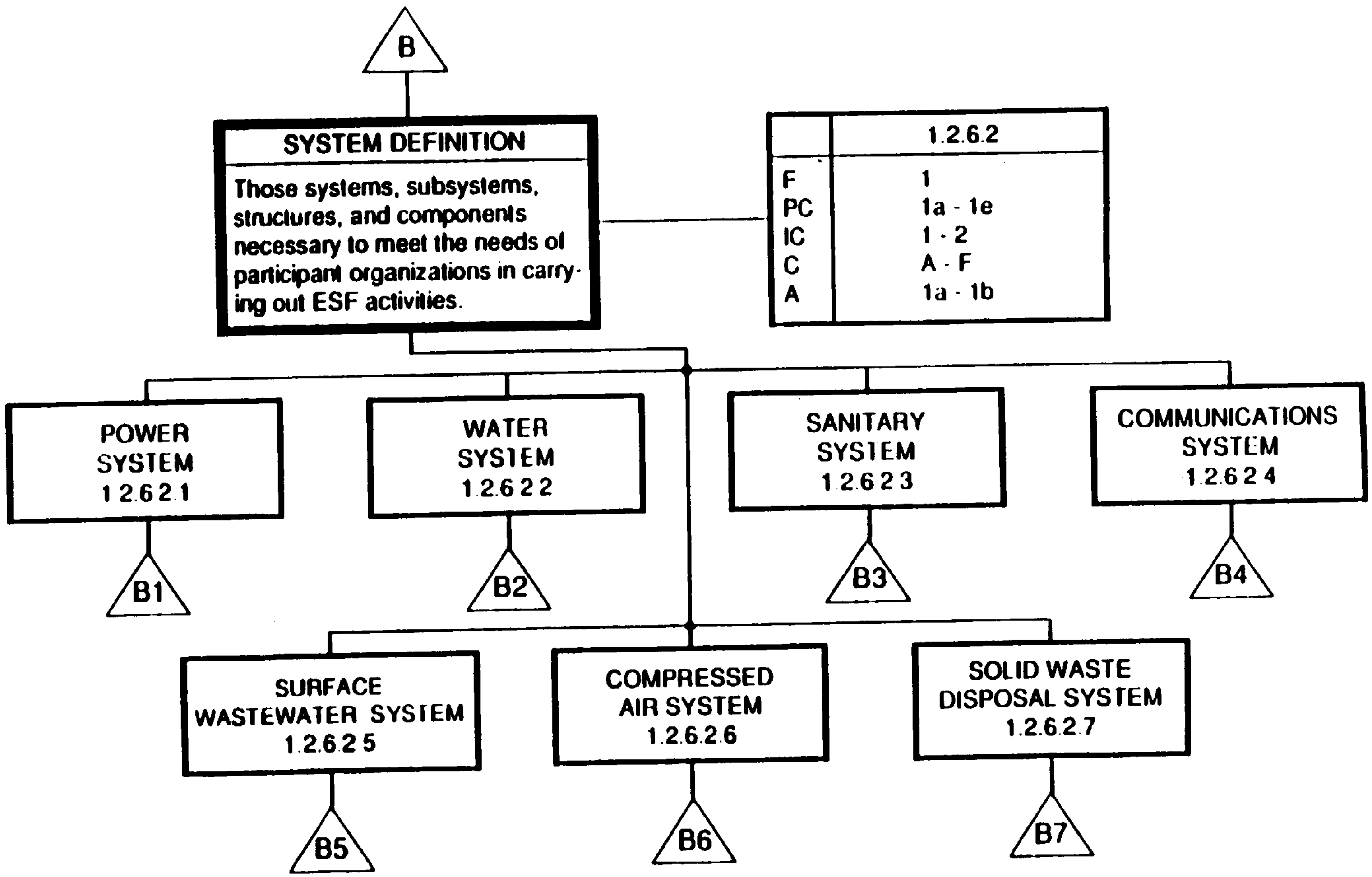
A4

SYSTEM DEFINITION

Defined as those items and measures utilized to control drainage and runoff water to preclude damage by erosion or flooding.

	1.2.6.1.4
F	1
PC	1
IC	None
C	A
A	None

SURFACE UTILITIES



YMP CC-0013, Rev. 5/21/91

POWER SYSTEM

B1

SYSTEM DEFINITION

Those systems, subsystems, components, and structures that supply electrical power to the ESF Site.

	1.2.6.2.1
F	1
PC	1a - 1j
IC	None
C	A - G
A	None

WATER SYSTEM

B2

SYSTEM DEFINITION

Those systems, subsystems, and components that supply and distribute the potable and process water for ESF facilities, site preparation, and testing.

	1.2.6.2.2
F	1
PC	1a - 1i
IC	None
C	A - G
A	1

SANITARY SYSTEM

B3

SYSTEM DEFINITION

Those systems, subsystems, and components that provide for the collection, treatment, and disposal of sanitary sewage for the support of ESF operations and during in situ site characterization.

	1.2.6.2.3
F	1
PC	1a - 1c
IC	None
C	A - C
A	None

COMMUNICATIONS SYSTEM

B4

SYSTEM DEFINITION

Those systems, subsystems, and components that provide equipment and services for linking the surface areas, the underground areas, and the facilities with each other and with all outside commercial communications systems.

	1.2.6.2.4
F	1
PC	1a - 1g
IC	None
C	A - J
A	1

ESFDR1 057/3 26 91

SURFACE WASTEWATER SYSTEM

B5

SYSTEM DEFINITION

Those systems, subsystems, and components that provide equipment for collection, transfer, treatment, and disposal of liquid non-sanitary wastes generated underground in the ESF during construction and operations.

	1.2.6.2.5
F	1
PC	1
IC	None
C	A - C
A	None

COMPRESSED AIR SYSTEM

B6

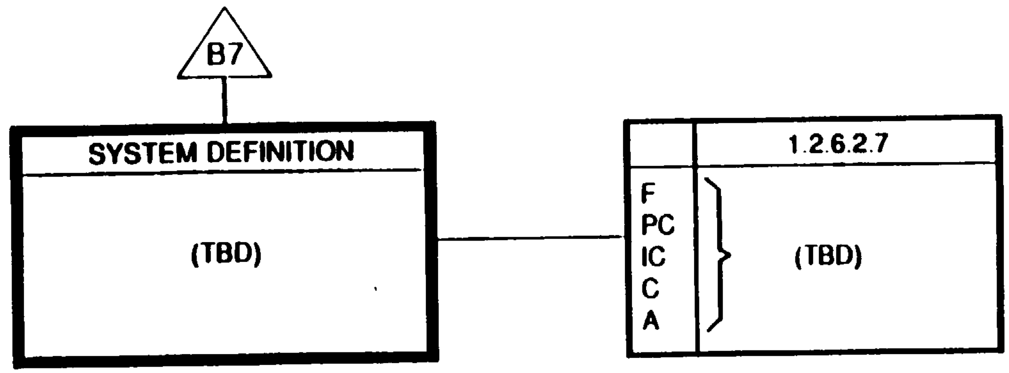
SYSTEM DEFINITION

Those systems, subsystems, and components that provide the production and distribution of compressed air throughout the ESF.

	1.2.6.2.6
F	1
PC	1a - 1d
IC	None
C	A
A	None

YMP CC-0013, Rev.

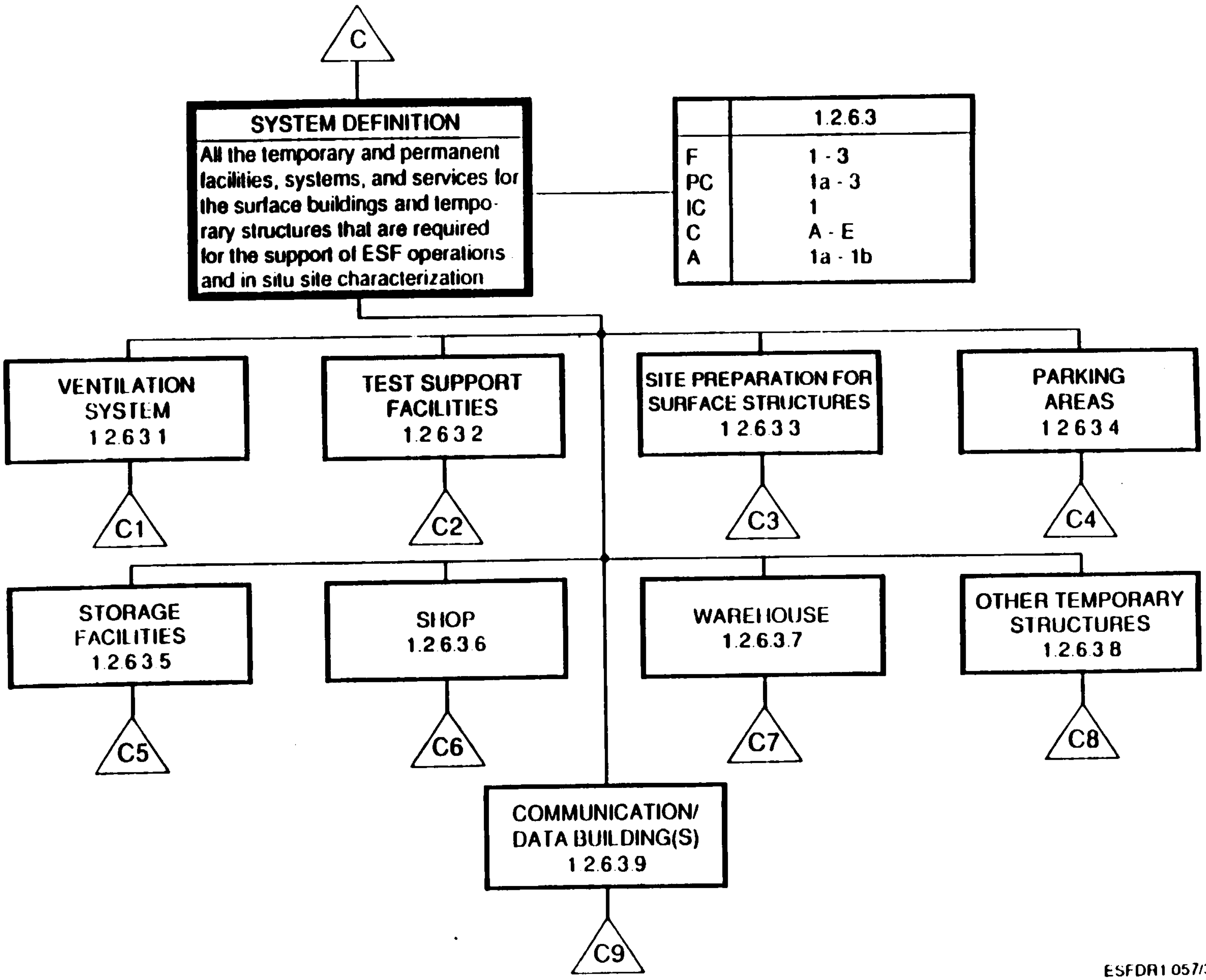
SOLID WASTE DISPOSAL SYSTEM



YMP/CC-0012, Rev.

ESFDR1 057/3 26 91

SURFACE FACILITIES



ESFDR1 057/3 26 91

VENTILATION SYSTEM

C1

SYSTEM DEFINITION
Those surface systems, subsystems, and components that supply fresh air, conditioned if required, to the ventilation distribution system.

	1.2.6.3.1
F	1
PC	1a - 1e
IC	None
C	A - D
A	1

TEST SUPPORT FACILITIES

C2

SYSTEM DEFINITION
Those surface facilities that accommodate the Principal Investigators' testing apparatus for equipment assembly, check out, and repair.

	1.2.6.3.2
F	1
PC	1
IC	None
C	None
A	None

YMP CC-0013, Rev. 5/31/91

SITE PREPARATION FOR SURFACE STRUCTURES

C3

SYSTEM DEFINITION

All of the facilities, systems, and services required by the structures during construction and operation of the ESF.

	1.2.6.3.3
F	1
PC	1a - 1b
IC	None
C	None
A	None

PARKING AREAS

C4

SYSTEM DEFINITION

All space and allowances for vehicle parking required to support construction, operation, and testing in the ESF.

	1.2.6.3.4
F	1
PC	1a - 1e
IC	None
C	A - B
A	None

STORAGE FACILITIES

C5

SYSTEM DEFINITION

All areas, structures, and supporting services to store equipment, supplies, and vehicles in a yard type environment.

	1.2.6.3.5
F	1
PC	1a - 1c
IC	None
C	A - B
A	None

SHOP

C6

SYSTEM DEFINITION

All of the facilities, systems, and services for the routine maintenance and repair of the construction and testing equipment and of the equipment for maintenance of the grounds designated for the ESF.

	1.2.6.3.6
F	1
PC	1a - 1e
IC	None
C	A - E
A	1

ESFDR1 057 13/5 9 91

YMP/CC-0013, Rev. 5/31/91

WAREHOUSE

C7

SYSTEM DEFINITION
All the facilities, systems, and services for the safe storage and dispensing of ESF materials that require indoor storage and are not stored in the open areas provided under 1.2.6.3.5, Storage Facilities.

	1.2.6.3.7
F	1
PC	1a - 1b
IC	None
C	A - E
A	None

OTHER TEMPORARY STRUCTURES

C8

SYSTEM DEFINITION
The systems and services that will be utilized for the offices, change rooms, first aid and underground rescue apparatus center, security offices, and space required to support ESF construction, scientific, operations, and maintenance personnel for the Site Characterization Program including site preparation.

	1.2.6.3.8
F	1
PC	1a - 1e
IC	None
C	A - B
A	1 - 2

ESFDR1 057/3 26 91

COMMUNICATIONS/DATA BUILDING(S)

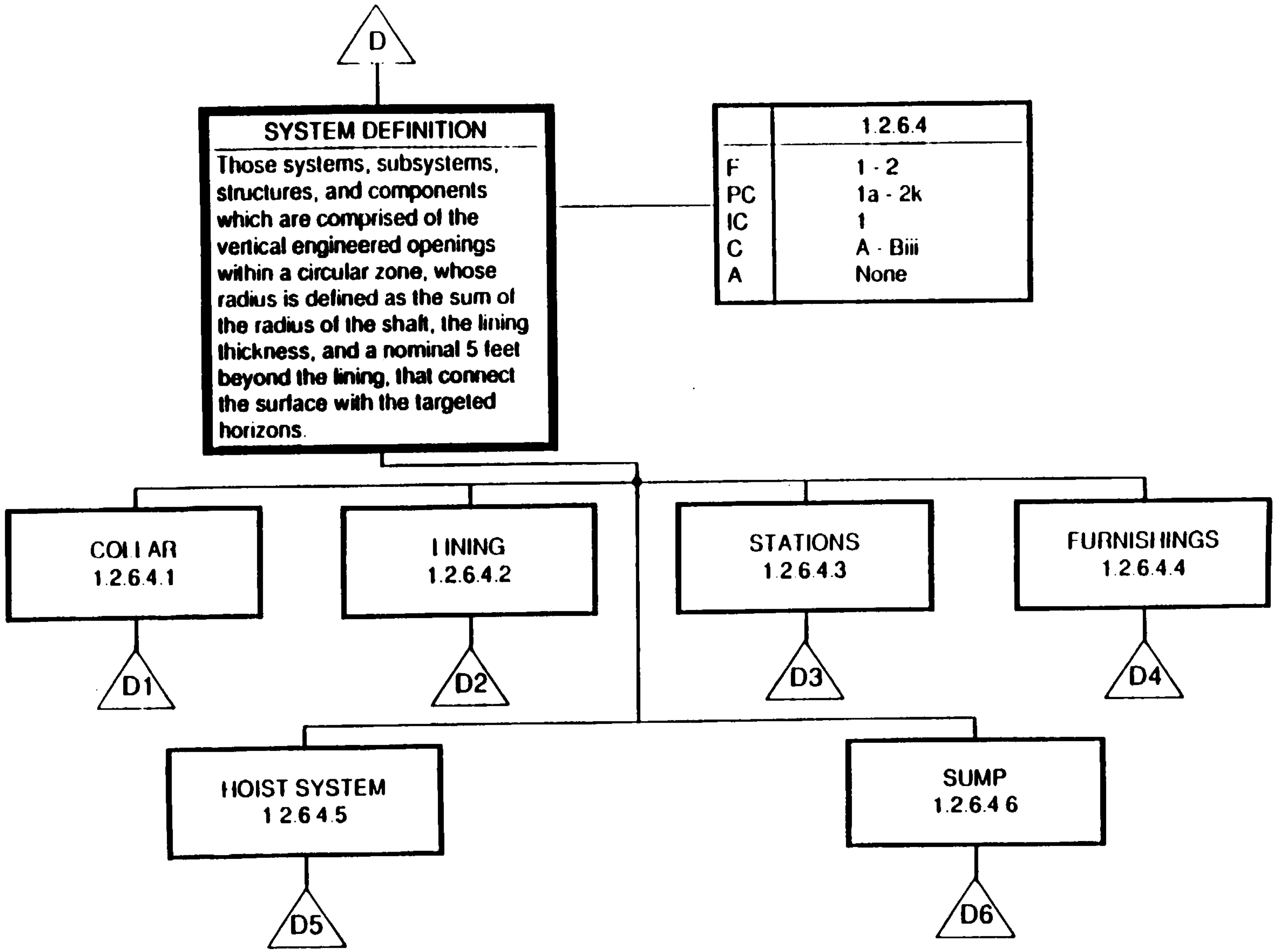
C9

SYSTEM DEFINITION

Provides for all the facilities, systems, and services for the communications, data collection, and transmissions that are required to support construction and testing.

	1.2.6.3.9
F	1
PC	1a - 1d
IC	None
C	A
A	None

SHAFT ACCESS



APPENDIX G-16

COLLAR

D1

SYSTEM DEFINITION

The foundation at the uppermost portion of the shaft used to support the headframe and shaft construction activities.

	1.2.6.4.1
F	1
PC	1a - 1b
IC	None
C	A - B
A	None

LINING

D2

SYSTEM DEFINITION

Those components (e.g., concrete) which are provided to maintain the integrity of the intended opening.

	1.2.6.4.2
F	1
PC	1a - 1d
IC	None
C	A - C
A	None

STATIONS

D3

SYSTEM DEFINITION

The initial underground opening at predetermined horizons adjacent to the shaft.

	1.2.6.4.3
F	1
PC	1a - 1h
IC	None
C	None
A	None

FURNISHINGS

D4

SYSTEM DEFINITION

Those structural steel sets consisting of buntons attached to fabricated brackets, which are fixed to the shaft wall or to other structural members.

	1.2.6.4.4
F	1
PC	1a - 1l
IC	None
C	A - C
A	None

HOIST SYSTEM

D5

SYSTEM DEFINITION
Those systems and components for the transportation of personnel and equipment between the surface and subsurface to meet the needs of shaft construction and underground site characterization testing.

	1.2.6.4.5
F	1
PC	1a - 1j
IC	None
C	A - I
A	None

SUMP

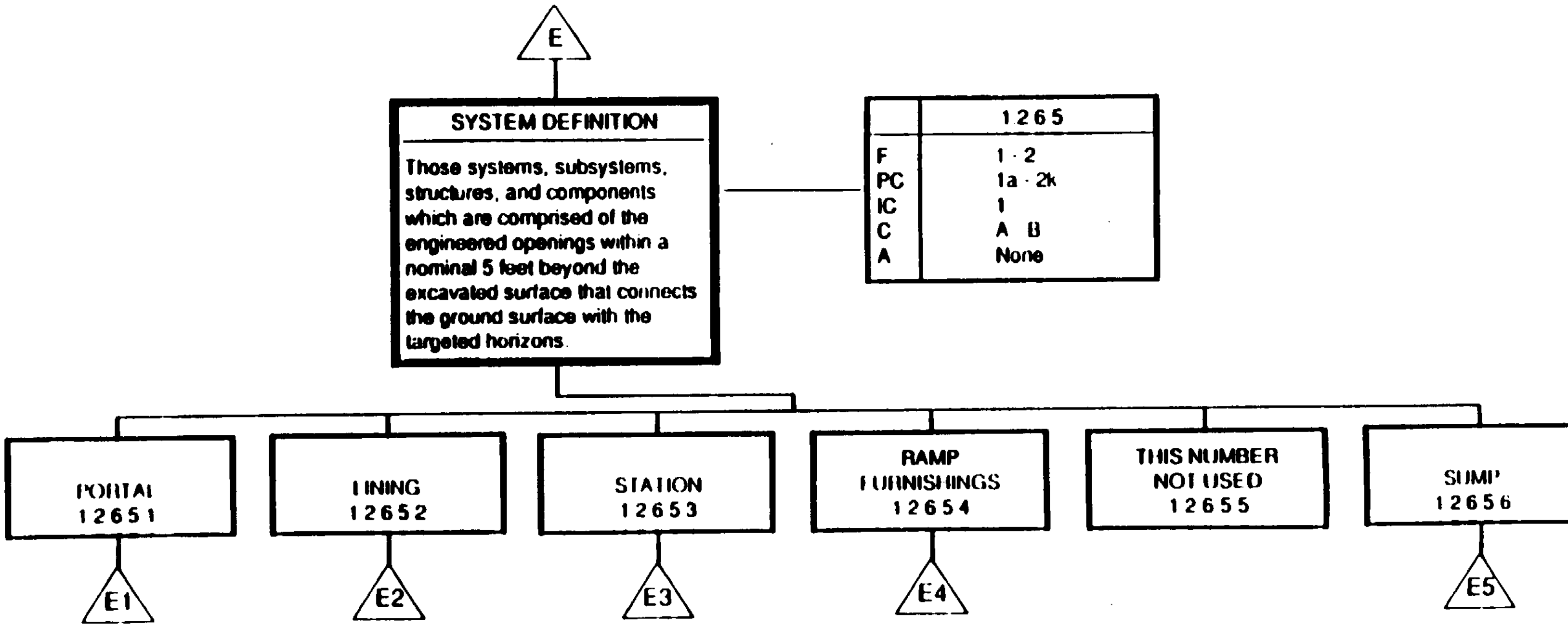
D6

SYSTEM DEFINITION
The area at the bottom of the shaft, below the adjacent horizontal excavation, that contains collection and transfer equipment for the underground wastewater system.

	1.2.6.4.6
F	1
PC	1a - 1c
IC	None
C	A - B
A	None

YMP CC-0013, Rev. 5/31/91

RAMP ACCESS



ESFDR2 057/3 26 91

PORTAL

E1

SYSTEM DEFINITION
Ramp Portal is the rock face and retaining structure at the uppermost portion of the ramp.

	1.2.6.5.1
F	1
PC	1
IC	None
C	A - B
A	None

LINING

E2

SYSTEM DEFINITION
Lining is those components which are provided to maintain integrity of the intended opening (e.g., concrete).

	1.2.6.5.2
F	1
PC	1a - 1e
IC	None
C	A - C
A	None

YMP/CC-0013, Rev. 5/31/91

STATION

E3

SYSTEM DEFINITION

Station is the initial underground opening at the predetermined horizon adjacent to the ramp.

	1.2.6.5.3
F	1
PC	1a - 1e
IC	None
C	None
A	None

RAMP FURNISHINGS

E4

SYSTEM DEFINITION

Furnishings include fabricated brackets which are fixed to the ramp wall or other support members.

	1.2.6.5.4
F	1
PC	1a - 1c
IC	None
C	A - C
A	None

SUMP

E5

SYSTEM DEFINITION

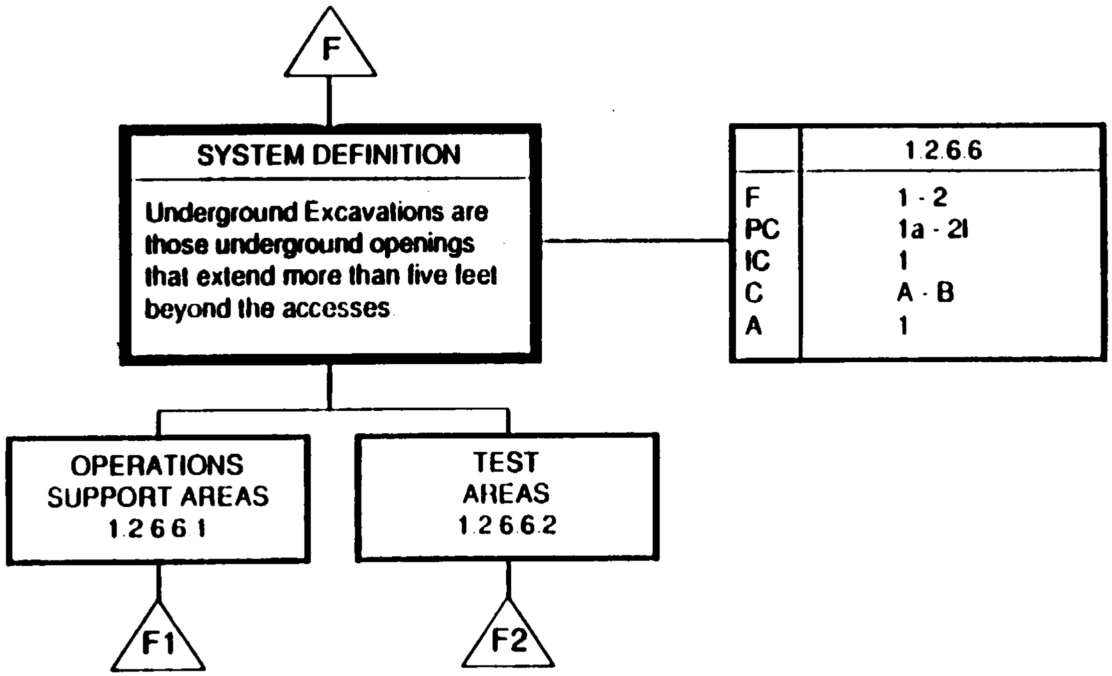
Sump is the area(s) within the ramp that contains the underground wastewater system collection and transfer equipment.

	1.2.6.5.6
F	1
PC	1a - 1b
IC	None
C	None
A	None

ESFDR2 057/3 26 91

YMP CC-0013, Rev. 5/31/91

UNDERGROUND EXCAVATIONS



YMP/CC-0013, Rev. 5/31/91

OPERATIONS SUPPORT AREAS

F1

SYSTEM DEFINITION

Operations Support Areas are underground openings: drift(s), refuge room(s), operations admin. area, underground shop(s), lunchroom(s), storage facility(ies), maintenance shop(s), power dist. areas, fuel storage, and equipment storage.

	1.2.6.6.1
F	1
PC	1a - 1c
IC	None
C	A - B
A	None

TEST AREAS*

F2

SYSTEM DEFINITION

Test Areas are openings excavated off the ESF access stations at the upper demonstration breakout room, the main test level, and other required levels.

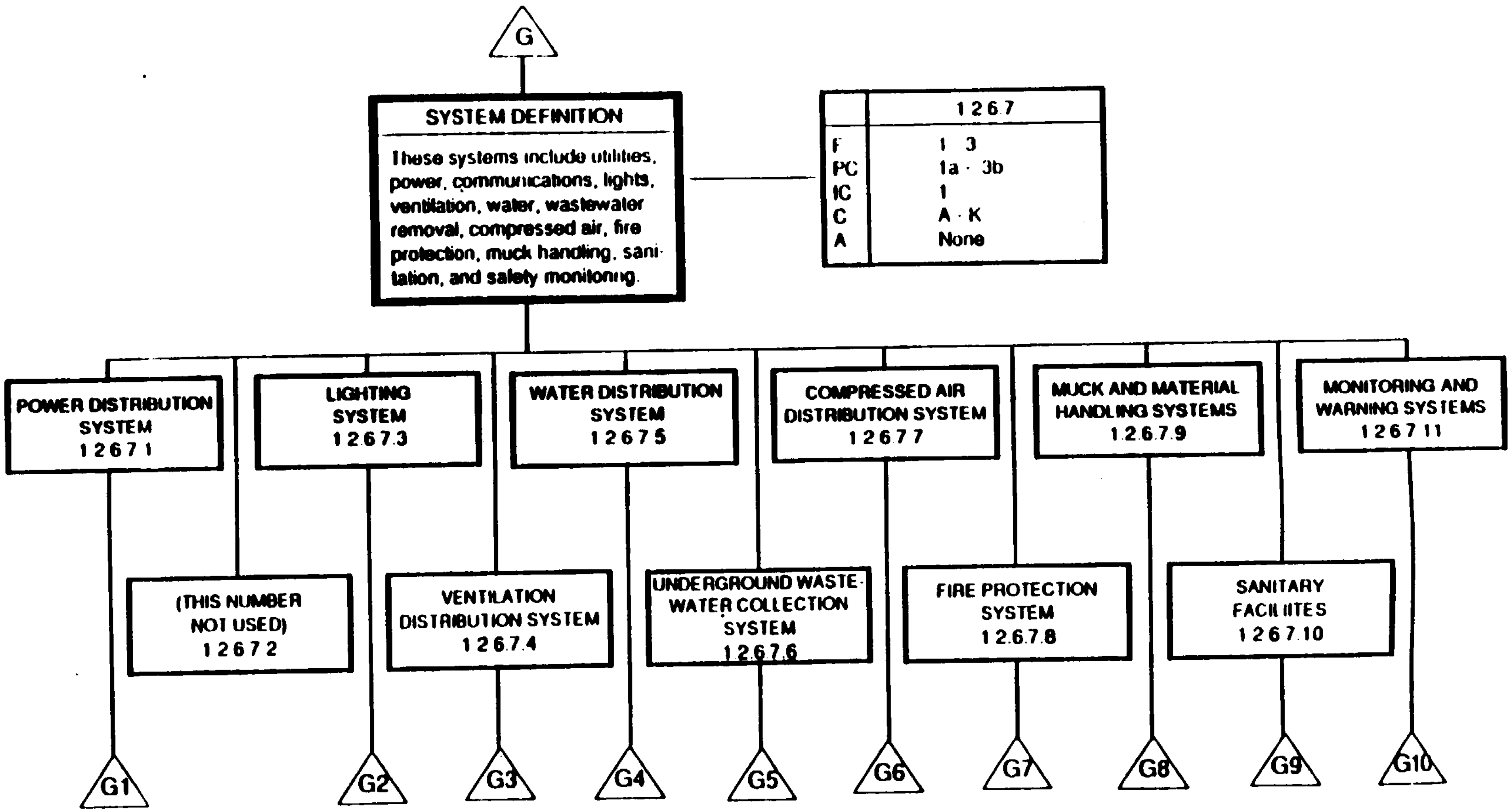
	1.2.6.6.2
F	1
PC	1
IC	None
C	A - B
A	None

* The tests that will be performed in these areas are defined in Appendices B & C of the ESFDR.

ESFDR2 057/3 26 91

YMP/CC-0013, Rev. 5/31/91

UNDERGROUND SUPPORT SYSTEMS



ESFDR2 057/3 26 91

YMP/CC-0013, Rev. 5/31/91

POWER DISTRIBUTION SYSTEM

G1

SYSTEM DEFINITION

Systems, subsystems, and components that distribute electric power to the underground system.

	1.2.6.7.1
F	1
PC	1a - 1d
IC	None
C	A - F
A	None

YMP/CC-0013, Rev. 5/31/91

ESFDR2 057/3 26 91

LIGHTING SYSTEM

G2

SYSTEM DEFINITION

Systems, subsystems, and components that provide for the illumination of the ESF underground areas.

	1.2.6.7.3
F	1
PC	1a - 1d
IC	None
C	A - C
A	None

VENTILATION DISTRIBUTION SYSTEM

G3

SYSTEM DEFINITION

Systems, subsystems, and components that allow fresh air to be supplied and exhaust air to be removed from the underground working areas.

	1.2.6.7.4
F	1
PC	1a - 1g
IC	None
C	A - I
A	1

WATER DISTRIBUTION SYSTEM

G4

SYSTEM DEFINITION

Systems, subsystems, and components that distribute water within the underground facility.

	1.2.6.7.5
F	1
PC	1
IC	None
C	A
A	1

UNDERGROUND WASTEWATER COLLECTION SYSTEM

G5

SYSTEM DEFINITION

Systems, subsystems, and components that collect, control, and transfer to the surface wastewater system (1.2.6.2.5).

	1.2.6.7.6
F	1
PC	1a - 1l
IC	None
C	A
A	None

YMP/CC-0013, Rev. 5/31/91

COMPRESSED AIR DISTRIBUTION SYSTEM

G6

SYSTEM DEFINITION

Systems, subsystems, and components that distribute compressed air throughout the underground ESF facility.

	1.2.6.7.7
F	1
PC	1
IC	None
C	None
A	None

FIRE PROTECTION SYSTEM

G7

SYSTEM DEFINITION

Systems, subsystems, and components that provide detection corrective response to extinguish fires.

	1.2.6.7.8
F	1
PC	1a - 1c
IC	None
C	A - C
A	None

YMP/CC-0013, Rev. 5/31/91

MUCK AND MATERIAL HANDLING SYSTEMS

G8

SYSTEM DEFINITION

Systems, subsystems, structures, equipment, and components that transport excavated rock (muck), materials, and equipment between surface and subsurface.

	1.2.6.7.9
F	1
PC	1a - 1c
IC	None
C	A - E
A	None

SANITARY FACILITIES

G9

SYSTEM DEFINITION

System that provides for human waste collection.

	1.2.6.7.10
F	1
PC	1a - 1c
IC	None
C	None
A	None

ESFDR2 057/3 26 91

YMP/CC-0013, Rev. 5/31/91

MONITORING AND WARNING SYSTEMS

G10

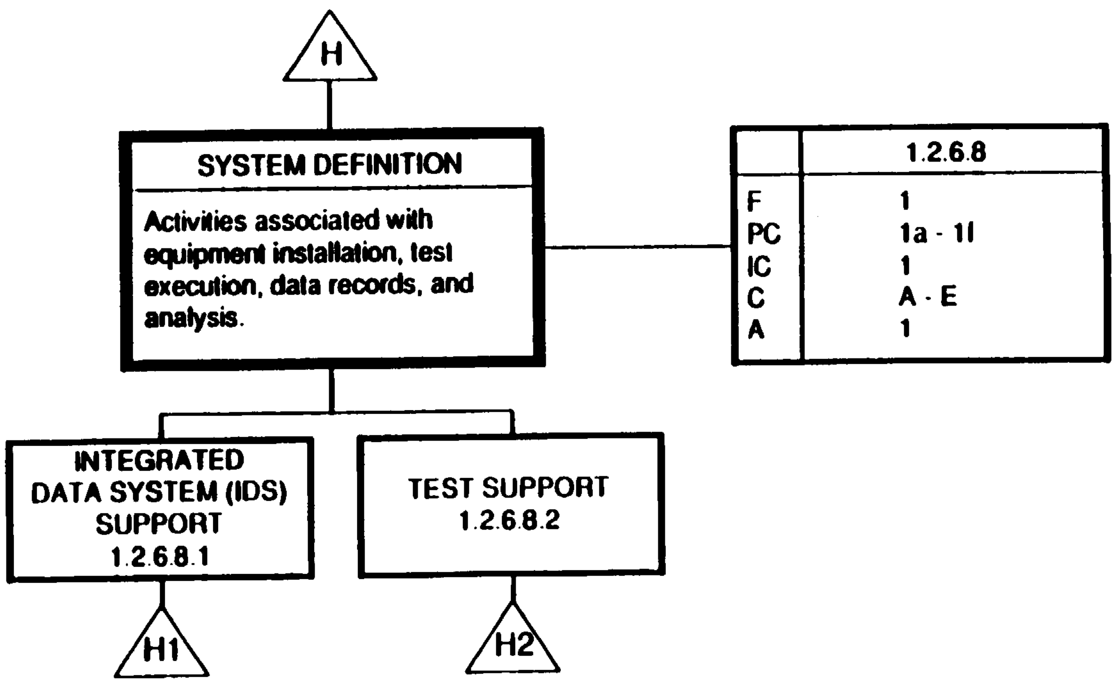
SYSTEM DEFINITION

System required to monitor underground conditions and to alert onsite personnel of possible dangerous situations.

	1.2.6.7.11
F	1
PC	1a - 1f
IC	None
C	A - B
A	None

YMP/CC-0013, Rev. 5/31/91

UNDERGROUND TEST SUPPORT*



* Tests are defined in Appendices B & C of the ESFDR.

ESFDR2 057/3 26 91

YMP/CC-0013, Rev. 5/31/91

INTEGRATED DATA SYSTEM (IDS) SUPPORT

H1

SYSTEM DEFINITION

Providing facilities as described in ESFDR Appendix B

	1.2.6.8.1
F	1
PC	1
IC	1 - 2
C	None
A	None

TEST SUPPORT

H2.

SYSTEM DEFINITION

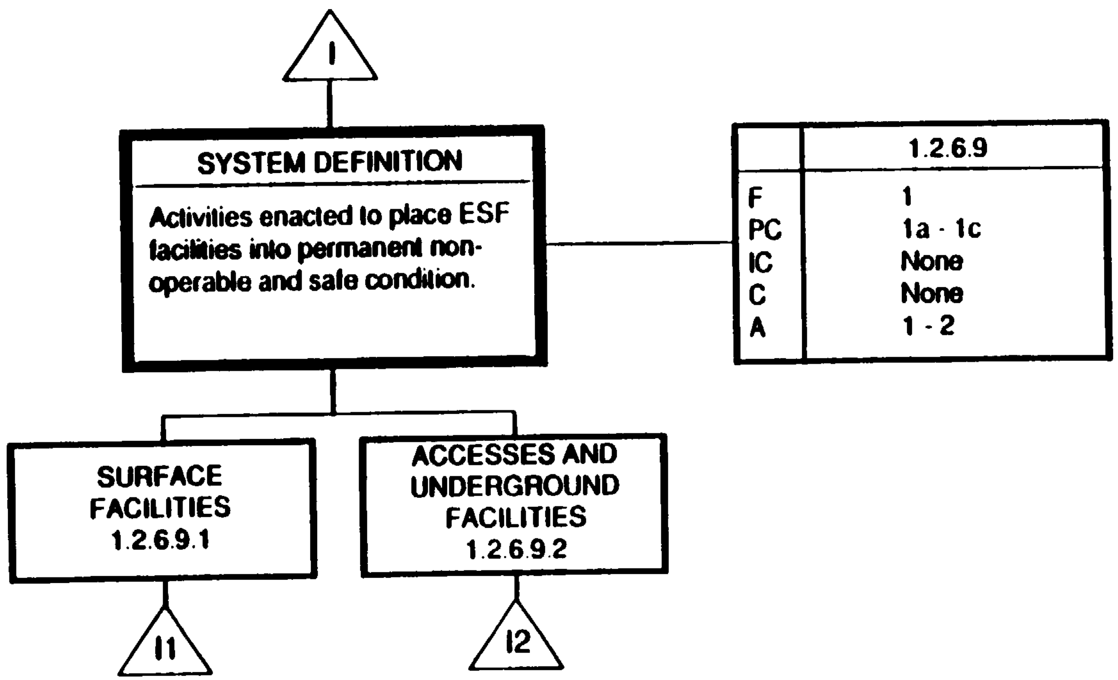
Four types of tests:
- Geologic
- Geomechanic
- Near-field and thermally perturbed
- Hydrologic and transport phenomena

	1.2.6.8.2
F	1
PC	1
IC	None
C	A
A	None

ESFDR2 057/3 26 91

YMP/CC-0013, Rev. 5 11/91

ESF DECOMMISSIONING AND CLOSURE



YMP-CC-0013, Rev. 5/31/91

SURFACE FACILITIES

I1

SYSTEM DEFINITION

All facilities, systems, and subsystems as defined in previous sections (ESF site, surface utilities, facilities, etc.).

	1.2.6.9.1
F	1
PC	1a - 1b
IC	None
C	A - B
A	None

ACCESSES AND UNDERGROUND FACILITIES

I2

SYSTEM DEFINITION

All facilities, systems, and subsystems described in previous sections (accesses, underground excavations, utility systems, etc.).

	1.2.6.9.2
F	1
PC	1
IC	None
C	A
A	None

ESFDR2 057/3 26 91

YMP CC-0013, Rev. 5/31/91

YMP CC-0013, Rev. 5 31 91

APPENDIX H

RESPONSIBILITY MATRIX

YMP/CC-0013, Rev. 5/31/91

APPENDIX H

The terms and format of the Responsibility Matrix are explained as follows:

Column (1), ESFDR Section, lists the requirements by ESFDR section number. Please refer to the ESFDR for the actual requirements.

Column (2), DAA Recommendations, provides information that identifies the ESFDR requirements that correspond to DAA recommendations (see ESF Title I Design Acceptability Analysis and Comparative Evaluations of Alternative ESF Locations, Volume 1, Page 2-54 through 2-58). Typical references used to identify recommendations are C2-5 and C2-5,7. The C2 identifies this as a recommendation related to NRC Concern #2. The 5 and 7 identify specific Recommendations Numbers 5 and 7 related to NRC Concern #2.

Column (3), Category, provides information regarding the verification of the ESF requirements to a source of authority. The status codes used in this category column are identified on the bottom of each page. TBV indicates this requirement is "TO BE VERIFIED." A second term in this column may appear as a TBD which indicated this requirement needs a quantified value or range and is "TO BE DETERMINED."

Column (4), Responsible Organization, shows the organization(s) that have accepted responsibility to design and implement per that requirement. If two or more organizations appear in this column, responsibility may be shared or responsibility may be assigned to one organization. Resolution of disputes will be referred to higher authority as needed. The same is true for support organizations.

Column (5), Support Organization, identifies the organizations that might provide analysis support for quantifying the requirement (i.e., value or range) and may or may not be the same as the Responsible Organization. This task will include verification of analysis, such as independent technical review. Other examples of support might be acquisition of permits or tests.

YMP CC-0013, Rev. 5/31/91

(1) ESFDR Section	(2) DAA Recommendations	(3) Category	(4) Resp Org	(5) Sup Org
1.2.6.0 EXPLORATORY STUDIES FACILITY				
1.2.6.0 DEF		NV	RSN	
1.2.6.0 BI		NV	RSN	
1.2.6.0 ARCS		NV	RSN	
1.2.6.0 ARCS [2]		NV	RSN	
1.2.6.0 ARCS [3]		NV	RSN	
1.2.6.0 FR 1.		OK	PO	RSN/LANL/SNL/REECO
1.2.6.0 FR 2.		OK	SNL	RSN
1.2.6.0 PC 1a.		OK	SNL	
1.2.6.0 PC 1b.		OK	SNL RSN	
1.2.6.0 PC 1c.		OK	SNL	
1.2.6.0 PC 1d.		OK TBD	LANL	
1.2.6.0 PC 1d.i		NV	RSN	
1.2.6.0 PC 1d.ii		NV	RSN	
1.2.6.0 PC 1d.iii		NV TBD	RSN	
1.2.6.0 PC 1e.		OK	RSN	
1.2.6.0 PC 1f.		OK	RSN	
1.2.6.0 PC 1g.		OK	RSN	
1.2.6.0 PC 1h.		OK	RSN	
1.2.6.0 PC 1i.		OK	RSN	SNL
1.2.6.0 PC 1j.		OK	RSN	
1.2.6.0 PC 1j.i		NV	RSN	
1.2.6.0 PC 1j.ii		NV	RSN	PO/REEC
1.2.6.0 PC 1k.		OK	RSN	
1.2.6.0 PC 2a.		OK	SNL/RSN	
1.2.6.0 PC 2b.		OK	SNL/RSN	
1.2.6.0 PC 2b.i		NV	SNL/RSN	
1.2.6.0 PC 2b.ii		NV	SNL/RSN	
1.2.6.0 PC 2b.iii		NV	SNL/RSN	
1.2.6.0 PC 2b.iv		NV	SNL/RSN	
1.2.6.0 PC 2b. (end)		NV	RSN	
1.2.6.0 PC 2c.		OK	RSN	SNL
1.2.6.0 PC 2c.i		NV	RSN	SNL/REECO
1.2.6.0 PC 2c.ii		NV	RSN	SNL/REECO
1.2.6.0 PC 2c.iii		NV	RSN	SNL/REECO

(3) Category:
OK = Verified source of authority; NV = Not verified to source of authority;
(Blank) = Test not available for source check

 YMP/CC-0013, Rev. 5/31/91

(1) ESFDR Section	(2) DAA Recommendations	(3) Category	(4) Resp Org	(5) Sup Org
1.2.6.0 PC 2c.iv		NV	RSN	SNL/REECO
1.2.6.0 PC 2c.v	C1-12, -20	NV	RSN	SNL/REECO
1.2.6.0 PC 2c.vi		NV	RSN	SNL
1.2.6.0 PC 2d.		OK	SNL	
1.2.6.0 PC 2e.		OK	RSN	SNL
1.2.6.0 PC 2f.		OK	RSN	
1.2.6.0 PC 2f.i		NV	RSN/LANL	
1.2.6.0 PC 2f.i.a		NV	RSN/LANL	
1.2.6.0 ICR 1.		OK TBD	PO	T&MSS
1.2.6.0 ICR 2.		NV	RSN	
1.2.6.0 C A.		OK	PO	
1.2.6.0 C B.		OK	REECO	PO
1.2.6.0 C C.		OK	LANL	
1.2.6.0 C C.(1)		OK	LANL	
1.2.6.0 C C.(2)		OK	RSN	LANL/SNL
1.2.6.0 C C.(3)		OK	RSN	LANL/SNL
1.2.6.0 C C.(4)		OK	LANL	RSN/SNL
1.2.6.0 C C.i		NV	LANL/REECO	
1.2.6.0 C C.ii		NV	LANL	
1.2.6.0 C C.iii		OK	SNL/LANL	
1.2.6.0 C C.iv		NV TBD	RSN/SNL/LANL	SNL/LANL
1.2.6.0 C C.v		NV	LANL	REECO
1.2.6.0 C C.v[2]		NV	RSN	
1.2.6.0 C C.v[3]		NV	RSN	
1.2.6.0 C C.vi		NV	LANL	
1.2.6.0 C C.vii		NV	REECO	
1.2.6.0 C C.viii		NV	SNL	
1.2.6.0 C D.		OK	PO	LANL
1.2.6.0 C D.[2]		OK	LANL/SNL	
1.2.6.0 C E.		OK	RSN	
1.2.6.0 C E.i		NV	SNL	RSN
1.2.6.0 C E.ii		NV	RSN	
1.2.6.0 C F.		OK	RSN	LANL
1.2.6.0 C G.		OK	RSN	REECO
1.2.6.0 C G.i		NV	RSN	
1.2.6.0 C H.		OK	RSN	
1.2.6.0 C I.		OK	RSN	
1.2.6.0 C J.		OK	REECO	RSN
1.2.6.0 C K.		OK	RSN	
1.2.6.0 C L.		OK TBD	RSN	
1.2.6.0 C M.		OK	RSN	
1.2.6.1. ESF SITE(S)				
1.2.6.1 DEF		NV	RSN	

(3) Category:
OK = Verified source of authority; NV = Not verified to source of authority;
(Blank) = Test not available for source check

YMP CC-0013, Rev. 5/31/91

(1) ESFDR Section	(2) DAA Recommendations	(3) Category	(4) Resp Org	(5) Sup Org
1.2.6.1 BI		NV	RSN	
1.2.6.1 ARCS 1.		NV	RSN	
1.2.6.1 ARCS 2.		NV	RSN	
1.2.6.1 ARCS 3.		NV		
1.2.6.1 ARCS 4.		NV	RSN	
1.2.6.1 ARCS 5.		NV	RSN	
1.2.6.1 ARCS 6.		NV	RSN	
1.2.6.1 ARCS (end)		NV	RSN	
1.2.6.1 FR 1.		OK		
1.2.6.1 PC 1a.		OK	RSN	
1.2.6.1 PC 1b.		OK	RSN	
1.2.6.1 PC 1c.		OK	RSN	
1.2.6.1 PC 1d.		OK	RSN	
1.2.6.1 PC 1e.		OK	RSN	
1.2.6.1 PC 1f.		NV	RSN	
1.2.6.1 PC 1g.		OK	RSN	
1.2.6.1 PC 1h.		OK	RSN	
1.2.6.1 ICR 1.		NV	RSN	
1.2.6.1 ICR (end)		NV	RSN	
1.2.6.1 C A.	C1-1,2,4,6,7,8,9, 10,11,12,14,15,17, 18,19,20	OK TBD	SNL	
1.2.6.1 C B.		OK	RSN	
1.2.6.1 C C.		OK		
1.2.6.1 C C.i		NV TBD	SNL	SNL
1.2.6.1 C C.ii	C1-1, C2-6	NV	RSN	SNL
1.2.6.1 C C.iii	C1-1,2,3,4,5,6,7, 8,10,11,12,13,14, 15,16,18,19,20	NV	RSN	
1.2.6.1 C D.	C2-4	OK	RSN	LANL
1.2.6.1 C E.		OK	LANL/RSN	
1.2.6.1 C F.		OK		
1.2.6.1 C F.i		NV	RSN	LANL
1.2.6.1 C F.ii		NV	RSN	SNL/LANL
1.2.6.1 C F.iii		NV	RSN	
1.2.6.1 C F.iv		NV TBD	RSN	LANL
1.2.6.1 C F.v		NV	RSN	LANL
1.2.6.1 C G.		OK	RSN	
1.2.6.1 C H.		OK	RSN	
1.2.6.1 C I.		OK	RSN	
1.2.6.1 C J.		OK	RSN	
1.2.6.1 C K.		OK	RSN	
1.2.6.1 C L.		OK	RSN	
1.2.6.1 C M.		OK	RSN	

(3) Category:
OK = Verified source of authority; NV = Not verified to source of authority;
(Blank) = Test not available for source check

YMP CC-0013, Rev. 5/31/91

(1) ESFDR Section	(2) DAA Recommendations	(3) Category	(4) Resp Org	(5) Sup Org
1.2.6.1 C N.		OK	RSN	REECO/LANL
1.2.6.1 C C.		OK	RSN	LANL
1.2.6.1 A 1.		NV	RSN	
1.2.6.1 A 2.		NV	RSN	
1.2.6.1 A 3.		NV	RSN	LANL
1.2.6.1.1 DEF		NV	RSN	
1.2.6.1.1 BI		NV	RSN	
1.2.6.1.1 FR 1.		OK	RSN	
1.2.6.1.1 PC 1a.		OK		
1.2.6.1.1 PC 1a.i		OK	RSN	
1.2.6.1.1 PC 1a.ii		OK	RSN	
1.2.6.1.1 PC 1a.iii		OK	RSN	
1.2.6.1.1 PC 1a.iv		OK	RSN	
1.2.6.1.1 PC 1a.v		OK	RSN	
1.2.6.1.1 PC 1a.vi		OK	RSN	
1.2.6.1.1 PC 1a.vii		OK	RSN	
1.2.6.1.1 PC 1a.viii		OK	RSN	
1.2.6.1.1 PC 1a.ix		OK	RSN	
1.2.6.1.1 PC 1a.x		OK	RSN	
1.2.6.1.1 PC 1a.xi		OK	RSN	
1.2.6.1.1 PC 1a.xii		OK	RSN	
1.2.6.1.1 PC 1b.		OK	RSN	
1.2.6.1.1 C A.		OK	RSN	
1.2.6.1.1 C B.		OK	RSN	
1.2.6.1.1 A 1.		NV	RSN	
1.2.6.1.2 DEF		NV	RSN	
1.2.6.1.2 BI		NV	RSN	
1.2.6.1.2 FR 1.		OK	RSN	
1.2.6.1.2 PC 1a.		NV	RSN	
1.2.6.1.2 PC 1a.i		NV	RSN	
1.2.6.1.2 PC 1a.i.a		NV	RSN	
1.2.6.1.2 PC 1a.i.b		NV	RSN	
1.2.6.1.2 PC 1a.i.c		NV	RSN	
1.2.6.1.2 PC 1a.i.d		NV	RSN	
1.2.6.1.2 PC 1a.i.e		NV	RSN	
1.2.6.1.2 PC 1a.i.f		NV	RSN	
1.2.6.1.2 PC 1a.ii		NV	RSN	LANL
1.2.6.1.2 PC 1a.ii.a		NV	RSN	
1.2.6.1.2 PC 1a.ii.b		NV	RSN	
1.2.6.1.2 PC 1a.ii.c		NV	RSN	

(3) Category:
OK = Verified source of authority; NV = Not verified to source of authority;
(Blank) = Test not available for source check

YMP-CC-0013, Rev. 5/31/91

(1) ESFDR Section	(2) DAA Recommendations	(3) Category	(4) Resp Org	(5) Sup Org
1.2.6.1.2 PC 1a.ii.d		NV	RSN	
1.2.6.1.2 PC 1a.ii.e		NV	RSN	
1.2.6.1.2 PC 1a.ii.f		NV	RSN	
1.2.6.1.2 PC 1a.ii.g		NV	RSN	
1.2.6.1.2 PC 1a.ii.h		NV	RSN	
1.2.6.1.2 PC 1a.ii.i		NV	RSN	
1.2.6.1.2 PC 1a.ii.j		NV	RSN	
1.2.6.1.2 PC 1a.iii		NV	RSN	
1.2.6.1.2 PC 1a.iii.a		NV	RSN	
1.2.6.1.2 PC 1a.iii.b		NV	RSN	
1.2.6.1.2 PC 1a.iii.c		NV	RSN	
1.2.6.1.2 PC 1a.iii.d		NV	RSN	
1.2.6.1.2 PC 1a.iii.e		NV	RSN	
1.2.6.1.2 PC 1a.iii.f		NV	RSN	
1.2.6.1.2 PC 1a.iv		NV	RSN	
1.2.6.1.2 PC 1a.iv.a		NV	RSN	
1.2.6.1.2 PC 1a.v		NV	RSN	LANL
1.2.6.1.2 PC 1a.v.a		NV	RSN	LANL
1.2.6.1.2 PC 1a.v.b		NV	RSN	LANL
1.2.6.1.2 PC 1a.v.c		NV	RSN	LANL
1.2.6.1.2 PC 1a.v.d		NV	RSN	LANL
1.2.6.1.2 PC 1a.v.e		NV	RSN	LANL
1.2.6.1.2 PC 1a.v.f		NV	RSN	LANL
1.2.6.1.2 PC 1a.v.g		NV	RSN	
1.2.6.1.2 PC 1a.vi		NV	RSN	LANL
1.2.6.1.2 PC 1a.vi.a		NV	RSN	LANL
1.2.6.1.2 PC 1a.vi.b		NV	RSN	LANL
1.2.6.1.2 PC 1a.vi.c		NV	RSN	LANL
1.2.6.1.2 PC 1a.vi.d		NV	RSN	LANL
1.2.6.1.2 PC 1a.vi.e		NV	RSN	LANL
1.2.6.1.2 PC 1b.		OK	RSN	
1.2.6.1.2 PC 1b.i		OK	RSN	
1.2.6.1.2 PC 1b.ii		OK	RSN	
1.2.6.1.2 PC 1b.iii		OK	RSN	
1.2.6.1.2 PC 1b.iv		OK	RSN	
1.2.6.1.2 PC 1b.v		OK	RSN	
1.2.6.1.2 C A.		OK	RSN	
1.2.6.1.2 C B.		OK	RSN	
1.2.6.1.2 C C.		OK	RSN	
1.2.6.1.2 C D.		OK	RSN	
1.2.6.1.2 A 1.		NV	RSN	
1.2.6.1.2 A 2.		NV	RSN	

(3) Category:
OK = Verified source of authority; NV = Not verified to source of authority;
(Blank) = Test not available for source check

(1) ESFDR Section	(2) DAA Recommendations	(3) Category	(4) Resp Org	(5) Sup Org
1.2.6.1.3 DEF		NV	RSN	
1.2.6.1.3 BI		NV	RSN	
1.2.6.1.3 FR 1.		OK	RSN	
1.2.6.1.3 PC 1a.		OK	RSN	
1.2.6.1.3 PC 1b.		OK	RSN	
1.2.6.1.3 PC 1c.		OK	RSN	
1.2.6.1.3 PC 1d.		OK	RSN	
1.2.6.1.3 C A.		OK TBD	RSN	
1.2.6.1.3 C B.		OK TBD	RSN	
1.2.6.1.3 C C.		OK	RSN	
1.2.6.1.3 C D.		OK	RSN	
1.2.6.1.3 C E.		OK	RSN	
1.2.6.1.3 C F.		OK	RSN	
1.2.6.1.3 C G.		OK	RSN	
1.2.6.1.4 DEF		NV	RSN	
1.2.6.1.4 BI		NV	RSN	
1.2.6.1.4 FR 1.		OK	RSN	
1.2.6.1.4 PC 1.		OK	RSN	
1.2.6.1.4 C A.		OK	RSN	
1.2.6.2 SURFACE UTILITIES				
1.2.6.2 DEF		NV	RSN	
1.2.6.2 BI		NV	RSN	
1.2.6.2 ARCS		NV	RSN	
1.2.6.2 ARCS EP		NV	RSN	
1.2.6.2 ARCS 1.		NV	RSN	
1.2.6.2 ARCS 2.		NV	RSN	
1.2.6.2 ARCS 3.		NV	RSN	
1.2.6.2 ARCS L		NV	RSN	
1.2.6.2 ARCS 1.		NV	RSN	
1.2.6.2 ARCS SP		NV	RSN	
1.2.6.2 ARCS 1.		NV	RSN	
1.2.6.2 ARCS 2.		NV	RSN	
1.2.6.2 ARCS UP		NV	RSN	
1.2.6.2 ARCS 1.		NV	RSN	
1.2.6.2 ARCS 2.		NV	RSN	
1.2.6.2 ARCS 3.		NV	RSN	
1.2.6.2 ARCS WS		NV	RSN	
1.2.6.2 ARCS 1.		NV	RSN	
1.2.6.2 ARCS 2.		NV	RSN	
1.2.6.2 ARCS 3.		NV	RSN	

(3) Category:
OK = Verified source of authority; NV = Not verified to source of authority;
(Blank) = Test not available for source check

YMP/CC-0013, Rev. 5/31/91

(1) ESFDR Section	(2) DAA Recommendations	(3) Category	(4) Resp Org	(5) Sup Org
1.2.6.2 ARCS SS		NV	RSN	
1.2.6.2 ARCS 1.		NV	RSN	
1.2.6.2 ARCS 2.		NV	RSN	
1.2.6.2 ARCS CS		NV	RSN	
1.2.6.2 ARCS 1.		NV	RSN	
1.2.6.2 ARCS SWW		NV	RSN	
1.2.6.2 ARCS 1.		NV	RSN	
1.2.6.2 ARCS 2.		NV	RSN	
1.2.6.2 ARCS CA		NV	RSN	
1.2.6.2 ARCS 1.		NV	RSN	
1.2.6.2 ARCS (end)		NV	RSN	
1.2.6.2 FR 1.		OK	RSN	LANL
1.2.6.2 PC 1a.		OK	RSN	LANL
1.2.6.2 PC 1b.		OK	RSN	
1.2.6.2 PC 1c.		OK	RSN	
1.2.6.2 PC 1d.		OK	RSN	LANL
1.2.6.2 PC 1e.		OK	RSN	
1.2.6.2 ICR 1.		NV	SNL	
1.2.6.2 ICR 2.		NV	RSN	
1.2.6.2 ICR (end)		NV	RSN	
1.2.6.2 C A.		OK	SNL	
1.2.6.2 C B.		OK	RSN	
1.2.6.2 C C.		OK	RSN	
1.2.6.2 C D.		OK	RSN	LANL
1.2.6.2 C E.	C1-4	OK	RSN	
1.2.6.2 C F.		OK	RSN	
1.2.6.2 A 1.		NV	RSN	
1.2.6.2 A 1.a		NV	RSN	
1.2.6.2 A 1.b		NV	RSN	
1.2.6.2.1 DEF		NV	RSN	
1.2.6.2.1 DEF [2]		NV	RSN	
1.2.6.2.1 BI		NV	RSN	
1.2.6.2.1 FR 1.		OK	RSN	
1.2.6.2.1 PC 1a.		OK	RSN	LANL
1.2.6.2.1 PC 1b.		OK	RSN	LANL
1.2.6.2.1 PC 1c.		OK	RSN	
1.2.6.2.1 PC 1d.		OK	RSN	
1.2.6.2.1 PC 1e.		OK	RSN	
1.2.6.2.1 PC 1f.		OK	RSN	
1.2.6.2.1 PC 1g.		OK TBV	RSN	
1.2.6.2.1 PC 1g.i		NV TBV	RSN	
1.2.6.2.1 PC 1g.ii		NV TBV	RSN	
1.2.6.2.1 PC 1g.iii		NV TBV	RSN	

(3) Category:
OK = Verified source of authority; NV = Not verified to source of authority;
(Blank) = Test not available for source check

YMP/CC-0013, Rev. 5/31/91

(1) ESFDR Section	(2) DAA Recommendations	(3) Category	(4) Resp Org	(5) Sup Org
1.2.6.2.1 PC 1g.iv		NV TBV	RSN	
1.2.6.2.1 PC 1g.v		NV TBV	RSN	
1.2.6.2.1 PC 1g.vi		NV TBV	RSN	
1.2.6.2.1 PC 1g.vii		NV TBV	RSN	
1.2.6.2.1 PC 1g.viii		NV TBV	RSN	
1.2.6.2.1 PC 1g.ix		NV TBV	RSN	
1.2.6.2.1 PC 1g.x		NV TBV	RSN	
1.2.6.2.1 PC 1g.xi		NV TBV	RSN	
1.2.6.2.1 PC 1h.		OK	RSN	
1.2.6.2.1 PC 1i.		OK	RSN	
1.2.6.2.1 PC 1i.i		NV	RSN	
1.2.6.2.1 PC 1i.ii		NV	RSN	REECO
1.2.6.2.1 PC 1j.		OK	RSN	LANL
1.2.6.2.1 PC 1j.i		NV	RSN	LANL
1.2.6.2.1 C A.		OK	RSN	
1.2.6.2.1 C B.		OK	RSN	
1.2.6.2.1 C C.		OK	RSN	
1.2.6.2.1 C D.		OK	RSN	
1.2.6.2.1 C E.		OK	RSN	
1.2.6.2.1 C F.		OK	RSN	
1.2.6.2.1 C G.		OK	RSN	
1.2.6.2.2 DEF		NV	RSN	
1.2.6.2.2 BI		NV	RSN	
1.2.6.2.2 FR 1.		OK	RSN	LANL
1.2.6.2.2 PC 1a.		OK	RSN	LANL
1.2.6.2.2 PC 1b.		OK	RSN	
1.2.6.2.2 PC 1c.		OK	RSN	
1.2.6.2.2 PC 1d.		OK	RSN	
1.2.6.2.2 PC 1e.		OK	RSN	
1.2.6.2.2 PC 1f.		OK	RSN	
1.2.6.2.2 PC 1g.		OK	RSN	
1.2.6.2.2 PC 1h.		OK	RSN	LANL
1.2.6.2.2 PC 1i.		OK	RSN	
1.2.6.2.2 C A.		OK	RSN	
1.2.6.2.2 C B.		OK	RSN	
1.2.6.2.2 C C.		OK	RSN	
1.2.6.2.2 C D.		OK	RSN	
1.2.6.2.2 C E.		OK	RSN	LANL
1.2.6.2.2 C F.		OK	RSN	
1.2.6.2.2 C F.i		NV	RSN	
1.2.6.2.2 C G.		OK	RSN	LANL
1.2.6.2.2 A 1.		NV	RSN	

(3) Category:
OK = Verified source of authority; NV = Not verified to source of authority;
(Blank) = Test not available for source check

(1) ESFDR Section	(2) DAA Recommendations	(3) Category	(4) Resp Org	(5) Sup Org
1.2.6.2.3 DEF		NV	RSN	
1.2.6.2.3 BI		NV	RSN	
1.2.6.2.3 FR 1.		OK	RSN	
1.2.6.2.3 PC 1a.		OK	RSN	
1.2.6.2.3 PC 1b.		OK	RSN	
1.2.6.2.3 PC 1c.		OK TBD	RSN	
1.2.6.2.3 C A.		OK	RSN	
1.2.6.2.3 C B.		OK TBD	RSN	SNL
1.2.6.2.3 C C.		OK	RSN	
1.2.6.2.4 DEF		NV	RSN	
1.2.6.2.4 BI		NV	RSN	
1.2.6.2.4 FR 1.		OK	RSN	LANL
1.2.6.2.4 PC 1a.		OK	RSN	
1.2.6.2.4 PC 1b.		OK	RSN	
1.2.6.2.4 PC 1c.		OK	RSN	
1.2.6.2.4 PC 1d.		OK	RSN	
1.2.6.2.4 PC 1e.		OK	RSN	LANL
1.2.6.2.4 PC 1f.		OK	RSN	
1.2.6.2.4 PC 1g.		OK	RSN	
1.2.6.2.4 C A.		OK	RSN	
1.2.6.2.4 C B.		OK	RSN	
1.2.6.2.4 C C.		OK	RSN	
1.2.6.2.4 C D.		OK	RSN	
1.2.6.2.4 C E.		OK	RSN	
1.2.6.2.4 C F.		OK	RSN	
1.2.6.2.4 C G.		OK	RSN	LANL
1.2.6.2.4 C H.		OK	RSN	
1.2.6.2.4 C I.		OK	RSN	
1.2.6.2.4 C J.		OK	RSN	
1.2.6.2.4 A 1.		NV	RSN	
1.2.6.2.5 DEF		NV	RSN	
1.2.6.2.5 BI		NV	RSN	
1.2.6.2.5 FR 1.		OK	RSN	
1.2.6.2.5 PC 1.		OK TBD	RSN	
1.2.6.2.5 C A.		OK TBD	RSN	SNL/LANL
1.2.6.2.5 C B.		OK TBD	SNL	SNL/LANL
1.2.6.2.5 C C.		OK	RSN	
1.2.6.2.6 DEF		NV	RSN	
1.2.6.2.6 BI		NV	RSN	
1.2.6.2.6 FR 1.		OK	RSN	
1.2.6.2.6 PC 1a.		OK	RSN	LANL
1.2.6.2.6 PC 1b.		OK	RSN	LANL

(3) Category:
OK = Verified source of authority; NV = Not verified to source of authority;
(Blank) = Test not available for source check

YMP/CC-0013, Rev. 5 31 91

(1) ESFDR Section	(2) DAA Recommendations	(3) Category	(4) Resp Org	(5) Sup Org
1.2.6.2.6 PC 1c.		OK	RSN	LANL
1.2.6.2.6 PC 1d.		OK	RSN	
1.2.6.2.6 C A.		OK	RSN	
1.2.6.3 SURFACE FACILITIES				
1.2.6.3 DEF		NV	PO	RSN/LANL
1.2.6.3 BI		NV	RSN	
1.2.6.3 ARCS		NV	RSN	
1.2.6.3 ARCS 1.		NV	RSN	
1.2.6.3 ARCS 2.		NV	RSN	
1.2.6.3 ARCS (end)		NV	RSN	
1.2.6.3 FR 1.		OK	RSN	
1.2.6.3 FR 2.		OK	RSN	
1.2.6.3 FR 3.		OK	RSN	
1.2.6.3 PC 1a.		OK	RSN	
1.2.6.3 PC 1a.i		OK	RSN	
1.2.6.3 PC 1a.ii		OK	RSN	LANL
1.2.6.3 PC 1a.iii		OK	RSN	
1.2.6.3 PC 1a.iv		OK	RSN	
1.2.6.3 PC 1a.v		OK	RSN	LANL
1.2.6.3 PC 1a.vi		OK	RSN	LANL
1.2.6.3 PC 1a.vii		OK	RSN	LANL
1.2.6.3 PC 1a.viii		OK	RSN	LANL
1.2.6.3 PC 1a.ix		OK	RSN	
1.2.6.3 PC 1a.x		OK	RSN	
1.2.6.3 PC 1a.xi		OK	RSN	
1.2.6.3 PC 1a.xii		OK	RSN	
1.2.6.3 PC 1a.xiii		OK	RSN	
1.2.6.3 PC 1a.xiv		OK	RSN	
1.2.6.3 PC 1a.xv		OK	RSN	
1.2.6.3 PC 1a.xvi		OK	RSN	
1.2.6.3 PC 1a.xvii		OK	RSN	
1.2.6.3 PC 1a.xviii		OK	RSN	
1.2.6.3 PC 1a.xix		OK	RSN	
1.2.6.3 PC 1a.xx		OK	RSN	
1.2.6.3 PC 1a.xxi		OK	RSN	
1.2.6.3 PC 1b.		OK	RSN	LANL
1.2.6.3 PC 1c.		OK	RSN	
1.2.6.3 PC 1d.		OK	RSN	PO/LANL
1.2.6.3 PC 1e.		OK	RSN	
1.2.6.3 PC 1f.		OK	RSN	
1.2.6.3 PC 1g.		OK	RSN	LANL
1.2.6.3 PC 1h.		OK	RSN	

(3) Category:
OK = Verified source of authority; NV = Not verified to source of authority;
(Blank) = Test not available for source check

YMP CC-0013, Rev. 5/31/91

(1) ESFDR Section	(2) DAA Recommendations	(3) Category	(4) Resp Org	(5) Sup Org
1.2.6.3 PC 1i.		OK	RSN	
1.2.6.3 PC 2a.		OK	RSN	
1.2.6.3 PC 2b.		OK	RSN	
1.2.6.3 PC 3.		OK	RSN	
1.2.6.3 ICR 1.		NV	RSN	
1.2.6.3 ICR (end)		NV	RSN	
1.2.6.3 C A.		OK	RSN	
1.2.6.3 C B.		OK	RSN	
1.2.6.3 C C.		OK	RSN	
1.2.6.3 C D.		OK	RSN	
1.2.6.3 C E.		OK	RSN	
1.2.6.3 A 1.		NV	RSN	
1.2.6.3 A 1.a		NV	RSN	
1.2.6.3 A 1.b		NV	RSN	
1.2.6.3.1 DEF		NV	RSN	
1.2.6.3.1 BI		NV	RSN	
1.2.6.3.1 FR 1.		OK	RSN	
1.2.6.3.1 PC 1a.		OK	RSN	
1.2.6.3.1 PC 1b.		OK	RSN	
1.2.6.3.1 PC 1c.		OK	RSN	
1.2.6.3.1 PC 1d.		OK	RSN	
1.2.6.3.1 PC 1e.		OK	RSN	
1.2.6.3.1 C A.		OK	RSN	LANL
1.2.6.3.1 C B.		OK	RSN	LANL
1.2.6.3.1 C C.		OK	RSN	
1.2.6.3.1 C D.		OK	RSN	
1.2.6.3.1 A 1.		NV	RSN	
1.2.6.3.2 DEF		NV	RSN	
1.2.6.3.2 BI		NV	RSN	LANL
1.2.6.3.2 FR 1.		OK TBD	RSN	LANL
1.2.6.3.2 PC 1.		OK	RSN	LANL
1.2.6.3.3 DEF		NV	RSN	
1.2.6.3.3 BI		NV	RSN	
1.2.6.3.3 FR 1.		OK	RSN	
1.2.6.3.3 PC 1a.		OK	RSN	LANL
1.2.6.3.3 PC 1b.		OK	RSN	
1.2.6.3.4 DEF		NV	RSN	
1.2.6.3.4 BI		NV	RSN	
1.2.6.3.4 FR 1.		OK	RSN	
1.2.6.3.4 PC 1a.		OK	RSN	
1.2.6.3.4 PC 1a.i		OK	RSN	

(3) Category:
OK = Verified source of authority; NV = Not verified to source of authority;
(Blank) = Test not available for source check

YMP CC-0013, Rev. 5 31 91

(1) ESFDR Section	(2) DAA Recommendations	(3) Category	(4) Resp Org	(5) Sup Org
1.2.6.3.4 PC 1a.ii		OK	RSN	
1.2.6.3.4 PC 1a.iii		OK	RSN	
1.2.6.3.4 PC 1a.iv		OK	RSN	
1.2.6.3.4 PC 1a.v		OK	RSN	
1.2.6.3.4 PC 1a.vi		OK	RSN	
1.2.6.3.4 PC 1b.		OK	RSN	
1.2.6.3.4 PC 1c.		OK	RSN	
1.2.6.3.4 PC 1d.		OK	RSN	
1.2.6.3.4 PC 1e.		OK	RSN	
1.2.6.3.4 C A.		OK	RSN	
1.2.6.3.4 C B.		OK	RSN	
1.2.6.3.5 DEF		NV	RSN	
1.2.6.3.5 BI		NV	RSN	
1.2.6.3.5 FR 1.		OK	RSN	LANL
1.2.6.3.5 PC 1a.		OK	RSN	
1.2.6.3.5 PC 1a.i		OK	RSN	
1.2.6.3.5 PC 1a.ii		OK	RSN	
1.2.6.3.5 PC 1a.iii		OK	RSN	
1.2.6.3.5 PC 1a.iv		OK	RSN	
1.2.6.3.5 PC 1a.v		OK	RSN	
1.2.6.3.5 PC 1a.vi		OK	RSN	
1.2.6.3.5 PC 1a.vii		OK	RSN	
1.2.6.3.5 PC 1a.viii		OK	RSN	
1.2.6.3.5 PC 1a.ix		OK	RSN	
1.2.6.3.5 PC 1a.x		OK	RSN	
1.2.6.3.5 PC 1a.xi		OK	RSN	
1.2.6.3.5 PC 1b.		OK	RSN	
1.2.6.3.5 PC 1c.		OK	RSN	
1.2.6.3.5 C A.		OK	RSN	
1.2.6.3.5 C B.		OK	RSN	
1.2.6.3.6 DEF		NV	RSN	
1.2.6.3.6 BI		NV	RSN	
1.2.6.3.6 FR 1.		OK	RSN	LANL
1.2.6.3.6 PC 1a.		OK	RSN	LANL
1.2.6.3.6 PC 1b.		OK	RSN	LANL
1.2.6.3.6 PC 1c.		OK	RSN	REECO
1.2.6.3.6 PC 1d.		OK	RSN	
1.2.6.3.6 PC 1e.		OK	RSN	
1.2.6.3.6 C A.		OK	RSN	
1.2.6.3.6 C B.		OK	RSN	
1.2.6.3.6 C C.		OK	RSN	

(3) Category:
OK = Verified source of authority; NV = Not verified to source of authority;
(Blank) = Test not available for source check

YMP/CC-0013, Rev. 5/31/91

(1) ESFDR Section	(2) DAA Recommendations	(3) Category	(4) Resp Org	(5) Sup Org
1.2.6.3.6 C D.		OK	RSN	
1.2.6.3.6 C E.		OK	RSN	
1.2.6.3.6 A 1.		NV	RSN	
1.2.6.3.7 DEF		NV	RSN	
1.2.6.3.7 BI		NV	RSN	
1.2.6.3.7 FR 1.		OK	RSN	LANL
1.2.6.3.7 PC 1a.		OK	RSN	LANL
1.2.6.3.7 PC 1b.		OK	RSN	LANL
1.2.6.3.7 C A.		OK	RSN	
1.2.6.3.7 C B.		OK	RSN	
1.2.6.3.7 C C.		OK	RSN	
1.2.6.3.7 C D.		OK	RSN	
1.2.6.3.7 C E.		OK	RSN	
1.2.6.3.8 DEF		NV	RSN	
1.2.6.3.8 BI		NV	RSN	
1.2.6.3.8 FR 1.		OK	RSN	
1.2.6.3.8 PC 1a.		OK	RSN	
1.2.6.3.8 PC 1a.i		OK	RSN	
1.2.6.3.8 PC 1a.ii		OK	RSN	
1.2.6.3.8 PC 1a.iii		OK	RSN	
1.2.6.3.8 PC 1a.iv		OK	RSN	LANL
1.2.6.3.8 PC 1a.v		OK	LANL	
1.2.6.3.8 PC 1a.vi		OK	RSN	
1.2.6.3.8 PC 1b.		OK	RSN	
1.2.6.3.8 PC 1c.		OK	RSN	
1.2.6.3.8 PC 1d.		OK	RSN	
1.2.6.3.8 PC 1e.		OK	RSN	LANL
1.2.6.3.8 C A.		OK	RSN	
1.2.6.3.8 C B.		OK	RSN	
1.2.6.3.8 A 1.		OK	RSN	
1.2.6.3.8 A 2.		OK	RSN	
1.2.6.3.9 DEF		NV	RSN	
1.2.6.3.9 BI		NV	RSN	
1.2.6.3.9 FR 1.		OK	RSN	LANL
1.2.6.3.9 PC 1a.		OK	RSN	
1.2.6.3.9 PC 1b.		OK	RSN	LANL
1.2.6.3.9 PC 1c.		OK	RSN/LANL	
1.2.6.3.9 PC 1c.i		OK	RSN	LANL
1.2.6.3.9 PC 1c.ii		OK	RSN	LANL
1.2.6.3.9 PC 1c.iii		OK	RSN	LANL
1.2.6.3.9 PC 1c.iv		OK	RSN	LANL
1.2.6.3.9 PC 1c.v		OK	RSN	LANL

(3) Category:
OK = Verified source of authority; NV = Not verified to source of authority;
(Blank) = Test not available for source check

YMP/CC-0013, Rev. 5/31/91

(1) ESFDR Section	(2) DAA Recommendations	(3) Category	(4) Resp Org	(5) Sup Org
1.2.6.3.9 PC 1c.vi		OK	RSN	LANL
1.2.6.3.9 PC 1c.vii		OK	RSN	LANL
1.2.6.3.9 PC 1d.		OK	LANL	
1.2.6.3.9 C A.		OK	RSN	
1.2.6.4 SHAFT ACCESS				
1.2.6.4 DEF		NV TBV	RSN	
1.2.6.4 BI		NV	RSN	LANL
1.2.6.4 ARCS		NV	RSN	
1.2.6.4 FR 1.		OK	RSN	
1.2.6.4 FR 2.		OK	RSN	
1.2.6.4 PC 1a.		OK	LANL/PO	LANL
1.2.6.4 PC 1a.i		NV	RSN	LANL
1.2.6.4 PC 1a.ii		NV TBD	RSN	LANL
1.2.6.4 PC 1a.iii	C3-1	NV	RSN	LANL
1.2.6.4 PC 1a.iv	C2-10	NV TBD	RSN	LANL
1.2.6.4 PC 1b.		OK	RSN	LANL
1.2.6.4 PC 1c.		OK	RSN	
1.2.6.4 PC 1c.i	C3-3	NV	RSN	LANL
1.2.6.4 PC 1c.ii		NV	RSN	LANL
1.2.6.4 PC 1c.iii		NV TBD	RSN	LANL
1.2.6.4 PC 1c.iv		NV TBD	RSN	LANL/SNL
1.2.6.4 PC 1d.		OK	RSN	
1.2.6.4 PC 1d.i		NV TBD	RSN	LANL/SNL
1.2.6.4 PC 1d.ii		NV	RSN	
1.2.6.4 PC 1d.iii	C2-2	NV TBD	SNL	LANL
1.2.6.4 PC 1d.iv		NV	RSN	
1.2.6.4 PC 1d.v		NV	RSN	
1.2.6.4 PC 1d.vi		NV	LANL	SNL
1.2.6.4 PC 1d.vii		NV TBD	LANL	
1.2.6.4 PC 1d.viii		NV	RSN	SNL/LANL
1.2.6.4 PC 1d.ix		NV TBD	SNL	LANL
1.2.6.4 PC 1d.x		NV	RSN	LANL
1.2.6.4 PC 1d.xi		NV	RSN	LANL
1.2.6.4 PC 1d.xii		NV TBD	SNL	SNL/LANL
1.2.6.4 PC 1e.		OK	RSN	
1.2.6.4 PC 1f.		OK	RSN	
1.2.6.4 PC 1f.i		NV	RSN	
1.2.6.4 PC 1f.ii		NV	RSN	LANL
1.2.6.4 PC 1g.		OK	RSN	
1.2.6.4 PC 1h.		OK	RSN	
1.2.6.4 PC 1h.i		NV	RSN	
1.2.6.4 PC 1h.ii		NV	RSN	

(3) Category:
OK = Verified source of authority; NV = Not verified to source of authority;
(Blank) = Test not available for source check

 YMP/CC-0013, Rev. 5/31/91

(1) ESFDR Section	(2) DAA Recommendations	(3) Category	(4) Resp Org	(5) Sup Org
1.2.6.4 PC 1i.		OK	RSN	
1.2.6.4 PC 1i.i		NV	RSN	LANL
1.2.6.4 PC 1i.ii		NV TBD	RSN	
1.2.6.4 PC 1i.iii		NV	RSN	LANL
1.2.6.4 PC 1j.		OK	RSN	
1.2.6.4 PC 1j.i		NV	RSN	LANL
1.2.6.4 PC 1j.ii		NV	RSN	LANL
1.2.6.4 PC 2a.		OK	RSN	LANL
1.2.6.4 PC 2a.i		NV	RSN	
1.2.6.4 PC 2a.ii		NV TBD	RSN	
1.2.6.4 PC 2a.ii.a		NV	RSN	
1.2.6.4 PC 2a.ii.b		NV	RSN	
1.2.6.4 PC 2a.ii.c	C1-6	NV	RSN	
1.2.6.4 PC 2a.ii.d		NV	RSN	
1.2.6.4 PC 2a.ii.e		NV	RSN	
1.2.6.4 PC 2a.ii.f		NV	RSN	
1.2.6.4 PC 2a.iii		NV TBD	LANL	SNL/LLNL
1.2.6.4 PC 2a.iv	C1-6	NV TBD	SNL	LANL
1.2.6.4 PC 2a.v		NV TBD	SNL	
1.2.6.4 PC 2b.		OK	RSN	LANL/SNL
1.2.6.4 PC 2b.i		NV	RSN	LANL/SNL
1.2.6.4 PC 2b.ii		NV TBD	RSN	LANL
1.2.6.4 PC 2b.iii		NV TBD	SNL	
1.2.6.4 PC 2b.iv.		NV TBD	RSN	SNL
1.2.6.4 PC 2c.		OK	RSN	
1.2.6.4 PC 2d.		OK	RSN	LANL
1.2.6.4 PC 2d.i		NV TBD	SNL	
1.2.6.4 PC 2d.ii		NV TBD	SNL	
1.2.6.4 PC 2d.iii		NV TBD	SNL	LANL
1.2.6.4 PC 2d.iv		NV	RSN	
1.2.6.4 PC 2d.v		NV TBD	RSN	
1.2.6.4 PC 2e.		OK	RSN	
1.2.6.4 PC 2e.i		NV	RSN	
1.2.6.4 PC 2e.ii		NV TBD	RSN	SNL
1.2.6.4 PC 2f.		OK	RSN	LANL
1.2.6.4 PC 2g.		OK	RSN	SNL
1.2.6.4 PC 2g.i		NV	RSN	SNL
1.2.6.4 PC 2g.ii		NV TBD	RSN	
1.2.6.4 PC 2g.iii		NV TBD	RSN	
1.2.6.4 PC 2g.iv		NV TBD	RSN	
1.2.6.4 PC 2h.		NV	RSN	LANL
1.2.6.4 PC 2h.i		NV	RSN	
1.2.6.4 PC 2h.ii		NV TBD	SNL	SNL/LANL
1.2.6.4 PC 2h.iii		NV	RSN	
1.2.6.4 PC 2i.		OK	RSN	LANL

(3) Category:
OK = Verified source of authority; NV = Not verified to source of authority;
(Blank) = Test not available for source check

YMP/CC-0013, Rev. 5/31/91

(1) ESFDR Section	(2) DAA Recommendations	(3) Category	(4) Resp Org	(5) Sup Org
1.2.6.4 PC 2i.i		NV	RSN	
1.2.6.4 PC 2i.ii		NV	RSN	
1.2.6.4 PC 2i.iii		NV	RSN	
1.2.6.4 PC 2i.iii.a		NV TBD	RSN	
1.2.6.4 PC 2i.iii.b		NV TBD	RSN	
1.2.6.4 PC 2i.iii.c		NV TBD	RSN	
1.2.6.4 PC 2i.iii.d		NV TBD	RSN	
1.2.6.4 PC 2i.iv		NV	RSN	
1.2.6.4 PC 2i.iv.a		NV	RSN	
1.2.6.4 PC 2i.iv.b		NV	RSN	
1.2.6.4 PC 2i.iv.c		NV	RSN	
1.2.6.4 PC 2i.iv.d		NV	RSM	
1.2.6.4 PC 2i.v		NV	RSN	
1.2.6.4 PC 2i.v (end)		NV	RSN	
1.2.6.4 PC 2i.v.a		NV TBD	SNL	SNL
1.2.6.4 PC 2i.v.b		NV	RSN	
1.2.6.4 PC 2i.vi		NV TBD	RSN	LANL/SNL
1.2.6.4 PC 2i.vii		NV TBD	RSN	SNL/LANL
1.2.6.4 PC 2i.viii		NV	RSN	
1.2.6.4 PC 2j.		NV	RSN	
1.2.6.4 PC 2j.i		NV	RSN	LANL
1.2.6.4 PC 2j.ii		NV	RSN	
1.2.6.4 PC 2j.iii	C1-18	NV TBD	RSN	
1.2.6.4 PC 2k.		OK	RSN	SNL/LANL
1.2.6.4 PC 2k. [2]		OK	RSN	SNL/LANL
1.2.6.4 PC 2k.i		NV	RSN	SNL/LANL
1.2.6.4 PC 2k.ii	C1-17	NV	RSN	
1.2.6.4 PC 2k.iii		NV	RSN	SNL/LANL
1.2.6.4 PC 2k.iii.a		NV	RSN	SNL/LANL
1.2.6.4 PC 2k.iii.b		NV	RSN	SNL/LANL
1.2.6.4 PC 2k.iii.c		NV	RSN	SNL/LANL
1.2.6.4 PC 2k.iii NOTE		NV	RSN	SNL/LANL
1.2.6.4 PC 2k.iv		NV	RSN	
1.2.6.4 PC 2k.v		NV	RSN	SNL/LANL
1.2.6.4 ICR 1.		NV	RSN	
1.2.6.4 ICR (end)		NV	RSN	
1.2.6.4 C A.		OK	PO	LANL
1.2.6.4 C A. [2]		OK	LANL	SNL
1.2.6.4 C A.i		NV TBD	RSN	LANL
1.2.6.4 C B.		OK	RSN	
1.2.6.4 C B.i		NV	RSN	LANL
1.2.6.4 C B.ii		NV TBD	RSN	LANL
1.2.6.4 C B.iii		NV	RSN	LANL

(3) Category:
OK = Verified source of authority; NV = Not verified to source of authority;
(Blank) = Test not available for source check

YMP/CC-0013, Rev. 5/31/91

(1) ESFDR Section	(2) DAA Recommendations	(3) Category	(4) Resp Org	(5) Sup Org
1.2.6.4.1 DEF		NV	RSN	
1.2.6.4.1 BI		NV	RSN	
1.2.6.4.1 FR 1.		OK	RSN	
1.2.6.4.1 PC 1a.		OK	RSN	
1.2.6.4.1 PC 1b.		OK	RSN	
1.2.6.4.1 C A.		OK TBD	RSN	
1.2.6.4.1 C B.		OK	RSN	
1.2.6.4.2 DEF		NV	RSN	
1.2.6.4.2 BI		NV	RSN	
1.2.6.4.2 FR 1.		OK	RSN	LANL
1.2.6.4.2 PC 1a.		OK	RSN	
1.2.6.4.2 PC 1b.		OK TBD	RSN	LANL
1.2.6.4.2 PC 1c.		OK	RSN	
1.2.6.4.2 PC 1d.		OK	RSN	
1.2.6.4.2 C A.		OK	RSN	
1.2.6.4.2 C B.		OK	RSN	LANL
1.2.6.4.2 C C.		OK	RSN	
1.2.6.4.3 DEF		NV	RSN	
1.2.6.4.3 BI		NV	RSN	
1.2.6.4.3 FR 1.		OK	RSN	LANL
1.2.6.4.3 PC 1a.		OK	RSN	LANL
1.2.6.4.3 PC 1b.		OK	RSN	
1.2.6.4.3 PC 1c.		OK	RSN	
1.2.6.4.3 PC 1d.		OK	RSN	
1.2.6.4.3 PC 1e.		OK	RSN	
1.2.6.4.3 PC 1f.		OK	RSN	
1.2.6.4.3 PC 1g.		OK	RSN	
1.2.6.4.3 PC 1h.		OK	RSN	LANL
1.2.6.4.4 DEF		NV	RSN	
1.2.6.4.4 BI		NV	RSN	
1.2.6.4.4 FR 1.		OK	RSN	
1.2.6.4.4 PC 1a.		OK	RSN	
1.2.6.4.4 PC 1b.		OK	RSN	
1.2.6.4.4 PC 1c.		OK	RSN	
1.2.6.4.4 PC 1d		OK	RSN	
1.2.6.4.4 PC 1e.		OK	RSN	LANL
1.2.6.4.4 PC 1f.		OK	RSN	LANL
1.2.6.4.4 PC 1f.i		OK	RSN	LANL
1.2.6.4.4 PC 1f.ii		OK	RSN	LANL
1.2.6.4.4 PC 1f.iii		OK	RSN	LANL
1.2.6.4.4 PC 1f.iv		OK	RSN	LANL

(3) Category:
OK = Verified source of authority; NV = Not verified to source of authority;
(Blank) = Test not available for source check

(1) ESFDR Section	(2) DAA Recommendations	(3) Category	(4) Resp Org	(5) Sup Org
1.2.6.4.4 PC 1f.v		OK	RSN	LANL
1.2.6.4.4 PC 1f.vi		OK	RSN	LANL
1.2.6.4.4 PC 1f.vii		OK	RSN	
1.2.6.4.4 PC 1f.viii		OK	RSN	
1.2.6.4.4 C A.		OK	RSN	
1.2.6.4.4 C B.		OK	RSN	
1.2.6.4.4 C C.		OK	RSN	
1.2.6.4.5 DEF		NV	RSN	
1.2.6.4.5 DEF [2]		NV	RSN	
1.2.6.4.5 BI		NV	RSN	
1.2.6.4.5 FR 1.		OK	RSN	LANL
1.2.6.4.5 PC 1a.		OK	RSN	
1.2.6.4.5 PC 1b.		OK	RSN	
1.2.6.4.5 PC 1c.		OK	RSN	LANL
1.2.6.4.5 PC 1d.		OK	RSN	
1.2.6.4.5 PC 1e.		OK	RSN	
1.2.6.4.5 PC 1f.		OK	RSN	
1.2.6.4.5 PC 1g.		OK	RSN	
1.2.6.4.5 PC 1h.		OK	RSN	
1.2.6.4.5 PC 1i.		OK	RSN	
1.2.6.4.5 PC 1j.		OK	RSN	
1.2.6.4.5 C A.		OK	RSN	
1.2.6.4.5 C B.		OK	RSN	
1.2.6.4.5 C C.		OK	RSN	
1.2.6.4.5 C D.		OK	RSN	
1.2.6.4.5 C E.		OK	RSN	
1.2.6.4.5 C F.		OK	RSN	
1.2.6.4.5 C G.		OK	RSN	
1.2.6.4.5 C H.		OK	RSN	
1.2.6.4.5 C I.		OK	RSN	
1.2.6.4.6 DEF		NV	RSN	
1.2.6.4.6 BI		NV	RSN	
1.2.6.4.6 FR 1.		OK	RSN	LANL
1.2.6.4.6 PC 1a.		OK	RSN	
1.2.6.4.6 PC 1b.		OK	RSN	
1.2.6.4.6 PC 1c.		OK	RSN	
1.2.6.4.6 C A.		OK TBV	RSN	SNL
1.2.6.4.6 C B.		OK	RSN	
1.2.6.5 RAMP ACCESS				
1.2.6.5 DEF		NV TBV	RSN	
1.2.6.5 BI		NV	RSN	

(3) Category:
OK = Verified source of authority; NV = Not verified to source of authority;
(Blank) = Test not available for source check

YMP CC-0013, Rev. 5/31/91

(1) ESFDR Section	(2) DAA Recommendations	(3) Category	(4) Resp Org	(5) Sup Org
1.2.6.5 ARCS		NV	RSN	
1.2.6.5 FR 1.		OK	RSN	
1.2.6.5 FR 2.		OK	RSN	
1.2.6.5 PC 1a.		OK	RSN	LANL
1.2.6.5 PC 1a.i		NV	RSN	LANL
1.2.6.5 PC 1a.ii		NV TBD	RSN	LANL
1.2.6.5 PC 1a.iii	C3-1	NV	RSN	LANL
1.2.6.5 PC 1b.		OK	RSN	LANL
1.2.6.5 PC 1c.		OK	RSN	
1.2.6.5 PC 1c.i	C3-3	NV	RSN	LANL
1.2.6.5 PC 1c.ii		NV	RSN	LANL
1.2.6.5 PC 1c.iii		NV	RSN	LANL
1.2.6.5 PC 1c.iv		NV	RSN	
1.2.6.5 PC 1c.v		NV	RSN	
1.2.6.5 PC 1d.		OK	RSN	
1.2.6.5 PC 1d.i		NV TBD	RSN	LANL
1.2.6.5 PC 1d.ii		NV	RSN	LANL
1.2.6.5 PC 1d.iii	C2-2	NV TBD	RSN	LANL
1.2.6.5 PC 1d.iv		NV	RSN	LANL
1.2.6.5 PC 1d.v		NV	RSN	LANL/SNL
1.2.6.5 PC 1d.vi		NV	LANL	SNL
1.2.6.5 PC 1d.vii		NV TBD	LANL	
1.2.6.5 PC 1d.viii		NV	RSN	LANL
1.2.6.5 PC 1d.ix		NV TBD	RSN	LANL
1.2.6.5 PC 1d.x		NV	RSN	LANL
1.2.6.5 PC 1d.xi		NV	RSN	LANL
1.2.6.5 PC 1d.xii		NV TBD	RSN	SNL/LANL
1.2.6.5 PC 1e.		OK	RSN	
1.2.6.5 PC 1f.		OK	RSN	
1.2.6.5 PC 1f.i		NV	RSN	
1.2.6.5 PC 1f.ii		NV	RSN	
1.2.6.5 PC 1f.iii		NV	RSN	
1.2.6.5 PC 1f.iv		NV	RSN	
1.2.6.5 PC 1f.v		NV	RSN	
1.2.6.5 PC 1g.		OK	RSN	
1.2.6.5 PC 1h.		OK	RSN	
1.2.6.5 PC 1h.i		NV	RSN	
1.2.6.5 PC 1h.ii		NV	RSN	
1.2.6.5 PC 1i.		OK	RSN	
1.2.6.5 PC 1i.i		NV	RSN	
1.2.6.5 PC 1i.ii		NV	RSN	
1.2.6.5 PC 1i.iii		NV	RSN	
1.2.6.5 PC 1i.iv		NV TBD	RSN	

(3) Category:
OK = Verified source of authority; NV = Not verified to source of authority;
(Blank) = Test not available for source check

YMP/CC-0013, Rev. 5 31 91

(1) ESFDR Section	(2) DAA Recommendations	(3) Category	(4) Resp Org	(5) Sup Org
1.2.6.5 PC 1i.v		NV	RSN	
1.2.6.5 PC 1j.		OK	RSN	
1.2.6.5 PC 1j.i		NV	RSN	
1.2.6.5 PC 1j.ii		NV	RSN	
1.2.6.5 PC 2a.		OK	SNL	
1.2.6.5 PC 2a.i		NV	SNL	SNL/LANL
1.2.6.5 PC 2a.ii		NV TBD	RSN	
1.2.6.5 PC 2a.ii.a		NV	RSN	
1.2.6.5 PC 2a.ii.b		NV	RSN	
1.2.6.5 PC 2a.ii.c	C1-6	NV	RSN	
1.2.6.5 PC 2a.ii.d		NV	RSN	
1.2.6.5 PC 2a.ii.e		NV	RSN	
1.2.6.5 PC 2a.ii.f		NV	RSN	
1.2.6.5 PC 2a.iii		NV TBD	SNL	SNL/LANL
1.2.6.5 PC 2a.iv	C1-6	NV TBD	RSN	LANL
1.2.6.5 PC 2a.v		NV TBD	RSN	
1.2.6.5 PC 2b.		OK	RSN	
1.2.6.5 PC 2b.i		NV	RSN	
1.2.6.5 PC 2b.ii		NV TBD	RSN	LANL
1.2.6.5 PC 2b.iii		NV TBD	RSN	
1.2.6.5 PC 2b.iv		NV TBD	RSN	
1.2.6.5 PC 2c.		OK	RSN	
1.2.6.5 PC 2d.		OK	RSN	
1.2.6.5 PC 2d.i		NV TBD	RSN	
1.2.6.5 PC 2d.ii		NV TBD	SNL	
1.2.6.5 PC 2d.iii		NV TBD	RSN	
1.2.6.5 PC 2d.iv		NV	RSN	
1.2.6.5 PC 2d.v		NV TBD	RSN	
1.2.6.5 PC 2e.		OK	RSN	
1.2.6.5 PC 2e.i		NV	RSN	
1.2.6.5 PC 2e.ii		NV TBD	RSN	
1.2.6.5 PC 2f.		OK	RSN	LANL
1.2.6.5 PC 2g.		OK	RSN	LANL
1.2.6.5 PC 2g.i		NV TBD	RSN	
1.2.6.5 PC 2g.ii		NV	RSN	SNL
1.2.6.5 PC 2g.iii		NV TBD	TBD	SNL
1.2.6.5 PC 2g.iv		NV TBD	RSN	LANL
1.2.6.5 PC 2g.v		NV TBD	RSN	
1.2.6.5 PC 2h.		OK	RSN	
1.2.6.5 PC 2h.i		NV	RSN	
1.2.6.5 PC 2h.ii		NV TBD	LANL	SNL
1.2.6.5 PC 2h.iii		NV	RSN	
1.2.6.5 PC 2i.		OK	RSN	
1.2.6.5 PC 2i.i		NV	RSN	
1.2.6.5 PC 2i.ii		NV	RSN	

(3) Category:
OK = Verified source of authority; NV = Not verified to source of authority;
(Blank) = Test not available for source check

YMP CC-0013, Rev. 5.31.91

(1) ESFDR Section	(2) DAA Recommendations	(3) Category	(4) Resp Org	(5) Sup Org
1.2.6.5 PC 2i.iii		NV	RSN	
1.2.6.5 PC 2i.iii.a		NV TBD	RSN	
1.2.6.5 PC 2i.iii.b		NV TBD	RSN	
1.2.6.5 PC 2i.iii.c		NV TBD	RSN	
1.2.6.5 PC 2i.iii.d		NV TBD	RSN	
1.2.6.5 PC 2i.iv		NV	RSN	
1.2.6.5 PC 2i.iv.a		NV	RSN	
1.2.6.5 PC 2i.iv.b		NV	RSN	
1.2.6.5 PC 2i.iv.c		NV	RSN	
1.2.6.5 PC 2i.iv.d		NV	RSN	
1.2.6.5 PC 2i.v		NV	RSN	
1.2.6.5 PC 2i [end]		NV	RSN	
1.2.6.5 PC 2i.v.a		NV TBV	SNL	SNL
1.2.6.5 PC 2i.v.b		NV	RSN	
1.2.6.5 PC 2i.vi		NV TBD	RSN	LANL/SNL
1.2.6.5 PC 2i.vii		NV TBD	RSN	LANL/SNL
1.2.6.5 PC 2i.viii		NV	RSN	
1.2.6.5 PC 2j.		OK	RSN	
1.2.6.5 PC 2j.i		NV	RSN	
1.2.6.5 PC 2j.ii		NV	RSN	
1.2.6.5 PC 2j.iii	C1-18	NV TBD	RSN	
1.2.6.5 PC 2k.		OK	RSN	
1.2.6.5 PC 2k. [2]		OK	RSN	
1.2.6.5 PC 2k.i		NV	RSN	
1.2.6.5 PC 2k.ii	C1-17	NV	RSN	
1.2.6.5 PC 2k.iii		NV	RSN	
1.2.6.5 PC 2k.iii.a		NV	RSN	
1.2.6.5 PC 2k.iii.b		NV	RSN	
1.2.6.5 PC 2k.iii.c		NV	RSN	
1.2.6.5 PC 2k.iv		NV	RSN	
1.2.6.5 PC 2k.v		NV	RSN	
1.2.6.5 ICR 1.		NV	RSN	
1.2.6.5 ICR (end)		NV	RSN	
1.2.6.5 C A.		OK	RSN	LANL
1.2.6.5 C A. [2]		OK	RSN	
1.2.6.5 C A.i		NV TBD	RSN	LANL
1.2.6.5 C B.		OK	RSN	LANL
1.2.6.5 C B.i		NV	RSN	
1.2.6.5 C B.ii		NV TBD	RSN	LANL
1.2.6.5 C B.iii		NV	RSN	LANL
1.2.6.5.1 DEF		NV	RSN	
1.2.6.5.1 BI		NV	RSN	

(3) Category:
OK = Verified source of authority; NV = Not verified to source of authority;
(Blank) = Test not available for source check

YMP/CC-0013, Rev. 5/31/91

(1) ESFDR Section	(2) DAA Recommendations	(3) Category	(4) Resp Org	(5) Sup Org
1.2.6.5.1 FR 1.		OK	RSN	
1.2.6.5.1 PC 1.		OK	RSN	
1.2.6.5.1 C A.		OK TBD	RSN	
1.2.6.5.1 C B.		OK	RSN	
1.2.6.5.2 DEF		NV	RSN	
1.2.6.5.2 BI		NV	RSN	
1.2.6.5.2 FR 1.		OK	RSN	
1.2.6.5.2 PC 1a.		OK	RSN	
1.2.6.5.2 PC 1b.		OK	RSN	
1.2.6.5.2 PC 1c.		OK	RSN	
1.2.6.5.2 PC 1d.		OK	RSN	
1.2.6.5.2 PC 1e.		OK	RSN	
1.2.6.5.2 C A.		OK	RSN	
1.2.6.5.2 C B.		OK	RSN	LANL
1.2.6.5.2 C C.		NV	RSN	
1.2.6.5.3 DEF		NV	RSN	
1.2.6.5.3 BI		NV	RSN	
1.2.6.5.3 FR 1.		OK	RSN	LANL
1.2.6.5.3 PC 1a.		OK	RSN	LANL
1.2.6.5.3 PC 1b.		OK	RSN	LANL
1.2.6.5.3 PC 1c.		OK	RSN	
1.2.6.5.3 PC 1d.		OK	RSN	
1.2.6.5.3 PC 1e.		OK	RSN	
1.2.6.5.4 DEF		NV	RSN	
1.2.6.5.4 BI		NV	RSN	
1.2.6.5.4 FR 1.		OK	RSN	
1.2.6.5.4 PC 1a.		OK	RSN	
1.2.6.5.4 PC 1b.		OK	RSN	
1.2.6.5.4 PC 1c.		OK	RSN	LANL
1.2.6.5.4 PC 1c.i		OK	RSN	LANL
1.2.6.5.4 PC 1c.ii		OK	RSN	LANL
1.2.6.5.4 PC 1c.iii		OK	RSN	LANL
1.2.6.5.4 PC 1c.iv		OK	RSN	LANL
1.2.6.5.4 PC 1c.v		OK	RSN	LANL
1.2.6.5.4 PC 1c.vi		OK	RSN	LANL
1.2.6.5.4 PC 1c.vii		OK	RSN	
1.2.6.5.4 PC 1c.viii		OK	RSN	
1.2.6.5.4 C A.		OK	RSN	
1.2.6.5.4 C B.		OK	RSN	
1.2.6.5.4 C C.		OK	RSN	

(3) Category:
OK = Verified source of authority; NV = Not verified to source of authority;
(Blank) = Test not available for source check

(1) ESFDR Section	(2) DAA Recommendations	(3) Category	(4) Resp Org	(5) Sup Org
1.2.6.5.5 This number not used				
1.2.6.5.6 DEF		NV	RSN	
1.2.6.5.6 BI		NV	RSN	
1.2.6.5.6 FR 1.		OK	RSN	LANL
1.2.6.5.6 PC 1a.		OK	RSN	
1.2.6.5.6 PC 1b.		OK	RSN	
1.2.6.6 UNDERGROUND EXCAVATIONS				
1.2.6.6 DEF		NV TBV	RSN	
1.2.6.6 BI		NV	RSN	
1.2.6.6 ARCS		NV	RSN	
1.2.6.6 FR 1.		OK	RSN	LANL
1.2.6.6 FR 2.		OK	RSN	
1.2.6.6 PC 1a.		OK	RSN	LANL
1.2.6.6 PC 1a.i		NV	RSN	LANL
1.2.6.6 PC 1a.ii		NV	RSN	LANL
1.2.6.6 PC 1a.iii		NV	RSN	LANL
1.2.6.6 PC 1a.iv		NV TBD	RSN	
1.2.6.6 PC 1b.		OK	RSN	LANL
1.2.6.6 PC 1b.i		NV	RSN	
1.2.6.6 PC 1b.ii		NV	RSN	LANL
1.2.6.6 PC 1c.		OK	RSN	
1.2.6.6 PC 1c.i		NV	RSN	LANL
1.2.6.6 PC 1c.ii	C3-3	NV	RSN	LANL
1.2.6.6 PC 1c.iii		NV	RSN	LANL
1.2.6.6 PC 1c.iv		NV	RSN	LANL
1.2.6.6 PC 1c.v		NV	RSN	LANL
1.2.6.6 PC 1c.vi		NV	RSN	LANL
1.2.6.6 PC 1c.vii		NV TBD	RSN	LANL
1.2.6.6 PC 1c.viii		NV TBD	RSN	
1.2.6.6 PC 1c.ix		NV TBD	RSN	
1.2.6.6 PC 1c.x		NV	RSN	
1.2.6.6 PC 1d.		OK	RSN	
1.2.6.6 PC 1d.i		NV	RSN	LANL
1.2.6.6 PC 1d.ii		NV TBD	SNL	LANL
1.2.6.6 PC 1d.iii		NV TBD	SNL	LANL
1.2.6.6 PC 1d.iv		NV TBD	RSN	LANL
1.2.6.6 PC 1d.v		NV	RSN	
1.2.6.6 PC 1d.vi	C2-2	NV TBD	SNL	LANL
1.2.6.6 PC 1d.vii	C2-7	NV	RSN	LANL
1.2.6.6 PC 1d.viii	C2-2	NV	RSN	LANL

(3) Category:
OK = Verified source of authority; NV = Not verified to source of authority;
(Blank) = Test not available for source check

YMP CC-0013, Rev. 5 31 91

(1) ESFDR Section	(2) DAA Recommendations	(3) Category	(4) Resp Org	(5) Sup Org
1.2.6.6 PC 1d.ix		NV	LANL	
1.2.6.6 PC 1d.x	C2-3	NV TBD	RSN	LANL/SNL
1.2.6.6 PC 1d.xi		NV	RSN	
1.2.6.6 PC 1d.xii		NV	SNL	LANL/REECO
1.2.6.6 PC 1d.xiii		NV TBD	SNL	
1.2.6.6 PC 1d.xiv	C2-5	NV	RSN	LANL
1.2.6.6 PC 1d.xv		NV	RSN	LANL
1.2.6.6 PC 1d.xvi		NV	RSN	LANL
1.2.6.6 PC 1d.xvii		NV TBD	SNL	LANL
1.2.6.6 PC 1e.		OK	RSN	
1.2.6.6 PC 1e.i		NV TBD	SNL	
1.2.6.6 PC 1f.		OK	RSN	
1.2.6.6 PC 1f.i		NV	RSN	LANL
1.2.6.6 PC 1f.ii		NV	RSN	
1.2.6.6 PC 1f.iii		NV	RSN	LANL
1.2.6.6 PC 1g.		OK	RSN	
1.2.6.6 PC 1h.		NV	RSN	
1.2.6.6 PC 1h.i		NV	RSN	
1.2.6.6 PC 1h.ii		NV	RSN	
1.2.6.6 PC 1h.iii		NV	RSN	LANL
1.2.6.6 PC 1h.iv		NV	RSN	
1.2.6.6 PC 1i.		OK	RSN	
1.2.6.6 PC 1i.i		NV	RSN	LANL
1.2.6.6 PC 1i.ii		NV	RSN	
1.2.6.6 PC 1i.iii		NV	RSN	
1.2.6.6 PC 2a.		OK	RSN	LANL
1.2.6.6 PC 2a.i		NV TBD	SNL	LANL
1.2.6.6 PC 2a.ii		NV TBD	RSN	
1.2.6.6 PC 2a.ii.a		NV	RSN	
1.2.6.6 PC 2a.ii.b		NV	RSN	
1.2.6.6 PC 2a.ii.c	C1-6	NV	RSN	
1.2.6.6 PC 2a.ii.d		NV	RSN	
1.2.6.6 PC 2a.ii.e		NV	RSN	
1.2.6.6 PC 2a.ii.f		NV	RSN	
1.2.6.6 PC 2a.iii	C1-6	NV TBD	RSN	LANL
1.2.6.6 PC 2a.iv		NV TBD	RSN	
1.2.6.6 PC 2b.		OK	RSN	LANL
1.2.6.6 PC 2b.i	C1-14	NV	RSN	LANL
1.2.6.6 PC 2b.ii	C1-15	NV TBV	SNL	LANL
1.2.6.6 PC 2b.iii		NV	RSN	LANL
1.2.6.6 PC 2b.iii.a		NV	RSN	LANL
1.2.6.6 PC 2b.iii.b		NV	RSN	
1.2.6.6 PC 2b.iii.c	C1-13	NV	RSN	LANL
1.2.6.6 PC 2c.		OK	RSN	LANL
1.2.6.6 PC 2c.i		NV	RSN	

(3) Category:
OK = Verified source of authority; NV = Not verified to source of authority;
(Blank) = Test not available for source check

YMP/CC-0013, Rev. 5/31/91

(1) ESFDR Section	(2) DAA Recommendations	(3) Category	(4) Resp Org	(5) Sup Org
1.2.6.6 PC 2c.ii		NV TBV	RSN	LANL
1.2.6.6 PC 2c.iii		NV TBD	RSN	
1.2.6.6 PC 2c.iv		NV TBD	RSN	
1.2.6.6 PC 2c.v		NV TBD	RSN	
1.2.6.6 PC 2c.vi		NV	RSN	LANL
1.2.6.6 PC 2c.vii		NV TBD	RSN	
1.2.6.6 PC 2c.viii		NV	RSN	LANL
1.2.6.6 PC 2c.ix		NV TBV	RSN	
1.2.6.6 PC 2c.x		NV TBD	RSN	
1.2.6.6 PC 2d.		OK	RSN	LANL
1.2.6.6 PC 2e.		OK	RSN	LANL
1.2.6.6 PC 2e.i		NV	SNL	LANL
1.2.6.6 PC 2e.ii	C1-16,C2-5,-9	NV TBV	SNL	LANL
1.2.6.6 PC 2e.iii		NV	RSN	
1.2.6.6 PC 2e.iv		NV TBD	SNL	
1.2.6.6 PC 2e.v		NV	RSN	
1.2.6.6 PC 2f.		OK	RSN	
1.2.6.6 PC 2f.i		NV	RSN	
1.2.6.6 PC 2f.ii	C1-9	NV TBD	SNL	
1.2.6.6 PC 2f.iii		NV	RSN	
1.2.6.6 PC 2f.iv		NV	RSN	
1.2.6.6 PC 2g.		OK	RSN	LANL
1.2.6.6 PC 2g.i		NV TBD	SNL	LANL
1.2.6.6 PC 2g.ii	C1-12	NV	RSN	
1.2.6.6 PC 2g.iii		NV	RSN	LANL
1.2.6.6 PC 2h.		OK	RSN	LANL
1.2.6.6 PC 2h.i		NV	RSN	
1.2.6.6 PC 2h.ii		NV	RSN	
1.2.6.6 PC 2h.iii		NV TBD	RSN	LANL
1.2.6.6 PC 2h.iv		NV	RSN	LANL
1.2.6.6 PC 2h.v		NV TBD	SNL	
1.2.6.6 PC 2h.vi		NV TBD	RSN	LANL
1.2.6.6 PC 2h.vii	C1-2	NV TBD	RSN	
1.2.6.6 PC 2i.		OK	RSN	LANL
1.2.6.6 PC 2i.i		NV	RSN	
1.2.6.6 PC 2i.ii		NV	RSN	
1.2.6.6 PC 2i.iii		NV	RSN	
1.2.6.6 PC 2i.iv		NV	RSN	LANL
1.2.6.6 PC 2i.v		NV	RSN	LANL
1.2.6.6 PC 2j.		OK	RSN	LANL
1.2.6.6 PC 2j.i		NV	RSN	LANL
1.2.6.6 PC 2j.ii		NV	RSN	
1.2.6.6 PC 2j.iii		NV	RSN	
1.2.6.6 PC 2j.iii.a		NV TBD	RSN	
1.2.6.6 PC 2j.iii.b		NV TBD	RSN	

(3) Category:
OK = Verified source of authority; NV = Not verified to source of authority;
(Blank) = Test not available for source check

(1) ESFDR Section	(2) DAA Recommendations	(3) Category	(4) Resp Org	(5) Sup Org
1.2.6.6 PC 2j.iii.c		NV TBD	RSN	
1.2.6.6 PC 2j.iii.d		NV TBD	RSN	
1.2.6.6 PC 2j.iv		NV	RSN	
1.2.6.6 PC 2j.iv[2]		NV	RSN	
1.2.6.6 PC 2j.v		NV	RSN	
1.2.6.6 PC 2j.v.a		NV	RSN	
1.2.6.6 PC 2j.v.b		NV	RSN	
1.2.6.6 PC 2j.v.c		NV	RSN	
1.2.6.6 PC 2j.v.d		NV	RSN	
1.2.6.6 PC 2j.vi		NV	RSM	
1.2.6.6 PC 2j.vi[2]		NV	RSN	
1.2.6.6 PC 2j.vi.a		NV TBV	SNL	SNL/LANL
1.2.6.6 PC 2j.vi.b		NV	RSN	
1.2.6.6 PC 2j.vii		NV	RSN	
1.2.6.6 PC 2j.viii		NV	RSN	
1.2.6.6 PC 2j.ix		NV TBD	RSN	LANL
1.2.6.6 PC 2j.x	C2-1	NV TBD	RSN	LANL
1.2.6.6 PC 2k.		OK	RSN	
1.2.6.6 PC 2k.i	C1-19	NV	RSN	
1.2.6.6 PC 2k.ii		NV	RSN	
1.2.6.6 PC 2k.iii		NV TBD	RSN	LANL
1.2.6.6 PC 2k.iv		NV	RSN	
1.2.6.6 PC 2k.v		NV	RSN	LANL
1.2.6.6 PC 2l.		OK	RSN	
1.2.6.6 PC 2l. [2]		OK	RSN	
1.2.6.6 PC 2l.i		NV	RSN	
1.2.6.6 PC 2l.ii		NV	RSN	
1.2.6.6 PC 2l.iii		NV TBD	RSN	
1.2.6.6 PC 2l.iv		NV	RSN	
1.2.6.6 PC 2l.v		NV	RSN	
1.2.6.6 PC 2l.vi		NV	RSN	
1.2.6.6 PC 2l.vi.a		NV	RSN	
1.2.6.6 PC 2l.vi.b		NV TBD	RSN	
1.2.6.6 PC 2l.vi.c		NV TBD	RSN	
1.2.6.6 PC 2l.vi.d		NV TBD	RSN	
1.2.6.6 ICR		NV	RSN	
1.2.6.6 ICR (end)		NV	RSN	
1.2.6.6 C A.		OK	RSN	LANL
1.2.6.6 C A. [2]		OK	RSN	
1.2.6.6 C A.i		NV TBD	SNL	LANL
1.2.6.6 C A.ii		NV	RSN	
1.2.6.6 C B.		OK	RSN	LANL
1.2.6.6 C B.i		NV	RSN	LANL
1.2.6.6 C B.ii		NV TBD	RSN	LANL

(3) Category:
OK = Verified source of authority; NV = Not verified to source of authority;
(Blank) = Test not available for source check

YMP/CC-0013, Rev. 5/31/91

(1) ESFDR Section	(2) DAA Recommendations	(3) Category	(4) Resp Org	(5) Sup Org
1.2.6.6 C B.iii		NV	RSN	LANL
1.2.6.6 A 1.		NV	RSN	
1.2.6.6.1 DEF		NV	RSN	
1.2.6.6.1 BI		NV	RSN	
1.2.6.6.1 FR 1.		OK	RSN	LANL
1.2.6.6.1 PC 1a.		OK	RSN	LANL
1.2.6.6.1 PC 1b.		OK	RSN	
1.2.6.6.1 PC 1c.		OK	RSN	LANL
1.2.6.6.1 C A.		OK	RSN	LANL
1.2.6.6.1 C B.		OK	RSN	
1.2.6.6.2 DEF		NV	RSN	
1.2.6.6.2 BI		NV	RSN	
1.2.6.6.2 FR 1.		OK	RSN	LANL
1.2.6.6.2 PC 1.		OK	RSN	LANL
1.2.6.6.2 C A.		OK	RSN	LANL
1.2.6.6.2 C B.		OK	RSN	LANL
1.2.6.7 UNDERGROUND SUPPORT SYSTEMS				
1.2.6.7 DEF		NV	RSN	
1.2.6.7 BI		NV	RSN	
1.2.6.7 ARCS G 1.		NV	RSN	
1.2.6.7 ARCS G 2.		NV	RSN	
1.2.6.7 ARCS E 1.		NV	RSN	
1.2.6.7 ARCS E 2.		NV	RSN	
1.2.6.7 ARCS E 3.		NV	RSN	
1.2.6.7 ARCS L 1.		NV	RSN	
1.2.6.7 ARCS UP 1.		NV	RSN	
1.2.6.7 ARCS UP 2.		NV	RSN	
1.2.6.7 ARCS UP 3.		NV	RSN	
1.2.6.7 ARCS WS 1.		NV	RSN	
1.2.6.7 ARCS WS 2.		NV	RSN	
1.2.6.7 ARCS WS 3.		NV	RSN	
1.2.6.7 ARCS UWCS 1.		NV	RSN	
1.2.6.7 ARCS UWCS 2.		NV	RSN	
1.2.6.7 ARCS VSDC 1.		NV	RSN	
1.2.6.7 ARCS VSDC 2.		NV	RSN	
1.2.6.7 ARCS VSDC (end)		NV	RSN	
1.2.6.7 FR 1.		OK	RSN	LANL
1.2.6.7 FR 2.		OK	RSN	
1.2.6.7 FR 3.		OK	RSN	
1.2.6.7 PC 1a.		OK	RSN	

(3) Category:
OK = Verified source of authority; NV = Not verified to source of authority;
(Blank) = Test not available for source check

YMP/CC-0013, Rev. 5/31/91

(1) ESFDR Section	(2) DAA Recommendations	(3) Category	(4) Resp Org	(5) Sup Org
1.2.6.7 PC 1b.		OK	RSN	LANL
1.2.6.7 PC 1c.		OK	RSN	
1.2.6.7 PC 1d.		OK	RSN	LANL
1.2.6.7 PC 1e.		OK	RSN	LANL
1.2.6.7 PC 1f.		OK	RSN	
1.2.6.7 PC 2a.		OK	RSN	LANL
1.2.6.7 PC 2b.		OK	RSN	
1.2.6.7 PC 3a.		OK	RSN	LANL
1.2.6.7 PC 3b.		OK	RSN	
1.2.6.7 ICR 1.		NV	RSN	
1.2.6.7 ICR (end)		NV	RSN	
1.2.6.7 C A.		OK	RSN	
1.2.6.7 C B.		OK	RSN	
1.2.6.7 C B.i		NV	RSN	
1.2.6.7 C C.		OK	RSN	LANL
1.2.6.7 C C.i		NV	RSN	LANL
1.2.6.7 C D.		OK	RSN	
1.2.6.7 C D.i		NV	RSN	
1.2.6.7 C D.ii		NV	RSN	
1.2.6.7 C E.		OK	RSN	LANL
1.2.6.7 C E.i		NV TBD	RSN	LANL
1.2.6.7 C E.ii		NV	RSN	LANL
1.2.6.7 C E.iii	C3-3	NV TBD	RSN	LANL
1.2.6.7 C F.		OK	RSN	
1.2.6.7 C F.i		NV	RSN	
1.2.6.7 C F.ii		NV	RSN	
1.2.6.7 C F.iii		NV	RSN	LANL
1.2.6.7 C G.		OK	RSN	
1.2.6.7 C G.i		NV	RSN	LANL
1.2.6.7 C H.		OK	RSN	LANL
1.2.6.7 C I.		OK	RSN	
1.2.6.7 C J.		OK	RSN	
1.2.6.7 C K.		OK	RSN	
1.2.6.7.1 DEF		NV	RSN	
1.2.6.7.1 BI		NV	RSN	
1.2.6.7.1 FR 1.		OK	RSN	
1.2.6.7.1 PC 1a.		OK	RSN	
1.2.6.7.1 PC 1b.		OK	RSN	
1.2.6.7.1 PC 1c.		OK	RSN	
1.2.6.7.1 PC 1d.		OK	RSN	LANL
1.2.6.7.1 C A.		OK	RSN	
1.2.6.7.1 C B.		OK	RSN	
1.2.6.7.1 C C.		OK	RSN	

(3) Category:
OK = Verified source of authority; NV = Not verified to source of authority;
(Blank) = Test not available for source check

YMP/CC-0013, Rev. 5 31 91

(1) ESFDR Section	(2) DAA Recommendations	(3) Category	(4) Resp Org	(5) Sup Org
1.2.6.7.1 C D.		OK	RSN	
1.2.6.7.1 C E.		OK	RSN	
1.2.6.7.1 C F.		OK	RSN	
1.2.6.7.2 This number not used				
1.2.6.7.3 DEF		NV	RSN	
1.2.6.7.3 BI		NV	RSN	
1.2.6.7.3 FR 1.		OK	RSN	LANL
1.2.6.7.3 PC 1a.		OK	RSN	LANL
1.2.6.7.3 PC 1b.		OK	RSN	LANL
1.2.6.7.3 PC 1c.		OK	RSN	
1.2.6.7.3 PC 1d.		OK	RSN	LANL
1.2.6.7.3 C A.		OK	RSN	LANL
1.2.6.7.3 C B.		OK	RSN	
1.2.6.7.3 C C.		OK	RSN	
1.2.6.7.4 DEF		NV	RSN	
1.2.6.7.4 BI		NV	RSN	
1.2.6.7.4 FR 1.		OK	RSN	
1.2.6.7.4 PC 1a.		OK	RSN	
1.2.6.7.4 PC 1b.		OK	RSN	
1.2.6.7.4 PC 1c.		OK	RSN	
1.2.6.7.4 PC 1d.		OK	RSN	LANL
1.2.6.7.4 PC 1e.		OK	RSN	
1.2.6.7.4 PC 1f.		OK	RSN	
1.2.6.7.4 PC 1g.		OK	RSN	
1.2.6.7.4 C A.		OK	RSN	
1.2.6.7.4 C B.		OK	RSN	
1.2.6.7.4 C C.		OK	RSN	
1.2.6.7.4 C D.		OK	RSN	
1.2.6.7.4 C E.		OK	RSN	
1.2.6.7.4 C F.		OK	RSN	
1.2.6.7.4 C G.		OK	RSN	
1.2.6.7.4 C H.		OK	RSN	
1.2.6.7.4 C I.		OK	RSN	
1.2.6.7.4 A 1.		NV	RSN	
1.2.6.7.5 DEF		NV	RSN	
1.2.6.7.5 BI		NV	RSN	
1.2.6.7.5 FR 1.		OK	RSN	
1.2.6.7.5 PC 1.		OK	RSN	LANL
1.2.6.7.5 C A.		OK	LANL	
1.2.6.7.5 A 1.		NV	RSN	

(3) Category:
OK = Verified source of authority; NV = Not verified to source of authority;
(Blank) = Test not available for source check

YMP/CC-0013, Rev. 5/31/91

(1) ESFDR Section	(2) DAA Recommendations	(3) Category	(4) Resp Org	(5) Sup Org
1.2.6.7.6 DEF		NV	RSN	
1.2.6.7.6 BI		NV	RSN	
1.2.6.7.6 FR 1.		OK	RSN	
1.2.6.7.6 PC 1a.		OK	RSN	
1.2.6.7.6 PC 1b.		OK	RSN	LANL
1.2.6.7.6 PC 1b.i		NV	RSN	
1.2.6.7.6 PC 1b.ii		NV	RSN	
1.2.6.7.6 PC 1b.iii		NV	RSN	
1.2.6.7.6 PC 1b.iv		NV	RSN	LANL
1.2.6.7.6 PC 1b.v		NV	RSN	
1.2.6.7.6 PC 1c.		OK	RSN	LANL
1.2.6.7.6 PC 1c.i		NV	RSN	
1.2.6.7.6 PC 1d.		OK	RSN	
1.2.6.7.6 PC 1e.		OK	RSN	
1.2.6.7.6 PC 1f.		OK	RSN	
1.2.6.7.6 C A.		OK	RSN	
1.2.6.7.7 DEF		NV	RSN	
1.2.6.7.7 BI		NV	RSN	
1.2.6.7.7 FR 1.		OK	RSN	LANL
1.2.6.7.7 PC 1.		OK	RSN	LANL
1.2.6.7.8 DEF		NV	RSN	
1.2.6.7.8 BI		NV	RSN	
1.2.6.7.8 FR 1.		OK	RSN	
1.2.6.7.8 PC 1a.		OK	RSN	
1.2.6.7.8 PC 1b.		OK	RSN	
1.2.6.7.8 PC 1c.		OK	REECO	
1.2.6.7.8 C A.		OK	RSN	LANL
1.2.6.7.8 C B.		OK	RSN	
1.2.6.7.8 C C.		OK	RSN	LANL
1.2.6.7.9 DEF		NV	RSN	
1.2.6.7.9 BI		NV	RSN	
1.2.6.7.9 FR 1.		OK	RSN	
1.2.6.7.9 PC 1a.		OK	RSN	LANL
1.2.6.7.9 PC 1b.		OK	RSN	
1.2.6.7.9 PC 1c.		OK	RSN	
1.2.6.7.9 C A.		OK	RSN	
1.2.6.7.9 C B.		OK	RSN	
1.2.6.7.9 C C.		OK	RSN	
1.2.6.7.9 C D.		OK	RSN	
1.2.6.7.9 C E.		OK	RSN	

(3) Category:
OK = Verified source of authority; NV = Not verified to source of authority;
(Blank) = Test not available for source check

YMP CC-0013, Rev. 5 31 91

(1) ESFDR Section	(2) DAA Recommendations	(3) Category	(4) Resp Org	(5) Sup Org
1.2.6.7.10 DEF		NV	REECO	
1.2.6.7.10 BI		NV	REECO	
1.2.6.7.10 FR 1.		OK	REECO	
1.2.6.7.10 PC 1a.		OK	REECO	
1.2.6.7.10 PC 1b.		OK	REECO	
1.2.6.7.10 PC 1c.		OK	REECO	
1.2.6.7.11 DEF		NV	RSN	
1.2.6.7.11 BI		NV	RSN	
1.2.6.7.11 FR 1.		OK	RSN	
1.2.6.7.11 PC 1a.		OK	RSN	LANL
1.2.6.7.11 PC 1b.		OK	RSN	LANL
1.2.6.7.11 PC 1c.		OK	RSN	LANL
1.2.6.7.11 PC 1d.		OK	RSN	
1.2.6.7.11 PC 1e.		OK	RSN	LANL
1.2.6.7.11 PC 1e.i		NV	RSN	LANL
1.2.6.7.11 PC 1f.		OK	RSN	
1.2.6.7.11 C A.		OK	RSN	LANL
1.2.6.7.11 C B.		OK	RSN	
1.2.6.8 UNDERGROUND TEST SUPPORT				
1.2.6.8 DEF		NV	RSN	
1.2.6.8 BI		NV	RSN	
1.2.6.8 ARCS		NV	RSN	
1.2.6.8 FR 1.		OK	RSN	LANL
1.2.6.8 PC 1a.		OK	RSN	LANL
1.2.6.8 PC 1b.		OK	RSN	LANL
1.2.6.8 PC 1c.		OK	LANL	LANL
1.2.6.8 PC 1d.		OK	RSN	LANL
1.2.6.8 PC 1e.		OK	RSN	LANL
1.2.6.8 PC 1f.		OK	RSN	
1.2.6.8 ICR 1.		NV	RSN	LANL
1.2.6.8 C A.		OK	LANL	SNL
1.2.6.8 C B.		OK	LANL	LANL
1.2.6.8 C B.i		NV TBD	RSN	
1.2.6.8 C C.		OK	RSN	LANL
1.2.6.8 C C.i		NV TBD	LANL	LANL
1.2.6.8 C D.		OK	RSN	LANL
1.2.6.8 C D.i	C1-11	NV	RSN	LANL
1.2.6.8 C D.ii		NV TBD	RSN	LANL
1.2.6.8 C D.iii	C1-14	NV TBD	LANL	SNL
1.2.6.8 C E.		OK	RSN	LANL
1.2.6.8 C E.i	C1-6,C2-2	NV	LANL	

(3) Category:
OK = Verified source of authority; NV = Not verified to source of authority;
(Blank) = Test not available for source check

YMP-CC-0013, Rev. 5/31/91

(1) ESFDR Section	(2) DAA Recommendations	(3) Category	(4) Resp Org	(5) Sup Org
1.2.6.8 C E.ii	C1-5	NV TBD	SNL	LANL
1.2.6.8 C E.iii		NV TBD	SNL	LANL
1.2.6.8 C E.iv		NV	RSN	LANL
1.2.6.8 C E.v		NV	RSN	LANL
1.2.6.8 C E.vi		NV	RSN	LANL
1.2.6.8 C E.vii		NV	RSN	LANL
1.2.6.8 C E.viii	C1-5, C2-8	NV TBD	RSN	LANL
1.2.6.8 C E.ix		NV	RSN	LANL/SNL
1.2.6.8 A 1.		NV	LANL	RSN
1.2.6.8.1 DEF		NV	RSN	LANL
1.2.6.8.1 BI		NV	RSN	LANL
1.2.6.8.1 FR 1.		OK	RSN	LANL
1.2.6.8.1 PC 1.		NV	RSN	LANL
1.2.6.8.1 ICR 1.		NV	RSN	LANL
1.2.6.8.1 ICR 1. (end)		NV	RSN	LANL
1.2.6.8.1 ICR 2.		NV	LANL	LANL
1.2.6.8.1 ICR 2.i		NV	LANL	LANL
1.2.6.8.1 ICR 2.ii		NV	LANL	LANL
1.2.6.8.2 DEF		NV	RSN	LANL
1.2.6.8.2 DEF [2]		NV	RSN	LANL
1.2.6.8.2 DEF [3]		NV	RSN	LANL
1.2.6.8.2 DEF [4]		NV	RSN	LANL
1.2.6.8.2 BI		NV	RSN	LANL
1.2.6.8.2 FR 1.		OK	RSN	LANL
1.2.6.8.2 PC 1.		OK	RSN	LANL
1.2.6.8.2 C A.		OK	RSN	
1.2.6.9 ESF DECOMMISSIONING AND CLOSURE				
1.2.6.9 DEF		NV	RSN	
1.2.6.9 BI		NV	RSN	
1.2.6.9 ARCS		NV	RSN	
1.2.6.9 FR 1.		NV	RSN	LANL
1.2.6.9 PC 1a.		OK	RSN	
1.2.6.9 PC 1b.		OK	RSN	LANL
1.2.6.9 PC 1c.		NV	RSN	
1.2.6.9 A 1.		NV	RSN	LANL
1.2.6.9 A 2.		NV	RSN	LANL

(3) Category:
OK = Verified source of authority; NV = Not verified to source of authority;
(Blank) = Test not available for source check

YMP/CC-0013, Rev. 5/31/91

(1) ESFDR Section	(2) DAA Recommendations	(3) Category	(4) Resp Org	(5) Sup Org
1.2.6.9.1 DEF		NV	RSN	
1.2.6.9.1 BI		NV	RSN	
1.2.6.9.1 FR 1.		OK	RSN	
1.2.6.9.1 PC 1a.		OK	RSN	
1.2.6.9.1 PC 1b.		OK	RSN	
1.2.6.9.1 C A.		NV	RSN	
1.2.6.9.1 C A.i		NV	RSN	
1.2.6.9.1 C A.ii		NV	RSN	
1.2.6.9.1 C A.iii		NV	RSN	
1.2.6.9.1 C B.		OK TBD	RSN	
1.2.6.9.2 DEF		NV	RSN	
1.2.6.9.2 BI		NV	RSN	
1.2.6.9.2 FR 1.		OK	RSN	LANL
1.2.6.9.2 PC 1.		OK	RSN	LANL
1.2.6.9.2 C A.		NV	RSN	LANL
1.2.6.9.2 C A.i		NV	RSN	
1.2.6.9.2 C A.ii		NV	RSN	
1.2.6.9.2 C A.iii		NV	RSN	
1.2.6.9.2 C A.iv		NV	RSN	

(2) Category:
OK = Verified source of authority; NV = Not verified to source of authority;
(Blank) = Test not available for source check

YMP CC-0013, Rev. 5/31/91

APPENDIX I

PERFORMANCE ASSESSMENT ANALYSES

YMP CC-0013, Rev. 5 31 91

APPENDIX I: PERFORMANCE ASSESSMENT ANALYSES

I.1 Introduction

This appendix presents the relationship between the NRC regulations governing the design, construction, and operation of the Exploratory Shaft Facility (ESF) and the ESF design requirements (ESF DR) for which analysis support is necessary. Summaries of the analyses defined to address a subset of these requirements and their application to the ESF DR are also included.

The relationships among ESF DR requirements, the NRC 10 CFR 60 requirements, and support analyses are discussed in Section I.1. Summaries of support analyses defined to date and recommendations derived from the results of the analyses are presented in Section I.2. The ESF DR sections requiring support analyses and the corresponding 10 CFR 60 requirements are included in Section I.3.

Table I.1 contains a list of the analyses defined to date. These analyses were defined to quantify criteria in Chapters 0 through 5 of the ESF SDRD benchmark 5 and were grouped by disciplines: hydraulics, rock mechanics, thermal, chemical, and safety. Since their definition, the SDRD has evolved into the ESF DR of which these analyses are applicable but not exhaustive. Analyses 1--9 have been completed while analyses 10 and 11 are integral parts of the design and construction process and are ongoing. These analyses are based on available data and on the present conceptual understanding of the processes and mechanisms perceived active at Yucca Mountain and may be refined as better understanding evolves through site characterization and through additional analyses, which will address uncertainties and the sensitivity of the results to alternate conceptual models. Recommendations based on the results of these analyses are intended to provide guidance for applying engineering judgment during the design, construction, and operation of the ESF. Additional analyses will be defined as appropriate, through interactions among analysts, architectural engineers, and investigators responsible for site characterization activities.

Table I.2 presents the ESF DR sections requiring analyses support; their relationship with the 10 CFR 60 regulations for the design, construction, and operation of the ESF; and the current status of support analyses. Table I.2 is the reference baseline for analysis support for the ESF DR. Support analyses are identified by analysis number (from Table I.1) in the final column of Table I.2. This and other descriptive notes are included at the end of Table I-2.

I.2 Analyses Summary

The analyses summarized in this appendix are based on widely used conceptual and mathematical models that incorporate our present understanding of processes and mechanisms ongoing at Yucca Mountain. It should be emphasized that the results of these analyses may not agree with results of similar analyses based on alternate conceptual models. As our knowledge of the site increases these uncertainties may be reduced or removed by future analyses.

YMP CC-0013, Rev. 5 31 91

TABLE I.1 Analyses Supporting ESF Design

Analysis Number	Title
1	Surface Construction Water Movement
2	Shaft Construction Water Movement
3	Sewage and Settling Pond Water Movement
4	Water Entry into Shafts Through Rock Mass Surrounding Shaft Collar & Liner
5	Shaft and Main Pad Blasting Effects
6	Shaft and Collar Creep
7	Shaft and Collar Thermal Stress
8	Far Field Thermal Effects
9	Systems and Components Important to Safety
10	Hydrologic and Geochemical Effects of Tracers
11	Hydrologic and Geochemical Effects of Chemicals

Table I.2 Analysis Support for the ESF

10 CFR Requirement	ESF DR Requirement	ESF DR Description	Subsystem	Status ESF DR	Status SA
60.15(b)					
60.15(c)(1)	1.2.6.1 C A.	Limit potential for adverse impacts on repository performance	Main site	TBD	*
60.15(c)(1)	1.2.6.4 PC 2a.i	Limit potential for adverse impacts on repository performance	Shaft	TBD	*
60.15(c)(1)	1.2.6.5 PC 2a.i	Limit potential for adverse impacts on repository performance	Ramp	TBD	*
60.15(c)(1)	1.2.6.6 PC 2a.i	Limit potential for adverse impacts on repository performance	MTL	TBD	*
60.15(c)(1)	1.2.6.7 C B.i	Limit potential for adverse impacts on repository performance	UU		*
60.15(c)(1)	1.2.6.4 PC 2a.ii	All materials or substances shall be reviewed before used	Shaft	TBD	11
60.15(c)(1)	1.2.6.5 PC 2a.ii	All materials or substances shall be reviewed before used	Ramp	TBD	11
60.15(c)(1)	1.2.6.6 PC 2a.ii	All materials or substances shall be reviewed before used	UE	TBD	11
60.15(c)(1)	1.2.6.4 PC 2a.iv	Materials control program	Shaft	TBD	11
60.15(c)(1)	1.2.6.5 PC 2a.iv	Materials control program	Ramp	TBD	11
60.15(c)(1)	1.2.6.6 PC 2a.iii	Materials control program	UE	TBD	11
60.15(c)(1)	1.2.6.4 PC 1d.ix	Evaluate chemical content of blasting agents & explosives	Shaft	TBD	*
60.15(c)(1)	1.2.6.5 PC 1d.ix	Evaluate chemical content of blasting agents & explosives	Ramp	TBD	*
60.15(c)(1)	1.2.6.6 PC 1d.xiii	Evaluate chemical content of blasting agents & explosives	UE	TBD	*
60.15(c)(1)	1.2.6.4 PC 2g.i	Limit water use in underground construction to 15 gal/ton of rock execav.	Shaft		*
60.15(c)(1)	1.2.6.5 PC 2g.ii	Limit water use in underground construction to 15 gal/ton of rock execav.	Ramp		*
60.15(c)(1)	1.2.6.6 PC 2h.iv	Limit water use in underground construction to 15 gal/ton of rock execav.	UE		*
60.15(c)(2)					
60.15(c)(3)	1.2.6.8 C D.iii	Boreholes shall not penetrate TSW2 base without evaluation	UT	TBD	*
60.15(c)(4)	1.2.6.0 C C.iii	Control all substances & tracers			10,11
60.15(c)(4)	1.2.6.0 C C.iv	Hydrocarbons & solvents comply with performance criteria requirements		TBD	11
60.16					

Table I.2 Analysis Support for the ESF (cont.)

10 CFR Requirement	ESF DR Requirement	ESF DR Description	Subsystem	Status: ESF DR	Status: SA
60.21(c)(1)(ii)(D)					
60.21(c)(11)					
60.111					
60.112					
60.113(a)(1)(i)					
60.130					
60.131(b)(2)					
60.131(b)(4)(i)					
60.133(a)(1)	1.2.6.4 PC 1d.xii	Accesses shall be located so as to not interfere with each other	Shaft	*	2
60.133(a)(1)	1.2.6.5 PC 1d.xii	Accesses shall be located so as to not interfere with each other	Ramp	*	2
60.133(a)(1)	1.2.6.5 PC 2e.ii	Spacing between drifts >= two drift diameters	UE	TBV	f
60.133(a)(2)	1.2.6.4 PC 2e.ii	Design collar to prevent significant water inflow during floods	Shaft	*	4
60.133(a)(2)	1.2.6.5 PC 2e.ii	Design portal to prevent significant water inflow during floods	Ramp	TBD	f
60.133(b)					
60.133(d)	1.2.6.1 C F.i	Water limited consistent with performance objectives	Surface		1
60.133(d)	1.2.6.4 PC 1d.vi	Fluids & materials shall be evaluated before used	Shaft		11
60.133(d)	1.2.6.5 PC 1d.vi	Fluids & materials shall be evaluated before used	Ramp		11
60.133(d)	1.2.6.6 PC 1d.ix	Fluids & materials shall be evaluated before used	UF		11
60.133(d)	1.2.6.4 PC 2g.ii	Water use in const./oper. to limit increase in avg. saturation to ____	Shaft	TBD	2f
60.133(d)	1.2.6.5 PC 2g.iii	Water use in const./oper. to limit increase in avg. saturation to ____	Ramp	TBD	2f
60.133(d)	1.2.6.6 PC 2h.v	Water use in const./oper. to limit increase in avg. saturation to ____	UF	TBD	2f
60.133(d)	1.2.6.8 C E.iii	Water use in testing. to limit increase in avg. saturation to ____	UT	TBD	2f
60.133(d)	1.2.6.7.6 PC 1e	Proper disposal of fluids recovered during construction	Shaft		3,11
60.133(d)	1.2.6.8 C E.v	Proper disposal of fluids recovered during construction	UT		3,11
60.133(d)	1.2.6.7.6 PC 1b.i	Groundwater collection system, etc. to include water inflow from rock	Shaft		4f

YMP/CC-0013, Rev. 5/31/91

Table I.2 Analysis Support for the ESF (cont.)

10 CFR Requirement	ESF DR Requirement	ESF DR Description	Subsystem	Status	
				ESF DR	SA
60.133(d)	1.2.6.4 PC 1d.iii	Water use in const./oper. shall not cause interference of tests	Shaft	*	2
60.133(d)	1.2.6.5 PC 1d.iii	Water use in const./oper. shall not cause interference of tests	Ramp	*	2
60.133(d)	1.2.6.6 PC 1d.vi	Water use in const./oper. shall not cause interference of tests	UF	TBD	f
60.133(d)	1.2.6.8 C E.ii	Limit water use to limit effects on waste containment & isolation	UT	TBD	*
60.133(d)	1.2.6.4 PC 1d.vii	Tag fluids, gases, and other materials	Shaft	TBD	10
60.133(d)	1.2.6.5 PC 1d.vii	Tag fluids, gases, and other materials	Ramp	TBD	10
60.133(d)	1.2.6.6 PC 1d.x	Tag fluids, gases, and other materials	UE	TBD	10
60.133(e)(2)	1.2.6.4 PC 2h.ii	Locate accesses to limit potential mech. & hydrological interference	Shaft	TBD	2f
60.133(e)(2)	1.2.6.5 PC 2h.ii	Locate accesses to limit potential mech. & hydrological interference	Ramp	TBD	2f
60.133(f)	1.2.6.1 C C.i	Shall not significantly increase pathways/reduce performance	Main site	TBD	5
60.133(f)	1.2.6.1 C C.ii	Control blasting to limit damage to prevent creating perf. pathways	Main site		4,5
60.133(f)	1.2.6.4 PC 2i.va	Blast induced change in permeability < .5 opening dimension < 1 O.M.	Shaft	TBD	5
60.133(f)	1.2.6.5 PC 2i.va	Blast induced change in permeability < .5 opening dimension < 1 O.M.	Ramp		f
60.133(f)	1.2.6.6 PC 2j.via	Blast induced change in permeability < .5 opening dimension < 1 O.M.	UE	TBV	5
60.133(f)	1.2.6.4 PC 2i.iiia	Areas w/o thermal load, daimetrical closure rate decreasing after const.	Shaft		f
60.133(f)	1.2.6.5 PC 2i.iiia	Areas w/o thermal load, daimetrical closure rate decreasing after const.	Ramp		
60.133(f)	1.2.6.6 PC 2j.iiia	Areas w/o thermal load, closure rate decreasing after const.	Drifts	TBD	f
60.133(f)	1.2.6.4 PC 2i.iiib	Areas with thermal load, closure rate <= 3 times thermoelastic	Shaft		f
60.133(f)	1.2.6.5 PC 2i.iiib	Areas with thermal load, closure rate <= 3 times thermoelastic	Ramp		
60.133(f)	1.2.6.6 PC 2j.iiib	Areas with thermal load, closure rate <= 3 times thermoelastic	Drifts	TBD	f
60.133(f)	1.2.6.4 PC 2i.vii	Use controlled blasting to limit excavation induced damage	Shaft	TBD	5
60.133(f)	1.2.6.5 PC 2i.vii	Use tunnel boring machine to limit excavation induced damage	Ramp	TBD	5
60.133(f)	1.2.6.6 PC 2j.xii	Controlled drilling and blasting methods shall provide for site char.	UE		f
60.133(h)					

YMP CC-0013, Rev. 5/31/91

Table I.2 Analysis Support for the ESF (conc.)

10 CFR Requirement	ESF DR Requirement	ESF DR Description	Subsystem	Status ESF DR	Status SA
60.133(i)	1.2.6.4 PC 2j.i	Consider thermomechanical response of host rock & ground water	Shaft		6f
60.133(i)	1.2.6.5 PC 2j.i	Consider thermomechanical response of host rock & ground water	Ramp		6f
60.133(i)	1.2.6.6 PC 2k.i	Consider thermomechanical response of host rock & ground water	UE		6f
60.133(i)	1.2.6.4 PC 2j.iii	The liner shall withstand pressures exerted along its length...	Shaft	TBD	7
60.133(i)	1.2.6.5 PC 2j.iii	The liner shall withstand pressures exerted along its length...	Ramp	TBD	f
60.133(i)	1.2.6.6 PC 2k.iii	The liner shall withstand pressures exerted along its length...	UE	TBD	f
60.133(i)	1.2.6.6 PC 2k.v	Thermal effects shall not increase temp. in TSw3 or CHn above 115 C	UT		8
60.134					
60.137					
60.140(c)					
60.140(d)(1)					
	1.2.6.2.3 C B.	Location of sewage ponds to be determined by PA	SS	*	3
	1.2.6.2.5 C A.	Dispose of liquid wastes in an environmentally safe way	MWS	TBD	11
	1.2.6.2.5 C B.	Location of wastewater ponds to be determined by PA	MWS	*	3

Column	Definition
Subsystem	
MTL	Main test level
MWS	Mine wastewater system
SS	Sewage system
TA	Test areas
UE	Underground excavation
UF	Underground facilities
USS	Underground support system
UT	Underground testing
UU	Underground utilities

Column	Definition
Status ESF DR	
TBD	To be determined
TBV	To be verified
*	Removal of TBD or TBV
Status SA	
Number	Analysis number from Table I.1 (indicates that results from that analysis apply)
*	Results from the 11 analysis apply; more analysis may be required
f	Future analyses are required

YMP/CC-0013, Rev. 5/31/91

YMP CC-0013, Rev. 5 31 91

Recommendations based on these analyses are provided only as guidance and will be evaluated and revised through continual interactions among the architectural engineers, analysts, and investigators responsible for site characterization. Thus, refinement of the results is an ongoing and iterative process, which must complement site characterization.

I.2.1 Analysis 1. Surface Construction Water Movement Above the Repository

Purpose

To provide numerical criteria for limiting the amount of water that can be placed on the surface above the repository and for determining the lateral extent of water as it flows within the mountain due to the application of water at the surface.

The calculations were performed in accordance with SNL internal documents Problem Definition Memos PDM 72-28 (one-dimensional) and PDM 72-29 (two-dimensional).

A series of one-dimensional calculations were made using TOSPAC to estimate changes in saturation at depth and to provide input to the two-dimensional calculations. The two-dimensional calculations were performed using NORIA-SP to substantiate the one-dimensional results and to determine the lateral movement of the water within the mountain due to application of water at the surface.

The physics associated with water transport at the surface are complicated and include unpredictable unknowns such as the weather and surface topology. Thus, the amount of water that will enter the mountain can only be inferred from measurements of rainfall, surface evaporation, run-off, the amount of water applied on the surface and through a surface water balance. Because only the water that enters the mountain can effect repository performance and underground tests, these calculations were posed in terms of the amount of water penetrating the surface rather than the amount of water applied to the surface. This minimizes complications and uncertainties associated with surface water balances and scenarios for water application in the calculations.

The result of this analysis shows that 16 cubic meters of water per square meter of surface area can enter the mountain without increasing the saturation at the repository horizon within 10,000 years. Additionally, the lateral extent of the water is confined to within four times the assumed pad surface area. Using the Title I design area for the ESF pad and roads this corresponds to 6.256 million cubic meters of water.

These values apply to ESF DR requirement 1.2.6.1 C F.i.

Recommendation: The results of Analysis 1 indicate that a goal for the amount of water used by operations on the shafts/ramps surface sites which limits the total water budget to 2 gallons/yard^2/day over a five-year period will not impact the performance of the repository in 10,000 years (1.2.6.1 C F.i). Following discussions with constructors, a similar value consistent with standard practices may be considered as a more practical limit.

The problem definition memos (which include citations for the data used, lists of assumptions, and results) from which these conclusions and recommendations were drawn can be found in SNL's YMP record center under file codes 72/12147/PDM 72-28/1.0/QA and 72/12147/PDM 72-29/1.0/QA.

I.2.2 Analysis 2. Analyses of Shaft Construction Water Movement

Purpose

To estimate the potential for water used in the construction of shafts and ramps to interfere with experiments conducted in the surrounding host rock.

The calculations were performed in accordance with the SNL internal document Problem Definition Memo PDM 72-30.

One-dimensional calculations using NORIA-SP were performed to determine construction water movement from shafts and drifts. The results and conclusions for drifts may also be applied to ramps. These calculations are extensions of the analyses performed by Eaton and Peterson [1988] but at higher construction water requirements and higher retention factors (i.e., for more water entering the surrounding host rock). The calculations were performed as summarized below:

- Shafts
  - Geometry
    - One-dimensional axisymmetric
    - Shaft radius: 2.21 m
    - Modified Permeability Zone (MPZ): one diameter
  - Parameters
    - Yucca Mountain Stratigraphic Units: Tiva Canyon, Paintbrush, Topopah Springs, Calico Hills
    - Construction water used: 2.856 cubic meters per meter of shaft
    - Retention factor
      - Without ventilation: 15 percent
      - With ventilation: 10, 15, 20 percent
- Drifts
  - Geometry
    - One-dimensional cartesian
    - Wall dimensions: height 1m, length 25 m
    - Modified Permeability Zone (MPZ): 2.76 m
  - Parameters
    - Yucca Mountain Stratigraphic Units: Topopah Springs, Calico Hills
    - Construction water used: 2.918 cubic meters per meter of drift
    - Retention factor
      - Without ventilation: 15 percent
      - With ventilation: 10, 15, 20 percent

The results of these calculations show that ventilation removes the retained construction water and dries out the surrounding rock.

YMP CC-0013, Rev. 5 31 91

The penetration of water into the rock at constant values of saturation change is illustrated as a function of time. These curves provide bounds for evaluating the interference of construction water with experiments conducted in the surrounding host rock and remove the TBD's associated with ESF DR requirements 1.2.6.4 PC 1d.xii, 1.2.6.5 PC 1.d.xii, 1.2.6.4 PC 1d.iii, and 1.2.6.5 PC 1d.iii. These curves also provide the hydrological information to remove TBD's in requirements 1.2.6.4 PC 2h.ii and 1.2.6.5 PC 2h.ii.

Recommendation: The results of Analysis 2 indicate that a goal for the amount of water used in the construction of the Title I shaft design shall be limited to 230 gallons/foot of advance (1.2.6.4 PC 1d.iii and 1.2.6.5 PC 1d.iii). Following discussions with constructors, a similar value consistent with standard practices may be considered as a more practical limit.

Recommendation: The results of Analysis 2 indicate that a goal for the distance between accesses (shafts and ramps) that limits potential hydrological interference between the accesses is 15 m (1.2.6.4 PC 1d.xii, 1.2.6.5 PC 1d.xii, 1.2.6.4 PC 1d.iii and 1.2.6.5 PC 1d.iii). Following discussions with constructors, a similar value consistent with standard practices may be considered as a more practical limit.

The problem definition memo (which includes citations for the data used, lists of assumptions, and results) from which these conclusions and recommendations were drawn can be found in SNL's YMP record center under file code 72/12147/PDM 72-30/1.0/QA.

I.2.3 Analysis 3. Analyses of Sewage and Settling Pond Water Movement

Purpose

To estimate the potential for water leakage from settling ponds in the muck storage area and discharged from the sewage pond system to interfere with experiments conducted in the ESF.

The calculations were performed in accordance with Problem Definition Memo PDM 72-31.

Calculations were performed to evaluate both sewage ponds and settling ponds using the conditions summarized below.

Sewage ponds

The potential effects of the sewage pond locations were investigated by performing calculations at two locations; one near the edge of the repository block and the other approximately two miles east of the repository boundary. These calculations predicted water movement from the sewage ponds at the two locations. These locations were selected to correspond to the Title I design for the locations for muck settling ponds and sewage ponds.

The Title I design was used for sewage pond size and the pond was assumed to be unlined and to contain a constant 1.83 meters of sewage for five years.

 YMP CC-0013, Rev. 5/31/91

Settling ponds

Water movement from settling ponds and the effects of leaks in pond liners were predicted by calculations for leakages which correspond to 100, 10, and 1 percent of the Title I design settling pond surface area. Leaks were assumed to be discrete with negligible impedance to flow and the depth of the pond was assumed to be a constant 3.05 m.

These calculations show that water leakage from settling pond in the muck storage area and in the location of the sewage ponds have no effect on the saturation at the repository horizon and will not interfere with experiments conducted in the ESF. These results remove the TBD's associated with ESF DR requirements 1.2.6.2.3 C B. and 1.2.6.2.5 C B. and apply to requirements 1.2.6.7.6 PC 1e and 1.2.6.8 C E.v. for fluids with transport properties similar to water.

Recommendation: The results of Analysis 3 indicate that the proposed location of the sewage pond beyond the perimeter of the repository subsurface facility referenced in Title I will not interfere with site characterization activities (1.2.6.2.3 C B.).

Recommendation: The results of Analysis 3 indicate that the proposed location of the wastewater system referenced in Title I will not interfere with site characterization activities (1.2.6.2.5 C B.).

Recommendation: The results of Analysis 3 indicate that fluids with transport properties similar to water recovered during construction and testing can be disposed of in settling ponds to avoid potential impacts on performance (1.2.6.7.6 PC 1e, and 1.2.6.8 C E.v).

The problem definition memo (which includes citations for the data used, lists of assumptions, and results) from which these conclusions and recommendations were drawn can be found in SNL's YMP record center under file code 72/12147/PDM 72-31/1.0/QA.

I.2.4 Analysis 4. Water Entry Into Shafts Through Rock Mass Surrounding Shaft Collar and Liner

Purpose

To determine the amount of water entering the shaft through the near-surface fracture network.

These calculations were performed in accordance with the SNL internal document Problem Definition Memo PDM 76-08.

Three scenarios considered in this study are as described below (Fernandez et al., 1989):

(1) The rainfall rate scenario in which the flow of water into the fractures is controlled by the rate of rainfall. Rain falling in excess of the fracture network's ability to absorb water is

YMP/CC-0013, Rev. 5/31/91

assumed to drain off of the ES pad. This implies that no restoration of the ES occurs and that the engineered drainage features around the ES pad will function to maintain drainage.

(2) The sheet flow scenario in which sheet flow is assumed to occur over the pad. This scenario assumes that no restoration of the ES pad occurs and that the amount of water entering the fracture network is limited only be the network's ability to absorb water.

(3) The channel flow scenario in which channel flow is assumed to occur to Coyote Wash. This channel is 82 m away from the Exploratory Shaft at its closest point. This calculation showed that the ES is outside of the zone of influence of floodwaters in Coyote Wash and did not contribute to water inflow to the ES.

These analyses were performed under the assumption that no remedial measures were performed in the vicinity of the shaft to limit water inflow into the rock matrix. In fact the retarding effect of an alluvial cover was conservatively neglected.

The primary conclusion of this analysis is that the water entry into the exploratory shaft by way of the rock mass behind the shaft collar is less than the storage and drainage capacity of the shaft sump under the host rock conditions. Performance implications associated with this water flow are not expected. For this reason no design constraints are imposed on the shaft collar to limit the permeability of rock behind the collar. This conclusion removes the TBD associated with ESF DR requirement 1.2.6.4 PC 2e.ii and applies to requirements 1.2.6.7.6 PC 1b.i and 1.2.6.1 C C.ii.

It is necessary to emphasize that should significant water entry occur behind the shaft collar as a result of shaft excavation, remedial measures may be applied. These remedial measures include grouting the fractures near the collar and restoring the pad area at closure using the strategies to control infiltration given in Section 8.3.2 of Fernandez et al. (1989).

Recommendation: The results of Analysis 4 indicate that significant water inflow from a flooding event during site characterization and repository operation will not adversely impact testing in the underground portion of the repository if standard engineering practices are employed during construction for the shaft collar (1.2.6.4 PC 2e.ii).

The problem definition memo (which includes citations for the data used, lists of assumptions, and results) from which these conclusions and recommendations were drawn can be found in SNL's YMP record center under file code 70/12471/PDM 76-8/1.0/QA.

I.2.5 Analysis 5. Shaft and Main Pad Blasting Effects

Purpose

To provide quantitative estimates of the extent of fracturing which may result from blasting used to excavate the shaft and bring the pad area to grade. The blast design will be assessed to determine the length of fractures predicted to extend from blast holes.

This evaluation was performed in accordance with the SNL internal document Design Investigation Memo DIM 257.

As assessment of the extent of fracturing in preparation of the pad, collar, and shaft for the Exploratory Shaft Facility has been completed. The investigation provides background and guidance for determining if controlled blasting can be used to limit excavation-induced damage to the rock. For this analysis a preliminary conceptual design for the pad was used because no reference design for the pad existed. For the collar and shaft the extent of fracturing was based on a report entitled "NNWSI Exploratory Shaft Facility - ESF Controlled Blasting Report (Study No. 4 of 11) Revision 1" by Fenix & Scisson, Inc. (1987).

For the pad, the assessment indicates that if the Tiva Canyon unit is locally high in lithophysal content, then surface preparations (which must include a cut and fill operation) could be completed by ripping. If the Tiva Canyon unit is low in lithophysal content, a bench blast design is conceived to minimize damage. This information applies to ESF DR requirements 1.2.6.1 C C.i and 1.2.6.1 C C.ii.

For the shaft, a review of the blast design prepared by Fenix and Scisson indicates that damage caused by blasting could extend 3 to 4 feet (0.9 to 1.2 m) beyond the excavation wall. The comments on this design provide a means to understand and possibly decrease the expected blast-induced damage. This information applies to ESF DR requirements 1.2.6.4 PC 2i.va and 1.2.6.6 PC 2j.via.

The empirical methods used in this analysis specifically were not developed for tuff and may not be directly applicable. Computer analysis methods employing a more quantitative approach will be conducted as the required data (e.g., dynamic rock properties) become available.

Recommendation: The results of Analysis 5 indicate that a goal for the extension of blast-induced fracturing into intact rock should be limited to less than 1 m using controlled blasting (1.2.6.4 PC 2i.va and 1.2.6.6 PC 2j.via). Following discussions with constructors, a similar value consistent with standard practices may be considered as a more practical limit.

Recommendation: The results of Analysis 5 indicate that excavation methods incorporating ripping in high lithophysae material and a bench blast design for low lithophysae material should be considered to limit damage to the underlying rock mass (1.2.6.1 C C.i and 1.2.6.1.C Cii). Following discussions with constructors, other excavation methods consistent with standard practices may be considered.

YMP/CC-0013, Rev. 5 31 91

The design information memo (which includes citations for the data used, lists of assumptions, and results) from which these conclusions and recommendations were drawn can be found in SNL's YMP record center under file code 60/12147/DIM 257/1.0/QA.

1.2.6 Analysis 6. Shaft and Collar Creep

Purpose

The purpose of this analysis is to estimate the potential for rock creep and its effect on the shaft and collar.

This analysis was performed in accordance with the SNL internal document Design Investigation Memo DIM 256.

This investigation provides background and guidance to assess if total closure of the rock around the shaft is expected to be less than 76 mm (3 inches) in 100 years and if the diametrical closure will average less than 1 mm per year.

The thermal and mechanical environment in the vicinity of the shafts (unlined) for the 100-year operational period is reviewed in light of potential time- dependent deformation mechanisms. Magnitudes of creep strains will be on the same order as the magnitudes of the instantaneous elastic and plastic strains resulting from excavation of the shaft ($\sim 10^{-3}$). Data from existing tunnels in rocks having mineralogies, structures (joints, fractures, and deformation), and overburden similar to those at the Yucca Mountain site suggest that creep deformation is not likely to lead to deformations that produce instability. Calculations of the creep strain in granitic rocks at temperatures and stresses more severe than those expected at the ESF result in creep strain magnitudes that are on the same order as the elastic and plastic strain magnitudes expected in tuff. The most significant unknown in this study is the potential magnitude of creep along fractures. It is concluded that creep strains on favorably oriented fractures may exceed the estimated matrix strains. The strain magnitudes postulated based on the review of available information can be accommodated in an appropriate liner design for the ESF.

Data available for predicting the creep strains at the ESF are sparse. The potential creep phenomena should be further studied through an integrated laboratory and field experimentation program and monitoring program coupled with analyses.

This analysis applies to the thermomechanical response of the rocks in ESF DR requirements 1.2.6.4 PC 2j.i, 1.2.6.5 PC 2j.i, and 1.2.6.6 2k.i.

Recommendation: **The results of Analysis 6 indicate that the thermomechanical response of the host rock matrix and surrounding strata to time-dependent deformation mechanisms will be comparable to the instantaneous elastic and plastic strains ($\sim 10^{-3}$) resulting from excavation of the shaft (1.2.6.4 PC 2j.i, 1.2.6.5 PC 2j.i and 1.2.6.6 2k.i). Following discussions with constructors, a similar value consistent with standard practices may be considered as a more practical limit.**

YMP-CC-0013, Rev. 5/31/91

The design information memo (which includes the citations for the data used, lists of assumptions, and results) from which these conclusions and recommendations were drawn may be found in SNL's YMP record center under file code 60/12147/DIM 256/1.0/QA.

I.2.7 Analysis 7. Shaft and Collar Thermal Stress

Purpose

The purpose of this analysis is to provide quantitative estimates of the thermal stresses expected on the shaft liner and collar, through the shaft breakout zones, the main test level, and along the main access drifts in the potential repository.

The analysis was performed in accordance with the SNL internal document Problem Definition Memo PDM 75-13 Rev C.

The computer code STRES3D was used to predict the temperature, stress and strain resulting from the emplacement of heat generating high-level waste. This model simplifies the geometry of the potential repository as a semi-infinite elastic half space. The panels containing waste are modeled as four exponentially decaying source terms for the first 1,000 years after waste emplacement and six source terms for times of 1,000 to 10,000 years. Waste is assumed to be emplaced within 25 years. A total of 130 plate elements were used to model the waste panels.

The thermally-induced axial stress (vertical) change at the location of ES1 and ES2 indicate a stress decrease at all times. The thermally-induced horizontal normal stresses are compressive at elevations below 3450 ft elevation (in and below the TSw2) at both shaft locations with negative stress changes generated near the surface.

At the ES1 location, changes in the north-south and east-west horizontal stresses peak at approximately the same value at 2000 years. The maximum north-south horizontal stress change is approximately 1.8 MPa and the maximum east-west horizontal stress change is approximately 1.7 MPa. The maximum vertical stress change at the ES1 location occurs 300 years after the start of waste emplacement and is approximately 2.2 MPa (negative).

At the location of ES2, the maximum temperature is slightly less than that for ES1. The maximum vertical stress change is 1.6 MPa (negative) and occurs at 300 years. The maximum north-south horizontal stress change occurs at 2000 years at a value of approximately 1.7 MPa (compressive). The maximum east- west horizontal stress change of approximately 2.1 MPa (compressive) occurs at 500 years.

The temperature changes at the upper and lower breakout rooms are significantly lower than at the MTL. The temperatures and stress changes at the MTL are strongly dependent on the location relative to the closest waste emplacement panels.

YMP CC-0013, Rev. 5 31 91

Stress and temperature changes along the centerline of the mains and the exploratory drifts are presented. The temperature at the centerline of the main drifts will reach approximately 57? C (a change of 32? C). For the exploratory drifts, which later function as panel access drifts, temperature changes of approximately 70? C are predicted and the horizontal compressive stress at the drift location is predicted to increase by 11 MPa.

The numerical values presented are based on thermal and thermomechanical properties which are cited in PDM 75-13 Rev. C., and are sensitive to the repository layout, waste emplacement loading density, and the in situ site conditions.

The analysis applies to ESF DR requirement 1.2.6.4 PC 2j.iii.

Recommendation: The results of Analysis 7 indicate that the thermal and thermomechanical response of the host rock at the location of ES1 and ES2 indicates a decrease in vertical stress of less than 2 MPa due to waste emplacement at 100 years (1.2.6.4 PC 2j.iii).

Recommendation: The results of Analysis 7 indicate that horizontal stresses increase at the ES locations on the order of 0.3 MPa (maximum north-south horizontal stress change for first 100 years) and on the order of 1.3 MPa (maximum east-west horizontal stress change due to thermal loading of the repository). The maximum vertical stress is expected to decrease on the order of 1.7 MPa for the same time frame (1.2.6.4 PC 2j.iii).

The problem definition memo (which includes citations for the data used, lists of assumptions, and results) from which these conclusions and recommendations were drawn can be found in SNL's YMP record center under file code 70/124232/PDM 75-13 Rev. C/1.0/QA.

I.2.8 Analysis 8. Far Field Thermal Effects

Purpose

To provide three-dimensional far-field predictions for the temperatures surrounding a potential repository.

The analysis was performed in accordance with the SNL internal document Problem Definition Memo PDM 75-13.

The thermal calculations were conducted as part of the thermal-mechanical calculations using STRES3D and are discussed in analysis 7. The results of this analysis applies to ESF DR requirements 1.2.6.4 PC 2j.i and 1.2.6.6 PC 2k.v.

Recommendation: The results of Analysis 8 indicate that the thermal and thermomechanical response of the host rock at the location of ES1 and ES2 indicates a net decrease in the vertical stress of approximately 1.7 MPa at 100 years after waste emplacement (1.2.6.4 PC 2j.iii).

YMP-CC-0013, Rev. 5/31/91

Recommendation: The results of Analysis 8 indicate that the maximum temperature from waste emplacement at the TSw3-CHn boundary will be less than 45?C (1.2.6.6 PC 2k.v).

The problem definition memo (which includes citations for the data used, lists of assumptions, and results) from which these conclusions and recommendations were drawn can be found in SNL's YMP record center under file codes
70/124232/PDM 75-13 Rev. C/1.0/QA.

I.2.9 Analysis 9. Systems and Components Important to Safety

Purpose

To perform a technical review of the documentation identifying Items Important to Safety, Items Important to Waste Isolation and the Quality Activities List.

The documents describing the Q-List, the Quality Activities List and the Project Requirements List have been reviewed and published by the Quality Review Board as YMP/90-55, YMP/90-56, and YMP/90-57 respectively. The results of this analysis apply to 10 CFR 60.151, which is excluded from the ESF DR. (See the introduction of the ESF DR for the explanation.)

Recommendation: Items and activities to be included as Items Important to Safety, Items Important to Waste Isolation and the Quality Activities List are identified in the results of Analysis 9.

I.2.10 Analysis 10. Analyses of the Hydrologic and Geochemical Effects of Tracers

Purpose

To identify, characterize and control tracer tagging compounds and to evaluate their potential effects on experiments and waste isolation.

Analysis 10 and 11 have been combined into a Memo of Understanding (MOU 330011) among YMP participants which creates a control committee for tracers and materials including water which will be used at Yucca Mountain. This document formalizes the relationships required to perform the work described in Analyses 10 and 11.

Recommendation: Analysis 10 is ongoing as part of memorandum of understanding 330011. The region of influence related to hydrological and geochemical effects of tracers is assumed to be similiar to the area influenced by water (1.2.6.0 C C.iii). After the tracers have been identified and their transport properties characterized, analyses may show that the transport of certain tracers may significantly differ from the transport of water.

The analysis applies to ESF DR requirements 1.2.6.0 C C.iii, 1.2.6.4 PC 1d.vii, 1.2.6.5 PC 1d.vii and 1.2.6.6 PC 1d.x.

YMP CC-0013, Rev. 5/31/91

I.2.11 Analysis 11. Analyses of the Hydrologic and Geochemical Effects of Chemicals

Purpose

To identify, characterize, and control materials and chemicals and to evaluate their potential effects on experiments and waste isolation.

Analysis 10 and 11 have been combined into a Memo of Understanding (MOU 330011) among YMP participants which creates a control committee for tracers and materials including water which will be used at Yucca mountain. This document formalizes the relationships required to perform the work described in Analyses 10 and 11.

This analysis applies to ESF DR requirements 1.2.6.4 PC 2a.ii, 1.2.6.5 PC 2a.ii, 1.2.6.6 PC 2a.ii, 1.2.6.4 PC 2a.iv, 1.2.6.5 PC 2a.iv, 1.2.6.6 PC 2a.iii, 1.2.6.0 C C.iii, 1.2.6.0 C C.iv, 1.2.6.4 PC 1d.vi, 1.2.6.5 PC 1d.vi, 1.2.6.6 PC 1d.ix, 1.2.6.7.6 PC 1e, 1.2.6.8 C E.v, 1.2.6.2.5 C A..

Recommendation: Analysis 11 is ongoing as part of memorandum of understanding 330011. The region of influence related to hydrological and geochemical effects of hydrocarbons and solvents is assumed to be similiar to the area influenced by water (1.2.6.0 C C.iv). After the materials and chemicals have been identified and their transport properties characterized, analyses may show that the transport of certain materials and chemicals may significantly differ from the transport of water.

References

1. Eaton, R. R. and A. L. Peterson, 1990. Computed Distribution of Residual Shaft Drilling and Construction Water in the Exploratory Facilities at Yucca Mountain, Nevada, in: Proc. Int'l. High-Level Radioactive Waste Management Conference, April 1990.

2. Fernandez, J. A., T. E. Hinkebein and J. B. Case, 1989. Selected Analyses to Evaluate the Effect of the Exploratory Shafts on Repository Performance at Yucca Mountain. SAND 85-0598, Sandia National Laboratories.

I.3 NRC Requirements and ESF DR Sections Requiring Analysis Support

---

10 CFR 60.15(b)
Unless the Commission determines with respect to the site described in the application that it is not necessary, site characterization shall include a program of in situ exploration and testing at the depths that waste would be emplaced.

YMP/CC-0013, Rev. 5/31/91

ESF DR SECTION(S) REQUIRING ANALYSIS SUPPORT:

None

---

10 CFR 60.15(c)(1)
Investigations to obtain the required information shall be conducted in such a manner as to limit adverse effects on the long-term performance of the geologic repository to the extent practical.

ESF DR SECTION(S) REQUIRING ANALYSIS SUPPORT:

In accordance with 10 CFR 60.15(c)(1), the location, design, construction, and operation of the ___*___ shall incorporate aspects specifically directed at limiting the potential for adverse effects on the long term performance of the repository.

1.2.6.1 C A.	*	main site and auxiliary sites
1.2.6.4 PC 2a.i	*	shaft
1.2.6.5 PC 2a.i	*	ramp
1.2.6.6 PC 2a.i	*	main test level
1.2.6.7 C Bi	*	underground utilities

All materials or substances to be used underground shall first be reviewed for potential effects on engineered barriers and waste isolation. They may be used only following review and approval, and only in

10 CFR 60.15(c)(1)

those areas where use has been approved, and subject to whatever controls are established. Such materials or substances include, but are limited to, the following:

a. Concrete and other cementitious materials, such as shotcrete and grout.

b. Ground support materials, including chemical/resin anchorages.

c. Water (pH and organic content) and any additives to water for identification (tracers) or construction, operation, or testing.

d. Hydrocarbons and solvents.

e. Organic materials.

f. Explosives and blasting ancillaries, including the introduction of pressurized drilling water into the rock, and the chemical residues that are the products of blasting.

1.2.6.4 PC 2a.ii -- refers to shafts
1.2.6.5 PC 2a.ii -- refers to ramps
1.2.6.6 PC 2a.ii -- refers to underground excavations

A materials control program shall be implemented to enable establishment of limits on the inventory of materials left after decommissioning.
1.2.6.4 PC 2a.iv -- refers to shafts
1.2.6.5 PC 2a.iv -- refers to ramps
1.2.6.6 PC 2a.iii -- refers to underground excavations

The chemical content of the blasting agents and explosives shall be evaluated during their selection process and the chemical content of the blasts sampled, recorded, and the data used as necessary to preclude adverse effects on in situ site characterization.
1.2.6.4 PC 1d.ix -- refers to shafts
1.2.6.5 PC 1d.ix -- refers to ramps
1.2.6.6 PC 1d.xiii -- refers to underground excavations

10 CFR 60.15(c)(1)

The amount of water used in construction and operations shall be limited to that required for dust control and proper equipment operation so as to limit the effects on the containment and isolation capability of the site. The maximum quantity of water (based on use during construction) shall not exceed 15 gallons per ton of rock excavated.
1.2.6.4 PC 2g.i -- refers to ramps
1.2.6.5 PC 2g.ii -- refers to shafts
1.2.6.6 PC 2h.iv -- refers to underground excavations

---

10 CFR 60.15(c)(2)
The number of exploratory boreholes and shafts shall be limited to the extent practical consistent with obtaining the information needed for site characterization.

ESF DR SECTION(S) REQUIRING ANALYSIS SUPPORT:

None

---

10 CFR 60.15(c)(3)
To the extent practical, exploratory boreholes and shafts in the geologic repository operations area shall be located where shafts are planned for underground facility construction and operation or where large unexcavated pillars are planned.

YMP CC-0013, Rev. 5/31/91

ESF DR SECTION(S) REQUIRING ANALYSIS SUPPORT:

1.2.6.8 C D.iii — Boreholes drilled from the main test level shall not penetrate significantly below the base of the TWw2 host rock, unless the impacts of doing so, on the waste isolation performance of the site, have been evaluated and found to be acceptable.

---

10 CFR 60.15(c)(4)
Subsurface exploratory drilling, excavation, and in situ testing before and during construction shall be planned and coordinated with geologic repository operations area design and construction.

ESF DR SECTION(S) REQUIRING ANALYSIS SUPPORT:

1.2.6.0 C C.iii — All substances and tracers intended to be added to water to be piped underground for such purposes as drilling and dust control shall first be reviewed for potential to affect site characterization testing, repository testing or monitoring, and waste isolation. They may be added only following review and approval.

10 CFR 60.15(c)(4)

1.2.6.0 C C.iv — Use of hydrocarbons and solvents underground shall comply with criteria to be determined by performance assessment.

---

10 CFR 60.16
Before proceeding to sink shafts at any area which has been approved by the President for site characterization, DOE shall submit to the Director, for review and comment, a site characterization plan for such area. DOE shall defer the sinking of such shafts until such time as there has been an opportunity for Commission comments thereon to have been solicited and considered by DOE.

ESF DR SECTION(S) REQUIRING ANALYSIS SUPPORT:

None

---

10 CFR 60.21(c)(1)(ii)(D)
The assessment shall contain the effectiveness of engineered and natural barriers, including barriers that may not be themselves a part of the geologic repository operations area, against the release of radioactive material to the environment. The analysis shall also include a comparative evaluation of alternatives to the major design features that are important to waste isolation, with particular attention to the alternatives that would provide longer radionuclide containment and isolation.

YMP CC-0013, Rev. 5/31/91

ESF DR SECTION(S) REQUIRING ANALYSIS SUPPORT:

None

---

10 CFR 60.21(c)(11)
The safety analysis report shall include a description of design considerations that are intended to facilitate permanent closure and decontamination or dismantlement of surface facilities.

ESF DR SECTION(S) REQUIRING ANALYSIS SUPPORT:

None

---

10 CFR 60.111
(a) Protection against radiation exposures and releases of radioactive material. The geologic repository operations area shall be designed so that until permanent closure has been completed, radiation exposures and radiation levels, and releases of radioactive materials to unrestricted areas, will at all times be maintained within the limits specified in Part 20 of this chapter and such generally applicable environmental standards for radioactivity as may have been established by the Environmental Protection Agency.

(b)(1) The geologic repository operations area shall be designed to preserve the option of waste retrieval throughout the period during which wastes are being emplaced and, thereafter, until the completion of a performance confirmation program and Commission review of the information obtained from such a program. To satisfy this objective, the geologic repository operations area shall be designed so that any or all of the emplaced waste could be retrieved on a reasonable schedule starting at any time up to 50 years after waste emplacement operations are initiated, unless a different time period is approved or specified by the Commission. This different time period may be established on a case-by-case basis consistent with the emplacement schedule and the planned performance confirmation program.

ESF DR SECTION(S) REQUIRING ANALYSIS SUPPORT:

None

---

10 CFR 60.112
The geologic setting shall be selected and the engineered barrier system and the shafts, boreholes and their seals shall be designed to assure that releases of radioactive materials to the accessible environment following permanent closure conform to such generally applicable environmental standards for radioactivity as may have been established by the Environmental Protection Agency with respect to both anticipated processes and events and unanticipated processes and events.

ESF DR SECTION(S) REQUIRING ANALYSIS SUPPORT:

None

10 CFR 60.113(a)(1)(i)
The engineered barrier system shall be designed so that assuming anticipated processes and events: (A) Containment of HLW will be substantially complete during the period when radiation and thermal conditions in the engineered barrier system are dominated by fission product decay: and (B) any release of radionuclides from the engineered barrier system shall be a gradual process which results in small fractional releases to the geologic setting over long times. For disposal in the saturated zone, both the partial and complete filling with groundwater of available void spaces in the underground facility shall be appropriately considered and analyzed among the anticipated processes and events in designing the engineered barrier system.

(ii) In satisfying the preceding requirement, the engineered barrier system shall be designed, assuming anticipated process and events, so that: (A) Containment of HLW within the waste packages will be substantially complete for a period to be determined by the Commission taking into account the factors specified in ?(b) provided, that such period shall be not less than 300 years nor more than 1,000 years after permanent closure of the geologic repository: and

(B) The release rate of any radionuclide from the engineered barrier system following the containment period shall not exceed one part in 100,000 per year of the inventory of that radionuclide calculated to be present at 1,000 years following permanent closure, or such other fraction of the inventory as may be approved or specified by the Commission; provided, that this requirement does not apply to any radionuclide which is released at a rate less than 0.1% of the calculated total release rate limit. The calculated total release rate limit shall be taken to be one part in 100,000 per year of the inventory of radioactive waste, originally emplaced in the underground facility, that remains after 1,000 years of radioactive decay.

ESF DR SECTION(S) REQUIRING ANALYSIS SUPPORT:

None

10 CFR 60.130
Sections 60.131 through 60.134 specify minimum criteria for the design of the geologic repository operations area. These design criteria are not intended to be exhaustive, however. Omissions in ?? 60.131 through 60.134 do not relieve DOE from any obligation to provide such safety features in a specific facility needed to achieve the performance objectives. All design bases must be consistent with the results of site characterization activities.

ESF DR SECTION(S) REQUIRING ANALYSIS SUPPORT:

None

YMP CC-0013, Rev. 5 31 91

10 CFR 60.131(b)(2)
The structures, systems, and components important to safety shall be designed to withstand dynamic effects such as missile impacts, that could result from equipment failure, and similar events and conditions that could lead to loss of their safety functions.

ESF DR SECTION(S) REQUIRING ANALYSIS SUPPORT:

None

10 CFR 60.131(b)(4)(i)
The structures, systems, and components important to safety shall be designed to maintain control of radioactive waste and radioactive effluents, and permit prompt termination of operations and evacuation of personnel during an emergency.

ESF DR SECTION(S) REQUIRING ANALYSIS SUPPORT:

None

10 CFR 60.133(a)(1)
The orientation, geometry, layout, and depth of the underground facility, and the design of any engineered barriers that are part of the underground facility shall contribute to the containment and isolation of radionuclides.

ESF DR SECTION(S) REQUIRING ANALYSIS SUPPORT:

	Location of a shaft relative to any other access shall be such that testing in either access will not be adversely affected by activities in the other.
1.2.6.4 PC 1d.xii	-- refers to shafts
1.2.6.5 PC 1d.xii	-- refers to ramps
1.2.6.6 PC 2e.ii	The spacing between adjacent ESF drifts shall be a minimum of two drift diameters (using the maximum diameter of either opening and considering the closest proximity of any part of each opening) consistent with obtaining reliable and adequate information from site characterization, except where required otherwise by specific test requirements.

10 CFR 60.133(a)(2)
The underground facility shall be designed so that the effects of credible disruptive events during the period of operations, such as flooding, fires and explosions, will not spread through the facility.

YMP/CC-0013, Rev. 5/31/91

ESF DR SECTION(S) REQUIRING ANALYSIS SUPPORT:

The ___*___ shall be designed to prevent significant water inflow from a flooding event during site characterization and the planned period of repository operation, such that testing in the underground portion of the ESF and waste emplacement are not adversely affected.

1.2.6.4 PC 2e.ii	*	shaft collar
1.2.6.5 PC 2e.ii	*	ramp portal

---

10 CFR 60.133(b)
The underground facility shall be designed with sufficient flexibility to allow adjustments where necessary to accommodate specific site conditions identified through in situ monitoring, testing, or excavation.

ESF DR SECTION(S) REQUIRING ANALYSIS SUPPORT:

None

---

10 CFR 60.133(d)
The design of the underground facility shall provide for control of water or gas intrusion.

ESF DR SECTION(S) REQUIRING ANALYSIS SUPPORT:

1.2.6.1 C F.i — The amount of water used in site preparation and operations should be limited to that required for sanitation, dust control, compaction of engineered fill material, and proper equipment operation so as to limit the effects on the containment and isolation capability of the site.

Fluids and materials planned for use in the ___*___ shall be evaluated with respect to intended use and possible effects on site characterization or other testing, and appropriate controls implemented.

1.2.6.4 PC 1d.vi	*	shaft
1.2.6.5 PC 1d.vi	*	ramp
1.2.6.6 PC 1d.ix	*	ESF underground facility

10 CFR 60.133(d)

Water use in ___*___ shall be generally consistent with repository design goals to limit the increase in average percent saturation of the repository horizon to [TBD] percent, and limit the increase in the local percent saturation to [TBD] percent in waste emplacement areas.

1.2.6.4 PC 2g.ii	* shaft construction
1.2.6.5 PC 2g.iii	* ramp construction
1.2.6.6 PC 2h.v	* the underground facility
1.2.6.8 C E.iii	* testing
	Fluids recovered during ___*___ operations shall be disposed of in such a way to avoid potential for performance impacts.
1.2.6.7.6 PC 1e.	* construction -- refers to shafts
1.2.6.8 C E.v	* testing
1.2.6.7.6 PC 1b.i	Water handling and control underground shall be designed for all credible inflows, including inflow from penetration of fault structures or from perched water horizons, use of fire protection sprinklers, and from water line breakage.
	The amount of water used in the construction ___*___ shall be limited to preclude interference with tests.
1.2.6.4 PC 1d.iii	* and operation of the shaft
1.2.6.5 PC 1d.iii	* of the ramp
1.2.6.6 PC 1d.vi	* of the underground facility
1.2.6.8 C E.ii	The amount of water used in testing and operations shall be limited so as to limit the effects on the containment and isolation capability of the site.
	Fluids, gases, and other materials used in ESF construction and operations, and/or injected into the rock mass, shall be appropriately tagged. Selection of tracers shall consider, but not be limited to: (1) the possible future need to account for the mobility and disposition of all such materials as part of site characterization, and (2) the effects of tracers on site characterization.
1.2.6.4 PC 1d.vii	-- refers to shafts
1.2.6.5 PC 1d.vii	-- refers to ramps
1.2.6.6 PC 1d.x	-- refers to underground excavation

10 CFR 60.133(e)(2)
Openings in the underground facility shall be designed to reduce the potential for deleterious rock movement or fracturing of overlying or surrounding rock.

ESF DR SECTION(S) REQUIRING ANALYSIS SUPPORT:

An adequate distance between accesses shall be provided to limit potential mechanical and hydrological interference between the accesses and to reduce the potential for deleterious rock movement so they do not impact the capability to reliably and adequately characterize the site.

1.2.6.4 PC 2h.ii -- refers to shafts
1.2.6.5 PC 2h.ii -- refers to ramps

---

10 CFR 60.133(f)
The design of the underground facility shall incorporate excavation methods that will limit the potential for creating a preferential pathway for groundwater to contact the waste packages or radionuclide migration to the accessible environment.

ESF DR SECTION(S) REQUIRING ANALYSIS SUPPORT:

1.2.6.1 C C.i — The design and construction of the site (civil improvements) for the permanent and non-permanent ESF structures, systems, and components shall not significantly increase the preferential pathways for groundwater or radioactive waste migration to the accessible environment or otherwise significantly reduce the ability of the site to meet the performance objective as stated in the approved SCP.

1.2.6.1 C C.ii — Foundations for equipment, buildings, and structures shall be constructed using excavation methods such as controlled blasting to limit damage to the underlying rock mass, to the extent that it could affect the adequacy or reliability of information from site characterization. Methods shall be designed by the responsible organization to facilitate investigation and monitoring of such effects during and after construction.

Blast-induced changes to the average in situ permeability of the rock beyond a dimension (into the rock) equal to one half of the maximum opening dimension shall be less than one order of magnitude.

1.2.6.4 PC 2i.va -- refers to shafts
1.2.6.5 PC 2i.va -- refers to ramps
1.2.6.6 PC 2j.via -- refers to underground excavations

10 CFR 60.133(f)

In areas not affected by thermal load, ___*___ rate decreasing at all times after construction.

1.2.6.4 PC 2i.iiia * diametrical closure-- refers to shafts
1.2.6.5 PC 2i.iiia * diametrical closure-- refers to ramps
1.2.6.6 PC 2j.iia * closure-- refers to underground excavations

In areas affected by thermal load, closure rate no greater than three times that predicted by thermoelastic models.

YMP CC-0013, Rev. 5 31 91

1.2.6.4 PC 2i.iiib	-- refers to shafts
1.2.6.5 PC 2i.iiib	-- refers to ramps
1.2.6.6 PC 2j.iiib	-- refers to underground excavations
1.2.6.4 PC 2i.vii	Where required or preferred, the shaft and shaft stations shall be constructed using controlled blasting methods, to limit overbreak and damage to the surrounding rock mass, which could affect the adequacy or reliability of information from site characterization. The methods shall be designed to provide for the requirements of specific site characterization tests, such as limitations on the extent of excavation-induced damage, or the type of ground support that may be installed. The methods shall be designed to facilitate investigation and monitoring of excavation effects during and after construction.
1.2.6.5 PC 2i.vii	The typical cross section of the ESF ramp shall be constructed using a tunnel boring machine, to limit the damage to the surrounding rock mass, which could affect the adequacy or reliability of information from site characterization. Ramp stations and other secondary excavation may be developed by controlled drilling and blasting methods. The excavation methods shall be designed to provide for the requirements of specific site characterization tests, such as limitations on the extent of excavation-induced damage, or the type of ground support that may be installed. The methods shall be designed to facilitate investigation and monitoring of such effects during and after construction.

10 CFR 60.133(f)

1.2.6.6 PC 2j.xii	If the shaft or ramp breakouts and main test level of the ESF are constructed using controlled drilling and blasting methods to limit overbreak and damage to the surrounding rock mass; the methods shall be designed to provide for the requirements of specific site characterization tests, such as limitations on the extent of excavation-induced damage, or the type of ground support that may be installed. The methods shall be designed to facilitate investigation and monitoring of excavation effects during and after construction.

10 CFR 60.133(h)
Engineered barriers shall be designed to assist the geologic setting in meeting the performance objectives for the period following permanent closure.

ESF DR SECTION(S) REQUIRING ANALYSIS SUPPORT:

None

10 CFR 60.133(i)
The underground facility shall be designed so that the performance objectives will be met taking into account the predicted thermal and thermomechanical response of the host rock, and surrounding strata, groundwater system.

ESF DR SECTION(S) REQUIRING ANALYSIS SUPPORT:

	The predicted thermal and thermomechanical response of the host rock and surrounding strata and the groundwater system shall be considered in the ESF design.
1.2.6.4 PC 2j.i	-- refers to shafts
1.2.6.5 PC 2j.i	-- refers to ramps
1.2.6.6 PC 2k.i	-- refers to underground facilities
	The ___*___ liner shall withstand pressures exerted along its length and around the entire perimeter under anticipated conditions, including reaction to thermally-induced stresses resulting from thermal loads.
1.2.6.4 PC 2j.iii	* shaft
1.2.6.5 PC 2j.iii	* ramp
1.2.6.6 PC 2k.iii	* underground excavation support system

10 CFR 60.133.(i)

1.2.6.6 PC 2k.v	**The ESF shall be designed so that the thermal effects of ESF testing do not result in temperatures in excess of 115 degrees C in either the TSw3 or CHn units, compatible with the performance measure for the repository listed in Table 8.3.2.2-4 in Volume VI, Part B, of the Site Characterization Plan for the Yucca Mountain Site.**

YMP CC-0013, Rev. 5-31-91

---

10 CFR 60.134
(a) Seals for shafts [and ramps] and boreholes shall be designed so that following permanent closure they do not become pathways that compromise the geologic repository's ability to meet the performance objective for the period following permanent closure. (b) Materials and placement methods for seals shall be selected to reduce, to the extent practical: (1) The potential for creating a preferential pathway for groundwater to contact the waste packages or (2) for radionuclide migration through existing pathways.

(b) Materials and placement methods for seals shall be selected to reduce, to the extent practical: (1) The potential for creating a preferential pathway for groundwater to contact the waste packages or (2) For radionuclide migration through existing pathways.

ESF DR SECTION(S) REQUIRING ANALYSIS SUPPORT:

None

---

10 CFR 60.137
The geologic repository operations area shall be designed so as to permit implementation of a performance confirmation program that meets the requirements of Subpart F of this part.

ESF DR SECTION(S) REQUIRING ANALYSIS SUPPORT:

None

---

10 CFR 60.140(c)
The program shall include in situ monitoring, laboratory and field testing, and in situ experiments, as may be appropriate to accomplish the objective as stated above.

ESF DR SECTION(S) REQUIRING ANALYSIS SUPPORT:

None

---

10 CFR 60.140(d)(1)
The program shall be implemented so that:
(1) It does not adversely affect the ability of the natural and engineered elements of the geologic repository to meet the performance objectives.

ESF DR SECTION(S) REQUIRING ANALYSIS SUPPORT:

None

==

YMP/CC-0013, Rev. 5 31 91

The following ESF DR requirements are not direct descendants of 10 CFR 60 requirements:

1.2.6.2.3 C B.	Sanitary wastes shall be disposed of by means of collection piping from all buildings and trailers and discharged to a sanitary waste disposal system located beyond the perimeter of the proposed repository subsurface facility a distance to be determined by performance assessment. The sewage system shall be designed to prevent interference with site characterization activities.
1.2.6.2.5 C A.	Liquid wastes that cannot be disposed of on the ESF site in an environmentally acceptable manner shall be removed from the site for disposal in an appropriate facility.
1.2.6.2.5 C B.	The surface mine wastewater collection system shall discharge to a wastewater pond consistent with location constraints to be determined by performance assessment. The surface mine wastewater system shall be designed, operated, and maintained in such a way as to prevent interference with the site characterization activities.

YMP/CC-0013, Rev. 5/31/91

APPENDIX J

EXPLORATORY SHAFT FACILITY ENVIRONMENTAL REQUIREMENTS

YMP CC-0013, Rev. 5/31/91

EXPLORATORY SHAFT FACILITY ENVIRONMENTAL REQUIREMENTS

TABLE OF CONTENTS

APPENDIX I

EXPLORATORY SHAFT FACILITY ENVIRONMENTAL REQUIREMENTS

1.0 INTRODUCTION

1.1 PURPOSE

The purpose of this appendix to the Exploratory Shaft Facility (ESF) Requirements Document is to provide a brief, but comprehensive, presentation of the environmental requirements (Federal, State, and local) that apply to all ESF activities. These requirements affect all phases of the ESF process, from permitting before work is allowed to commence, through construction, operation, and closure. Inclusion of these requirements in the design of site characterization activities is essential to ensuring that the activities are conducted in a manner that will protect, maintain, and restore environmental quality; minimize potential threats to the environment, and comply with environmental regulations and policies.

1.2 OVERVIEW OF THE ENVIRONMENTAL PROGRAM

The U.S. Department of Energy (DOE) is committed to performing its activities in an environmentally safe and sound manner, and will comply with all applicable environmental statutes and regulations. To fulfill this commitment at the Yucca Mountain site, the DOE has established an environmental program that assures that site characterization studies will be conducted in such a way that applicable environmental regulatory and programmatic requirements are met. The Yucca Mountain Site Characterization Project (YMP) environmental program is structured to satisfy the statutory requirements of the Nuclear Waste Policy Act (NWPA), as amended; the National Environmental Policy Act (NEPA); the Atomic Energy Act (AEA); and other applicable statutes, regulations and DOE Orders.

The YMP environmental program has been delineated in documents previously issued by the DOE. The Environmental Management Plan describes how the program is managed and integrated with other parts of the YMP.

Federal and State statutes, regulations, requirements, and DOE Orders that apply to the YMP, and a brief description of each, are presented in the Environmental Regulatory and Compliance Plan (ERCP; DOE, 1988a). The ERCP describes how the YMP would satisfy the environmental regulatory requirements for site characterization, and identifies the information necessary to prepare a specific permit application. Environmental monitoring and mitigation program requirements being implemented by the YMP, as required by by the NWPA as amended, are set forth in the Environmental Monitoring and Mitigation Plan (EMMP; DOE, 1988b). Reclamation requirements applicable to the YMP are described in the Reclamation Implementation Plan (RIP; DOE, 1991), and the requirements to be satisfied for the Environmental Impact Statement (EIS) will be defined in the EIS Implementation Plan, to be prepared after EIS scoping meetings have been held. Data collection required by these plans is planned and performed as described in the Environmental Field Activity Plans (EFAPs).

1.3 SCOPE OF APPENDIX J

The documents mentioned in the previous section represent various elements of the YMP environmental program. Together, they (and certain others not essential to this document) provide a network of plans designed to ensure that the Yucca Mountain environment is protected throughout the period of site characterization study. Not all portions of the plans are relevant to ESF activities, however. The remainder of this document uses information provided in appropriate sections of these various plans to define the requirements that must be satisfied to comply with Federal, State, and local environmental regulations during the performance of ESF activities. Requirements are given for each of the major environmental areas of concern (e.g., air, water, biological resources, hazardous waste management, etc.) likely to be affected by ESF activities.

YMP/CC-0013, Rev. 5/31/91

2.0 AIR POLLUTION CONTROL

2.1 <u>CLEAN AIR ACT</u>, as amended (P.L. 95-95; 42 USC 7401-7642; 40 CFR 50-53, 58, 60-61, 81.300-81.400, 124; EO 11738; EO 12088; NRS 445.401 et seq; Nevada Administrative Code 445.430-445.995)

<u>Background</u>

The Clean Air Act (CAA, 1977) establishes Federal policy for preserving and enhancing the quality of the Nation's air resources to protect the public health and welfare. The Act ensures, through a State-issued permit program, that adequate steps are taken to control the release of air contaminants from industrial processes and land-disturbing activities. Section 118 of the CAA requires Federal agencies to comply with all Federal, State, interstate, and local requirements regarding the control and abatement of air pollution in the same manner, and to the same extent, as any non-governmental entity.

In 1980, the EPA approved Nevada's plan to implement and enforce the CAA (Nevada's State Implementation Plan [SIP]). On May 30, 1988, the EPA granted Nevada the authority to implement the "Prevention of Significant Deterioration" (PSD) Program. Authority to regulate radioactive air emissions has been retained by the EPA, however. Responsibility for implementing and enforcing the CAA in Nevada resides with the Nevada Division of Environmental Protection (NDEP).

<u>Applicability to the ESF</u>

Site characterization activities such as construction and operation of the exploratory shaft, operation of concrete-batch plants, and land disturbances from field testing and site preparation will generate particulate and gaseous emissions of air pollutants. The origin of most particulates will be non-point sources, e.g., drilling, blasting, rock removal and storage, surface grading and leveling, wind erosion, vehicle travel, and diesel and gasoline engines. Permits will be required for the performance of many of these activities.

YMP/CC-0013, Rev. 5/31/91

Requirements for the ESF

- An Air Quality Surface Disturbance Permit is required before any land-disturbing activities are initiated (CAA and Nevada Revised Statutes (NRS 445.401-601)). A strategy for dust minimization, in particular, must be included in any plan for surface-disturbing activities.

- All stationary sources (point sources) of air emissions shall comply with the applicable provisions of the CAA, as amended (42 USC 7401), which may include Prevention of Significant Deterioration (PSD) permitting, or offset Policy Review, or both. Federal regulations pertaining to compliance with the CAA include: 40 CFR 50 (National Primary and Secondary Ambient Air Quality Standards) and 40 CFR 60 (Standards of Performance for New Stationary Sources). The YMP shall comply with the State or local standards included under the stipulations of NRS Chapter 445.401-601 for Air Quality - (1) Permit to Construct, (2) Prevention of Significant Deterioration, and (3) Permit to Operate.

- Registration Certificates

  Registration Certificates are required for all new sources (property and/or equipment) that may emit air contaminants, including concrete batch plant, shaker plant, and ESF Exhaust Shaft.

  A separate Registration Certificate is required for each new single source of contaminants prior to the commencement of the activity generating the contaminants.

  The Registration Certificate for a point source will be denied if the point source (1) will prevent the maintenance of State and National ambient air-quality standards; (2) is contrary to the State's air-pollution control strategy; (3) will cause a violation

 YMP/CC-0013, Rev. 5/31/91

of 40 CFR 60-61 (New Source Performance Standards and National Emission Standards for Hazardous Air Pollutants); or (4) if the best available technology is not defined and adopted as an emission limitation for the source.

Exemptions to these requirements that are pertinent to site characterization at Yucca Mountain include air-conditioning equipment or fuel-burning equipment that has a heat-input rating of less than 4,000,000 Btu per hour; motor vehicles and internal combustion engines; incinerators with rated burning capacity of less then 25 pounds per hour; storage containers for gasoline, petroleum distillates, or other volatile organic compounds having a capacity of less then 40,000 gallons; equipment used solely for the processing of food for human consumption; disturbing less than 20 acres per year of topsoil; and process weight rates of less than 50 pounds per hour.

- Operating Permits

A valid Registration Certificate for the source must be in-hand before an Operating Permit is issued.

An Operating Permit is required within 180 days after start-up for each new source that emits or may emit air contaminants. It is a document issued and signed by the Air Quality Officer (AQO) that approves the operation of a new or existing single source of air contaminants. The Operating Permit may or may not include stipulations.

After obtaining an Operating Permit, the operator (in this case, the DOE) is responsible for maintaining emissions of air pollutants within the limits specified in the permit.

YMP CC-0013, Rev. 5 31 91

If limits are exceeded or if scheduled maintenance or equipment malfunctions occur, the operator is required to inform the AQC within 24 hours and prepare a written report to be sent to the State within 15 days of the event (Nevada Administrative Code 445.667).

 YMP/CC-0013, Rev. 5 31/91

3.0 WATER APPROPRIATIONS

3.1 NEVADA WATER LAW, (Nevada Administrative Code 533.325-540; 534.010-190)

Background

The State of Nevada requires a permit for the appropriation of State waters. The purpose of a Water Appropriation Permit is to prevent possible interference with prior water rights and/or improper use of waters not legally available for use. The Nevada State Engineer's Office administers Nevada water law.

Applicability to the ESF

Site characterization activities will require water. These requirements are currently based on the use of water from Well J-13, but apply to water from any well at the site.

Requirements for the ESF

- Water withdrawal cannot start until a permit is obtained.
- Construction of new facilities, including pumps and the water pipeline to the ESF, cannot begin until a permit is obtained.
- Water use must not exceed quantities allowed by the permit.
- Pump tests are generally excluded from a permit but the exclusion must be requested for each pump test.
- Any dam that will be 10 feet or more in height or, if less than 10 feet in height, will impound more than 10 acre feet of water, must be approved by the State Engineer at least 30 days before construction is to begin.

YMP-CC-0013, Rev. 5/31/91

4.0 DRINKING WATER PROTECTION

4.1 SAFE DRINKING WATER ACT OF 1974, as amended (P.L. 93-523; 42 USC 300f-300j-10; 40 CFR 124, 141, 143; EO 12088; NRS 445.361 et seq; Nevada Administrative Code 445.244-445.420)

Background

The Safe Drinking Water Act (SDWA, 1974) grants the EPA authority to regulate public drinking water supplies by establishing drinking water regulations, delegating authority for enforcement of drinking water standards to the States, and protecting aquifers from such things as injection of wastes and other materials into wells.

In 1978, the EPA approved Nevada's program for enforcing the drinking water standards established by the EPA. The Nevada Division of Health within the Nevada Department of Human Resources is the agency responsible for this enforcement.

Construction characteristics of water-supply wells are addressed in NAC 445.358 through 445.400. Storage and distribution specifications required for a public drinking water supply are discussed in NAC 445.410-445.418.

Applicability to the ESF

A drinking water system is planned for the ESF. By definition, the water supply is considered a "public water supply" since it will probably service 15 or more connections or 25 people for more than 60 days per year.

Requirements for the ESF

- A permit is needed to construct a drinking water system (NAC 445.370-445.420).

- Drinking water must meet the standards set forth in 40 CFR 141 and NAC 445.244 to 445.262.

YMP/CC-0013, Rev. 5/31/91

- The water quality monitoring system shall have the capability to sample, measure, and analyze physical, chemical, and biological conditions consistent with the requirements of the Clean Water Act (CWA, 1972) (33 USC 1251) and the SDWA (42 USC 300f). Such capability must also be compatible with the type and range of concentrations/occurrences of conditions specified in the governing regulations (e.g., 40 CFR 122, 125, 141, 142, 143, and State and local regulations).

- Periodic testing of the system's water quality (at the discretion of the State Health Officer, but probably monthly for bacteriological content) will be required.

4.2 UNDERGROUND INJECTION CONTROL PROGRAM OF THE SAFE DRINKING WATER ACT OF 1974 (91 Stat. 1397; P.L. 93-523; 42 USC 300h (Part C); 40 CFR Part 124, 144-147; Chapter 445 of the Nevada Administrative Code, Sections 1 through 96.1; NRS 445.131-445.354.

Background

Federal agencies engaged in any activity resulting in an underground injection that may jeopardize a drinking water supply must comply with all Federal, State, and local requirements concerning underground injections. The EPA granted the State of Nevada's Division of Environmental Protection the authority to implement and enforce an underground injection control (UIC) program. Nevada's UIC program seeks to prohibit the pollution of existing and potential sources of underground drinking water in Nevada. Exemptions to obtaining a permit would be granted only if the affected groundwater is not now, and will not be, a source of drinking water, or if the total dissolved solids of the affected groundwater exceeds 10,000 milligrams per liter but the water is not reasonably expected to become a supply of drinking water (Chapter 445 of the Nevada Administrative Code, Section 30).

YMP CC-0013, Rev. 5-31-91

Applicability to the ESF

Studies proposed for the ESF to characterize the hydrologic environment of Yucca Mountain may require the use of tracers. The State of Nevada has determined that the use of tracers must be regulated under the UIC program.

Requirements for the ESF

- A permit must be obtained for any activity that includes underground injection (NRS 445.131-354).

- Tracers added to the water system must be of a composition and concentration compatible with the sanitary waste disposal system.

- Infiltration studies using tracers may require a permit.

YMP/CC-0013, Rev. 5/31/91

5.0 WATER POLLUTION CONTROL

5.1 FEDERAL WATER POLLUTION CONTROL ACT, as amended by the Clean Water Act of 1977, and the WATER QUALITY ACT OF 1987, as amended (33 USC 1251-1376; 33 CFR 209, 320, 323-330; 40 CFR 110, 112, 116, 117, 121, 122-125, 129, 133, 136, 230, 401, and 403; EO 11735; EO 12088; Nevada Administrative Code 445.70- 445.241)

The Federal Acts cited in this section are referred to collectively throughout the remainder of this discussion as "the Clean Water Act." The Clean Water Act (CWA, 1972) establishes Federal policy for restoring and maintaining the chemical, physical, and biological integrity of the Nation's waters. Among other things, the Act provides for the EPA or Federally-authorized States to implement permit programs for regulating the discharge of pollutants to navigable waters from any point source, as follows:

- Title IV of the Act (i.e., Permits and Licenses, Section 402, the National Pollutant Discharge Elimination System [NPDES]) is administered by the State of Nevada;
- Federal effluent limitations for direct discharges, and pre-treatment standards for discharges into publicly-owned treatment works (Title III of the Act) are enforced by the EPA;
- A program to regulate the discharge of oil and hazardous substances (Section 311 of the Act) is enforced by the EPA; and
- A permit system for the use of dredge and fill material (Section 404 of the Act) is administered by the U.S. Army Corps of Engineers.

5.1.1 NPDES Permit Program

Background

Section 313 of the CWA directs Federal agencies to comply with all Federal, State, interstate, and local requirements regarding the control and

YMP/CC-0013, Rev. 5/31/91

abatement of water pollution in the same manner, and to the same extent, as any non-government entity.

On September 9, 1975, the EPA approved Nevada's NPDES permit program and authorized Nevada to implement and enforce the program. The Nevada Department of Environmental Protection (NDEP) is the agency responsible for issuing or denying NPDES permits.

Applicability to the ESF

Water-related activities which may require an NPDES permit include all point source discharges. Examples of these are sewage treatment facilities, mine waste-water ponds, rock storage piles, pump tests, drinking-water supplies, monitoring and injection wells, and infiltration studies.

Requirements for the ESF

- AN NPDES permit must be obtained for effluent discharges.

- All waste waters shall be treated and disposed of in accordance with NPDES permit conditions.

- NPDES permits may contain written effluent limitations based on a variety of criteria, including the effects of the discharge on the receiving waters and the use of these receiving waters (Nevada Administrative Code 445.155).

- The permit may also require, at the discretion of the Water Quality Officer (WQO), the installation, use, and maintenance of equipment to monitor specified pollutants, and that monitoring records be retained, generally for three years.

YMP CC-0013, Rev. 5 31 91

- If monitoring is required, the results of the monitoring will be reported to the WQO on a schedule specified in the permit, but not less frequently than once a year.

- The WQO has the authority to enter any premises where a permitted discharge is located for purposes of accessing and copying records, inspecting monitoring equipment, and sampling discharges. The costs of any test associated with these visits are the responsibility of the DOE.

- Any modifications of the facility or increases in the rate or type of permitted discharge must be reported to the WQO. If the modifications exceed permit conditions, a new NPDES permit must be obtained. An NPDES permit can be modified, suspended, or revoked by the WQO if, among other things, the terms of the permit are violated.

- A permit is valid for no more than 5 years. Renewal must be made to the WQO within 180 days of expiration.

5.1.2 Corps of Engineers Section 404 Permit

Background

Any Federal agency, State or individual that plans to dredge, fill, modify, or discharge into navigable waters or waters of the United States, as defined in the CWA, must first receive a Section 404 permit from the U.S. Army Corps of Engineers (Corps) (Section 404 of the CWA [33 CFR 320.2(g)]). Section 404 establishes Federal policy for restoring and maintaining the chemical, physical, and biological characteristics of the Nation's waterways.

Applicability to the ESF

On April 28, 1988, the DOE submitted an informal opinion to the Corps concerning the applicability of Section 404 of the CWA to site characterization at Yucca Mountain, and requested a formal determination by the Corps

YMP/CC-0013, Rev. 5/31/91

regarding Section 404 permitting applicability. Site characterization will require re-routing small segments of several dry washes along the east side of Yucca Mountain. The Corps conducted an on-site inspection at Yucca Mountain on October 18, 1989. On November 15, 1989, the Corps made a formal determination that re-routing of washes for site characterization would require Section 404 permitting, to be authorized under a Nationwide General Permit. This type of Section 404 permit allows the discharge of dredged or fill material into isolated, nontidal waters of the United States, including wetlands that are not part of a surface tributary system to interstate waters of the United States. The Corps included the YMP in a nationwide permit on August 17, 1990. Any significant changes in ESF design may require a review of our current Section 404 permit.

Requirements for the ESF

- A Section 404 permit must be obtained (or modified) before Yucca Mountain washes can be altered.

5.2 NEVADA WATER POLLUTION CONTROL LAW, (NRS 445.131-354)

Background

The Nevada Water Pollution Control Law was enacted to maintain the quality of the waters of the State of Nevada for public health and enjoyment, protection of animal life, operation of existing industries, the pursuit of agriculture, and the economic development of the State. This law is administered by the NDEP which requires that discharges of pollutants into the subsurface be controlled if the potential for contamination of groundwater supplies exists. If the NDEP determines that there is a potential for contamination, the agency will generally require, through issuance of zero-discharge permits, that impoundments be lined sufficiently to prevent seepage of pollutants into the ground.

YMP CC-0013, Rev. 5 31 91

Applicability to the ESF

Site characterization activities such as the construction and use of sewage lagoons and mud and cutting pits, must be evaluated to determine their potential to contaminate groundwater supplies.

Requirements for the ESF

- A discharge permit will be obtained or zero-discharge demonstrated for all ponds and water impoundments.

- Runoff from disturbed areas will be controlled to minimize erosion (see Reclamation Section).

- Runoff from potentially contaminated areas (e.g., parking lots) will be controlled.

5.3 SANITARY AND SEWAGE-COLLECTION SYSTEM REGULATIONS (NAC 445.179-182; 445.750-840)

Background

The purpose of this permit authority is to regulate the design, construction, and operation of sanitary and sewage collection systems and to grant operating permits for such facilities in an effort to prevent or limit discharges of pollutants into waters of the State. NDEP administers this regulation.

Applicability to the ESF

The ESF will require a sanitary and sewage collection system.

YMP/CC-0013, Rev. 5 31 91

Requirements for the ESF

- A permit will be required for sanitary and sewage collection or treatment systems.

- The design of the system must comply with NAC 445.140-174.

- Construction plans must be prepared by a licensed engineer.

- The facility must be located outside of the floodplain.

- The ultimate disposal of sludge from the wastewater treatment facilities shall be performed in accordance with the requirements of Section 405 of the CWA, in addition to any applicable permit conditions.

YMP/CC-0013, Rev. 5/31/91

6.0 SOLID AND HAZARDOUS WASTE MANAGEMENT

6.1 RESOURCE CONSERVATION AND RECOVERY ACT OF 1976, as amended (P.L. 94-580; 42 USC 6901-6987; 40 CFR 124, 240-247, 260-264, 266, 270, 271, and 280; NRS 459.400 et seq. Nevada Administrative Code 444.570 through 444.748, and 444.842 through 444.9335).

Background

Management and disposal of solid and hazardous wastes (excluding radioactive wastes) shall be conducted in accordance with the requirements of the Resource Conservation and Recovery Act (RCRA), as amended, which includes RCRA permitting for hazardous wastes. The EPA has authorized the State of Nevada to administer Subtitle C of RCRA, regulating the management and disposal of hazardous wastes.

Applicability to the ESF

ESF activities may require the use of hazardous materials and the generation of both solid and hazardous wastes. The proper handling and disposal of solid and hazardous materials will require compliance with various federal and state regulations. Reporting requirements in the event of spills are included. Activities covered in this section include hazardous materials, landfills, use of insecticides and pesticides, toxic substances, and transportation of hazardous materials.

Requirements for the ESF

- Use of hazardous materials onsite must receive prior approval from the Yucca Mountain Site Characterization Project Office (YMPO), as per AP-6.13.

- The use of hazardous materials onsite must conform to the guidelines provided in the Hazardous Materials Management and Handling Program (HMMHP).

- The requirements for management and disposal of hazardous wastes must be satisfied in accordance with Subtitle C of RCRA.
- Use of underground storage tanks must be in accordance with Subtitle I, RCRA.
- Use of recycled and recovered materials shall be given high priority, as required by Subtitle F.
- Non-hazardous solid waste will be recollected and hauled to an approved landfill, as required by NRS 444.440-620.
- Soil contaminated with spilled oil or fuel must be disposed of in an approved landfill or by another approved method.

6.2 COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION AND LIABILITY ACT (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) (42 USC 9601 et seq; 40 CFR 300, 302, 355, 370, and 372; Executive Orders 12286, 12288, and 12580)

Background

CERCLA (as amended by SARA), also known as "Superfund," was created in 1980. The act provides for the clean-up of, and emergency response to, hazardous substances released into the environment, and for the clean-up of hazardous waste sites that present a substantial danger to public health and welfare. The emergency response and clean-up of hazardous substances released into the environment shall be conducted according to CERCLA.

Applicability to the ESF

The use of hazardous materials at the ESF will require that materials be transported, handled, stored, and disposed of properly, and may result in spills requiring corrective action.

YMP/CC-0013, Rev. 5/31/91

Requirements for the ESF

- Any spills of hazardous substances must be reported to appropriate agencies and officials, and be cleaned up in compliance with the Superfund Act.

- A "Spill Contingency Plan" is required for ESF activities.

- All field personnel must be trained in the proper handling of hazardous substances and in response actions to be taken in the event of a spill.

- Use of hazardous materials must comply with Community-Right-To-Know regulations under Title III of SARA.

- Transportation of all hazardous materials to the Yucca Mountain site must meet the requirements of the Hazardous Material Transportation Act (49 USC 1801; 49 CFR 171-178).

- The handling, use, and disposal of any toxic substances shall comply with the requirements of the Toxic Substances Control Act (TSCA), as amended (15 USC 2601).

- The use of pesticides shall comply with the requirements of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA, P.L.2-140 and P.L.95-396).

YMP 00-0013, Rev. 5/31/91

7.0 BIOLOGICAL RESOURCE PROTECTION

7.1 ENDANGERED SPECIES ACT of 1973 (P.L. 93-205, as amended; 16 USC 1531-1543; 50 CFR Sections 17.11, 17.12, and 17.94-96; 50 CFR Parts 13, 222, 226, 227, 402, 424, and 450-453).

Background

Any Federal activity or Federally-supported activity must be performed in compliance with the Endangered Species Act (ESA, 1973). Accordingly, any Federal activity that could directly affect protected fish, wildlife, or vegetation, or destroy or alter the specific habitat of protected species, must be designed to avoid or mitigate all potentially adverse impacts.

Applicability to the ESF

The desert tortoise, existing at the Yucca Mountain site, has been listed as a Federally-protected, threatened species. ESF activities will require the performance of surface-disturbing work having the potential to affect the desert tortoise. Actions taken during site characterization must not jeopardize the continued existence of this species.

Requirements for the ESF

The following constraints are derived from requirements set forth in the Biological Opinion (BO) rendered by the U.S. Fish and Wildlife Service (McNatt, 1990) and are consistent with accepted revisions to the BO.

- Threatened or endangered species must be protected, in compliance with the ESA, as stipulated in the BO.

- Prior to any land disturbance, a preactivity survey must be conducted by qualified Project Office-designated participants to determine if the proposed activity will impact any important biological resources.

YMP/CC-0013, Rev. 5/31/91

- All personnel working at the site must complete the Environmental Requirements Training Program (ERTP).

- Any harassment of the desert tortoise is to be avoided. Neither the animal itself nor its burrow is to be touched or disturbed by other than a qualified biologist. Stay at least ten feet away from any burrow six inches or larger in height or width.

- If a desert tortoise is seen in the construction area, work shall cease and the Yucca Mountain Project Office (YMPO) and the Project Site Manager shall be notified. It may be necessary for a qualified biologist to relocate the tortoise before work may resume.

- Avoid hitting any animals which may be crossing roads or trails.

- Field participants are required to notify the YMPO immediately upon finding an injured or dead tortoise.

- Covered trash containers will be provided so that food and other garbage is discarded in a manner that will not attract ravens.

YMP/CC-0013, Rev. 5/31/91

8.0 ARCHAEOLOGICAL RESOURCE PROTECTION

8.1 NATIONAL HISTORIC PRESERVATION ACT OF 1966, as amended (16 USC 470 et seq; 36 CFR Parts 60, 61, 63, 65, 67, 68, and 800; Executive Order 11593), HISTORIC SITES, BUILDINGS, AND ANTIQUITIES ACT, as amended (16 USC 461-467), ARCHAEOLOGICAL AND HISTORIC PRESERVATION ACT (16 USC 469-469c)

AMERICAN INDIAN RELIGIOUS FREEDOM ACT OF 1978, (P.L. 95-341; 42 USC 1996; 36 CFR Part 296; 43 CFR Part 7)

ANTIQUITIES ACT (16 USC 431, 432, and 433; 25 CFR 261; 36 CFR 296; 43 CFR 3 and 7)

ARCHAEOLOGICAL RESOURCES PROTECTION ACT of 1979, (16 USC, Sections 470aa-470ll; 36 CFR 296; 43 CFR 7)

Background

The goal of all of the laws listed above, in terms of Federal activities, is to ensure consideration of the values of historic properties in carrying out Federal activities, and to make every effort to identify and mitigate impacts to significant historic properties. The National Historic Preservation Act (NHPA) is the principal authority to which the DOE will respond with regard to the protection of historic properties. The NHPA requires all Federal agencies to take into account the effects of their undertakings (e.g., site characterization) on historic properties, and to allow the Advisory Council on Historic Preservation (ACHP) to comment on the adequacy of the agency's plans. Historic properties are defined as any properties included in, or eligible for inclusion in, the National Register of Historic Places.

Applicability to the ESF

The YMP area contains many historic sites and artifacts which require protection under the NHPA, Antiquities Act (AA), the American Indian

YMP/CC-0013, Rev. 5/31/91

Religious Freedom Act (AIRFA), and the Archaeological Resources Protection Act (ARPA). The implementation of the "Programmatic Agreement" between the DOE and the ACHP will satisfy the YMP's commitments and responsibilities under these various Acts.

Requirements for the ESF

The following constraints established to protect archaeological resources are consistent with applicable Federal, State, and local environmental regulations.

- A preactivity survey must be conducted by qualified YMPO contractors to determine if the proposed activity will affect archaeological resources.

- If archaeological resources are identified within the area proposed for the activity, it may be necessary to relocate the activity, to recover data from the site prior to trenching, or to designate an "Inclusion Area" for the activity. An Inclusion Area should clearly delineate an area within which surface-disturbing activities are restricted. Any area beyond the Inclusion Area boundary is off-limits to equipment and personnel to prevent inadvertent disturbance of an archaeological resource.

- A site-specific Data Recovery Plan shall be prepared by a designated archaeologist and approved by the ACHP prior to recovering data from the site.

- If archaeological resources are discovered within the area approved for activity, work shall cease and the YMPO Operations Control Branch and Project Site Manager will be notified.

YMP CC-0013, Rev. 5/31/91

9.0 RECLAMATION

Background

In compliance with the NWPA, as amended, the DOE has developed a program for the reclamation of areas disturbed by site characterization. This program requires that disturbed land be returned to a stable ecological state with a form and productivity similar to its predisturbed state.

Applicability to the ESF

BLM Right-of-Way-Reservations and the NWPA Section 113(b)(1)(A) require that areas altered by site characterization activities be reclaimed. Any surface-disturbing activities to be undertaken at Yucca Mountain under the purview of the YMP must be planned in accordance with the Reclamation Implementation Plan (RIP; DOE, 1991).

Requirements for the ESF

- Reclamation activities will be carried out as described in the RIP.
- A preactivity survey must be conducted to determine biotic, soil type, and reclamation capabilities of each site.
- Surface-disturbing activity reclamation specifications shall include considerations to minimize dust and other environmental impacts.
- Guidelines in the RIP should be followed, including requirements for:
  - Site inventory
  - Site clearing
  - Topsoil storage and management

YMP/CC-0013, Rev. 5 31 91

- Erosion control
- Drainage control
- Site abandonment and facility decommissioning
- Recontouring
- Revegetation
- Irrigation
- Post-reclamation monitoring

10.0 RADIOLOGICAL HEALTH AND SAFETY

Background

The NWPA, as amended, and the NEPA require the DOE to conduct radiological studies and radiological monitoring at the Yucca Mountain site. The DOE, the EPA, and the NRC each have established rules, regulations, and orders pertaining to radiological health and safety. In the event of conflicts or duplications among the radiological requirements listed in the Yucca Mountain Regulatory Compliance Plan (YMP/90-33, September, 1990), the requirement holding the highest authority will prevail. In general, Public Laws are the most authoritative, followed by the Code of Federal Regulations, Project Positions and NRC guidance. Department Orders are the least authoritative. In the absence of more authoritative requirements, however, site characterization activities will be carried out in compliance with DOE Orders relating to radiological health, safety and environmental protection, as described in the Radiological Monitoring Plan (DOE, 1990).

Applicability to the ESF

It is anticipated that four potential sources of radioactive materials will exist at the Yucca Mountain site during site characterization.

1. Release of naturally-occurring radionuclides from mining activities;

2. Discharge of groundwater, expected to contain only natural background radioactivity, to the surface;

3. Resuspension of radioactive materials previously deposited during nuclear testing at the NTS; and

4. Release of short-lived radioactive tracers as part of geohydrological modeling, and the small potential for release of radioactive material during well-logging activities.

YMP/CC-0013, Rev. 5 31 91

Because only a small volume of rock will be mined and a small amount of groundwater released to the surface during site characterization, it is estimated that radioactive releases will amount to only a small fraction of the natural background radiation always present, and will not constitute a significant radiological impact.

The resuspension of previously-deposited radioactive materials during site characterization is also expected to be insignificant compared to natural background because of the low concentration of radioactive materials present in the existing environment. However, estimates presented in the Environmental Assessment (DOE, 1986) may include inherent uncertainties because past radiological monitoring at and around the Yucca Mountain site has been limited. To verify that there will be no significant impact, as mandated by the Environmental Monitoring and Mitigation Plan (EMMP; DOE, 1988b), radiological monitoring will be conducted in the areas of (1) radioactive material concentrations in air, soils, biota, and groundwater; and (2) external radiation background field.

Requirements for the ESF

- The ESF shall comply with the requirements of the Yucca Mountain Project Radiological Monitoring Plan (RMP; DOE, 1990).

- Consistent with the requirements of DOE Order 5480.11, equipment is considered to be potentially contaminated if it has been used or stored in a controlled area that has contained unconfined radioactive material. Prior to its use, such equipment must be surveyed to determine whether both removable and total surface contamination is greater than the levels specified in DOE Order 5400.5.

- The T&MSS Radiological Field Programs Department should be notified at least three weeks prior to initiation of an activity. Notification shall include date, duration, and description of all field activities being initiated so that potential changes to the radiological data can be reconciled consistent with the EMMP.

YMP/CC-0013, Rev. 5/31/91

- Limited radon monitoring in a mine or in mine exhaust is required when the mine is initially opened, and may be necessary throughout the duration of many site characterization activities.

- If radioactive tracers are used, the DOE will comply with 40 CFR Part 144 and NAC Chapter 445.

- If radioactive material or radiation-producing equipment is used on State or private land (not controlled by the U.S. Government), compliance with the State of Nevada Regulations for Radiation Control is required.

YMP/CC-0013, Rev. 5/31/91

11.0 LAND ACCESS

11.1 FEDERAL LAND POLICY AND MANAGEMENT ACT of 1976 (P.L. 94-579; 43 USC 1701-1784; 43 CFR 2800)

Background

The Federal Land Policy and Management Plan (FLPMA) establishes U.S. Government policy with regard to government-owned lands administered by the Bureau of Land Management (BLM). FLPMA mandates that such lands be managed in a manner that will (1) protect the quality of scientific, scenic, historical, ecological, environmental, and archaeological values; (2) preserve and protect certain public lands in their natural condition; (3) provide food and habitat for fish and domestic animals; and (4) provide for outdoor recreation and human occupancy and use.

Applicability to the ESF

Federal activities requiring access to, and activity on, public lands require compliance with the FLPMA. Because the Yucca Mountain site is partially on BLM-administered public land and BLM-administered Air Force land, and because activities will occur on BLM lands, as well, DOE compliance with BLM requirements for access and use of this land is mandatory.

The DOE obtained access to the BLM and Air Force lands for site characterization through Rights-of-Way granted in January 1988 and October 1989.

Requirements for the ESF

In issuing these Rights-of-Way, the BLM has stipulated specific environmental requirements which include:

- Access approval for the activity must be confirmed by the Project Office.

YMP-CC-0013, Rev. 5/31/91

- A copy of the BLM Right-of-Way Reservation (ROWR) Agreement (BLM, 1988; BLM, 1989) must be available at the job-site when work is being conducted in the field.

- Stipulations listed in the ROWR Agreement (BLM, 1988; BLM, 1989) must be followed.

- Off-road driving or parking is prohibited unless specifically permitted in writing by the YMPO. Any access route or area of disturbance will be specifically approved through the environmental review process. Existing trails may be used if prior environmental approval is obtained.

- Sand and gravel must be obtained from a source authorized by a BLM free-use permit or from a duly permitted commercial source.

- Core holes and wells containing potentially usable water should be left in a manner which facilitates their development as water sources. Prior to termination of the agreement or abandonment of the holes/wells, the DOE will consult BLM to determine if the holes will be sealed and capped, plugged, or turned over to the BLM as is.

- The DOE is required to fulfill all requirements applicable to the NEPA, as well as all requirements for mitigation, stabilization, and rehabilitation, as described in the Plan of Development and listed in Sections 4.1.1.4 and 4.1.2.6 of the Yucca Mountain Environmental Assessment (DOE, 1986). This responsibility will continue until the requirements are met, regardless of expiration of the Right-of-Way reservation.

YMP CC-0013, Rev. 5 31/91

12.0 FLOODPLAIN PROTECTION

Background

Executive Order (EO) 11988 requires that each Federal agency take action to reduce the risk of flood damage, minimize the impact of floods on human safety, health, and welfare, and restore and preserve the natural and beneficial values served by floodplains.

Applicability to the ESF

Activities planned within the 100-year floodplain at the Yucca Mountain site require certain compliance actions (EXECUTIVE ORDER 11988, FLOODPLAIN MANAGEMENT; as implemented by 10 CFR Part 1022).

Requirements for the ESF

- Any activity conducted in a floodplain must be preceded by a floodplain/wetlands assessment, in compliance with 10 CFR Part 1022.
- Alternatives to building in the defined 100-year floodplain must be identified and considered.
- Structures/facilities built in the floodplain should be designed to both minimize effects on the floodplain and protect the structure/facilities in the floodplain.

YMP CC-0013, Rev. 5 31 91

13.0 NOISE

13.1 THE NOISE CONTROL ACT (NCA) OF 1972, as amended by the Quiet Communities Act of 1978, (42 USC 4901-4918; Executive Order 12088)

Background

Federal agencies must carry out their programs in a manner that promotes an environment free of noise that could jeopardize public health or welfare.

Applicability to the ESF

Construction and operational activities for the ESF will cause noise pollution that must be monitored to ensure that the noise does not jeopardize worker health or cause significant impacts to wildlife.

Requirements for the ESF

- Noise levels must be controlled and monitored, in accordance with regulations implementing the NCA (40 CFR Chapter 1, Subchapter G).

YMP/CC-0013, Rev. 5/31/91

14.0 REFERENCES

AA (Antiquities Act), 1979. "Antiquities Act of 1906," as amended, U.S. Code, Title 16, Section 432.

AIRFA (American Indian Religious Freedom Act), 1978. "American Indian Religious Freedom Act of 1978," U.S. Code, Title 42, Sec. 1996.

ARPA (Archaeological Resources Protection Act), 1979. "Archaeological Resources Protection Act," U.S. Code, Title 16, Sec. 470aa-11.

AEA (Atomic Energy Act), 1954. "Atomic Energy Act," as amended, U.S. Code, Title 42, Sec. 2021(h).

BLM (U.S. Bureau of Land Management), 1988. Right-of-Way Reservation N-47748, January 6, 1988.

BLM (U.S. Bureau of Land Management), 1989. Right-of-Way Reservation N-48602, October 10, 1989.

CAA (Clean Air Act), 1977. "Clean Air Act," as amended, U.S. Code, Title 42, Sec. 7401.

CERCLA (Comprehensive Environmental Response, Compensation, and Liability Act), 1980. "Comprehensive Environmental Response, Compensation, and Liability Act," as amended by "The Superfund Amendments and Reauthorization Act of 1986," U.S. Code, Title 42, Sec. 9601.

CWA (Clean Water Act), 1972. "Federal Water Pollution Control Act of 1972, as amended by the Clean Water Act of 1977 and the Water Quality Act of 1987," U.S. Code, Title 33, Sec. 1251.

DOE (U.S. Department of Energy), 1986. "Environmental Assessment Yucca Mountain Site, Nevada Research and Development Area, Nevada," DOE/RW-0101, Washington, D.C.

DOE (U.S. Department of Energy), 1988a. "Environmental Regulatory Compliance Plan for Site Characterization," DOE/RW-0209, NNWSI Project, Las Vegas, Nevada.

DOE (U.S. Department of Energy), 1988b. "Environmental Monitoring and Mitigation Plan," DOE/RW-0208, Nevada Operations Office, Las Vegas, Nevada.

DOE (U.S. Department of Energy), 1990. "Radiological Monitoring Plan," YMP/88-14, YMSCP, Las Vegas, Nevada.

DOE (U.S. Department of Energy), 1991. "Reclamation Implementation Plan for the Yucca Mountain Project," YMP, Las Vegas, Nevada.

ESA (Endangered Species Act), 1973. "Endangered Species Act of 1973," U.S. Code, Title 16, Sec. 1531.

FIFRA (Federal Insecticide, Fungicide, and Rodenticide Act), 1978. Also Federal Pesticide Act of 1978 (P.L.2-140 and P.L.95-396).

FLPMA (Federal Land Policy and Management Act), 1976. "Federal Land Policy and Management Act of 1976," U.S. Code, Title 43, Sec. 1701.

HMTA (The Hazardous Materials Transportation Act), 1975. "The Hazardous Materials Transportation Act of 1975, " U.S. Code, Title 49, Sec. 1801.

Historic Site, Buildings, and Antiquities Act, 1935. "The Historic Sites, Buildings, and Antiquities Act of 1935," U.S. Code, Title 16, Sec. 461.

Materials Act, 1947. "Materials Act of 1947," U.S. Code, Title 30, Sec. 601.

McNatt, R. M., 1990. Letter from R. M. McNatt to C. P. Gertz regarding the U.S. Fish and Wildlife Service consultation and Biological Opinion on the potential for adverse impacts on the desert tortoise from Site Characterization Plan Activities. February 9, 1990.

NEPA (National Environmental Policy Act), 1969. "National Environmental Policy Act of 1969," U.S. Code, Title 42, Sec. 4321.

NHPA (National Historic Preservation Act), 1966. "National Historic Preservation Act of 1966," U.S. Code, Title 16, Sec. 470.

Noise Control Act, 1972. "Noise Control Act of 1972," U.S. Code, Title 42, Sec. 4901.

NWPA (Nuclear Waste Policy Act), 1982. "Nuclear Waste Policy Act of 1982, as amended by the Nuclear Waste Policy Amendments Act (NWPAA) of 1987," Public Law 97-425, U.S. Code, Title 42, Sec. 10101.

Office of the President, 1970. "Protection and Enhancement of Environmental Quality," Executive Order 11514, 35 Federal Register 46, Washington, D.C.

Office of the President, 1971. "Protection and Enhancement of the Cultural Environment," Executive Order 11593, 36 Federal Register 8921, Washington, D.C.

Office of the President, 1977a. "Floodplain Management," Executive Order 1988, 42 Federal Register 101, Washington, D.C.

Office of the President, 1977b. "Protection of Floodplains," Executive Order 11990, 42 Federal Register 101, Washington, D.C.

Office of the President, 1978. "Federal Compliance with Pollution Control Standards," Executive Order 12088, 43 Federal Register 201, Washington, D.C.

YMP.CC-0013, Rev. 5/31/91

PA (Programmatic Agreement), 1988. "(Draft) Programmatic Agreement Among the United States Department of Energy (DOE), the Advisory Council on Historic Preservation (Council), and the Nevada State Historic Preservation Officer (SHPO), for the First Nuclear Waste Deep Geology Repository," draft, yet to be issued.

RCRA (Resource Conservation and Recovery Act), 1976. "Resource Conservation and Recovery Act of 1976," U.S. Code, Title 42, Sec. 4901.

SDWA (Safe Drinking Water Act), 1974. "Safe Drinking Water Act of 1974," U.S. Code, Title 42, Sec. 300(f).

State of Nevada, 1984a. "Nevada Administrative Codes," Chapter 445, "Air Pollution Controls," Carson City, Nevada.

State of Nevada, 1984b. "Nevada Administrative Codes," Chapter 445, "Water Pollution Control," Carson City, Nevada.

State of Nevada, 1985. "Nevada Administrative Codes," Chapter 444, "Hazardous Waste Disposal," Carson City, Nevada.

State of Nevada, 1987a. "Nevada Revised Statutes," Chapter 533, Sec. 325, "Appropriation of Public Waters," Carson City, Nevada.

State of Nevada, 1987b. "Nevada Revised Statutes," Chapter 445, Sec. 131. "Nevada Water Pollution Control Law," Carson City, Nevada.

State of Nevada, 1987c. "Nevada Revised Statutes," Title 45, "Wildlife," Carson City, Nevada.

State of Nevada, 1987d. "Nevada Revised Statutes," Chapter 527, "Protection and Preservation of Timbered Lands, Trees and Flora," Carson City, Nevada.

TSCA (Toxic Substances Control Act), as amended (15 U.S.C. 2601).

10 CFR 1022, 1986. Title 10, "Energy," Part 1022, "Compliance with Floodplain/Wetlands Environmental Review Requirements," U.S. Government Printing Office, Washington, D.C.

25 CFR 261, 1987. Title 25, "Indians," Part 261, "Preservation of Antiquities," U.S. Government Printing Office, Washington, D.C.

33 CFR 209, 1987. Title 33, "Navigation and Navigable Waters," Part 209, "Administrative Procedure," U.S. Government Printing Office, Washington, D.C.

33 CFR Part 320, 1987. Title 33, "Navigation and Navigable Waters," Part 320, "General Regulatory Policies," U.S. Government Printing Office, Washington, D.C.

33 CFR Part 323, 1987. Title 33, "Navigation and Navigable Waters," Part 323, "Permits for Discharges of Dredged or Fill Material into Waters of the United States," U.S. Government Printing Office, Washington, D.C.

YMP/CC-0013, Rev. 5/31/91

33 CFR Part 324, 1987. Title 33, "Navigation and Navigable Waters," Part 324, "Permits for Ocean Dumping of Dredged Material," U.S. Government Printing Office, Washington, D.C.

33 CFR Part 325, 1987. Title 33, "Navigation and Navigable Waters," Part 325, "Processing of Department of Army Permits," U.S. Government Printing Office, Washington, D.C.

33 CFR Part 326, 1987. Title 33, "Navigation and Navigable Waters," Part 326, "Enforcement, Supervision and Inspection," U.S. Government Printing Office, Washington, D.C.

33 CFR Part 327, 1987. Title 33, "Navigation and Navigable Waters," Part 327, "Public Hearings," U.S. Government Printing Office, Washington, D.C.

33 CFR 329, 1987. Title 33, "Navigation and Navigable Waters," Part 329, "Definition of Navigable Waters of the United States," U.S. Government Printing Office, Washington, D.C.

33 CFR 330, 1987. Title 33, "Navigation and Navigable Waters," Part 330, "Nationwide Permits," U.S. Government Printing Office, Washington, D.C.

36 CFR Part 296, 1986. Title 36, "Protection of Archaeological Resources: Uniform Regulations," U.S. Government Printing Office, Washington, D.C.

36 CFR Part 800, 1987. Title 36, "Parks, Forests, and Public Lands," Part 800, "Protection of Historic Properties," U.S. Government Printing Office, Washington, D.C.

40 CFR Part 50, 1987. Title 40, "Protection of Environment," Part 50, "National Primary and Secondary Ambient Air Quality Standards," U.S. Government Printing Office, Washington, D.C.

40 CFR Part 51, 1987. Title 40, "Protection of Environment," Part 51, "Requirements for Preparation, Adoption, and Submittal of Implementation Plans," U.S. Government Printing Office, Washington, D.C.

40 CFR Part 52, 1987. Title 40, "Protection of Environment," Part 52, "Approval and Promulgation of Implementation Plans," U.S. Government Printing Office, Washington, D.C.

40 CFR Part 53, 1987. Title 40, "Protection of Environment," Part 53, "Ambient Air Monitoring Reference and Equivalent Methods," U.S. Government Printing Office, Washington, D.C.

40 CFR Part 58, 1987. Title 40, "Protection of Environment," Part 58, "Ambient Air Quality Surveillance," U.S. Government Printing Office, Washington, D.C.

40 CFR Part 60, 1987. Title 40, "Protection of Environment," Part 60, "Standards of Performance for New Stationary Standards," U. S. Government Printing Office, Washington, D.C.

YMP/CC-0013, Rev. 5/31/91

40 CFR Part 61, 1987. Title 40, "Protection of Environment," Part 61, "National Emission Standards for Hazardous Air Pollutants," U.S. Government Printing Office, Washington, D.C.

40 CFR Part 81, 1987. Title 40, "Protection of Environment," Part 81, "Designation of Areas for Air Quality Planning Purposes," U.S. Government Printing Office, Washington, D.C.

40 CFR Part 110, 1987. Title 40, "Protection of Environment," Part 110, "Discharge of Oil," U.S. Government Printing Office, Washington, D.C.

40 CFR Part 112, 1987. Title 40, "Protection of Environment," Part 112, "Oil Pollution Prevention," U.S. Government Printing Office, Washington, D.C.

40 CFR Part 116, 1987. Title 40, "Protection of Environment," Part 116, "Designation of Hazardous Substances," U.S. Government Printing Office, Washington, D.C.

40 CFR Part 117, 1987. Title 40, "Protection of Environment," Part 117, "Determination of Reportable Quantities for Hazardous Substances," U.S. Government Printing Office, Washington, D.C.

40 CFR Part 121, 1987. Title 40, "Protection of Environment," Part 121, "State Certification of Activities Requiring a Federal License or Permit," U.S. Government Printing Office, Washington, D.C.

40 CFR Part 122, 1987. Title 40, "Protection of Environment," Part 122, "EPA Administered Permit Programs: The National Pollution Discharge Elimination System," U.S. Government Printing Office, Washington, D.C.

40 CFR Part 123, 1987. Title 40, "Protection of Environment," Part 123, "State Program Requirements," U.S. Government Printing Office, Washington, D.C.

40 CFR Part 124, 1987. Title 40, "Protection of Environment," Part 124, "Procedures for Decisionmaking," U.S. Government Printing Office, Washington, D.C.

40 CFR Part 125, 1987. Title 40, "Protection of Environment," Part 125, "Criteria and Standards for the National Pollution Discharge Elimination System," U.S. Government Printing Office, Washington, D.C.

40 CFR Part 129, 1987. Title 40, "Protection of Environment," Part 129, "Toxic Pollutant Effluent Standards," U.S. Government Printing Office, Washington, D.C.

40 CFR Part 133, 1987. Title 40, "Protection of Environment," Part 133, "Secondary Treatment Regulation," U.S. Government Printing Office, Washington, D.C.

40 CFR Part 136, 1987. Title 40, "Protection of Environment," Part 136, "Guidelines Establishing Test Procedures for the Analysis of Pollutants," U.S. Government Printing Office, Washington, D.C.

YMP CC-0013, Rev. 5 31 91

40 CFR Part 141, 1987. Title 40, "Protection of Environment," Part 141, "National Primary Drinking Water Regulations," U.S. Government Printing Office, Washington, D.C.

40 CFR Part 142, 1987. Title 40, "Protection of Environment," Part 142, "National Primary Drinking Water Regulations Implementation," U.S. Government Printing Office, Washington, D.C.

40 CFR Part 143, 1987. Title 40, "Protection of Environment," Part 143, "National Secondary Drinking Water Regulations," U.S. Government Printing Office, Washington, D.C.

40 CFR Part 144, 1987. Title 40, "Protection of Environment," Part 144, "Underground Injection Control Program," U.S. Government Printing Office, Washington, D.C.

40 CFR Part 145, 1987. Title 40, "Protection of Environment," Part 145, "State Underground Injection Control Programs," U.S. Government Printing Office, Washington, D.C.

40 CFR Part 146, 1987. Title 40, "Protection of Environment," Part 146, "Underground Injection Control Program: Criteria and Standards," U.S. Government Printing Office, Washington, D.C.

40 CFR Part 147, 1987. Title 40, "Protection of Environment," Part 147, "State Underground Injection Control Programs," U.S. Government Printing Office, Washington, D.C.

40 CFR Part 149, 1987. Title 40, "Protection of Environment," Part 149, "Sole Source Aquifers," U.S. Government Printing Office, Washington, D.C.

40 CFR Part 191, 1984. Title 40, "Protection of Environment," Part 191, "Standards for Radioactive Releases to the Accessible Environment (Draft 4)," U.S. Government Printing Office, Washington, D.C. [A decision on July 17, 1987, by the U.S. Court of Appeals for the First Circuit has vacated and remanded to the EPA for further proceedings the post-closure standards (Subpart B) in 40 CFR 191].

40 CFR Part 230, 1987. Title 40, "Protection of Environment," Part 230, "Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material," U.S. Government Printing Office, Washington, D.C.

40 CFR Part 240, 1987. Title 40, "Protection of Environment," Part 240, "Guidelines for the Thermal Processing of Solid Wastes," U.S. Government Printing Office, Washington, D.C.

40 CFR Part 241, 1987. Title 40, "Protection of Environment," Part 241, "Guidelines for the Land Disposal of Solid Wastes," U.S. Government Printing Office, Washington, D.C.

YMP/CC-0013, Rev. 5/31/91

40 CFR Part 243, 1987. Title 40, "Protection of Environment," Part 243, "Guidelines for the Storage and Collection of Residential, Commercial, and Institutional Solid Waste," U.S. Government Printing Office, Washington, D.C.

40 CFR Part 244, 1987. Title 40, "Protection of Environment," Part 244, "Solid Waste Management Guidelines for Beverage Containers," U.S. Government Printing Office, Washington, D.C.

40 CFR Part 245, 1987. Title 40, "Protection of Environment," Part 245, "Promulgation Resource Recovery Facility Guidelines," U.S. Government Printing Office, Washington, D.C.

40 CFR Part 246, 1987. Title 40, "Protection of Environment," Part 246, "Source Separation for Materials Recover Guidelines," U.S. Government Printing Office, Washington, D.C.

40 CFR Part 247, 1987. Title 40, "Protection of Environment," Part 247, "Guidelines for Procurement of Products that Contain Recycled Material," U.S. Government Printing Office, Washington, D.C.

40 CFR Part 260, 1987. Title 40, "Protection of Environment," Part 260, "Hazardous Waste Management System: General," U.S. Government Printing Office, Washington, D.C.

40 CFR Part 261, 1987. Title 40, "Protection of Environment," Part 261, "Identification and Listing of Hazardous Waste," U.S. Government Printing Office, Washington, D.C.

40 CFR Part 262, 1987. Title 40, "Protection of Environment," Part 262, "Standards Applicable to Generators of Hazardous Waste," U.S. Government Printing Office, Washington, D.C.

40 CFR Part 263, 1987. Title 40, "Protection of Environment," Part 263, "Standards Applicable to Transporters of Hazardous Waste," U.S. Government Printing Office, Washington, D.C.

40 CFR Part 264, 1987. Title 40, "Protection of Environment," Part 264, "Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities," U.S. Government Printing Office, Washington, D.C.

40 CFR Part 266, 1987. Title 40, "Protection of Environment," Part 266, "Standards of the Management of Specific Hazardous Wastes and Specific Types of Hazardous Waste Management Facilities," U.S. Government Printing Office, Washington, D.C.

40 CFR Part 270, 1987. Title 40, "Protection of Environment," Part 270, "EPA Administered Permit Programs: The Hazardous Waste Permit Program," U.S. Government Printing Office, Washington, D.C.

40 CFR Part 271, 1987. Title 40, "Protection of Environment," Part 271, "Requirements for Authorization of State Hazardous Waste Programs," U.S. Government Printing Office, Washington, D.C.

YMP-CC-0013, Rev. 5/31/91

40 CFR Part 280, 1988. Title 40, "Protection of Environment," Part 280, "Underground Storage Tanks," U.S. Government Printing Office, Washington, D.C.

40 CFR Part 300, 1987. Title 40, "Protection of Environment," Part 300, "National Oil and Hazardous Substances Pollution Contingency," U.S. Government Printing Office, Washington, D.C.

40 CFR Part 302, 1987. Title 40, "Protection of Environment," Part 302, "Designation, Reportable Quantities, and Notification," U.S. Government Printing Office, Washington, D.C.

40 CFR Part 355, 1987. Title 40, "Protection of Environment," Part 355, "Emergency Planning and Notification," U.S. Government Printing Office, Washington, D.C.

40 CFR Part 401, 1987. Title 40, "Protection of Environment," Part 401, "Effluent Guidelines and Standards, General Provisions," U.S. Government Printing Office, Washington, D.C.

40 CFR Part 403, 1987. Title 40, "Protection of Environment," Part 403, "Effluent Guidelines and Standards, General Pretreatment Regulations for Existing and New Sources of Pollution," U.S. Government Printing Office, Washington, D.C.

40 CFR Chapter 5 (Parts 1500-1508), 1987. Title 40, "Protection of Environment," Parts 1500-1508, "Council on Environmental Quality," (CEQ) U.S. Government Printing Office, Washington, D.C.

43 CFR Part 3, 1988. Title 43, "Public Lands: Interior," Part 3, "Preservation of American Antiquities," U.S. Government Printing Office, Washington, D.C.

43 CFR Part 6220, 1988. Title 43, "Public Lands: Interior," Part 6220, "Protection and Preservation of Natural Values," U.S. Government Printing Office, Washington, D.C.

43 CFR Part 3600, 1988. Title 43, "Public Lands: Interior," Part 3600, "Mineral Materials Disposal; General," U.S. Government Printing Office, Washington, D.C.

49 CFR Part 171, 1988. Title 49, "Transportation," Subchapter C: Hazardous Materials Regulations, Part 171, "General Information, Regulations, and Definitions," U.S. Government Printing Office, Washington, D.C.

49 CFR Part 172, 1988. Title 49, "Transportation," Subchapter C: Hazardous Materials Regulations, Part 172, "Hazardous Materials Tables and Hazardous Materials Communications Regulations," U.S. Government Printing Office, Washington, D.C.

49 CFR Part 173, 1988. Title 49, "Transportation," Subchapter C: Hazardous Materials Regulations, Part 173, "Shippers - General Requirements for Shipments and Packagings," U.S. Government Printing Office, Washington, D.C.

 YMP CC-0013, Rev. 5/31/91

49 CFR Part 174, 1988. Title 49, "Transportation," Subchapter C: Hazardous Materials Regulations, Part 174, "Carriage by Rail," U.S. Government Printing Office, Washington, D.C.

49 CFR Part 175, 1988. Title 49, "Transportation," Subchapter C: Hazardous Materials Regulations, Part 175, "Carriage by Aircraft," U.S. Government Printing Office, Washington, D.C.

49 CFR Part 176, 1983. Title 49, "Transportation," Subchapter C: Hazardous Materials Regulations," Part 176, "Carriage by Vessel," U.S. Government Printing Office, Washington, D.C.

49 CFR Part 177, 1983. Title 49, "Transportation," Subchapter C: Hazardous Materials Regulations, Part 177, "Carriage by Public Highways," U.S. Government Printing Office, Washington, D.C.

49 CFR Part 178, 1983. Title 49, "Transportation," Subchapter C: Hazardous Materials Regulations, Part 178, "Shipping Container Specifications," U.S. Government Printing Office, Washington, D.C.

50 CFR Part 17, 1986. Title 50, "Wildlife and Fisheries," Part 17, "Endangered and Threatened Wildlife and Plants," U.S. Government Printing Office, Washington, D.C.

50 CFR Part 402, 1986. Title 50, "Wildlife and Fisheries," Part 402, "Interagency Cooperation - Endangered Species Act of 1973, as amended," U.S. Government Printing Office, Washington, D.C.

50 CFR Part 424, 1986. Title 50, "Wildlife and Fisheries," Part 424, "Listing Endangered and Threatened Species," U.S. Government Printing Office, Washington, D.C.

50 CFR Part 450, 1986. Title 50, "Wildlife and Fisheries," Part 450, "General Provisions: Endangered Species Exemption Process," U.S. Government Printing Office, Washington, D.C.

50 CFR Part 451, 1986. Title 50, "Wildlife and Fisheries," Part 451, "Application Procedures: Endangered Species Exemption Process," U.S. Government Printing Office, Washington, D.C.

50 CFR Part 452, 1986. Title 50, "Wildlife and Fisheries," Part 452, "Consideration of Application by the Secretary: Endangered Species Exemption Process," U.S. Government Printing Office, Washington, D.C.

50 CFR Part 453, 1986. Title 50, "Wildlife and Fisheries," Part 453, "Endangered Species Committee: Endangered Species Exemption Process," U.S. Government Printing Office, Washington, D.C.

YMP CC-0013, Rev. 5 31 91

APPENDIX K

CORRELATION OF DAA CRITERIA WITH CORRESPONDING ESFDR CRITERIA

APPENDIX K

The ESF Title I Design Acceptability Analysis and Comparative Evaluation of Alternative ESF Locations (DAA) was, in part, a review of the adequacy of ESF Title I design for three concerns expressed by the NRC. The three concerns are listed on page INTRO-2 of this document. This appendix contains the text of the criteria used in the review to evaluate ESF design. Appendix I-3 of the DAA contains a detailed discussion of the development process for the criteria.

This appendix enables the user to correlate DAA criteria with corresponding ESFDR criteria, and to understand how the criteria implement higher-level 10 CFR 60 requirements. The references shown in parentheses indicate the location of a corresponding statement in the ESFDR.

Some of the 10 CFR 60's (and corresponding DAA criteria) do not directly influence the ESF design and consequently do not appear in the ESFDR text. These have been listed in the ESFDR Introduction under the section titled 10 CFR 60 Requirements. They have been separated into the following five separate categories.

1. The 10 CFR 60 requirements that regulate the handling and control of radioactive material do not appear in the ESFDR because it is anticipated that radioactive waste will not be used during the ESF testing. These are identified as (I-1) under the DAA number.

2. Similarly, the 10 CFR 60 requirements for structures systems and components that protect the public's radiological health and safety do not appear in the ESFDR because such structures would not be needed where there is no radioactive material. These are identified as (I-2) under the DAA number.

3. The administrative requirements of 10 CFR 60 do not appear in the ESFDR because they are covered elsewhere and are irrelevant to the ESF design. These are identified as (I-3) under the DAA number.

4. There are 10 CFR 60 requirements that do not appear in the ESFDR simply because they cannot be evaluated or implemented at this time. These are identified as (I-4) under the DAA number.

5. Finally, the ESFDR has been revised to eliminate all requirements applicable to actual performance confirmation program because these belong in the SCPB. These are identified as (I-5) in the DAA number.

Additionally, there are some DAA requirements pertaining to underground testing that do not appear in the ESFDR Volume 1 but will be incorporated in the test plan reference Appendix B in ESFDR Volume 2. These are identified as (TP) under the DAA number.

 YMP CC-0013, Rev. 5 31 91

The criteria list is arranged in a structured fashion that is based upon a four element reference code, that contains information about the specific NRC concern (first element), 10 CFR 60 requirement (second element), ESF physical system (third element), and criterion (fourth element).

The specific requirements of 10 CFR 60 that are addressed by the criteria list are different for each NRC concern. The requirements that are relevant to each concern are indicated on the attached correlation matrix. Within the reference code, the specific requirements of 10 CFR 60 relevant to each of the NRC concerns are assigned a sequential number for each of the NRC concerns.

The third element of the code is based on the nine fourth-level elements of the ESF Physical System Description. These elements are:

1. ESF SITE
2. SURFACE UTILITIES
3. SURFACE FACILITIES
4. SHAFT ACCESS
5. RAMP ACCESS
6. UNDERGROUND EXCAVATIONS
7. UNDERGROUND SUPPORT SYSTEMS
8. UNDERGROUND TEST SUPPORT
9. ESF DECOMMISSIONING AND CLOSURE

The fourth element of the code is a sequential numbering of the criteria for each specific entry number under an ESF Physical System Element.

 YMP CC-0013, Rev. 5 31 91

NRC CONCERN NO: 1

The ESF design, construction, and operations should not compromise the ability of the site to isolate waste.

 YMP CC-0013, Rev. 5/31/91

1.1 Requirement 60.15(d)(1): Investigations to obtain the required information shall be conducted in such a manner as to limit adverse effects on the long term performance of the geologic repository to the extent practicable. *

1.1.1 Site

1.1.1.1 (1.2.6.1CA) The design of the main pad shall incorporate aspects specifically directed at limiting the potential for adverse impacts on the long term performance of the repository, and construction and operation of the main pad shall be performed in a manner that limits the potential for adverse impacts on the long term performance of the repository.

1.1.2 Surface Utilities

1.1.2.1 (1.2.6.2CA) The design of the surface utilities, including the waste water ponds and water handling system, shall incorporate aspects specifically directed at limiting the potential for adverse impacts on the long term performance of the repository, and construction and operation of the surface utilities shall be performed in a manner that limits the potential for adverse impacts on the long term performance of the repository.

1.1.4 First shaft

1.1.4.1 (1.2.6.4PC2a.i) The design of the first shaft shall incorporate aspects specifically directed at limiting the potential for adverse impacts on the long term performance of the repository, and construction and operation of the first shaft shall be performed in a manner that limits the potential for adverse impacts on the long term performance of the repository.

1.1.5 Second shaft

1.1.5.1 (1.2.6.5PC2a.i) The design of the second shaft shall incorporate aspects specifically directed at limiting the potential for adverse impacts on the long term performance of the repository, and construction and operation of the second shaft shall be performed in a manner that limits the potential for adverse impacts on the long term performance of the repository.

1.1.6 Underground excavation

1.1.6.1 (1.2.6.6PC2a.i) The design of the underground excavation shall incorporate aspects specifically directed at limiting the potential for adverse impacts on the long term performance of the repository, and construction and operation of the underground excavation shall be performed in a manner that limits the potential for

adverse impacts of the long term performance of the repository.

1.1.7 Underground utilities

1.1.7.1 (1.2.6.7CB.i) The design of the underground utilities shall incorporate aspects specifically directed at limiting the potential for adverse impacts on the long term performance of the repository, and construction and operation of the underground utilities shall be performed in a manner that limits the potential for adverse impacts on the long term performance of the repository.

1.1.8 Underground testing

1.1.8.1 (TP) The design of the underground testing program shall incorporate aspects specifically directed at limiting the potential for adverse impacts on the long term performance of the repository, and implementation and operation of the underground testing program shall be performed in a manner that limits the potential for adverse impacts on the long term performance of the repository.

1.1.8.2 (TP) Prior to implementing the underground testing program, or prior to implementing additional tests, an evaluation of the potential impacts of such testing on the waste isolation capability of the site shall be performed.

1.1.9 Decommissioning

1.1.9.1 (I-2) The first shaft, second shaft, all underground excavations, and all boreholes shall be constructed to allow backfilling and sealing as necessary to limit the release of radioactive material to the environment.

----

* The approach adopted for evaluation of the adequacy of this 10 CFR Part 60 Requirement involves consideration of criteria developed under other 10 CFR Part 60 Requirements. Rather than listing each of those criteria here, a matrix indicating those criteria that were considered in the evaluation of this 10 CFR Part 60 Requirement is presented in the Figure Appended to this Document.

1.2 Requirement: 60.15(d)(3) To the extent practical, exploratory boreholes and shafts in the geologic repository operations area shall be located where shafts are planned for underground facility construction and operation or where large unexcavated pillars are planned.

1.2.4 First shaft

1.2.4.1 (1.2.6.0PC2c.v) The shaft pillar is the buffer zone surrounding the shaft beyond which any instability of other underground openings has a negligible effect on shaft stability. Within the shaft pillar area, all facilities and openings shall be designed to be stable for a 100 year life and to limit any adverse effects on the stability of the shafts that could impact the ability of the site to isolate waste.

1.2.4.2 (1.2.6.4PC2b.i) The exploratory shafts shall be located, to the extent practicable, where shafts are planned for the repository facility.

1.2.5 Second shaft

1.2.5.1 (1.2.6.0PC2c.v) The shaft pillar is the buffer zone surrounding the shaft beyond which any instability of other underground openings has a negligible effect on shaft stability. Within the shaft pillar area, all facilities and openings shall be designed to be stable for a 100 year life and to limit any adverse effects on the stability of the shafts that could impact the ability of the site to isolate waste.

1.2.5.2 (1.2.6.5PC2b.i) The exploratory shafts shall be located, to the extent practicable, where shafts are planned for the repository facility.

1.2.6 Underground excavation

1.2.6.1 (1.2.6.6PC2b.i) Exploratory boreholes shall be located so that they do not intersect any underground openings.

1.2.6.2 (1.2.6.6PC2b.ii) For sealing purposes, exploratory boreholes shall be located a minimum distance of 15 m from any underground opening.

1.2.6.3 (1.2.6.6PC2b.iii.c) Borehole alignments and location shall be monitored, surveyed, and the results included on all underground working maps.

 YMP CC-0013, Rev. 5/31/91

1.2.8 Underground testing

1.2.8.1 (1.2.6.8CD.i) MPBH boreholes shall be located in pillars to the extent practicable.

1.2.8.2 (1.2.6.8CD.iii) Boreholes drilled from the underground portion of the ESF shall not penetrate significantly below the base of the TsW2 host rock, unless the impacts of doing so, on the waste isolation performance of the site, have been evaluated and found to be acceptable.

1.3 Requirement: 60.21(c)(1)(ii)(D). The assessment shall contain - The effectiveness of engineered and natural barriers, including barriers that may not be themselves a part of the geologic repository operations area, against the release of radioactive material to the environment. The analysis shall also include a comparative evaluation of alternatives to the major design features that are important to waste isolation, with particular attention to the alternatives that would provide longer radionuclide containment and isolation.

1.3.4 First shaft

(I-2) 1.3.4.1 The exploratory shaft locations should be selected, consistent with other goals of site characterization, to limit impacts on isolation.

(I-2) 1.3.4.2 The exploratory shaft ground support system should be selected, consistent with other goals of site characterization, to limit impacts on isolation. If the support system is determined to be important to waste isolation a comparative evaluation of alternatives shall be performed.

(I-2) 1.3.4.3 The exploratory shaft diameter should be selected, consistent with other goals of site characterization, to limit impacts on isolation. If the diameter is determined to be important to waste isolation a comparative evaluation of alternatives shall be performed.

(I-2) 1.3.4.4 The exploratory shaft liner should be designed, consistent with other goals of site characterization, to limit impacts on isolation. If the liner is determined to be important to waste isolation a comparative evaluation of alternatives shall be performed.

(I-2) 1.3.4.5 The exploratory shaft operational seals should be designed, consistent with other goals of site characterization, to limit impacts on isolation. If the seals are determined to be important to waste isolation a comparative evaluation of alternatives shall be performed.

1.3.5 Second shaft

(I-2) 1.3.5.1 The exploratory shaft locations should be selected, consistent with other goals of site characterization, to limit impacts on isolation.

(I-2) 1.3.5.2 The exploratory shaft ground support system should be selected, consistent with other goals of site characterization, to limit impacts on isolation. If the support system is determined to be important to waste isolation a comparative evaluation of alternatives shall be performed.

(I-2) 1.3.5.3 The exploratory shaft diameter should be selected, consistent with other goals of site characterization, to limit impacts on isolation. If the diameter is determined to be important to waste isolation a comparative evaluation of alternatives shall be performed.

(I-2) 1.3.5.4 The exploratory shaft liner should be designed, consistent with other goals of site characterization, to limit impacts on isolation. If the liner is determined to be important to waste isolation a comparative evaluation of alternatives shall be performed.

(I-2) 1.3.5.5 The exploratory shaft operational seals should be designed, consistent with other goals of site characterization, to limit impacts on isolation. If the seals are determined to be important to waste isolation a comparative evaluation of alternatives shall be performed.

1.3.6 Underground excavation

(I-2) 1.3.6.1 The Exploratory Shaft Underground Facility layout, including drift size, should be designed, consistent with other goals of site characterization, to limit impacts on isolation. If the layout is determined to be important to waste isolation a comparative evaluation of alternatives shall be performed.

(I-2) 1.3.6.2 The Exploratory Shaft Underground Facility support system should be designed, consistent with the other goals of site characterization, to limit the impacts on isolation. If the support system is determined to be important to waste isolation a comparative evaluation of alternatives shall be performed.

(I-2) 1.3.6.3 The Exploratory Shaft Underground Facility operational seals should be designed, consistent with other goals of site characterization, to limit impacts on isolation. If the seals are determined to be important to waste isolation a comparative evaluation of alternatives shall be performed.

 YMP CC-0013, Rev. 5 31 91

1.4 Requirement: 60.21(c)(11). The Safety Analysis Report shall include: A description of design consideration that are intended to facilitate permanent closure and decontamination or dismantlement of surface facilities.

1.4.1 Site

1.4.1.1 (1.2.6.1CB) The pad shall be designed to permit the ground to be restored to a contour compatible with its initial conditions.

1.4.4 First shaft

1.4.4.1 (1.2.6.4.2CD) The shaft liner shall be designed to be removable prior to permanent closure.

1.4.4.2 (1.2.6.4PC2k.ii) To prevent complications of seal evaluations and emplacement and limit chemical alteration in future seal environments, no pressure grouting shall take place during the construction period of the shaft at locations of potential seal testing or emplacement. Specifically, no pressure grouting shall be performed within 50 feet of the original ground surface and within 50 feet (above and below) the contact of the Pah Canyon and Topopah Spring tuffs.

1.4.4.3 (1.2.6.4.4CC) Furnishings in the shafts shall be designed to be removable, if necessary, prior to permanent closure.

1.4.5 Second shaft

1.4.5.1 (1.2.6.5.2CC) Shaft liners shall be designed to be removable prior to permanent closure.

1.4.5.2 (1.2.6.5PC2k.ii) To prevent complications of seal evaluations and emplacement and limit chemical alteration in future seal environments, no pressure grouting shall take place during the construction period of the shaft at locations of potential seal testing or emplacement. Specifically, no pressure grouting shall be performed within 50 feet of the original ground surface and within 50 feet (above and below) the contact of the Pah Canyon and Topopah Spring tuffs.

1.4.5.3 (1.2.6.5.4CC) Furnishings in the shafts shall be designed to be removable, if necessary, prior to permanent closure.

1.4.6 Underground excavation

1.4.6.1 (1.2.6.6PC2h.ii) The drainage plan for the ESF and long exploratory drifts should be consistent with postclosure sealing concerns.

1.4.6.2 (1.2.6.7CH) Nonpermanent components in the underground openings shall be designed to be removable, if necessary, prior to permanent closure.

YMP CC-0013, Rev. 5/31/91

1.4.9 Decommissioning

(I-2) 1.4.9.1 The first shaft, second shaft, all underground excavations, and all boreholes shall be constructed to allow backfilling and sealing as necessary to limit the release of radioactive material to the environment.

YMP CC-0013, Rev. 5-31-91

1.5 Requirement: 60.74 (a) DOE shall perform, or permit the Commission to perform, such tests as the Commission deems appropriate or necessary for the administration of the regulations in this part. These may include tests of: (1) Radioactive waste, (2) the geologic repository including its structures, systems, and components, (3) radiation detection and monitoring instruments, and (4) other equipment and devices used in connection with the receipt, handling, or storage of radioactive waste. (b) The tests required under this section shall include a performance confirmation program carried out in accordance with Subpart F of this part.

1.5.8 Underground testing

(TP) 1.5.8.1 The testing program and underground layout shall be designed with sufficient flexibility that tests that are deemed appropriate by the NRC can be performed. Prior to incorporating such tests, an evaluation of potential impacts on waste isolation shall be performed.

(TP) 1.5.8.2 Performance confirmation testing shall be carried out to meet the requirements of 10 CFR 60, Subpart F. Prior to incorporating such tests, an evaluation of potential impacts on waste isolation shall be performed.

1.6 Requirement: 60.112 The geologic setting shall be selected and the engineered barrier system and the shafts, boreholes and their seals shall be designed to assure that releases of radioactive materials to the accessible environment following permanent closure conform to such generally applicable environmental standards for radioactivity as may have been established by the Environmental Protection Agency with respect to both anticipated processes and events and unanticipated processes and events. *

1.6.1 Site

1.6.1.1 (1.2.6.1CC.iii) The Exploratory Shaft Facility pad shall be designed and constructed so that it does not lead to creation of pathways that compromise the repository's capability to meet the performance objective of 10 CFR Part 60.112.

1.6.2 Surface Utilities

1.6.2.1 (1.2.6.2CF) The surface utilities shall be designed and constructed so that they do not affect the capability of the repository to meet the Performance Objective of 10 CFR 60.112.

1.6.4 First shaft

1.6.4.1 (I-4) The shaft opening shall be designed and constructed so that, following permanent closure, it does not become a pathway that compromises the repository's ability to meet the performance objectives of 10 CFR Part 60.112.

1.6.5 Second shaft

1.6.5.1 (I-4) The shaft opening shall be designed and constructed so that, following permanent closure, it does not become a pathway that compromises the repository's ability to meet the performance objectives of 10 CFR Part 60.112.

1.6.6 Underground excavation

1.6.6.1 (I-4) **The Exploratory Shaft Facility underground excavation shall be designed and constructed so that, following permanent closure, it does not become a pathway that compromises the repository's ability to meet the performance objective of 10 CFR Part 60.112.**

1.6.7 **Underground Utilities**

1.6.7.1 (I-4) **The underground utilities shall be designed and constructed so that they do not affect the capability of the repository to meet the Performance Objective of 10 CFR 60.112.**

YMP CC-0013, Rev. 5-31-91

1.6.8 Underground testing

(TP) 1.6.8.1 The testing program shall not affect the capability of the underground repository to meet the performance objective of 10 CFR 60.112.

(TP) 1.6.8.2 Borehole openings shall be designed so that, following permanent closure, they do not become pathways that compromise the repository's ability to meet the performance objectives of 10 CFR Part 60.112.

1.6.9 Decommissioning

(I-4) 1.6.9.1 The first shaft, second shaft, all underground excavations, and all boreholes shall be constructed to allow backfilling and sealing as necessary to limit the release of radioactive material to the environment.

----

* The approach adopted for evaluation of the adequacy of this 10 CFR Part 60 Requirement involves consideration of criteria developed under other 10 CFR Part 60 Requirements. Rather than listing each of those criteria here, a matrix indicating those criteria that were considered in the evaluation of this 10 CFR Part 60 Requirement is presented in the Figure Appended to this Document.

1.7 Requirement 60.113(a)(1)(i): The engineered barrier system shall be designed so that, assuming anticipated processes and events: (A) Containment of HLW will be substantially complete during the period when radiation and thermal conditions in the engineered barrier system are dominated by fission product decay; and (B) any release of radionuclides from the engineered barrier system shall be a gradual process which results in small fractional releases to the geologic setting over long times.

1.7.6 Underground excavation

(I-4) 1.7.6.1 The underground excavation shall be designed to assist or not detract from the capability of the repository to ensure substantially complete containment and a release of radionuclides that is a gradual process after the containment period, and construction and operation of the underground excavation shall be performed in a manner designed to assist or not detract from the capability of the repository to ensure substantially complete containment and a release of radionuclides that is a gradual process after the containment period.

1.7.7 Underground utilities

(I-4) 1.7.7.1 The underground utilities shall be designed to assist or not detract from the capability of the repository to ensure substantially complete containment and a release of radionuclides that is a gradual process after the containment period, and construction of the underground utilities shall be performed in a manner designed to assist or not detract from the capability of the repository to ensure substantially complete containment and a release of radionuclides that is a gradual process after the containment period.

1.7.8 Underground testing

(TP) 1.7.8.1 The underground testing program shall be designed to assist or not detract from the capability of the repository to ensure substantially complete containment and a release of radionuclides that is a gradual process after the containment period, and construction and operation of the underground testing program shall be performed in a manner designed to assist or not detract from the capability of the repository to ensure substantially complete containment and a release of radionuclides that is a gradual process after the containment period.

YMP CC-0013, Rev. 5/31/91

1.8 Requirement 60.113(a)(1)(ii)(A): Containment of HLW within the waste packages will be substantially complete for a period determined by the commission taking into account the factors specified in 60.113 (b) provided that such period shall not be less than 300 years nor more than 1000 years after the permanent closure of the repository. *

1.8.6 Underground excavation

(I-4) 1.8.6.1 The underground excavation shall be designed to assist or not detract from the capability of the repository to ensure substantially complete containment for a period not less than 300 years nor more than 1000 years after the permanent closure of the repository, and construction and operation of the underground excavation shall be performed in a manner designed to assist or not detract from the capability of the repository to ensure substantially complete containment for a period not less than 300 years nor more than 1000 years after the permanent closure of the repository.

1.8.7 Underground utilities

(I-4) 1.8.7.1 The underground utilities shall be designed to assist or not detract from the capability of the repository to ensure substantially complete containment for a period not less than 300 years nor more than 1000 years after the permanent closure of the repository, and construction of the underground utilities shall be performed in a manner intended to assist or not detract from the capability of the repository to ensure substantially complete containment for a period not less than 300 years nor more than 1000 years after the permanent closure of the repository.

1.8.8 Underground testing

(TP) 1.8.8.1 The underground testing program shall be designed to assist or not detract from the capability of the repository to ensure substantially complete containment for a period not less than 300 years nor more than 1000 years after the permanent closure of the repository, and implementation and operation of the underground testing program shall be performed in a manner designed to assist or not detract from the capability of the repository to ensure substantially complete containment for a period not less than 300 years nor more than 1000 years after the permanent closure of the repository.

* The approach adopted for evaluation of the adequacy of this 10 CFR Part 60 Requirement involves consideration of criteria developed under other 10 CFR Part 60 Requirements. Rather than listing each of those criteria here, a matrix indicating those criteria that were considered in the evaluation of this 10 CFR Part 60 Requirement is presented in the Figure Appended to this Document.

YMP CC-0013, Rev. 5/31/91

1.9 Requirement 60.113(a)(1)(ii)(B): The release rate of any radionuclide from the engineered barrier system following the containment period shall not exceed one part in 100,000 per year of the inventory of that radionuclide calculated to be present at 1000 years following permanent closure. *

1.9.6 Underground excavation

(I-4) 1.9.6.1 The underground excavation shall be designed to assist or not detract from the capability of the repository to ensure that the release of radionuclides does not exceed a rate of one part in 100,000 per year of the inventory of radionuclides calculated to be present at 1000 years following permanent closure, and construction and operation of the underground excavation shall be performed in a manner designed to assist or not detract from the capability of the repository to ensure that the release of radionuclides does not exceed a rate of one part in 100,000 per year of the inventory of radionuclides calculated to be present at 1000 years following permanent closure.

1.9.7 Underground utilities

(I-4) 1.9.7.1 The underground utilities shall be designed to assist or not detract from the capability of the repository to ensure that the release of radionuclides does not exceed a rate of one part in 100,000 per year of the inventory of radionuclides calculated to be present at 1000 years following permanent closure, and construction of the underground utilities shall be performed in a manner designed to assist or not detract from the capability of the repository to ensure that the release of radionuclides does not exceed a rate of one part in 100,000 per year of the inventory of radionuclides calculated to be present at 1000 years following permanent closure.

1.9.8 Underground testing

(TP) 1.9.8.1 The underground testing program shall be designed to assist or not detract from the capability of the repository to ensure that the release of radionuclides does not exceed a rate of one part in 100,000 per year of the inventory of radionuclides calculated to be present at 1000 years following permanent closure, and construction and operation of the underground excavation

* The approach adopted for evaluation of the adequacy of this 10 CFR Part 60 Requirement involves consideration of criteria developed under other 10 CFR Part 60 Requirements. Rather than listing each of those criteria here, a matrix indicating those criteria that were considered in the evaluation of this 10 CFR Part 60 Requirement is presented in the Figure Appended to this Document.

YMP CC-0013, Rev. 5 31 91

shall be performed in a manner designed to assist or not detract from the capability of the repository to ensure that the release of radionuclides does not exceed a rate of one part in 100,000 per year of the inventory of radionuclides calculated to be present at 1000 years following permanent closure.

 YMP-CC-0013, Rev. 5-31-91

1.10 Requirement: 60.130: Sections 60.131 through 60.134 specify minimum criteria for the design of the geologic repository operations area. These design criteria are not intended to be exhaustive, however. Omissions in §§ 60.131 through 60.134 do not relieve DOE from any obligation to provide such safety features in a specific facility needed to achieve the performance objectives. All design bases must be consistent with the results of site characterization activities.

1.10.1 Site

1.10.1.1 (1.2.6.1CE) Pad operation and construction should limit adverse chemical changes by controlling the use of hydrocarbons, solvents, and chemicals.

1.10.4 First shaft

1.10.4.1 (1.2.6.4PC2a.ii) (1.2.6.4PC2a.iii) Shaft operation and construction should limit adverse chemical changes (type, quantity and location) particularly to pH and organic content of ground water, by controlling the use of hydrocarbons, solvents, and chemicals.

1.10.4.2 (1.2.6.4PC2a.ii.a) (1.2.6.4PC2a.ii.b) The usage of cement, shotcrete, and grout for bolt anchors or other rock mass support for shaft construction and operations should not exceed requirements for proper construction or safety considerations.

1.10.4.3 (1.2.6.4PC2a.ii) The chemistry of any water used in shaft construction, or operation should be compatible with postclosure requirements to isolate and contain waste.

1.10.4.4 (1.2.6.4PC2a.ii.c) Fluids and materials planned for use in the shaft shall be evaluated with respect to intended use for possible effects on the capability of the site to isolate waste, and appropriate controls instituted.

1.10.4.5 (1.2.6.4PC2a.iv) A materials control program should be implemented to enable establishment of limits on the inventory of materials left after decommissioning.

1.10.4.6 (1.2.6.4.2CD) The capability to enhance postclosure performance by removing shaft liners shall be retained.

1.10.4.7 (1.2.6.4PC2a.v) The shaft shall be designed with construction controls that enable flexibility in closure, such as the location of seals, so that a seismic event is unlikely to compromise the ability of the facility to isolate wastes.

YMP CC-0013, Rev. 5/31/91

1.10.4.8 (1.2.6.4PC2a.ii) Construction and operations should be executed in a manner that contributes to or does not detract from isolation capability of the site; for example by limiting organics in drilling fluids, construction materials, and explosive residues from blasting.

1.10.5 Second shaft

1.10.5.1 (1.2.6.5PC2a.ii) (1.2.6.5PC2a.iii) Shaft operation and construction should limit adverse chemical changes (type, quantity and location) particularly to pH and organic content of ground water, by controlling the use of hydrocarbons, solvents, and chemicals.

1.10.5.2 (1.2.6.5PC2a.ii.a) (1.2.6.5PC2a.ii.b) The usage of cement, shotcrete, and grout for bolt anchors or other rock mass support shaft construction and operations should not exceed requirements for proper construction or safety considerations.

1.10.5.3 (1.2.6.5PC2a.ii) The chemistry of any water used in shaft construction, or operation should be compatible with postclosure requirements to isolate and contain waste.

1.10.5.4 (1.2.6.5PC2a.ii.c) Fluids and materials planned for use in the shaft shall be evaluated with respect to intended use for possible effects on the capability of the site to isolate waste, and appropriate controls instituted.

1.10.5.5 (1.2.6.5PC2a.iv) A materials control program should be implemented to enable establishment of limits on the inventory of materials left after decommissioning.

1.10.5.6 (1.2.6.5.2CC) The capability to enhance postclosure performance by removing shaft liners shall be retained.

1.10.5.7 (1.2.6.5PC2a.v) The shaft shall be designed with construction controls that enable flexibility in closure, such as the location of seals, so that a seismic event is unlikely to compromise the ability of the facility to isolate wastes.

1.10.5.8 (1.2.6.5PC2a.ii) Construction and operations should be executed in a manner that contributes to or does not detract from isolation capability of the site; for example by limiting organics in drilling fluids, construction materials, and explosive residues from blasting.

1.10.6 Underground excavation

1.10.6.1 (1.2.6.6PC2c.i) The ESF shall be designed with a minimum distance of 75 feet between the centerlines of the adjacent ESF and waste emplacement drifts.

YMP CC-0013, Rev. 5 31 91

1.10.6.2 (1.2.6.6PC2a.ii) Underground facility operation and construction should limit adverse chemical changes (type, quantity and location) particularly to pH and organic content of ground water, by controlling the use of hydrocarbons, solvents, and chemicals.

1.10.6.3 (1.2.6.6PC2a.ii.a) (1.2.6.6PC2a.ii.b) Underground facility construction and operation should limit cement, shotcrete, and grout for bolt anchors or other rock mass support to that required for proper construction.

1.10.6.4 (1.2.6.6PC2a.ii) The chemistry of any water used in underground excavation construction or operation should be compatible with postclosure requirements to isolate and contain waste.

1.10.6.5 (1.2.6.6PC2a.ii.c) Fluids and materials planned for use in the underground excavation shall be evaluated with respect to intended use for possible effects on the capability of the site to isolate waste, and appropriate controls instituted.

1.10.6.6 (1.2.6.6PC2a.iii) A materials control program should be implemented to enable establishment of limits on the inventory of materials left after decommissioning.

1.10.6.7 (1.2.6.6PC2a.iv) The underground excavation shall be designed with construction controls that permit flexibility in closure, such as the location of seals, so that a seismic event is unlikely to compromise the ability of the facility to isolate wastes.

1.10.6.8 (1.2.6.6PC2a.ii) Construction and operations should be executed in a manner that contributes to or does not detract from isolation capability of the site; for example by limiting organics in drilling fluids, construction materials, and explosive residues from blasting.

1.10.7 Underground utilities

1.10.7.1 (1.2.6.7CD.i) Utility systems, including the water distribution and mine wastewater collection systems, shall be designed so that, in the event of seismic activity, the ability of the facility to isolate waste will not be compromised.

1.10.8 Underground testing

1.10.8.1 (1.2.6.8CE.i) Fluids and materials planned for use in the shaft shall be evaluated with respect to intended use for possible effects on the capability of the site to isolate waste, and appropriate controls instituted.

YMP CC-0013, Rev. 5/31/91

(TP) 1.10.8.2 The testing program should limit adverse chemical changes (type, quantity and location) particularly to pH and organic content of ground water, by controlling the use of hydrocarbons, solvents, and chemicals.

(TP) 1.10.8.3 The testing program should be executed in a manner that contributes to or does not detract from the isolation capability of the site; for example, by limiting organics in drilling fluids and explosive residues from blasting.

(TP) 1.10.8.4 The chemistry of any water used in the testing program should be compatible with isolation and containment objectives.

 YMP CC-0013, Rev. 5 31.91

1.11 Requirement: 60.133(a)(1) The orientation, geometry, layout, and depth of the underground facility, and the design of any engineered barriers that are part of the underground facility shall contribute to the containment and isolation of radionuclides.

1.11.4 First shaft

1.11.4.1 (1.2.6.4PC2d.iii) The shaft configuration (shaft location, shaft diameter, shaft separation, and shaft depth) should contribute to or not detract from the isolation capability of the site.

1.11.5 Second shaft

1.11.5.1 (1.2.6.5PC2d.iii) The shaft configuration (shaft location, shaft diameter, shaft separation, and shaft depth) should contribute to or not detract from the isolation capability of the site.

1.11.6 Underground excavation

1.11.6.1 (1.2.6.6PC2e.v) The underground facility configuration (drift location, orientation, geometry, and drift sizes) should contribute to or not detract from the capability of the site to isolate and contain waste.

1.11.6.2 (1.2.6.6PC2e.i) Overburden above the potential repository horizon must be > 200m.

1.11.6.3 (1.2.6.6PC1a.ii) If possible, confine Main Test Level facility to TsW2, although TsW1 can be considered.

1.11.6.4 (1.2.6.6PC2c.i) Location of underground facility should stay within the conceptual perimeter drift boundary, except as needed to characterize areas outside that boundary, taking into account any potential impacts on the waste isolation capabilities of the site.

1.11.6.5 (1.2.6.6PC2b.ii) The distance of underground facility openings from exploratory boreholes drilled from the surface should be at least 15m.

1.11.6.6 (1.2.6.6PC2e.ii) The spacing between adjacent ESF drifts shall be a minimum of two drift diameters (using the maximum diameter of either opening, and considering the closest proximity of any part of each opening).

1.11.6.7 (1.2.6.6PC1b.i) The number of interconnections between the dedicated test area and the repository should be limited to as few as possible, consistent with access and ventilation needs.

YMP CC-0013, Rev. 5 31 91

1.11.6.8 (1.2.6.6PC2h.ii) The drainage plan for the ESF and long exploratory drifts should be consistent with repository operations and postclosure sealing concerns. Specifically, drainage in the dedicated test area should be toward ES-1 and drainage in long drifts should be compatible with repository grades.

1.12 Requirement: 60.133(a)(2) The underground facility shall be designed so that the effects of credible disruptive events during the period of operations, such as flooding, fires and explosions, will not spread through the facility.

1.12.1 Site

1.12.1.1 (1.2.6.1PC1b) The areas around the shaft collar shall be designed and constructed to prevent water inflow from the probable maximum flood.

1.12.2 Surface Utilities

1.12.2.1 (1.2.6.2CC) Water storage tanks should be located, or protection provided to preclude water inflow to ESF following a possible tank failure.

1.12.2.2 (1.2.6.2CD) Piping shall be designed to preclude or limit possible water inflow to the ESF following a pipe rupture.

1.12.4 First shaft

1.12.4.1 (1.2.6.4PC2e.i) The exploratory shaft shall be designed so that the effects of credible disruptive events (e.g., flooding, fires, and explosions) shall be limited from spreading through the facility.

1.12.5 Second shaft

1.12.5.1 (1.2.6.5PC2e.i) The exploratory shaft shall be designed so that the effects of credible disruptive events (e.g., flooding, fires, and explosions) shall be limited from spreading through the facility.

1.12.6 Underground excavation

1.12.6.1 (1.2.6.6PC2f.i) The Exploratory Shaft Underground Facility shall be designed so that the effects of credible disruptive events (e.g., flooding, fires, and explosions) shall be limited from spreading through the facility.

1.12.6.2 (1.2.6.6PC2f.iv) The drainage plan for the ESF and long exploratory drifts should be designed to ensure that the effects of flooding shall be limited from spreading through the facility.

1.12.6.3 (1.2.6.6PC2f.ii) Materials should be selected such that effects of fire do not produce geochemical effects that impact waste isolation capabilities of the site.

1.12.6.4 (1.2.6.6PC2f.iii) The underground facility should be designed to limit any spread of fire, which could produce geochemical effects that impact waste isolation capabilities of the site.

 YMP CC-0013, Rev. 5/31/91

1.12.6.5 (1.2.6.6PC2h.vii) Operational seals shall be provided where necessary to control the spread of water through the facility.

1.12.7 Underground utilities

1.12.7.1 (1.2.6.7CJ) Water lines in ESF should be outfitted to limit water inflow to ESF following a possible line rupture.

1.12.7.2 (1.2.6.7.6PC1b.v) Effective redundant minewater discharge systems should be provided to limit possible impacts on the isolation capability of the site.

1.12.7.3 (1.2.6.7.8CA) Fire suppression agents shall be selected such that they do not produce geochemical effects that adversely impact waste isolation capabilities of the site.

YMP CC-0013, Rev. 5 31 91

1.13 Requirement: 60.133(b) The underground facility shall be designed with sufficient flexibility to allow adjustments where necessary to accommodate specific site conditions identified through in situ monitoring, testing, or excavation.

1.13.6 Underground excavation

1.13.6.1 (1.2.6.6PC2g.ii) The ESF should be designed so as not to interfere with the flexibility of the repository to accommodate specific site conditions.

1.13.6.2 (1.2.6.6PC1b.i) The number of interconnections between the dedicated test area and the repository should be limited to as few as practicable.

1.13.6.3 (1.2.6.6PC1b.ii) The area of the ESF underground excavations shall be limited to that necessary for conducting the needed site characterization and performance confirmation tests.

YMP CC-0013, Rev. 5/31/91

1.14 Requirement: 60.133(d) The design of the underground facility shall provide for control of water or gas intrusion.

1.14.1 Site

(1.2.6.1CF.i)	1.14.1.1	The amount of water used in construction, and operations, of the main pad should be limited so as to limit the effects on the containment and isolation capability of the site.
Deleted	1.14.1.2	Water use in pad construction shall not adversely impact goals to limit the average saturation of the repository horizon to <75% and limit the local saturation to 90%.
(1.2.6.1CF.ii)	1.14.1.3	Construction of the main pad shall be performed in a manner to avoid blockage of natural surface water drainageways and avoid creation of surface water impoundments that could impact post-closure performance.
(1.2.6.1CF.iii)	1.14.1.4	MPBHs or other surface drilled exploratory boreholes associated with the ESF shall be drilled dry.
(1.2.6.1CF.iv)	1.14.1.5	MPBHs shall incorporate a standpipe or other measures appropriate and adequate for protection against the effects of maximum credible floods during the period when MPBHs are accessible prior to borehole plugging and sealing.
(1.2.6.1CF.i)	1.14.1.6	Construction water shall be limited to that required for dust control and proper equipment operation consistent with performance objectives.
(1.2.6.1CF.v)	1.14.1.7	Construction procedures shall enable removal of excess water.
(1.2.6.1CO)	1.14.1.8	Operating procedures shall be developed to ensure water entering the ESF is managed appropriately, including quantity, location, and water balance.

1.14.2 Surface Utilities

(1.2.6.2CE)	1.14.2.1	Fluids recovered from sanitary uses or during construction operations should be disposed of in such a way as to avoid potential for performance impacts, for example in lined ponds.

1.14.4 First Shaft

1.14.4.1 (1.2.6.4PC2g.i) The amount of water used in construction and operations, should be limited so as to limit the effects on the containment and isolation capability of the site.

1.14.4.2 (1.2.6.4PC2g.ii) Water use in shaft construction should be generally consistent with repository design goals to limit the average saturation of the repository horizon to <75% and limit the local saturation to <90% in waste emplacement areas.

1.14.4.3 (1.2.6.6PC2h.ii) The drainage plan for the ESF and long exploratory drifts should be consistent with repository operations and postclosure sealing concerns. Specifically, drainage in the dedicated test area should be toward ES-1, and drainage in long drifts should be compatible with repository grades.

1.14.4.4 (1.2.6.4PC1i.iii) The shafts should be separated to maintain reasonable distances for power and instrument cabling and water piping as well as to provide for redundancy in mine water discharge.

1.14.4.5 (1.2.6.4PC1d.ii) Appropriate gravity drainage and/or pumping systems shall be incorporated into the shaft and underground facilities for draining water away from testing and other working areas to suitable collections point(s) for further treatment and/or disposal.

1.14.4.6 (1.2.6.4PC2g.iii) Operating procedures shall be developed to ensure water entering the ESF is managed appropriately, including quantity, location, and water balance.

1.14.4.7 (1.2.6.4PC2g.i) Construction water shall be limited to that required for dust control and proper equipment operation.

1.14.4.8 (1.2.6.4PC1d.i) Construction procedures shall enable removal of excess water.

1.14.4.9 (1.2.6.4PC2g.iv) Operational seals shall be provided where necessary to control the intrusion of water into the facility.

1.14.5 Second shaft

1.14.5.1 (1.2.6.5PC2g.ii) The amount of water used in construction and operations, should be limited so as to limit the effects on the containment and isolation capability of the site.

 YMP CC-0013, Rev. 5/31/91

1.14.5.2 (1.2.6.5PC2g.iii) Water use in shaft construction should be generally consistent with repository design goals to limit the average saturation of the repository horizon to <75% and limit the local saturation to <90% in waste emplacement areas.

1.14.5.3 (1.2.6.5PC2g.i) The drainage plan for the ESF and long exploratory drifts should be consistent with repository operations and postclosure sealing concerns. Specifically, drainage in the dedicated test area should be toward ES-1 and drainage in long drifts should be compatible with repository grades.

1.14.5.4 (1.2.6.5PC1d.ii) Appropriate gravity drainage and/or pumping systems shall be incorporated into the shaft and underground facilities for draining water away from testing and other working areas to suitable collections point(s) for further treatment and/or disposal.

1.14.5.5 (1.2.6.5PC2g.iv) Operating procedures shall be developed to ensure water entering the ESF is managed appropriately, including quantity, location, and water balance.

1.14.5.6 (1.2.6.5PC2g.ii) Construction water shall be limited to that required for dust control and proper equipment operation consistent with performance goals.

1.14.5.7 (1.2.6.5PC1d.i) Construction procedures shall enable removal of excess water.

1.14.5.8 (1.2.6.5PC2g.v) Operational seals shall be provided where necessary to control the intrusion of water into the facility.

1.14.6 Underground excavation

1.14.6.1 (1.2.6.6PC2h.iv) The amount of water used in construction and operations, should be limited so as to limit the effects on the containment and isolation capability of the site.

1.14.6.2 (1.2.6.6PC2h.v) Water used in construction and operations should not adversely impact the repository design goals to limit the average saturation of the repository horizon to <75% and limit local saturation to <90% in areas of waste emplacement.

1.14.6.3 (1.2.6.6PC2h.ii) The drainage plan for the ESF and long exploratory drifts should be consistent with repository operations and postclosure sealing concerns. Specifically, drainage in the dedicated test area should be toward ES-1 and drainage in long drifts should be compatible with repository grades.

YMP CC-0013, Rev. 5 31 91

1.14.6.4 (1.2.6.6PC2h.iv) Construction and operating water shall be limited to that required for dust control and proper equipment operation consistent with performance goals.

1.14.6.5 (1.2.6.6PC1d.iv) Construction procedure shall enable removal of excess water.

1.14.6.6 (1.2.6.6PC1d.v) Appropriate gravity drainage and/or pumping systems shall be incorporated into the shaft and underground facilities for draining water away from testing and other working areas to suitable collections point(s) for further treatment and/or disposal.

1.14.6.7 (1.2.6.6PC2h.vi) Operating procedures shall be developed to ensure water entering the ESF is managed appropriately, including quantity, location and water balance.

1.14.6.8 (1.2.6.6PC2h.vii) Operational seals shall be provided where necessary to control the intrusion of water into the facility.

1.14.7 Underground utilities

1.14.7.1 (1.2.6.7CF.i) Appropriate gravity drainage and/or pumping systems shall be incorporated into the shaft and underground facilities for draining water away from testing and other working areas to suitable collections point(s) for further treatment and/or disposal.

1.14.7.2 (1.2.6.7.6PC1b.i) The groundwater collection and control system shall be designed to include possible inflow from penetrations of fault structures during geologic drifting or from perched water horizons during shaft sinking and facility development,in addition to expected inflows.

1.14.7.3 (1.2.6.7.6PC1b.ii) The storage and pumping system shall be designed to provide the capacity to handle emergency situations such as unexpected inflow of water or water line breakage at a peak rate of 250 GPM, or a steady flow of 20 GPM.

1.14.8 Underground testing

1.14.8.1 (1.2.6.8CE.ii) The amount of water used in testing and operations, should be limited so as to limit the effects on the containment and isolation capability of the site.

1.14.8.2 (1.2.6.8CE.iii) Water use in testing should be generally consistent with repository design goals to limit the average saturation of the repository horizon to <75% and limit the local saturation to <90% in waste emplacement areas.

YMP CC-0013, Rev. 5 31 91

1.14.8.3 (1.2.6.8CE.iv) MPBHs or other surface drilled exploratory boreholes associated with the ESF shall be drilled dry.

1.14.8.4 (1.2.6.8CE.ii) Testing water should be limited to that required for dust control and proper test operation consistent with performance goals.

1.14.8.5 (1.2.6.8CE.vi) Testing procedures shall require removal of excess water.

1.14.8.6 (1.2.6.8CE.vii) Any cleaning of ESF walls to facilitate photogrammetry, mapping, or other testing shall be done using compressed air/mist using control procedures.

1.14.8.7 (1.2.6.8CE.viii) Test procedures must be developed to ensure water entering the ESF is managed appropriately, including quantity, location, and water balance.

1.14.8.8 (1.2.6.8CE.ix) Gaseous products used in characterization should not produce geochemical effects that impact waste isolation capabilities of site.

 YMP.CC-0013, Rev. 5/31/91

1.15 Requirements: 60.133(e)(2) Openings in the underground facility shall be designed to reduce the potential for deleterious rock movement or fracturing of overlying or surrounding rock.

1.15.4 First shaft

1.15.4.1 (1.2.6.4PC2i.ii) The shaft shall be designed to provide stability and to reduce the potential for deleterious rock movement or fracturing that may create a pathway for radionuclide migration.

1.15.4.2 (1.2.6.4PC2h.ii) An adequate distance between shafts should be provided to reduce potential mechanical interference between the two shafts.

1.15.5 Second shaft

1.15.5.1 (1.2.6.5PC2i.ii) The shaft should be designed to provide stability and to reduce the potential for deleterious rock movement or fracturing that may create a pathway for radionuclide migration.

1.15.5.2 (1.2.6.5PC2h.ii) An adequate distance between shafts should be provided to reduce potential mechanical interference between the two shafts.

1.15.6 Underground excavation

1.15.6.1 (1.2.6.6PC2j.ii) The underground excavation be designed to provide stability and to minimize the potential for deleterious rock movement or fracturing that may create a pathway for radionuclide migration.

1.15.6.2 (1.2.6.6PC2i.v) (1.2.6.6PC2j.ii) The design of underground openings and their supports shall utilize pillar and opening geometries that limit stress concentration to acceptable levels, so as to minimize the potential for deleterious rock movement or fracturing that may create a pathway for radionuclide migration.

1.15.6.3 (1.2.6.6PC2e.ii) The spacing between adjacent ESF drifts shall be a minimum of two drift diameters (using the maximum diameter of either opening, and considering the closest proximity of any part of each opening).

1.15.6.4 (1.2.6.6PC2c.ix) The ESF shall be designed to be consistent with the repository design goal to limit the extraction ratio to less than 30%.

 YMP CC-0013, Rev. 5.31.91

1.16 Requirement: 60.133(f) The design of the underground facility shall incorporate excavation methods that will limit the potential for creating a preferential pathway for groundwater to contact the waste packages or radionuclide migration to the accessible environment.

1.16.1 Site

1.16.1.1 (1.2.6.1CC.ii) Excavation techniques used for pad construction shall control overbreak of rock and limit disturbance to the integrity of the adjoining rock mass.

1.16.4 First shaft

1.16.4.1 (1.2.6.4PC2i.viii) The exploratory shaft construction method should be selected, consistent with other goals of site characterization, to limit impacts on isolation.

1.16.4.2 (1.2.6.4PC2i.i) Excavation techniques used for shaft and station construction shall control overbreak of rock and limit disturbance to the integrity of the adjoining rock mass.

1.16.4.3 (1.2.6.4PC2i.vi) Drill and blast specifications should include controls related to types and amounts of explosives, shot patterns, and hole depth in order to limit the magnitude and extent of blast-induced permeability.

1.16.4.4 (1.2.6.4PC2i.v.a) The excavation methods should be compatible with repository design goals to limit permeability changes beyond 3 m from the walls of the excavation to less than one order of magnitude.

1.16.5 Second shaft

1.16.5.1 (1.2.6.5PC2i.viii) The exploratory shaft construction method should be selected, consistent with other goals of site characterization, to limit impacts on isolation.

1.16.5.2 (1.2.6.5PC2i.i) Excavation techniques used for shaft and station construction shall control overbreak of rock and limit disturbance to the integrity of the adjoining rock mass.

1.16.5.3 (1.2.6.5PC2i.vi) Drill and blast specifications should include controls related to types and amounts of explosives, shot patterns, and hole depth in order to limit the magnitude and extent of blast-induced permeability.

1.16.5.4 (1.2.6.5PC2i.v.a) The excavation methods should be compatible with repository design goals to limit permeability changes beyond 3 m from the walls of the excavation to less than one order of magnitude.

YMP CC-0013, Rev. 5 31 91

1.16.6 Underground excavation

1.16.6.1 (1.2.6.6PC2j.i) Excavation techniques used for ESF construction shall control overbreak of rock and limit disturbance to the integrity of the adjoining rock mass.

1.16.6.2 (1.2.6.6PC2j.x) Drill and blast specifications shall include controls related to types and amounts of explosives, shot patterns, and hole depth in order to limit the magnitude and extent of blast-induced permeability.

YMP CC-0013, Rev. 5 31 91

1.17 Requirement: 60.133(h) Engineered barriers. Engineered barriers shall be designed to assist the geologic setting in meeting the performance objectives for the period following permanent closure.

1.17.4 First shaft

(I-2) 1.17.4.1 Engineered barriers in the shafts shall assist the geologic setting in limiting the release of radionuclides to the accessible environment.

1.17.5 Second shaft

(I-2) 1.17.5.1 Engineered barriers in the shafts shall assist the geologic setting in limiting the release of radionuclides to the accessible environment.

1.17.6 Underground excavation

(I-2) 1.17.6.1 The engineered barriers in the underground excavation must be designed such that other systems, structures, and components of the ESF and the candidate repository do not eventually become ground-water flow paths and do not promote the release of radionuclides to the accessible environment.

(I-2) 1.17.6.2 The engineered barriers in the underground excavation shall not preclude the repository from creating a waste package environment that favorably controls chemical reactions affecting waste package performance.

1.17.9 Decommissioning

(I-2) 1.17.9.1 The first shaft, second shaft, all underground excavations, and all boreholes shall be constructed to allow backfilling and sealing as necessary to limit the release of radioactive material to the environment.

YMP CC-0013, Rev. 5-31-91

1.18 Requirement: 60.133(i) The underground facility shall be designed so that the performance objectives will be met taking into account the predicted thermal and thermomechanical response of the host rock, and surrounding strata, groundwater system.

1.18.4 First shaft

1.18.4.1 (1.2.6.4PC2j.iii) The shaft liner shall withstand pressures exerted along its length and around the entire perimeter under anticipated conditions, including reaction to thermally induced stresses resulting from thermal loads.

1.18.5 Second shaft

1.18.5.1 (1.2.6.5PC2j.iii) The shaft liner shall withstand pressures exerted along its length and around the entire perimeter under anticipated conditions, including reaction to thermally induced stresses resulting from thermal loads.

1.18.6 Underground excavation

1.18.6.1 (1.2.6.6PC2k.i) The ESF shall be designed, taking into account the predicted thermal and thermomechanical response of the host rock and surrounding strata so that the performance objectives of the repository can be met.

1.18.6.2 (1.2.6.6PC2k.iii) The ESF shall be designed such that the thermal and thermomechanical effects of ESF operations and testing do not produce failure of intact rock, nor gross rock mass failure, along potential pathways from the repository to the accessible environment.

1.18.6.3 (1.2.6.6PC2k.iii) The ESF shall be designed so that the thermal and thermomechanical effects of ESF operations and testing on the groundwater system, do not significantly increase the saturation of the host rock in the waste emplacement area.

1.18.6.4 (1.2.6.6PC2k.iv) The underground excavation support system shall be designed to withstand pressures under anticipated conditions, including reaction to thermally induced stresses resulting from thermal loads.

1.18.8 Underground testing

1.18.8.1 (1.2.6.6PC2k.iii) The ESF shall be designed such that the thermal and thermomechanical effects of ESF testing does not produce failure of intact rock, nor gross rock mass failure, along potential pathways from the repository to the accessible environment.

YMP/CC-0013, Rev. 5 31 91

1.18.8.2 (1.2.6.6PC2k.iii) The ESF shall be designed so that the thermal and thermomechanical effects of ESF testing on the groundwater system, do not significantly increase the saturation of the host rock in the waste emplacement area.

1.18.8.3 (1.2.6.6PC2k.v) The ESF shall be designed so that the thermal effects of ESF testing do not result in temperatures in excess of 115°C in either the TsW3 or CHn units.

YMP CC-0013, Rev. 5 31 91

1.19 Requirement: 60.137 The geologic repository operations area shall be designed so as to permit implementation of a performance confirmation program that meets the requirements of Subpart F of this part.

1.19.6 Underground excavation

(1.2.6.6CB.i) 1.19.6.1 The underground excavations shall be designed to accommodate the performance confirmation tests required by 60.141 and 60.142, and taking into account any potentially adverse impacts these excavations could have on the waste isolation capabilities of the site.

1.19.8 Underground testing

(TP) 1.19.8.1 The testing program shall accommodate the performance confirmation tests required by 60.141 and 60.142, and taking into account any potentially adverse impacts these tests could have on the waste isolation capabilities of the site.

YMP CC-0013, Rev. 5 31 91

1.20 Requirement 60.140(d): The program shall be implemented so that: (1) it does not adversely affect the ability of the natural and engineered elements of the geologic repository to meet the performance objectives. *

1.20.8 Underground testing

(TP) 1.20.8.1 The design of the performance confirmation testing program shall incorporate aspects specifically directed at limiting the potential for adverse impacts on the long term performance of the repository, and implementation of the performance confirmation testing program and operation of the facility shall be performed in a manner that limits the potential for adverse impacts on the long term performance of the repository.

----

* The approach adopted for evaluation of the adequacy of this 10 CFR Part 60 Requirement involves consideration of criteria developed under other 10 CFR Part 60 Requirements. Rather than listing each of those criteria here, a matrix indicating those criteria that were considered in the evaluation of this 10 CFR Part 60 Requirement is presented in the Figure Appended to this Document.

YMP CC-0013, Rev. 5 31 91

NRC CONCERN NO: 2

The ESF design, construction, and operations should not compromise the ability to characterize the site.

2.1 Requirement: 60.74 (a) DOE shall perform, or permit the Commission to perform such tests as the Commission deems appropriate or necessary for the administration of the regulations in this part. These may include tests of: (1) Radioactive waste, (2) the geologic repository including its structures, systems, and components, (3) radiation detection and monitoring instruments, and (4) other equipment and devices used in connection with the receipt, handling, or storage of radioactive waste. (b) The tests required under this section shall include a performance confirmation program carried out in accordance with Subpart F of this part.

2.1.4 First shaft

(1.2.6.4CA.i) 2.1.4.1 The structures, systems, components and operation of the exploratory shafts shall be designed to accommodate additional tests that may be required by the NRC for site characterization and performance confirmation.

2.1.5 Second shaft

(1.2.6.5CA.i) 2.1.5.1 The structures, systems, components and operation of the exploratory shafts shall be designed to accommodate additional tests that may be required by the NRC for site characterization and performance confirmation.

2.1.6 Underground excavation

(1.2.6.6CA.i) 2.1.6.1 The dedicated test area should include adequate allowance for additional testing that may be required by the NRC.

(1.2.6.6CA.i) 2.1.6.2 The dedicated test area shall be designed to support such additional testing as may be required by the NRC without disruption of or interference with testing in progress or planned testing.

2.1.7 Underground Utilities

(1.2.6.7CC.i) 2.1.7.1 The structures, systems, components, and operation of the shaft breakouts and main test level of the ESF shall be designed to accommodate additional tests that may be required by the NRC for site characterization and performance confirmation.

2.1.8 Underground testing

(TP) 2.1.8.1 The underground test program shall be designed to accommodate the requirements of 10 CFR Part 60.74.

(TP) 2.1.8.2 The testing program shall be designed to be able to accommodate additional testing that may be deemed appropriate by the Commission.

YMP/CC-0013, Rev. 5/31/91

(TP) 2.1.8.3 Prior to initiation of additional tests requested by the Commission, an analysis of the potential for the tests to affect the ability of the site to be characterized shall be performed.

2.2 Requirement 60.130: Sections 60.131 through 60.134 specify minimum design criteria for the design of the geologic repository operations area. These design criteria are not intended to be exhaustive, however. Omissions in ¶ 60.131 through 134 do not relieve the DOE from any obligation to provide such safety features in a specific facility needed to acheive the performance objectives. All design bases must be consistent with the results of site characterization.

2.2.4 First Shaft

2.2.4.1 (1.2.6.4PC1d.vi) Fluids and materials planned for use in the shaft shall be evaluated with respect to intended use and possible effects on site characterization or other testing, and appropriate controls will be implemented.

2.2.5 Second Shaft

2.2.5.1 (1.2.6.5PC1d.vi) Fluids and materials planned for use in the shaft shall be evaluated with respect to intended use and possible effects on site characterization or other testing, and appropriate controls will be implemented.

2.2.6 Underground Excavation

2.2.6.1 (1.2.6.6PC1d.ix) Fluids and materials planned for use in the ESF underground facility shall be evaluated with respect to intended use and possible effects on site characterization or other testing, and appropriate controls will be implemented.

2.2.8 Underground Tests

2.2.8.1 (1.2.6.8CE.i) Fluids and materials planned for use in testing in the ESF shall be evaluated with respect to intended use and possible effects on site characterization or other testing, and appropriate controls will be implemented.

YMP CC-0013, Rev. 5 31 91

2.3 Requirement: 60.133(a)(2) The underground facility shall be designed so that the effects of credible disruptive events during the period of operations such as flooding, fires and explosions, will not spread through the facility.

2.3.1 Site

2.3.1.1 (1.2.6.1PC1b) The areas around the shaft collar shall be designed and constructed to prevent water inflow from the probable maximum flood such that testing in the underground portion of the ESF is not adversely affected.

2.3.4 First Shaft

2.3.4.1 (1.2.6.4PC2e.ii) The exploratory shaft collar shall be designed to prevent significant water inflow from a maximum credible flooding event during site characterization and the planned period of repository operation, such that testing in the underground portion of the ESF is not adversely affected.

2.3.5 Second shaft

2.3.5.1 (1.2.6.5PC2e.ii) The exploratory shaft collar shall be designed to prevent significant water inflow from a maximum credible flooding event during site characterization and the planned period of repository operation, such that testing in the underground portion of the ESF is not adversely affected.

2.3.6 Underground Excavation

2.3.6.1 (1.2.6.6PC1d.iii) (1.2.6.6PC1d.iv) (1.2.6.6PC2f.i) The Exploratory Shaft Underground Facility shall be designed so that the effects of credible disruptive events shall be limited from spreading through the facility and affecting characterization.

2.3.6.2 (1.2.6.6PC2f.iv) The drainage plan for the ESF and long exploratory drifts should be designed to ensure that the effects of flooding shall be limited from spreading through the facility and affecting characterization.

2.3.6.3 (1.2.6.6PC1d.xi) The presence of combustible materials in the underground facility shall be controlled and limited such that testing in the ESF is not adversely affected.

2.3.7 Underground utilities

2.3.7.1 (1.2.6.7.6PC1b.v) The ESF shall have redundant mine water discharge systems to control and limit the impact of water intrusion on testing in the ESF.

2.3.7.2 (1.2.6.7.8PC1a) The underground portion of the ESF shall incorporate a fire protection system to control and limit the impact of a credible fire on testing in the ESF.

YMP CC-0013, Rev. 5 31 91

2.3.7.3 (1.2.6.7CD.ii) The underground utility system shall be designed to control and limit the impact, of utility system failures caused by credible disruptive events such as fire, explosion, or seismic events, on site characterization and other testing.

2.3.7.4 (1.2.6.7.6PC1b.i) The mine water collection, control, and removal system shall be designed with capacity for emergency situations such as unexpected inflow or water line breakage, inflow from penetrations of fault structures during drifting, or from perched water encountered during shaft sinking and ESF development, such that the capability to adequately characterize the site is maintained.

YMP CC-0013, Rev. 5/31/91

2.4 Requirement: 60.133(b) The underground facility shall be designed with sufficient flexibility to allow adjustments where necessary to accommodate specific site conditions identified through in situ monitoring, testing, or excavation.

2.4.4 First shaft

2.4.4.1 (1.2.6.4PC1c.ii) The configuration of the shaft shall be adequate to support site characterization testing, and future testing that may be reasonably expected for site characterization. This shall include an allowance to accommodate site specific conditions encountered in the shaft without adversely affecting testing that is planned or ongoing.

2.4.4.2 (1.2.6.4PC1a.iv) The design of ES-1 shall include flexibility to deepen the shaft to at least 1,500 feet, or approximately 100' deeper than the Topopah Spring/Calico Hills unit contact, without adversely affecting other testing that may be ongoing. Such flexibility shall consider aspects of hoisting capacity, underground utilities, ground support, and muck handling.

2.4.5 Second shaft

2.4.5.1 (1.2.6.5PC1c.ii) The configuration of the shaft shall be adequate to support site characterization testing, and future testing that may be reasonably expected for site characterization. This shall include an allowance to accommodate site specific conditions encountered in the shaft without adversely affecting testing that is planned or ongoing.

2.4.6 Underground excavation

2.4.6.1 (1.2.6.6PC1d.xiv) The ESF shall be designed so that testing areas are separated from possible repository shop, training, operations, or waste emplacement areas, to limit adverse effects from activities in these areas on future testing, including performance confirmation, in the dedicated test area.

2.4.6.2 (1.2.6.6PC1c.iv) The design of the shaft breakouts and main test level of the ESF shall: (1) limit the extent of interference between tests and (2) limit interference between ESF construction and operation activities and testing activities.

2.4.6.3 (1.2.6.6PC1c.iv) The design of the shaft breakouts and main test level shall have sufficient flexibility to: (1) relocate experiments as necessary to limit interference between tests and aid in ensuring that test location acceptance criteria are met, (2) incorporate additional tests, as

 YMP CC-0013, Rev. 5-31-91

needed, in the dedicated test area, (3) allow development and testing in other areas as needed (e.g. southern portion of repository block or Calico Hills Tuff), and (4) accommodate schedule changes as needed.

2.4.6.4 (1.2.6.6PC2g.iii) A contingency plan shall be established for underground excavation to accommodate unexpected or site specific conditions that may be encountered, such as highly fractured zones, lithophysae-rich zones, perched water, or pathways for significant water movement.

2.4.6.5 (1.2.6.6PC1c.iii) The ESF underground excavation shall be of adequate size to support site characterization testing and future testing that may be reasonably expected for site characterization. This shall include an allowance to accommodate site specific conditions encountered in the dedicated test area, and capacity to extend an exploratory drift from the main test level, if necessary, up to approximately 10,000 feet to other parts of the repository block.

2.4.7 Underground utilities

2.4.7.1 (1.2.6.7CE.i) The design of underground utilities for the ESF shall be capable of supporting expansion of the main test level for additional testing and an exploratory drift from the main test level, if necessary, up to approximately 10,000 feet to other parts of the repository block.

2.4.7.2 (1.2.6.7CE.ii) The underground utilities for the ESF shall not preclude monitoring and investigation of in situ conditions, and shall be designed to accommodate site specific conditions, construction, and operation of the ESF.

YMP CC-0013, Rev. 5 31 91

2.5 Requirement: 60.133(d) The design of the underground facility shall provide for control of water or gas intrusion.

2.5.4 First shaft

2.5.4.1 (1.2.6.4PC1d.iii) The amount of water used in the construction and operation of the shaft should be limited to preclude interference with tests.

2.5.4.2 (1.2.6.4PC1d.i) Shaft construction and operating procedures shall require the removal of excess water to preclude interference with tests.

2.5.4.3 (1.2.6.4PC1i.iii) The shafts should be separated to maintain reasonable distances for power and instrument cabling and water piping as well as to provide for redundancy in mine water discharge to preclude interference with tests.

2.5.5 Second shaft

2.5.5.1 (1.2.6.5PC1d.iii) The amount of water used in the construction and operation of the shaft should be limited to preclude interference with tests.

2.5.5.2 (1.2.6.5PC1d.i) Shaft construction and operating procedures shall require the removal of excess water to preclude interference with tests.

2.5.6 Underground excavation

2.5.6.1 (1.2.6.6PC1d.vi) The amount of water used in construction and operations of the underground facility should be limited to preclude interference with tests.

2.5.6.2 (1.2.6.6PC1d.iv) Underground facility construction and operating procedures shall require the removal of excess water to preclude interference with tests.

2.5.6.3 (1.2.6.6PC1d.v) (1.2.6.6PC2h.ii) The drainage plan for the ESF and long exploratory drifts should be consistent with repository operations and not impact the capability to characterize the site. Specifically, drainage in the dedicated test area should be toward ES-1 and that in long drifts should be compatible with repository grades.

2.5.6.4 (1.2.6.6PC1d.viii) Construction methods shall be designed and implemented so that the effects of fluids, gases, or other materials used do not adversely affect the adequacy or reliability of information from site characterization.

2.5.6.5 (1.2.6.6PC1d.vii) Methods for dust control and cleaning of walls in the underground portion of the ESF shall be designed to limit adverse effects on the adequacy and reliability of information from site characterization.

 YMP CC-0013, Rev. 5 31 91

2.5.6.6 (1.2.6.6PC1d.x) Fluids,gases, and other materials used in ESF construction and operations, and/or injected into the rock mass, shall be appropriately tagged. Selection of tracers shall consider, but not be limited to: (1) the possible future need to account for the mobility and disposition of all such materials as part of site characterization, and (2) the effects of tracers on site characterization.

2.5.7 Underground utilities

2.5.7.1 (1.2.6.7.6PC1b.i) The mine water collection, control, and removal system shall be designed to accommodate inflow from penetrations of fault structures during drifting, or from perched water encountered during shaft sinking and ESF development such that the capability to adequately characterize the site is maintained. The mine water control system shall be designed with capacity for emergency situations such as unexpected inflow or water line breakage.

2.5.7.2 (1.2.6.7CF.iii) The design of the ESF underground utility system, including ventilation, shall facilitate monitoring of moisture influx to the ESF from the rock mass and from ventilation, and moisture efflux from mine water removal and ventilation exhaust to limit possible impacts on the capability to adequately characterize the site.

2.5.8 Underground Testing

2.5.8.1 (1.2.6.8CE.i) The amount of water used in testing in the shaft should be limited to preclude interference with tests.

2.5.8.2 (1.2.6.8CE.vi) Test procedures shall require the removal of excess water.

2.5.8.3 (1.2.6.8CE.viii) Test procedures shall be developed to ensure that water entering the ESF is managed appropriately, including quantity, location, and water balance.

YMP CC-0013, Rev. 5-31-91

2.6 Requirement: 60.133(e)(2) Openings in the underground facility shall be designed to reduce the potential for deleterious rock movement or fracturing of overlying or surrounding rock.

2.6.4 First Shaft

2.6.4.1 (1.2.6.4PC2i.ii) The shaft shall be designed to provide stability and to reduce the potential for deleterious rock movement or fracturing that could impact the capability to reliably and adequately characterize the site.

2.6.4.2 (1.2.6.4PC2h.ii) An adequate distance between shafts shall be provided to limit potential mechanical and hydrological interference between the two shafts to the extent that it could impact the capability to reliably and adequately characterize the site.

2.6.5 Second Shaft

2.6.5.1 (1.2.6.5PC2i.ii) The shaft shall be designed to provide stability and to reduce the potential for deleterious rock movement or fracturing that could impact the capability to reliably and adequately characterize the site.

2.6.5.2 (1.2.6.5PC2h.ii) An adequate distance between shafts shall be provided to limit potential mechanical and hydrological interference between the two shafts to the extent that it could impact the capability to reliably and adequately characterize the site.

2.6.6 Underground excavation

2.6.6.1 (1.2.6.6PC2i.iv) The main test level of the ESF shall be designed to limit overall response to excavation, including rock fall, considering all planned drifts and future drifting that may be performed in the dedicated test area, consistent with obtaining adequate and reliable information from site characterization.

2.6.6.2 (1.2.6.6PC2i.v) The design of underground openings and their supports in the ESF shall utilize pillar and opening geometries that limit stress concentration, changes in rock mass permeability, and changes in rock mass deformability to levels consistent with acquiring adequate and reliable information from site characterization.

2.6.6.3 (1.2.6.6PC2e.ii) The spacing between adjacent ESF drifts shall be a minimum of two drift diameters (using the maximum diameter of either opening and considering the closest proximity of any part of each opening) consistent with obtaining reliable and adequate information from site characterization.

YMP CC-0013, Rev. 5 31 91

2.6.8 Underground testing

2.6.8.1 (1.2.6.6.2CA) The ESF shall be designed to limit mechanical, hydrologic, or geochemical interference between underground tests that may be associated with damage to the rock mass caused by excavation.

2.7 Requirement: 60.133(f) The design of the underground facility shall incorporate excavation methods that will limit the potential for creating a preferential pathway for groundwater to contact the waste packages or radionuclide migration to the accessible environment.

2.7.1 Site

2.7.1.1 (1.2.6.1CC.ii) The main pad shall be constructed using excavation methods that will limit damage to the underlying rock mass to the extent that it could affect the adequacy or reliability of information from site characterization. Methods shall be designed to facilitate investigation and monitoring of such effects during and after construction.

2.7.4 First Shaft

2.7.4.1 (1.2.6.4PC2i.vii) The shaft and shaft stations of the exploratory shaft shall be constructed using controlled blasting methods, to limit overbreak and damage to the surrounding rock mass, which could affect the adequacy or reliability of information from site characterization. The methods shall be designed to facilitate investigation and monitoring of such effects during and after construction.

2.7.5 Second shaft

2.7.5.1 (1.2.6.5PC2i.vii) The shaft and shaft stations of the exploratory shaft shall be constructed using controlled blasting methods, to limit overbreak and damage to the surrounding rock mass, which could affect the adequacy or reliability of information from site characterization. The methods shall be designed to facilitate investigation and monitoring of such effects during and after construction.

2.7.6 Underground excavation

2.7.6,1 (1.2.6.6PC2j.x) The shaft breakouts and main test level of the ESF shall be constructed using controlled blasting methods, to limit overbreak and damage to the surrounding rock mass, which could affect the adequacy or reliability of site characterization. The methods shall be designed to provide for the requirements of specific site characterization tests, such as limitations on the extent of excavation-induced damage, or the type of ground support that may be installed. The methods shall be designed to facilitate monitoring and investigation of excavation effects during and after construction.

YMP CC-0013, Rev. 5 31 91

2.8 Requirement: 60.137 The geologic repository operations area shall be designed so as to permit implementation of a performance confirmation program that meets the requirements of Subpart F of this part.

2.8.1 Site

(1.2.6.1CD) 2.8.1.1 The ESF site shall be designed to facilitate appropriate performance confirmation measurement and monitoring to obtain adequate and reliable information about the site. The performance confirmation program shall include measurement and monitoring of the performance of the ESF site to the extent that aspects of the site are part of the geologic setting that could contribute to the waste isolation performance of a repository.

2.8.4 First shaft

(1.2.6.4CB.ii) 2.8.4.1 The configuration of the shaft shall be adequate to support performance confirmation testing, and future performance confirmation testing that may be reasonably expected for site characterization. This shall include an allowance to accommodate site specific conditions encountered in the shaft without adversely affecting testing that is planned or ongoing.

(1.2.6.4CB.iii) 2.8.4.2 The shafts of the ESF shall be designed to facilitate performance confirmation testing to obtain adequate and reliable information about the site, during and after construction, as required for the geologic repository by 10 CFR 60, Subpart F.

(I-5) 2.8.4.3 The shafts of the ESF shall be designed so that baseline performance confirmation data can be acquired, pertaining to parameters and natural processes that may be significantly altered by site characterization. In addition, the ESF shall be designed to facilitate monitoring of changes to the baseline condition of parameters that could affect performance of a geologic repository.

2.8.5 Second shaft

(1.2.6.5PCB.ii) 2.8.5.1 The configuration of the shaft shall be adequate to support site performance confirmation testing, and future performance confirmation testing that may be reasonably expected for site characterization. This shall include an allowance to accommodate site specific conditions encountered in the shaft without adversely affecting testing that is planned or ongoing.

YMP CC-0013, Rev. 5 31.91

2.8.5.2 (1.2.6.5CB.iii) The shafts of the ESF shall be designed to facilitate performance confirmation testing to obtain adequate and reliable information about the site, during and after construction, as required for the geologic repository by 10 CFR 60, Subpart F.

2.8.5.3 (I-5) The shafts of the ESF shall be designed so that baseline performance confirmation data can be acquired, pertaining to parameters and natural processes that may be significantly altered by site characterization. In addition, the ESF shall be designed to facilitate monitoring of changes to the baseline condition of parameters that could affect performance of a geologic repository.

2.8.6 Underground excavation

2.8.6.1 (1.2.6.6CB.iii) The shaft breakouts and main test level of the ESF shall be designed to facilitate performance confirmation testing, during and after construction, as required for the geologic repository by 10 CFR 60, Subpart F.

2.8.6.2 (I-5) The shaft breakouts and main test level of the ESF shall be designed so that baseline performance confirmation data can be acquired, pertaining to parameters and natural processes that may be significantly altered by site characterization. In addition, the ESF shall be designed to facilitate monitoring of changes to the baseline condition of parameters that could affect performance of a geologic repository.

2.8.6.3 (1.2.6.6CB.ii) The ESF underground excavation shall be of adequate size to support performance confirmation testing and future testing that may be reasonably expected for performance confirmation. This shall include an allowance to accommodate site specific conditions encountered in the dedicated test area.

2.8.6.4 (1.2.6.6PC1c.iv) The design of the shaft breakouts and main test level of the ESF shall: limit the extent of interference between characterization tests, performance confirmation tests and ESF construction and operation activities.

2.8.6.5 (1.2.6.6PC1c.iv) The design of the shaft breakouts and main test level shall have sufficient flexibility to: (1) relocate experiments as necessary to limit interference between tests, (2) incorporate additional performance confirmation tests, as needed, in the dedicated test area, and, (3) accommodate schedule changes as required.

YMP CC-0013, Rev. 5-31-91

2.8.7 Underground Utilities

2.8.7.1 (1.2.6.7CG.i) The design of underground utilities for the ESF shall be capable of supporting the performance confirmation testing.

2.8.7.2 (1.2.6.7CE.ii) The underground utilities for the ESF shall not preclude monitoring and investigation of in situ conditions, and shall be designed to accommodate site specific conditions, construction, and operation of the ESF.

2.8.8 Underground testing

2.8.8.1 (TP) Performance confirmation testing shall be conducted in the ESF during and after construction, to meet the requirements which pertain to such testing in the geologic repository as stated in 10 CFR 60, Subpart F.

 YMP CC-0013, Rev. 5/31/91

NRC CONCERN NO: 3

The ESF design, construction, and operations should provide representative data.

 YMP CC-0013, Rev. 5 31 91

3.1 Requirement: 60.15(b) Unles ne Commission determines with respect to the site described in the applica__on that it is not necessary, site characterization shall include a program of in situ exploration and testing at the depths that wastes would be emplaced.

3.1.4 First shaft

3.1.4.1 (1.2.6.4PC1a.i) Shaft design and construction shall provide access for site characterization activities to be performed at the planned waste emplacement horizon.

3.1.4.2 (1.2.6.4PC1a.iii) Selection of the horizon for the main test level shall be based on evaluation of stratigraphic information sources available during construction (e.g., from the MPBH activity, geologic mapping of the shafts, and a probe corehole drilled ahead of the shaft face in portions of the shaft) with respect to explicit horizon criteria.

3.1.5 Second shaft

3.1.5.1 (1.2.6.5PC1a.i) Shaft design and construction shall provide access for site characterization activities to be performed at the planned waste emplacement horizon.

3.1.5.2 (1.2.6.5PC1a.iii) Selection of the horizon for the main test level shall be based on evaluation of stratigraphic information sources available during construction (e.g., from the MPBH activity, geologic mapping of the shafts, and a probe corehole drilled ahead of the shaft face in portions of the shaft) with respect to explicit horizon criteria.

3.1.6 Underground excavation

3.1.6.1 (1.2.6.6PC1a.ii) The ESF main test level shall be constructed at the planned repository horizon.

3.1.8 Underground testing

3.1.8.1 (TP) Underground testing shall be conducted in a facility constructed at the planned repository horizon.

 YMP-CC-0013, Rev. 5/31/91

3.2 Requirement: 60.15(d)(2) The number of exploratory boreholes and shafts shall be limited to the extent practical consistent with obtaining the information needed for site characterization.

3.2.4 First Shaft

(1.2.6.4PC1b) 3.2.4.1 The number and depth of exploratory shafts shall be consistent with obtaining needed information for site characterization, while contributing to acquisition of representative data.

3.2.5 Second Shaft

(1.2.6.5PC1b) 3.2.5.1 The number and depth of exploratory shafts shall be consistent with obtaining needed information for site characterization, while contributing to acquisition of representative data.

3.2.8 Underground testing

(TP) 3.2.8.1 The number and length of exploratory and monitoring boreholes drilled from the underground portion of the ESF shall be consistent with obtaining the needed information for site characterization.

YMP CC-0013, Rev. 5 31 91

3.3 Requirement: 60.15(d)(3) To the extent practical, exploratory boreholes and shafts in the geologic repository operations area shall be located where shafts are planned for underground facility construction and operation or where large unexcavated pillars are planned.

3.3.8 Underground testing

(TP) 3.3.8.1 Exploratory, monitoring and testing boreholes shall be located where pillars are planned in the repository underground facility to the extent practicable. Implementation of this criterion within the designated test area of the ESF shall be consistent with obtaining the needed information for site characterization.

3.4 Requirement 60.74 (a) DOE shall perform, or permit the Commission to perform such tests as the commission deems appropriate or necessary for the administration of the regulations in this part. These may include tests of: (1) Radioactive waste, (2) the geologic repository including its structures, systems, and components, (3) radiation detection and monitoring instruments, and (4) other equipment and devices used in connection with the receipt, handling, or storage of radioactive waste. (b) The tests required under this section shall include a performance confirmation program carried out in accordance with Subpart F of this part.

3.4.8 Underground testing

(TP) 3.4.8.1 The area set aside for future site characterization and performance confirmation testing, shall be representative of the overall designated test area with respect to rock characteristics that control acceptability of test locations.

YMP CC-0013, Rev. 5 31 91

3.5 Requirement: 60.133(b) The underground facility shall be designed with sufficient flexibility to allow adjustments where necessary to accommodate specific site conditions identified through in situ monitoring, testing, or excavation.

3.5.4 First shaft

3.5.4.1 (1.2.6.4PC1c.i) The shaft design shall have the flexibility needed to ensure that the location, orientation, geometry, and configuration of each test can be modified, as necessary to meet specific test location acceptance criteria for each test in the shaft, in response to actual site conditions encountered during construction.

3.5.5 Second shaft

3.5.5.1 (1.2.6.5PC1c.i) The shaft design shall have the flexibility needed to ensure that the location, orientation, geometry, and configuration of each test can be modified, as necessary to meet specific test location acceptance criteria for each test in the shaft, in response to actual site conditions encountered during construction.

3.5.6 Underground excavation

3.5.6.1 (1.2.6.6PC1c.ii) The design of the shaft breakouts, and the layout of the main test level of the ESF, shall have the flexibility to ensure that the location, orientation, geometry, and configuration of each planned test can be modified, as necessary, to meet specific test location acceptance criteria, in response to actual site conditions encountered during construction.

3.5.7 Underground utilities

3.5.7.1 (1.2.6.7CE.iii) The design of the underground utilities shall provide the flexibility needed to support required flexibility in the design of the shafts, shaft breakouts, and the layout of the main test level of the ESF.