YMP/CC-0003

U.S. DEPARTMENT OF ENERGY

Received w/Ltr Dated 9/15/[illegible]

OCRWM

YUCCA MOUNTAIN

YUCCA MOUNTAIN PROJECT

PROJECT CCB CONTROLLED DOCUMENT

EXPLORATORY SHAFT FACILITY (ESF)

SUBSYSTEM DESIGN REQUIREMENTS DOCUMENT (SDRD)

FOR TITLE II

VOLUME 1

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

UNITED STATES DEPARTMENT OF ENERGY
NEVADA OPERATIONS OFFICE/YUCCA MOUNTAIN PROJECT OFFICE

YMP/CC-0003

U.S. DEPARTMENT OF ENERGY

OCRWM

YUCCA MOUNTAIN

YUCCA MOUNTAIN PROJECT

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Revision 1
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PROJECT CCB CONTROLLED DOCUMENT

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UNITED STATES DEPARTMENT OF ENERGY
NEVADA OPERATIONS OFFICE/YUCCA MOUNTAIN PROJECT OFFICE

YUCCA MOUNTAIN PROJECT
DOCUMENT CHANGE NOTICE (DCN) RECORD

Y-AD-059
06/89

1 Document Title:	2 Document Number:
Revision to ESF-SDRD for Title II (from ESF-SDRD Rev. 0 to ESF-SDRD Rev. 1)	YMP/CC-0003
	3 Date Prepared: 2/5/90

The document identified in Blocks 1 and 2 has been changed. The changed pages attached to this DCN are identified in Block 8 opposite the latest DCN number in Block 4. 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.

4 DCN NO.	5 CR NO.	6 DOCUMENT Rev./ICN #	7 BRIEF DESCRIPTION	8 AFFECTED PAGES	CHANGE	ADD	DELETE	9 DATE
90/004 001	90/004	1	Revision of ESF SDRD	All	X			2/5/90

YUCCA MOUNTAIN PROJECT
CHANGE DIRECTIVE (CD)

Y-AD-057
01/89

IDENTIFICATION

[1] Title of Change:
Revision to ESF-SDRD for Title II (from ESF-SDRD Rev. 0 to ESF-SDRD Rev. 1)

[2] CR No.: 90/004

[3] Change Classification:
☐ Class 1 ☐ Class 3
☒ Class 2 ☐ Class 4
☐ Non-Baseline CCB Controlled Document

DISPOSITION

[4] CR Disposition:
☐ Approved
☒ Approved with Conditions
☐ Disapproved

[5] Conditions (if applicable):

Conditions on the Directive approving the ESF SDRD for Title II, Rev. 0 (Ref: CR-89/023) have been completed or are to be closed out as follows:

1. CR-89/023 Condition #1 (page 1):

--- LANL - Completed 1/5/90, reference letter, TWS-EES-1-LV-01-90-05
--- T&MSS - Completed 3/25/89, reference letter, L89-SED-JDW-318.
--- H&N - Completed 4/14/89, reference letter, YMP:TPO:89-268.
--- FSN - Completed 4/4/89, reference letter, FS-YMP-0323.
--- SNL - Unconfirmed, HOLD points will be established in the Project Hold Status System to track the completion of this condition. Until such time as said hold

(See CR Continuation Page 2)

[6] Implementation Direction (if applicable):

1. The ESF SDRD for Title II, Rev. 1, is issued as a CCB Controlled Document. The ESF SDRD for Title II, Rev. 1, is assigned document number YMP/CC-0003. Upon release, all YMP Participants work pertinent to the Project shall be held accountable to the requirements of the ESF SDRD for Title II, Rev. 1.

2. SNL shall furnish the CCB Chairman with a letter certifying that the conditions (procedures) exist before proceeding with their assignments for Title II design.

3. The T&MSS Contractor shall initiate a Change Request (CR) to implement any changes to the ESF SDRD for Title II, Rev. 1, required by subsequent approval of revisions to OGR/B-2, Appendix E, by the OCRWM.

(See CR Continuation Page 2)

[7] Directive Issued By Disposition Authority:
Name: Edwin L. Wilmot Title: Dep Proj Mgr
Signature: [signature] Date: 2/6/90

[8] Release Date: (Optional)
2/15/90

CONCURRENCE

[9] Division Director Concurrence in Classification (Class 4 Change Only):
Division Director Name: _____ Division: _____
Signature: _____ Date: _____

[10] Quality Assurance Organization Concurrence (Class 1 & 2 Changes Only):
Name: Donald G. Horton Org.: PQA
Signature: [signature] Date: 2/6/90

1 Title of Change:	2 CR No.:
Revision to ESF-SDRD for Title II (from ESF-SDRD Rev. 0 to ESF-SDRD Rev. 1)	90/004
	3 Originator's Control No.:

4 Originating Org.: SNL	5 Prepared By: J. Waddell	6 Date: 1/9/90

5 Condition (continued)

is released, SNL is not authorized to proceed with any efforts for ESF Title II design.

2. CR-89/023 Condition #2 (page 2):

--- The HOLD points 6.OS.89-001, "Design Verification of the Initial ESF Site Preparation and Mobilization," 6.OS.89-003,"Design Verification of the ESF Main Pad," and 6.OS.89-005, "Design Verification of the ESF ES-1 Collar" have been established in the Project HOLD Status System, the release of which shall be dependent on and contingent with the completion of:

-- The Design Acceptability Analyst (DAA);
-- Review per QMP 06-03;
-- Review per QMP 02-08;
-- Incorporation of revisions to the Generic Requirements Document Appendix E into the ESF SDRD, for Title II; and
-- Independent review and verification (where required) by SNL consistent with guidance in letter to SNL cf 2/14/89.
No design output products shall be released for construction and/or procurement until these Holds are released.

3. CR:89/023 Condition #3: (page 2)

-- Upon completion of the actions noted in 2 (above), the ESF SDRD for Title II, Rev. 1 shall be resubmitted to the CCB for disposition, i.e., this condition transfers from the CD for CR:89/023 to this directive for CR:90/004.

4. CR:89/023 Condition #4:

--- Appropriate HOLD points shall be established in the Project Hold Status System so that data referenced in the ESF SDRD for Title II, Rev. 1 which may be used in licensing actions is identified and so designated (see AP-5.3Q and the Reference Information Base) and shall be evaluated using a process consistent with NUREG 1298. To the extent that such data is necessary for changes to or implementation of the ESF SDRD for Title II, Rev. 1, evaluation of such data shall be completed (using the process stipulated in AP-5.9Q) before design outputs are released for construction and/or procurement. In the event such evaluation cannot occur before

YUCCA MOUNTAIN PROJECT
CHANGE DOCUMENTATION CONTINUATION PAGE

Y-AD-055
4/89

[1] Title of Change:	[2] CR No.:
Revision to ESF-SDRD for Title II (from ESF-SDRD Rev. 0 to ESF-SDRD Rev. 1)	90/004
	[3] Originator's Control No.:

[4] Originating Org.: SNL | [5] Prepared By: J. Waddell | [6] Date: 1/9/90

5 Conditions (continued)

design outputs are released, e.g., where additional data collection is required during and after construction, an alternate mechanism for data recovery shall be utilized.

5. An alternative mechanism for data evaluation noted under Condition 4, Block 5 shall be established and shall receive written concurrence by the Director of the Yucca Mountain Project Office Quality Assurance organization prior to issuance of any Title II design product.

6. Prior to release, the CR Originator shall replace any reference to Administrative Procedure 5.6Q with reference to Administrative Procedure 5.19Q.

7. Prior to release, the CR Originator shall change page Intro-5, Appendix E to read "This appendix lists some known ESF applicable regulations, codes and specifications".

6 Implementation Direction (continued)

4. The Director, Engineering and Development Division is directed to establish appropriate Hold points per conditions 1 and 4.

5. The Project Office shall prepare the alternative mechanism described under condition 5.

SUBMITTALS AND APPROVALS

This Exploratory Shaft Facility (ESF) Subsystem Design Requirements Document (SDRD) for the Yucca Mountain Project is submitted by the T&MSS with Project Office concurrence by:

Date: 12/14/89

Leo E. Little, Director
Engineering and Development Division
Yucca Mountain Project Office

Date: 1/3/90

Donald G. Horton
Project Quality Manager
Yucca Mountain Project Office

This document is approved for the initiation of Title II design. Verification of applicable requirements must be completed prior to the acceptance of design output.

YUCCA MOUNTAIN PROJECT

EXPLORATORY SHAFT FACILITY (ESF)

SUBSYSTEM DESIGN REQUIREMENTS DOCUMENT

FOR TITLE II

Prepared by Yucca Mountain Project participants as part of the Civilian Radioactive Waste Management Program. The Yucca Mountain Project is managed by the Project Office of the U.S. Department of Energy, Nevada Operations Office. Project work is sponsored by the DOE Office of Civilian Radioactive Waste Management.

Compiled by:

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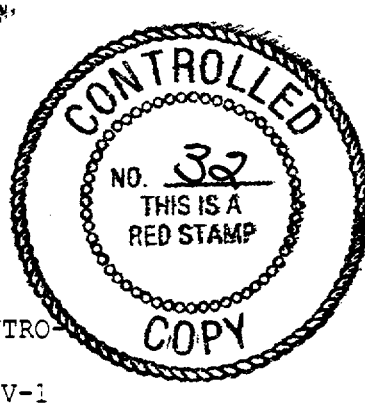
Prepared for:

U.S. Department of Energy
Nevada Operations Office
Yucca Mountain Project Office
P.O. Box 98518
Las Vegas, Nevada 89193-8518

Contract DE-AC08-87NV10576

The technical content of this document is 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 start of ESF Title II design. Specific authorization for use of the data to finalize design packages for construction must be obtained from the Project Office.

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 Project procedures.



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LIST OF TABLES

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 the responsibility of 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 the Yucca Mountain Project as the sole site to be characterized.

Evaluation of the suitability of Yucca Mountain as a geologic repository is the responsibility of the Yucca Mountain Project, which is managed within the DOE Nevada Operations Office (NVO) by the Yucca Mountain Project Office. The Exploratory Shaft 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 required by 10 CFR Part 60 for the conduct of in situ testing at depth. This testing must be completed 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 Part 60.

PRIMARY GUIDELINES

The primary guidelines for the Yucca Mountain Project 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 Unit. The design of the ESF will consider the need to obtain significant and unique information about site properties during shaft sinking and underground construction.

- The ESF will be constructed by conventional mining in the area of Coyote Wash with the necessary facilities and support systems to perform the subsurface site characterization testing. ESF testing will focus on the information that is 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 Subsystems Design Requirements Document (SDRD) provides the functional requirements, performance criteria, constraints, and assumptions for all systems and subsystems within the scope of the ESF in accordance with the applicable guidance of the Office of Geologic Repositories (OGR) document OGR/B-2, Generic Requirements For A Mined Geologic Disposal System (GR), Appendix E, Generic Requirements For Exploratory Shaft Facility (ESF) Design, Construction, and Operations (DOE/HQ, January 4, 1989, Proposed Modifications to GR Appendix E to satisfy applicable 10 CFR 60 requirements). For the purposes of the SDRD, a number of basic guidelines were utilized and incorporated. The structure of the SDRD follows the applicable guidance of OGR Document OGR/B-7, Systems Engineering Management Plan For The Office of Geologic Repositories, Section 5.3.3, "Site-Specific MGDS Requirements." This section (OGR/B-7, 5.3.3) requires that the site specific requirements document (SDRD) include the following:

- DEFINITION OF SUBSYSTEM ELEMENTS.
- APPLICABLE REGULATIONS, CODES, AND SPECIFICATIONS.
- FUNCTIONAL REQUIREMENTS.
- PERFORMANCE CRITERIA.
- INTERFACE CONTROL REQUIREMENTS.
- CONSTRAINTS.
- ASSUMPTIONS.

This document conforms to this outline within each subsystem section. The overall structure of Volume 1 of the ESF SDRD is diagrammed in Figure 1, ESF Breakdown Structure, page 8 of this Introduction.

It is the responsibility of each Yucca Mountain Project participant to comply with all applicable higher level requirements as identified in this document for design and construction of the ESF. Requirements of Sections 6.1 and 6.8 of the GR Appendix E that pertain to management and operation of the ESF are not included or imposed in this document. Requirements of Sections 6.1 and 6.8 of the GR Appendix E are implemented by management plans, implementing plans, and implementing procedures contained in documents identified in the Project Management Plan.

The ESF SDRD translates the OCRWM requirements into the site specific requirements from which the Yucca Mountain Project participants responsibilities are assigned to ensure that all of the design criteria, requirements, and responsibilities are met.

EXPLANATION OF ESF SDRD VOLUME 1 NOTATIONS AND ORGANIZATION

Each of the above Sections of the ESF SDRD 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 SDRD which may impact the satisfaction of the requirements in the section of interest.

The APPLICABLE REGULATIONS, CODES, AND SPECIFICATIONS 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.

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.

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.

Each subsystem statement, whether FR, PC, IR, 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:

- [E6.2PC2b] - This citation identifies that Performance Criteria 2b from section 6.2 of the GR Appendix E has been quoted verbatim for this statement. All GR Appendix E sources are identified by an initial capital E.

- [NEV,E6.3CA] - This citation identifies the statement is a project specific statement associated with Constraint A of section 6.3 of the GR Appendix E. The statement is a subsystem allocation and not a direct quote. The citation may identify more than one GR Appendix E source item.

- [NEV] - This citation indicates the statement contains no equivalent in the GR Appendix E and is unique to the Yucca Mountain Project.

- [10 CFR 60.123] - This citation identifies the statements source is 10 CFR 60.

- [RL-XX] - This citation identifies a statement taken from the DOE/HQ flowdown task force report.

- [E89] - This citation identifies a GR Appendix E quote which has been modified by the January 4, 1989 draft of the GR Appendix.

- [SR] - This citation identifies a quote from the Yucca Mountain Project System Requirements (SR) Document.

Direct quotes of 10 CFR 60 statements deemed applicable to the ESF have been inserted into Volume I of the ESF SDRD in the requirements, criteria, and constraints sections as appropriate. The purpose of providing direct 10 CFR 60 quotes in this document is as follows:

- Provide proof of Hierarchy requirements flowdown.

- Provide a vehicle and basis for presentation of sub-tier requirements, criteria, and constraints which provide the means and/or direction for satisfaction of the quoted 10 CFR 60 requirement. Quotes from 10 CFR 60 without sub-tier statements attached are currently considered stand alone in their guidance of ESF design.

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.

EXPLANATION OF ESF SDRD VOLUME 2 NOTATIONS AND ORGANIZATION

The ESF SDRD Volume 2 contains Volume 1 support information arranged as appendix A through H. The contents of individual appendix are as follows:

- Appendix A - This appendix contains necessary repository interface and ESF sealing requirements, specific design basis and design methodology provided by Sandia. The appendix is divided into 6 subparts which are listed in the table of contents.

- Appendix B - This appendix contains general descriptions and requirements of the underground tests to be performed in the ESF main test level (MTL) and the requirements of the Integrated Data System (IDS). A list of the tests described is contained in the table at the beginning of the appendix.

- Appendix C - This appendix lists all currently known drilling requirements for the ESF.

- Appendix D - This appendix contains a listing of all ESF related referencable Project Documentation as identified in Section 8.4 of the Site Characterization Plan (SCP).

- Appendix E - This appendix contains a listing of some known ESF applicable regulations, codes, and specifications.

- Appendix F - This appendix contains cross reference listings which allows the reader to determine the relationships between the ESF SDRD and the following: 10 CFR 60, GR Appendix E, and the SR. The cross reference for 10 CFR 60 is presented in both a standard and matrix format.

- Appendix G - This appendix contains the ESF functional analysis logic tree whose purpose is to map both the internal and external functional ESF interfaces and therefore the requirement logic for the ESF SDRD.

- Appendix H - This appendix contains a compilation of all current ESF related performance assessment requirements that are included in volume 1 of the ESF SDRD.

Because of the total size of the appendices, volume 2 is divided into two volumes, 2A and 2B, to utilize standard binders and for user convenience.

PROJECT QUALITY ASSURANCE

All activities associated with the ESF shall be performed to applicable Quality Assurance requirements, and specific approved Quality Assurance Level

Assignment sheets (QALAS) for ESF items and activities. The basic Quality Assurance policy is established by the Yucca Mountain Project Quality Assurance Plan (NNWSI/88-9) and shall be implemented to provide assurance of quality in all phases of the ESF project. The latest revision of NNWSI/88-9 includes all Quality Assurance elements identified in the Code of Federal Regulation, Title 10, Part 50, Appendix B, and requires that each participating organization develop Quality Assurance program plans and procedures for all Yucca Mountain Project activities.

ESF SDRD QUALITY ASSURANCE

The review and approval of this document meets the requirements of a 10 CFR 60 Subpart G Quality Assurance program. The review and approval process was performed in accordance with Yucca Mountain Project Quality Management Procedures QMP-06-03, "Document Review/Acceptance/Approval" and QMP-02-08, "Technical Assessment Review". The assignment of Quality Levels to individual items and activities described in this document will be accomplished by Quality Assurance Level Assignments (QALA) for specific items and activities. This document is not assigned a quality level, nor does it assign quality levels. Production of this document was a QA Level I activity and all revisions of the ESF SDRD for Title II design shall be performed under QA Level I controls in accordance with NNWSI/88-9 criteria. The ESF SDRD is expected to be revised on a semiannual basis. Indicated changes, if any, resulting from program redirection or GR Appendix E changes will be incorporated during the semiannual revisions.

SDRD DATA TO BE VERIFIED/VALIDATED

Section

1.2.6.0 through 1.2.6.9 and Appendices.

Verifying Organization and Schedule

The organizations responsible for verifying individual requirements values or statements are listed in Section 1 of the Responsibility Matrix. The Responsibility Matrix will be issued and controlled through the Project Office and produced by Sandia National Laboratory. Requirements values or statements needing verification are identified in Table 1, List of Items To Be Verified (TBV), following this Introduction. The requirements to be verified are identified in Volume I of the text by a bracketed "TBV", e.g., [TBV].

REQUIREMENTS TO BE DETERMINED

Section

1.2.6.0 through 1.2.6.9 and appendices as noted in the text.

Determining Organization and Schedule

The organizations responsible for determining, providing, and verifying individual requirements values or statements are listed in Section 2 of the Responsibility Matrix. The Responsibility Matrix will be issued and controlled through the Project Office and produced by Sandia National Laboratory.

Requirements values or statements which need to be determined, provided, and verified are identified in Table 2, List of Items To Be Determined (TBD), following the TBV Table. The requirements to be determined are identified in Volume I of the text by a bracketed "TBD", e.g., [TBD].

ESF SDRD 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 baseline Reference Information Base (RIB), DOE 1989, Yucca Mountain Project Reference Information Base, Version 4.0, YMP/CC-0002.

ESF SDRD 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 achieving 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 insure that they are acceptable from the repository performance perspective. If the predicted values are acceptable, associated goals will be revised accordingly and replaced in the ESF SDRD.

TABLE 1. LIST OF ITEMS TO BE VERIFIED (TBV)

REQUIREMENT	REFERENCE	COMPLETION DATE	COMMENT
ESF SDRD Volume 1:			
1.2.6.0PC2bi	[E6.0CU]		[tbv]
1.2.6.0PC2bii	[E6.2PC3d]		
1.2.6.0PC2biii	[E6.3PC1n]		
1.2.6.0PC2biv	[E6.2PC4o]		
1.2.6.0PC2bv	[E6.4PC1b,E6.5PC1h]		
1.2.6.0PC2bvi	[E6.6PC1b]		
1.2.6.0PC2bvii	[NEV,E6.0CU]		
1.2.6.0PC2bviii	[NEV]		
1.2.6.0PC3bi	[E6.0PC3b]		
1.2.6.0PC5g	[SR]		[tbv]
1.2.6.0PC6d	[E6.0PC6c]		[tbv]
1.2.6.1CH	[NEV]		
None in 1.2.6.1.1			NONE
1.2.6.1.2PC1e	[NEV]		[tbv]
None in 1.2.6.1.3			NONE
None in 1.2.6.1.4			NONE
None in 1.2.6.2			NONE
1.2.6.2.1PC1g	[NEV]		[tbv]
1.2.6.2.1CC	[NEV]		[tbv]
None in 1.2.6.2.2			NONE
1.2.6.2.3PC1d	[NEV]		
None in 1.2.6.2.4			NONE
None in 1.2.6.2.5			NONE
None in 1.2.6.2.6			NONE
1.2.6.3PC1e	[E6.3PC1i]		
1.2.6.3CC	[SR1.2CS]		[tbv]
1.2.6.3.1CB	[NEV]		
None in 1.2.6.3.2			NONE
None in 1.2.6.3.3			NONE
1.2.6.3.4F1	[NEV]		[tbv]
None in 1.2.6.3.5			NONE
None in 1.2.6.3.6			NONE
None in 1.2.6.3.7			NONE
1.2.6.3.8CA	[NEV]		[tbv]
1.2.6.3.8CB	[NEV]		[tbv]
1.2.6.3.8A2	[NEV]		[tbv]
None in 1.2.6.3.9			NONE
1.2.6.4Def	[NEV,E6.4DEFINITION]		
1.2.6.4PC1fiva	[NEV,E6.4PC1c]		
1.2.6.4PC1fivb	[NEV]		
1.2.6.4PC1fivc	[NEV]		
1.2.6.4PC1fva	[NEV]		
1.2.6.4PC1fvb	[NEV,E6.4PC1d]		
1.2.6.4PC3i	[E6.4PC3]		
1.2.6.4PC3ii	[NEV]		
1.2.6.4PC4ci	[E6.4PC1i] [E89]		
1.2.6.4PC4cia	[NEV,E6.4PC1i]		
1.2.6.4CAii	[NEV]		

TABLE 1. LIST OF ITEMS TO BE VERIFIED (TBV)

REQUIREMENT	REFERENCE	COMPLETION DATE	COMMENT
1.2.6.4CJi	[NEV]		
1.2.6.4CJiv	[NEV]		
1.2.6.4COiv	[NEV]		
1.2.6.4CSii	[E6.4CD]		
1.2.6.4CSiii	[NEV]		
1.2.6.4CViiia	[NEV]		
1.2.6.4CViiib	[NEV]		
1.2.6.4CViiic	[NEV]		
1.2.6.4CViv	[NEV]		
1.2.6.4CVv	[NEV]		
1.2.6.4.1CA	[NEV]		
None in 1.2.6.4.2			NONE
None in 1.2.6.4.3			NONE
None in 1.2.6.4.4			NONE
1.2.6.4.5A1	[NEV]		
1.2.6.4.5A3	[NEV]		
1.2.6.4.6CB	[NEV]		
1.2.6.5Def	[NEV,E6.5DEFINITION]		
1.2.6.5PC3fi	[E6.5PC1f]		
1.2.6.5PC3fia	[NEV,E6.5PC1f]		
1.2.6.5PC3hiva	[NEV,E6.5PC1b]		[tbv]
1.2.6.5PC3hivb	[NEV]		
1.2.6.5PC3hivc	[NEV]		[tbv]
1.2.6.5PC3hia	[NEV]		
1.2.6.5PC3hib	[NEV,E6.5PC1c]		
1.2.6.5CCii	[NEV]		
1.2.6.5CJi	[NEV]		
1.2.6.5CJii	[NEV]		
1.2.6.5CJiv	[NEV]		
1.2.6.5CSii	[E6.5CC]		[tbv]
1.2.6.5CViv	[NEV]		[tbv]
1.2.6.5CVv	[NEV]		
1.2.6.5.1CA	[NEV]		
None in 1.2.6.5.2			NONE
None in 1.2.6.5.3			NONE
None in 1.2.6.5.4			NONE
1.2.6.5.5A2	[NEV]		
None in 1.2.6.5.6			NONE
1.2.6.6Def	[NEV,E6.6DEF]		
1.2.6.6PC1eiii	[E6.6PC1h]		
1.2.6.6PC1iv	[NEV,E6.6PC1h]		
1.2.6.6PC1hiiia	[NEV]		[tbv]
1.2.6.6PC1hiiib	[NEV]		[tbv]
1.2.6.6PC1hiiic	[NEV]		[tbv]
1.2.6.6PC1hiiid	[NEV]		[tbv]
1.2.6.6PC1hiiie	[NEV,E6.6PC1d]		[tbv]
1.2.6.6PC1hiva	[NEV]		[tbv]
1.2.6.6PC1hivb	[NEV]		[tbv]
1.2.6.6CDii	[NEV]		
1.2.6.6CDiiia	[NEV]		[tbv]
1.2.6.6CEv	[NEV]		[tbv]
1.2.6.6CJii	[NEV]		[tbv]

TABLE 1. LIST OF ITEMS TO BE VERIFIED (TBV)

REQUIREMENT	REFERENCE	COMPLETION DATE	COMMENT
1.2.6.6CMv	[NEV]		
1.2.6.6COv	[NEV]		[tbv]
1.2.6.6CPxi	[NEV]		
1.2.6.6CRvi	[NEV]		[tbv]
1.2.6.6CRvii	[NEV]		[tbv]
1.2.6.6CSiii	[E6.6CH]		
1.2.6.6CSiv	[E6.6CI]		
1.2.6.6CSv	[NEV,E6.6CI]		
1.2.6.6CViii	[NEV]		[tbv]
1.2.6.6CVvia	[NEV]		[tbv]
1.2.6.6CVvib	[NEV]		[tbv]
1.2.6.6CVvic	[NEV]		[tbv]
1.2.6.6CVvid	[NEV]		[tbv]
1.2.6.6.1			NONE
1.2.6.6.2			NONE
1.2.6.7CB	[E6.7CB]		[tbv]
1.2.6.7.1CC	[NEV]		
None in 1.2.6.7.2			NONE
None in 1.2.6.7.3			NONE
1.2.6.7.4CA	[E6.7CC]		
1.2.6.7.4CC	[NEV,E6.4CD,E6.5CC]		[tbv]
1.2.6.7.4CD	[NEV,E6.6CH,E6.7CB]		[tbv]
1.2.6.7.4CE	[NEV,E6.6CI,E7.4CD]		[tbv]
None in 1.2.6.7.5			NONE
None in 1.2.6.7.6			NONE
None in 1.2.6.7.7			NONE
None in 1.2.6.7.8			NONE
None in 1.2.6.7.9			NONE
None in 1.2.6.7.10			NONE
None in 1.2.6.7.11			NONE
1.2.6.8CKii	[NEV]		[tbv]
None in 1.2.6.8.1			NONE
None in 1.2.6.8.2			NONE
None in 1.2.6.8.3			NONE
None in 1.2.6.8.4			NONE
None in 1.2.6.8.5			NONE
None in 1.2.6.9			NONE
None in 1.2.6.9.1			NONE
None in 1.2.6.9.2			NONE

ESF SDRD Volume 2A:

None in Appendix A.1
None in Appendix A.2
None in Appendix A.3
None in Appendix A.4
None in Appendix A.5
None in Appendix A.6

TABLE 1. LIST OF ITEMS TO BE VERIFIED (TBV)

REQUIREMENT REFERENCE	COMPLETION DATE	COMMENT
ESF SDRD Volume 2B:		
Appendix B -		
B-MECH-8 A2	2 months after Study Plan approval.	Performance modeling.
B-MECH-10 C1	2 months after ESF Title II completion.	Evaluate controlled blasting specifications and procedures.
B-WP-1 A4	2 months after Study Plan.	Performance Modeling calculations, backup for SCP Section 8.4.
None in Appendix C		
None in Appendix D		
None in Appendix E		
None in Appendix F		
None in Appendix G		
None in Appendix H		

TABLE 2. LIST OF ITEMS TO BE DETERMINED (TBD)

REQUIREMENT	REFERENCE	COMPLETION DATE	COMMENT
ESF SDRD Volume 1:			
1.2.6.0PC1a	[E6.0PC1a]		
1.2.6.0PC1d	[NEV]		
1.2.6.0PC2viii	[NEV]		
1.2.6.0PC5aia	[E6.0PC5a]		
1.2.6.0PC5aiv	[NEV]		
1.2.6.0PC5f	[SR]		
1.2.6.0 INTERFACE CONTROL REQUIREMENTS			
1.2.6.0CAxi	[NEV]		
1.2.6.0CGvi	[NEV]		
1.2.6.0CGvii	[NEV]		
1.2.6.0 ASSUMPTIONS			
1.2.6.0A1	[NEV]		
1.2.6.1 INTERFACE CONTROL REQUIREMENTS			
1.2.6.1CAi	[NEV]		
1.2.6.1CCi	[NEV]		
1.2.6.1CCii	[NEV]		
1.2.6.1CEi	[NEV]		
1.2.6.1CFi	[NEV]		
1.2.6.1CFii	[NEV] jdw689		
1.2.6.1CFiii	[NEV]		
1.2.6.1CFiv	[NEV]		
1.2.6.1CFvi	[NEV]		
1.2.6.1.1PC1b	[NEV]		
1.2.6.1.1PC1d	[RL-2]		
1.2.6.1.2PC1b	[E6.2PC4k]		
1.2.6.1.2PC1di	[NEV]		
1.2.6.1.3PC1a	[E6.2PC4a]		
1.2.6.1.4PC1	[E6.2PC4e]		
1.2.6.1.4CA	[NEV]		
1.2.6.2 INTERFACE CONTROL REQUIREMENTS			
1.2.6.2CA	[NEV,10 CFR 60.15(d)(1)]		
1.2.6.2CD	[NEV]		
None in 1.2.6.2.1			NONE
1.2.6.2.2CF	[NEV]		
1.2.6.2.2CH	[NEV]		
1.2.6.2.3CB	[NEV]		
1.2.6.2.3CC	[NEV]		
None in 1.2.6.2.4			NONE
1.2.6.2.5PC1c	[NEV]		
1.2.6.2.5CA	[NEV]		
1.2.6.2.5CB	[NEV]		
None in 1.2.6.2.6			NONE
1.2.6.3PC4c	[NEV]		
1.2.6.3 INTERFACE CONTROL REQUIREMENTS			
1.2.6.3CD	[NEV]		
1.2.6.3.1PC1h	[NEV]		
1.2.6.3.2PC1a	[NEV]		
None in 1.2.6.3.3			NONE

TABLE 2. LIST OF ITEMS TO BE DETERMINED (TBD)

REQUIREMENT	REFERENCE	COMPLETION DATE	COMMENT
None in 1.2.6.3.4			NONE
None in 1.2.6.3.5			NONE
1.2.6.3.6PC1c	[NEV]		
None in 1.2.6.3.7			NONE
1.2.6.3.8PC1b	[NEV]		
None in 1.2.6.3.9			NONE
1.2.6.4PC1ci	[NEV]		
1.2.6.4PC1di	[E6.4PC1e]		
1.2.6.4PC1dii	[NEV]		
1.2.6.4PC5ii	[E6.4PC5]		
1.2.6.4 INTERFACE CONTROL REQUIREMENTS			
1.2.6.4CBi	[NEV]		
1.2.6.4CBii	[NEV]		
1.2.6.4CBv			
1.2.6.4CBx	[E6.4CC]		
1.2.6.4CFii	[NEV]		
1.2.6.4CFiii	[NEV]		
1.2.6.4CFiv	[NEV]		
1.2.6.4CFv	[NEV]		
1.2.6.4CMi	[NEV]		
1.2.6.4CMii	[E6.4CE]		
1.2.6.4CNii	[NEV]		
1.2.6.4CPiv	[NEV]		
1.2.6.4CPv	[NEV]		
1.2.6.4CPxiv	[NEV]		
1.2.6.4CPxv	[NEV]		
1.2.6.4CQii	[NEV]		
1.2.6.4CRii	[NEV]		
1.2.6.4CRiii	[NEV]		
1.2.6.4.1PC1a	[SR]		
1.2.6.4.2CA	[NEV]		
None in 1.2.6.4.3			NONE
1.2.6.4.4CA	[NEV]		NONE
1.2.6.4.5PC1a	[E6.5PC1i]		
None in 1.2.6.4.6			NONE
1.2.6.5PC3ci	[NEV]		
1.2.6.5PC3eia	[NEV]		
1.2.6.5 INTERFACE CONTROL REQUIREMENTS			
1.2.6.5CBi	[NEV]		
1.2.6.5CBii	[NEV]		
1.2.6.5CBiv	[NEV]		
1.2.6.5CBv	[NEV]		
1.2.6.5CFii	[NEV]		
1.2.6.5CFiii	[NEV]		
1.2.6.5CFiv	[NEV]		
1.2.6.5CFv	[NEV]		
1.2.6.5CMi	[NEV]		
1.2.6.5CPiii	[NEV]		
1.2.6.5CPiv	[NEV]		
1.2.6.5CQii	[NEV]		
1.2.6.5.1PC1a	[SR]		
None in 1.2.6.5.2			NONE

TABLE 2. LIST OF ITEMS TO BE DETERMINED (TBD)

REQUIREMENT	REFERENCE	COMPLETION DATE	COMMENT
None in 1.2.6.5.3			NONE
1.2.6.5.4CB	[NEV]		
1.2.6.5.5PC1c	[E6.5PC1i]		
None in 1.2.6.5.6			NONE
1.2.6.6 INTERFACE CONTROL REQUIREMENTS			
1.2.6.6CBi	[NEV]		
1.2.6.6CBii	[NEV]		
1.2.6.6CBiv	[NEV]		
1.2.6.6CFiii	[NEV]		
1.2.6.6CNi	[NEV]		
1.2.6.6CPvi	[NEV]		
1.2.6.6CPvii	[NEV]		
1.2.6.6CPxiii	[NEV]		
1.2.6.6CUiii	[NEV]		
1.2.6.6CUv	[NEV]		
None in 1.2.6.6.1			NONE
1.2.6.6.2CC	[NEV]		
1.2.6.7 INTERFACE CONTROL REQUIREMENTS			
1.2.6.7CJ	[NEV]		
None in 1.2.6.7.1			NONE
None in 1.2.6.7.2	[1.2.6.7.2 COMMUNICATIONS SYSTEM Combined with Section 1.2.6.2.4 by previous Project ECR]		NONE
None in 1.2.6.7.3			NONE
1.2.6.7.4PC1b	[E6.7PC3b]		
None in 1.2.6.7.5			NONE
None in 1.2.6.7.6			NONE
None in 1.2.6.7.7			NONE
None in 1.2.6.7.8			NONE
None in 1.2.6.7.9			NONE
None in 1.2.6.7.10			NONE
None in 1.2.6.7.11			NONE
1.2.6.8CC	[E6.9CD]		
1.2.6.8CDi	[NEV]		
1.2.6.8CHii	[NEV]		
1.2.6.8CHiii	[NEV]		
1.2.6.8CLii	[NEV]		
1.2.6.8CLiii	[NEV]		
1.2.6.8 INTERFACE CONTROL REQUIREMENTS			
1.2.6.8.1PC1	[NEV]		
1.2.6.8.1PC2	[NEV]		
1.2.6.8.1PC3	[NEV]		
1.2.6.8.1 INTERFACE CONTROL REQUIREMENTS			
None in 1.2.6.8.2			NONE
None in 1.2.6.8.3			NONE
None in 1.2.6.8.4			NONE
None in 1.2.6.8.5			NONE
1.2.6.9 INTERFACE CONTROL REQUIREMENTS			
1.2.6.9.1CC	[NEV]		[tbd]
None in 1.2.6.9.2			NONE

TABLE 2. LIST OF ITEMS TO BE DETERMINED (TBD)

REQUIREMENT	REFERENCE	COMPLETION DATE	COMMENT
ESF SDRD Volume 2A:			
REQUIREMENT	REFERENCE	COMPLETION DATE	COMMENT
Appendix A.3 -			
Section 3			
Appendix A.4 -			
References			Draft References
Appendix A.6 -			
Page 1, Paragraph 1			
ESF SDRD Volume 2B:			
Appendix B -			
Table of Contents "WBS"		TBD	Baselined WBS structure to the individual test level required for cost control.
B-MECH-8 PC1		Completion of ESF Title II design.	
B-MECH-9 PC (All)		2 months after Study Plan approval.	
B-MECH-9 C (All)		As above.	
B-MECH-9 Interface Req's (All)		As above.	
B-SEAL-1 (ALL)		Readiness review for site prep.	Procedure TBD.
B-HYD-8 A4		Upon observation of perched water.	Field determination.
B-HYD-9 PC6		Readiness review for site prep.	Procedure TBD.

TABLE 2. LIST OF ITEMS TO BE DETERMINED (TBD)

REQUIREMENT REFERENCE	COMPLETION DATE	COMMENT
Appendix C -		
"Hole directions"	2 months prior to construction	Requisits are 1) Approved facility design and 2) Study Plans and 3) Test Modeling calculations. This entry can be expanded to track individual holes but is currently premature.
None in Appendix D		NONE
None in Appendix E		NONE
None in Appendix F.1		NONE
None in Appendix F.2		NONE
Appendix F.3, (All)	TBD	
None in Appendix G		NONE
Appendix H, (All)	TBD	

REVISION 1

VOLUME 1

ESF SDRD FOR TITLE II DESIGN

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

Subparts are
- 1.2.6.1 ESF Site
- 1.2.6.2 Surface Utilities
- 1.2.6.3 Surface Facilities
- 1.2.6.4 First Shaft
- 1.2.6.5 Second Shaft
- 1.2.6.6 Underground Excavations
- 1.2.6.7 Underground Utility Systems
- 1.2.6.8 Underground Tests
- 1.2.6.9 ESF Decommissioning and Closure

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The Exploratory Shaft Facility (ESF) is defined by 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 shafts and connecting drifts) and supporting systems required to support site characterization testing at depth. The underground limits for ESF use are defined in the ESF-Repository interface drawings contained in SDRD Appendix A.1. [NEV]

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project Interface Control Document(s). (An Interface Control Document(s) is a controlled document, i.e., Component Interface Document (CID), Interface Control Drawing (ICD), or System Interface Document (SID) that provides clarification of site and design features for co-functioning equipment, computer software, and facilities. Interface control documents will also identify interfacing organizations and approval requirements. These documents are used to identify and control interface features throughout all phases of site characterization, design, construction, and operation.) (See AP-5.19Q.) Boundaries and interfaces internal to a participating organizations design shall be controlled by the procedures of that organization. Boundaries are the limits of influence of a system or subsystem. Interfaces are the points at which independent systems or subsystems meet and act on or communicate with each other. 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 in the following sections:

1.2.6.1 ESF SITE
1.2.6.2 SURFACE UTILITIES
1.2.6.3 SURFACE FACILITIES
1.2.6.4 FIRST SHAFT
1.2.6.5 SECOND SHAFT
1.2.6.6 UNDERGROUND EXCAVATIONS

1.2.6.7 UNDERGROUND SUPPORT SYSTEMS
1.2.6.8 UNDERGROUND TESTS
1.2.6.9 ESF DECOMMISSIONING AND CLOSURE

APPLICABLE REGULATIONS, CODES, AND SPECIFICATIONS

It is the responsibility of the Architect-Engineer (A/E) to identify, subject to the approval of the Project Office, which specific regulations, codes, and standards apply Citations can be found in each section of this document as applicable. Specific citations of the applicable regulations, codes, and specifications can be found in the ESF Basis for Design Documents and Environmental Regulatory Compliance Plan. SDRD Appendix E contains a listing of some additional commonly used regulations, codes, and standards. The latest edition or revision of a regulation, code, or standard in effect at the time of baselining of this document shall be used. In the event of conflicting requirements, the mandatory standard providing the greater protection shall apply. The Project Manager of the Yucca Mountain Project Office, or his designee, shall be requested in writing to approve or obtain any required waivers.

FUNCTIONAL REQUIREMENTS

1. 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)]

    i. Support in situ site characterization for the Mined Geologic Disposal System and provide testing facilities for in situ site characterization as required by DOE/OGR milestones and Site Characterization Plan. [E6.0FR1] [E89]

2. 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(d)(4)]

    i. Provide an ESF that can be incorporated into the repository and can be used to support Phase I repository construction. [E6.0FR2] [E89]

3. Provide a suitable location for in situ site characterization. [E6.0FR3] [E89]

4. Provide equipment and facilities for ensuring a safe, healthful, and productive working environment. [E6.0FR4] [E89]

5. Provide the facilities to alert on-site personnel of possibly dangerous situations [E6.0FR5] [E89]

6. Provide design and construction methods that will demonstrate licensability and constructibility for the candidate repository. [E6.0FR6] [E89]

PERFORMANCE CRITERIA

1a. 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] [E6.0PC1a] (D,O,P) [E89]

1b. 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 demonstrated that critical parts of the allowance would require excessive costs, schedule, test disruption, or other program impacts to design, procure, and/or construct 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. [E6.0PC1b] (D,O,P,T) [E89]

1c. 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. [E6.0PC1c] (D) [E89]

1d. All allowances for uncertainty of the major ESF systems are to be determined as soon as possible after the start of Title II. [TBD] [NEV] (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 [E6.0PC1d] (D,O) [E89]

1f. [The Safety Analysis Report shall include] an analysis of the performance of the major design structures, systems, and components, both surface and subsurface, to identify those that are important to safety. For the purposes of this analysis, it shall be assumed that operations at the geologic repository operations area will be carried out at the maximum capacity and rate of receipt of radioactive waste stated in the application. [10 CFR 60.21(c)(1)(ii)(E)]

i. Management shall provide an analysis of the major design structures, systems and components in the ESF to identify those that are important to safety. (See YMP baselined Q-List) [RL-6] [E6.1PC1g] [E89] (D)

1g. 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 [Chapter 10] and such generally applicable environmental standards for radioactivity as may have been established by the Environmental Protection Agency. [10 CFR 60.111(a)]

i. The ESF 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 limits specified in 10 CFR 20 and such generally applicable environmental standards for radioactivity as may be established by the Environmental Protection Agency. [NEV] (D,O)

1h. 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 functions. [10 CFR 60.131(b)(2)]

i. To the extent that any ESF components are determined to be important to safety, those components shall be designed to withstand dynamic effects such as credible cases of projectile missile impacts that could result from equipment failure and similar events and conditions that could lead to the loss of their safety functions. [NEV] (D)

1i. The design of the underground facility shall provide for control of water or gas intrusion. [10 CFR 60.133(d)]

i. The design of the ESF shall provide for control of water and gas intrusion. [NEV] (D)

2a. The quality assurance program applies to all systems, structures and components important to safety, to design and characterization of barriers important to waste isolation and to activities related thereto (See YMP baselined Q-list and baselined QAL). These activities include: site characterization, facility and equipment construction, facility operation, performance confirmation, permanent closure, and decontamination and dismantling of surface facilities. [10 CFR 60.151]

DOE shall implement a quality assurance program based on the criteria of Appendix B of 10 CFR Part 50 as applicable, and appropriately supplemented by additional criteria as required by § [10 CFR] 60.151. [10 CFR 60.152]

i. ESF permanent structures, systems, and components (repository quality) that will be incorporated into the repository shall be designed and constructed with the same criteria, standards, and quality assurance levels as required for the repository to the extent known at the time of ESF design. [E6.0PC2] (D,O,W) [E89]

ii. The items, listed below, are the "ESF permanent systems, structures, and components" identified in the GR Appendix E that shall be designed, procured, and constructed to be incorporated into the repository: [NEV]

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

b. Shaft Liner(s)--all permanent components placed between the inside limits of the shaft and the accessible extent of the underground opening.

c. 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 when the ESF is incorporated into the repository.

d. 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 and quality as specified for the repository. (See 1.2.6.0PC2b.) [NEV] (D,O,W)

2b. The design life for ESF systems, components, and structures shall be as follows: [NEV]

i. The design life for all ESF systems, components, and structures shall be 5 years unless otherwise specified. [TBV] [E6.0CU] [E89]

ii. Drainage ponds and rock storage liners shall be designed and constructed for a 25-year life. [TBV] [E6.2PC3d] (D) [E89]

iii. Shaft collars shall be designed and constructed for a maintainable 100-year design life. [TBV] [E6.3PC1n] (O,S,M) [E89]

iv. Site preparation for shaft collars shall be designed and constructed for a maintainable 100-year design life. [TBV] [E6.2PC4o] (D,O,M) [E89]

v. Permanent shaft structures, systems, and components shall be designed and constructed for a maintainable 100-year design life. [TBV] [E6.4PC1b] [E6.5PC1h] (O,S,M) [E89]

vi. Permanent ESF structures, systems and components shall be designed and constructed for a 100-year maintainable design life. [TBV] [E6.6PC1b]

vii. The rock storage (muck pile) liner shall be designed and constructed for a maintainable 25-year [TBV] life. [NEV,E6.0CU] (D,O,M)

viii. The maintainable design life for those ESF structures, systems, and components that are necessary for initial repository construction shall be 15 years. [TBD] [TBV] [NEV] [NEV] (D,O,M)

3a. The ESF shall conform with the siting requirements of the Generic Requirements for a Mined Geological Disposal System (OGR/B-2). [E6.0PC3a] (T,W) [E89]

3b. 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)]

i. The location of the ESF shall be within the candidate repository site and representative of the features and conditions expected at the candidate repository site. [TBV] [E6.0PC3b] (D) [E89]

ii. The thickness, lateral extent, physical and chemical properties, and composition of the host rock for the ESF shall be representative of the candidate repository. [E6.0PC3c] (D) [E89]

iii. Drill cores and other geologic data shall be used to confirm the location of and to design the ESF shafts and underground openings. [E6.0PC3d] (D,O,T) [E89]

3c. The ESF shall conform to applicable Federal, State, and local codes and standards pertaining to natural hazards and foundation stability, such as the requirements specified in General Design Criteria Manual, DOE Order 6430.1A. [E6.0PC3e] (D) [E89]

3d. All geotechnical information used in the design of underground features (including seismic criteria) shall be consistent with information contained in the Reference Information Base (RIB), Yucca Mountain Project controlled documents, or standard reference information (e.g., standard handbooks). See SDRD Appendix D, E, and F for the indexes and cross references to other applicable and referenceable Project documentation. Records of the ESF design, construction, operation and in-situ testing shall be maintained sufficient to satisfy the requirements of 10 CFR 60.72 and GR, Appendix E, Performance Criteria 4. [NEV] (T)

3e. Performance confirmation testing shall be carried out to meet requirements of 10 CFR 60.140(b), .140(c), .140(d)(1), .141, and .142. [NEV] (D,O,P)

4a. 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, and N will give rise to rebuttable presumption that this requirement has not been met. [10 CFR 60.131(b)(9)]

i. Applicable provisions of the Federal Mine Safety and Health Act of 1977, as amended, shall apply to the design, construction, and operations of the ESF. [E6.0PC4a] (D,O,T) [E89]

4b. Quality and quantity of uncontaminated ventilation air supplied to the subsurface facilities of the ESF system shall provide a safe, healthy, and productive working environment to operations personnel. [NEV] (D,O,T,S)

4c. Two shafts shall be incorporated into the ESF to ensure adequate alternative means of egress. [E6.0PC4b] (D,O,S) [E89]

4d. The centerline coordinate locations for the first shaft, ES-1, and the second shaft, ES-2 shall be defined by the Nevada Coordinate System and as determined by Sandia and listed in the RIB, Chapter 2, Section 4, Item 1, as amended. [NEV]

5a. The structures, systems, and components important to safety shall be designed to perform their safety functions during and after credible fires or explosions in the geologic repository operations area. [10 CFR 60.131(b)(3)(i)]

To the extent practicable, the geologic repository operations area shall be designed to incorporate the use of noncombustible and heat resistant materials. [10 CFR 60.131(b)(3)(ii)]

The geologic repository operations area shall be designed to include explosion and fire detection alarm systems and appropriate suppression systems with sufficient capacity and capability to reduce the adverse effects of fires and explosions on structures, systems, and components important to safety. [10 CFR 60.131(b)(3)(iii)]

The geologic repository operations area shall be designed to include means to protect systems, structures, and components important to safety against the adverse effects of either the operation or failure of the fire suppression systems. [10 CFR 60.131(b)(3)(iv)]

i. Alarm systems shall indicate when the various monitored conditions exceed predetermined specified limits. Redundant systems shall be installed as required by applicable regulations. [E6.0PC5a] (S) [E89]

a. Redundant systems shall include either whole systems or critical components within the system to the extent practical. [TBD] [NEV]

ii. Monitoring of conditions such as noise, noxious or flammable gas, and radon shall be conducted in accordance with applicable Federal, State, and local regulations. [E6.0PC5b] (S) [E89]

a. Radon monitoring is radon daughter monitoring as required by 30 CFR 57.5037. [NEV]

iii. Detection equipment for fires and explosions shall be in accordance with DOE Order 5480.7; DOE Order 6430.1A, Division 15, Mechanical ; and any other applicable local, State, and Federal regulations [SR] (S)

iv. Monitoring of background shall be conducted in compliance with the radiological health and safety plan [reference TBD] within the surface and subsurface facilities of the ESF. [NEV] (P,T)

5b. Environmental monitoring shall take into account the requirements of DOE Order 5480.4, Environmental protection, Safety and Health Protection Standards. [NEV] [SR] (S)

5c. 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 (33 U.S.C 1251) and the Safe Drinking Water Act (42 U.S.C. 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). [NEV] [SR] (S)

5d. Noise levels at the surface facilities shall be monitored in accordance with 29 CFR 1910.95(d), 29 CFR 1926.52. [NEV] [SR] (S)

5e. A monitoring system to measure and characterize seismic activity, such as a microseismic network, shall be provided to measure magnitude, and determine the location, and depth of ground accelerations. [NEV] [SR] (S)

5f. Where first motion indication is required, a strong motion indicator shall be used where necessary. [TBD] [NEV] [SR] (S)

5g. Seismic monitoring shall be provided on a continual 7-day basis. [TBV] [NEV] [SR] (S)

6a. Shafts and other underground excavations shall be designed and constructed with reasonably available technology similar to or corresponding with the techniques planned for the candidate repository. [E6.0PC6a] (D,O,T) [E89]

6b. 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. [NEV] (D,O,T) [E89]

6c. The ESF structures, systems, and components that are incorporated into the repository shall meet the requirements of 10 CFR Part 60. Compliance with the requirements of 10 CFR 60 will be demonstrated at the time of repository license application. [E6.0PC6b] (D,O,W) [E89]

6d. For the ESF structures, systems, and components that shall be incorporated into the repository as engineered barriers and are

important to waste isolation, the following criterion applies (compliance will be demonstrated at the time of repository license application):

> Assuming anticipated processes and events, the release rate of any radionuclide from the engineered barrier system, excluding shaft and borehole seals, following the containment period shall not exceed 1 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 percent of the calculated total release rate limit. The calculated total release rate limit shall be taken to be 1 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.

[TBV] [E6.0PC6c] [E89]

6e. The ESF shall be designed so as to permit implementation of a Performance Confirmation Program that meets the requirements of 10 CFR 60 Subpart F. [RL-32] [E6.0PC6j] (D,O,T) [E89]

6f. 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(d)(1)]

i. ESF activities shall not affect overall site integrity of the Mined Geological Disposal System as required by 10 CFR 60.112. [E6.0PC6f] (D,O) [E89]

6g. [The Safety Analysis Report shall include an assessment containing an evaluation of] 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. [10 CFR 60.21(c)(1)(ii)(D)]

i. The ESF design shall include a comparative evaluation of alternatives to the major design features, with particular attention to the alternatives that would provide longer radionuclide containment and isolation. Such an evaluation shall be performed for any ESF permanent component determined to be important to waste isolation. [RL-5] [E6.0PC6i] (D,O) [E89] [10 CFR 60.21(c)(1)(ii)(D)]

6h. [The Safety Analysis Report shall include an assessment containing] an analysis of the performance of the major design structures, systems, and components, both surface and subsurface, to identify those that

are important to safety. For the purposes of this analysis, it shall be assumed that operations at the geologic repository operations area will be carried out at the maximum capacity and rate of receipt of radioactive waste stated in the application.
[10 CFR 60.21(c)(1)(ii)(E)]

i. Any ESF structures, systems and components found to be "Important To Safety" shall be designed to permit periodic inspection necessary to ensure their continued functioning and readiness. [RL-19] [E6.0PC6h] (D,O,M) [E89]

a. As part of the design process, the responsible AE shall evaluate and identify or develop specifications for operational inspection and testing of ESF structures, systems, and components important to safety. [NEV]

6i. 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 vunrestricted areas, will at all times be maintained within the limits specified in Part 20 of this chapter [Chapter 10] and such generally applicable environmental standards for radioactivity as may have been established by the Environmental Protection Agency.
[10 CFR 60.111(a)]

i. The ESF shall be designed and operated to maintain radiation exposures to the limits specified in 10 CFR 20. [RL-10] [RL-27] [E6.0PC6g] (D,O) [E89]

6j. 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.
[10 CFR 60.111(b)(1)]

i. The design of the ESF shall not preclude the option to retrieve emplaced waste as specified in the GR Appendix D. [RL-11] [E6.0PC6e] (D) [E89]

6k. (a) 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. (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]

i. ESF openings, boreholes, and their seals shall be designed and constructed so that they do not become preferential pathways that may compromise the repository's ability to meet the performance objectives of 10 CFR Part 60. Compliance with the criterion will be demonstrated in the license application. [E6.0PC6d] (W,T) [E89]

61. The quality assurance program applies to all systems, structures and components important to safety, to design and characterization of barriers important to waste isolation and to activities related thereto. These activities include: site characterization, facility and equipment construction, facility operation, performance confirmation, permanent closure, and decontamination and dismantling of surface facilities. [10 CFR 60.151]

DOE shall implement a quality assurance program based on the criteria of Appendix B of 10 CFR Part 50 as applicable, and appropriately supplemented by additional criteria as required by § [10 CFR] 60.151. [10 CFR 60.152]

i. All ESF structures, systems, and components determined to be important to safety and barriers (items) important to waste isolation, and activities related to their characterization, design, construction, and operation shall meet the requirements of 10 CFR 60.151 and 10 CFR 60.152. [SR] (D,O,S,W)

INTERFACE CONTROL REQUIREMENTS

1. The basic interface control requirements are established by the Yucca Mountain Project Administrative Procedure AP-5.19Q, Interface Control Procedure. This procedure is applicable to all work to be performed by participating organizations and contractors during the engineering phases for the ESF. Specific working groups may be formed, as required, to coordinate Project-specific interfaces. [TBD] [NEV]

CONSTRAINTS

A. The ESF system shall comply with all applicable federal environmental regulations and with State and local environmental regulations consistent with the DOE's responsibilities under the Nuclear Waste Policy Act of 1982 (NWPA) as amended. Such compliance should include the following:

i. Point-source discharges of treated waste waters into surface-water systems shall comply with the provisions of the Clean Water Act, as amended, as implemented by the Project Office through the National Pollutant Discharge Elimination System (NPDES) permit process.

ii. Any ESF activity involving a public drinking-water source must meet the National Interim Primary Drinking Water Regulations and the National Secondary Drinking Water Regulations under the Safe Drinking Water Act.

iii. The Management and disposal of solid and any hazardous wastes shall be conducted in accordance with the requirements of the Resource Conservation and Recovery Act (RCRA), as amended, and State's hazardous waste regulations.

iv. Noise levels shall be controlled in accordance with the requirements of the Noise Control Act of 1972.

v. Any activity involving underground injections shall comply with the provision of the Safe Drinking Water Act, as amended, and the corresponding State's Underground Injection Control (UIC) regulations.

vi. Any activity conducted in a floodplain must be preceded by a floodplain/wetlands assessment in compliance with 10 CFR Part 1022.

vii. Discharges of air pollutants must be in accordance with the Clean Air Act and State implementing regulations.

viii. Any spills of hazardous substance must be reported to the National Response Center and cleaned up in compliance with the Superfund Act. Community-Right-To-Know regulations under Title III of Superfund Amendments and Reauthorization Act (SARA) must be complied with when applicable.

ix. The Programmatic Agreement, which implements the National Historic Preservation Act, must be followed to protect cultural resources.

x. Discovery of threatened or endangered species would trigger compliance with the Endangered Species Act.

xi. The ESF shall comply with the requirements of the Yucca Mountain Project Radiological Monitoring Plan [reference TBD]. [NEV,2/89]

[E6.0CA] [E89]

B. Applicability of State and local regulations will be determined in consultation with State and local officials as stated in the final EAs, Mission Plan and NWPA, as amended. [E6.0CB] [E89]

C. Where there are conflicts between applicable Federal, State, and local safety regulations and codes, the requirements providing the greater protection shall govern. (DOE Order 5480.4) [E6.0CO] [E89]

D. To the extent practicable and consistent with procurement regulations, consideration of surplus government equipment shall be given to

fulfill the requirements for the support services and equipment. [E6.0CP] [E89]

E. To the extent practicable and consistent with procurement regulations, consideration of surplus government equipment shall be given to fulfill the requirements for ESF facilities and equipment. [E6.0CX] [E89]

F. 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)]

i. The ESF shall provide in situ exploration and testing at the depths at which waste will be emplaced. [E6.0CW] [E89]

G. The program of (ESF activities relating to) site characterization shall be conducted in accordance with the following:

(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(d)(1)]

(2) 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(d)(2)]

(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. [10 CFR 60.15(d)(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(d)(4)]

i. Underground ESF construction shall not adversely affect in-situ site characterization. [E6.0CS] [E89]

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. [E6.0CV] [E89]

Note: See baselined Quality Activities List (QAL).

iii. Exploratory Shaft Facility structures, systems, and components incorporated into the repository design shall not compromise the ability of the repository to isolate and contain radioactive wastes. [SR]

iv. 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 t affect site characterization testing, repository testing or monitoring, and waste isolation. They may be added only following review and approval. [NEV]

v. Use of hydrocarbons and solvents underground shall comply with criteria to be determined by performance assessment. [NEV]

vi. Precautions shall be taken to avoid and/or control spills of hydrocarbons, solvent, and cementitious materials. Spills which do occur will be cleaned up to the extent practicable. [NEV] [TBD]

vii. Testing instrumentation shall be removed to the extent practicable following its final use. [NEV] [TBD]

viii. To the extent practicable, avoid drilling with water into known large-aperture fractures. [NEV]

ix. ESF items and activities shall not affect overall site integrity of the MGDS as required by 10 CFR 60.112 (See baselined QAL). [NEV]

H. [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. [10 CFR 60.21(c)(11)]

i. ESF structures, systems, and components shall incorporate considerations for decommissioning and closure. [E6.0CT] [E89]

ii. All decommissioning-related air emissions shall comply with the requirements of the repository state's air quality protection program. Applicable air quality standards and emission control procedures would exist at the State or local level. [NEV] [GR Appendix C] [SR]

I. 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)]

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)]

J. 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]

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. Natural, credible disruptive events shall be identified by the A/E and reviewed and approved by the Project Office. 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 events shall be as described in the RIB. [NEV]

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 A/E and reviewed and approved by the Project Office. 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 events shall be developed by the responsible A/E and included in their design basis documentation. [NEV]

iii. The ESF site shall be located such that, on the basis of expected groundwater conditions, it will be unlikely that engineering measures beyond reasonably available technology will be required for ESF construction, operation, or closure. [E6.0CQ] [E89]

K. The structures, systems, and components important to safety shall be designed so that natural phenomena and environmental conditions anticipated at the geologic repository operations area will not interfere with necessary safety functions. [10 CFR 60.131(b)(1)]

   i. The ESF structures, systems, and components important to safety shall be designed so that natural phenomena and environmental conditions expected at the ESF and candidate repository site will not interfere with necessary safety functions. [E6.0CG] [E89]

L. 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 functions. [10 CFR 60.131(b)(2)]

i. The ESF structures, systems, and components important to safety shall be designed to withstand dynamic effects, such as projectile impacts, that could result from equipment failure, and similar events and conditions that could lead to loss of their safety functions. [E6.0CH] [E89]

M. The structures, systems, and components important to safety shall be designed to perform their safety functions during and after credible fires or explosions in the geologic repository operations area. [10 CFR 60.131(b) (3)(i)]

To the extent practicable, the geologic repository operations area shall be designed to incorporate the use of noncombustible and heat resistant materials. [10 CFR 60.131(b)(3)(ii)]

The geologic repository operations area shall be designed to include explosion and fire detection alarm systems and appropriate suppression systems with sufficient capacity and capability to reduce the adverse effects of fires and explosions on structures, systems, and components important to safety. [10 CFR 60.131(b)(3)(iii)]

The geologic repository operations area shall be designed to include means to protect systems, structures, and components important to safety against the adverse effects of either the operation or failure of the fire suppression systems. [10 CFR 60.131(b)(3)(iv)]

i. The ESF structures, systems, and components important to safety shall be designed and located to withstand the effects of credible fires and explosions as well as all other postulated design basis accidents. [E6.0CI] [E89]

a. Responsible AE and PI shall develop a list of hazardous substances whose use shall be controlled on surface and underground. The list shall contain information on maximum allowable quantities and their basis of determination. [NEV]

ii. To the extent practicable, the ESF shall be designed to incorporate the use of noncombustible and heat-resistant materials. [E6.0CL] [E89]

iii. The ESF shall be designed to include explosion and fire protection alarm systems and appropriate suppression systems with sufficient capacity to reduce the adverse effects of fires and explosions on structures, systems, and components important to safety. [NEV]

iv. The ESF shall be designed to include means to protect systems, structures, and components important to safety against adverse effects of either the operation or failure of fire suppression systems. [NEV]

N. 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. [10 CFR 60.131(b)(4)(i)]

i. To the extent that any ESF components are determined to be important to safety, ensure that structures, systems, and components important to safety will maintain control of radioactive materials, permit prompt termination of operations, and allow evacuation of personnel during an emergency. [NEV]

ii. The ESF structures, systems, and components important to safety shall be designed to ensure continued safe repository operation or prompt termination of operation and personnel evacuation, if necessary, under conditions resulting from the effects of natural phenomena and design-basis accidents. [E6.0CJ] [E89]

iii. The ESF shall be designed to include on site facilities and services that ensure a safe and timely response to emergency conditions and that facilitate the use of available off site services (such as fire, police, medical, and ambulance service) that may aid in recovery from emergencies. [E6.0CM] [E89]

O. 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, and N will give rise to rebuttable presumption that this requirement has not been met. [10 CFR 60.131(b)(9)]

i. If the subsurface facility has the potential to be classified as a gassy mine, then appropriate requirements of 30 CFR Part 57 in effect at the time of design shall be applicable. [E6.0CK] [E89]

P. 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)] [RL-21] [E6.0CC] [E89]

Q. 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)]

i. The ESF shall be designed so that the effects of credible disruptive events such as flooding, fires, and explosions shall be limited from spreading through the facility. [E6.0CD] [E89]

R. 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)]

i. The predicted thermal and thermomechanical response of the host rock and surrounding strata and the groundwater system shall be considered in the ESF design. [E6.0CN] [E89]

S. (a) 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. (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) foe radionuclide migration through existing pathways. [10 CFR 60.134]

i. The design and construction of the permanent ESF structures, systems, and components shall not significantly increase the preferential pathways for groundwater or radionuclide migration to the accessible environment. [E6.0CE] [E89]

ii. The ESF engineered barrier system must be designed such that systems, structures, and components of the ESF and the repository do not eventually become preferential groundwater flow paths and do not promote the release of radionuclides to the accessible environment. [E6.0CF] [E89]

T. A site shall be located such that ESF construction, operation, or closure will not significantly degrade the quality, or significantly reduce the quantity, of water from major sources of offsite supplies presently suitable for human consumption or crop irrigation unless such impacts can be compensated for, or mitigated by, reasonable measures. [NEV, 10 CFR 960.5-2-6(d)] [SR]

U. The ESF surface facilities shall comply with the applicable Federal, State, and local environmental protection regulations (DOE Order 5440.1c). Such compliance shall include the following: [NEV]

i. All stationary sources (point sources) of air emissions shall comply with the applicable provisions of the Clean Air Act, as amended (42 U.S.C. 7401), which could include Prevention of Significant Deterioration (PSD) permitting, or offset Policy Review, or both. Federal regulations pertaining to compliance with the Clean Air Act include: 40 CFR 50 (National Primary and Secondary Ambient Air quality Standards) and 40 CFR 60 (Standards of Performance for New Stationary Sources). Since the EPA has delegated the implementation and enforcement of this program to the Nevada Division of Environmental Protection (NDEP), the Project 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. [NEV]

ii. All fugitive air emissions (non-point sources) shall be controlled in accordance with the applicable provisions of the Clean Air Act, as amended (42 USC 7401), as well as all applicable State and local air quality regulations. [NEV]

iii. All point source discharges of treated waste waters into surface water systems shall comply with the provisions of the Clean Water Act, as amended (33 U.S.C. 1251-1376), as implemented through the National Pollutant Discharge Elimination System (NPDES) permit process (Section 402 of the Clean Water Act). Since the EPA has delegated the implementation and enforcement of the NPDES program to the NDEP, the Project shall comply with the State or local standards included under the stipulations of NRS Chapter 445.131-.354. [NEV]

iv. Runoff and erosion at the repository site shall be controlled in accordance with applicable State and local regulations. [NEV]

v. Any ESF activity which may impact a drinking water source must meet the National Interim Primary Drinking Water Regulations (40 CFR 141), National Interim Primary Drinking Water Regulations Implementation (40 CFR 142) and the National Secondary Drinking Water Regulations (40 CFR 143) and NRS Chapter 445.361 - 445.399. [NEV]

vi. The management and disposal of solid and any hazardous wastes (excluding any radioactive wastes) shall be conducted in accordance with the requirements of the Resource Conservation and Recovery Act (RCRA), as amended (42 U.S.C. 3521, et seq.), which could include RCRA permitting for the hazardous wastes. Since parts of the RCRA program are administered by the NDEP, the Project shall comply with State or local standards stated under the stipulations of NRS Chapter 444.700-.778 Hazardous Waste Management and NRS Chapter 444.440-.620, Solid Waste Management System. [NEV]

vii. The clean-up and emergency response procedures for hazardous substances released into the environment shall be conducted according to the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA). CERCLA requires notification of the National Response Center and appropriate agencies and officials when release of a reportable quantity of hazardous substance occurs. Applicable emergency planning and community right-to-know requirements under Title III of SARA, known as the "Emergency Planning and Community Right-to-Know Act of 1986" will also be implemented. [NEV]

viii. The handling, use, and disposal of any toxic substances shall comply with the requirements of the Toxic Substances Control Act

(TSCA), as amended (15 U.S.C. 2601). Federal regulations implementing TSCA are coded in Title 40, Chapter I, Subchapter R. [NEV]

ix. The use of pesticides shall comply with the requirements of the Federal Insecticide, Fungicide, and Rodenticide Act, Extension and the Federal Pesticide Act of 1978 (P.L. 2-140 and P.L. 95-396) and its implementing regulations which include 40 CFR Part 162 (Regulations for the Enforcement of the Federal Insecticide, Fungicide,and Rodenticide Act). Any applicable State and local regulations on pesticides shall also be followed. [NEV]

x. Noise levels shall be controlled in accordance with the applicable requirements of the Noise Control Act (NCA) of 1972 (P.L. 92 - 574, as amended), and shall adhere to applicable Federal (Federal regulations implementing NCA are coded in Title 40, Chapter 1, Subchapter G), State, and local regulations. [NEV]

xi. Any activity involving underground injections (i.e., of non-radioactive material) must comply with the provision of the Safe Drinking Water Act, as amended (42 USC 300f), which could require an Underground Injection Control (UIC) permit. Because the UIC program is administered by an authorized State agency, there could be additional, or more stringent, State or local standards (See NRS 445.131 - 445.354). [NEV] [SR]

xii. ESF construction and operations shall comply with State and local requirements for permitting that may be stipulated by NRS Chapter 512.160, item 3-Opening and Closing of Mines; NRS Chapter 535-Permit to Construct Tailing Dam (Note: Only applies if dam is $\geq$ 10 feet high or holds $\geq$ 10 acre-feet of water.); and NAC 504.510-.550-Modification of Habitat- Special Permit (for alterations to wildlife habitat). [NEV] [SR]

xiii. All waste-waters shall be treated and disposed of in accordance with the requirements of Section 402 of the Clean Water Act, and any applicable State and local requirements. [NEV] [GR Appendix C] [SR]

xiv. The ultimate disposal of sludge from the wastewater treatment facilities shall be performed in accordance with the requirements of Section 405 of the Clean Water Act, and any applicable State and local regulations. [NEV] [GR Appendix C] [SR]

xv. Onsite storage capacity will be sufficient for satisfying backfill requirements (if required and reusable); onsite/off-site rock handling capacity will be capable of disposing of all excess excavated rock in an environmentally acceptable manner. [NEV] [SR]

V. 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). [NEV]

W. The ESF powerlines shall conform to DOE/NVO overhead powerline standards. [NEV]

ASSUMPTIONS

1. The responsibilities of the Yucca Mountain ESF participants shall be defined in AP-5.18Q, as amended, ESF Design Control. [NEV]

2. Any portion of the ESF utilized in the repository will become part of the repository design. Design requirements for repository/ESF interfaces, standoff distances, seals, and drains required to prevent the ESF from becoming a preferential pathway for groundwater travel or radionuclide release or interfering with retrievability, are found in the ESF SDRD Appendix A1 and A2. [NEV]

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

Subparts are
- 1.2.6.1.1 Main Pad
- 1.2.6.1.2 Auxiliary Pads
- 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 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. The ESF site is comprised of the main pad, auxiliary pads, access roads, and a drainage system. [NEV]

The ESF will be located on Dead Yucca Ridge on the eastern side of Yucca Mountain at an elevation of about 4,130 feet and placed on a cut-and-fill rock shelf located on the side of Dead Yucca Ridge that bounds the Coyote Wash on the northeast. [NEV]

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project 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 1.2.6.1 necessitates an evaluation and understanding, by the designer, of the boundary and interface impacts of the requirements and criteria in the following sections: [NEV] jdw47

1.2.6.0 GENERAL (EXPLORATORY SHAFT FACILITY)
1.2.6.2 SURFACE UTILITIES
1.2.6.2.1 Power Systems
1.2.6.2.2 Water Systems
1.2.6.2.3 Sewage Systems
1.2.6.2.4 Communication System
1.2.6.2.5 Mine 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 Sites for Temporary Structures (Buildings and/or Trailers)
1.2.6.3.4 Parking Areas
1.2.6.3.5 Materials Storage Facilities
1.2.6.3.6 Shop
1.2.6.3.7 Warehouse
1.2.6.3.8 Temporary Structures (Buildings and/or Trailers)

1.2.6.3.9 Communications/Data Building
1.2.6.4 FIRST SHAFT
1.2.6.4.1 Collar
1.2.6.5 SECOND SHAFT
1.2.6.5.1 Collar
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

APPLICABLE REGULATIONS, CODES, AND SPECIFICATIONS

The design shall be in accordance with:

1. DOE 6430.1A, dated April 6, 1989, Division 1-General Requirements (except for the seismic requirements in 0111-2.7, earthquake loads); Division 2-Site and Civil Engineering; Division 3-Concrete; and Division 5-Metals. For shaft design seismic requirements, refer to SDRD Appendix A.4. For surface structures design seismic requirements, refer to UCRL - 15910, Draft (rev4). [NEV]

2. NAC-Chapter 445, Paragraph 705, Item 8. [NEV]

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

4. 30 CFR Part 57. [NEV]

5. 29 CFR Part 1910. [NEV]

6. DOE 5480.4. [NEV]

In addition, see Section 1.2.6.0, Applicable Regulations, Codes, and Specifications. [NEV]

FUNCTIONAL REQUIREMENTS

1. Provide archaeological and control surveys and maps. [E6.2FR1] [E89]

2. Provide for demolition and removal of existing roads, utilities, and structures that are unusable. [E6.2FR2] [E89]

3. Provide general civil improvements, include clearing, grading, excavating, filling, parking, drainage systems, temporary roads, laydown areas, and rock storage pads as required. [E6.2FR3] [E89]

4. Construct new and relocate or refurbish existing roads as well as power, water-supply, communications, and sewage-treatment systems for the site. Include provisions for road access to the site, as required. [E6.2FR4] [E89]

5. Provide for dust control. [E6.2FR5] [E89]

6. The pads shall provide areas of adequate size and shape to support construction and testing activities associated with sinking the ES-1 and ES-2 shafts simultaneously as supported by analysis. [NEV]

7. Provide suitable borrow areas for surface construction. [NEV]

PERFORMANCE CRITERIA

1. The ESF site shall be surveyed and mapped with sufficient detail for archaeological and construction needs. [E6.2PC1] (D) [E89]

2a. The area within the fenced boundaries shall be cleared of unusable roads, utilities, and structures that interfere with the ESF. [E6.2PC2a] (D) [E89]

2b. Existing roads, utilities, and structures shall be incorporated into the ESF if this incorporation can be shown to be cost effective. [E6.2PC2b] (D) [E89]

3a. Roads, building pads, utility corridors, and rock-storage areas shall be cleared, graded, and stabilized. Topsoil shall be stored in an environmentally acceptable manner. [E6.2PC3a] (D) [E89]

3b. The site layout shall be able to accommodate future expansion. [E6.2PC3b] (D) [E89]

3c. Shaft and shaft-collar areas shall be located and/or graded to protect them from the probable maximum flood. [E6.2PC3c] (D,O,S) [E89]

4a. The water storage and distribution system shall meet the needs of fire protection, construction, and operations. [E6.2PC4d] (D,O,S) [E89]

4b. All storm-water runoff shall be controlled in an environmentally acceptable manner. [E6.2PC4e] (D,O,M) [E89]

4c. Lighting in operations areas shall support security requirements. [E6.2PC4n] (D,O,M,T) [E89]

5a. 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. [E6.2PC5] (D,O,M) [E89]

5b. 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.). [NEV] (D,O,M)

6. The pads will be sized and arranged such that temporary facilities to support shaft sinking are incorporated as supported by analysis. [NEV] (D)

7. The borrow areas shall be located as close to the ESF as practical. [NEV]

INTERFACE CONTROL REQUIREMENTS

1. The ESF designers shall, as practical, 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. [TBD] [NEV]

   See Section 1.2.6.0, Interface Control Requirements. [NEV]

CONSTRAINTS

A. The program of site characterization shall be conducted in accordance with the following:

   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(d)(1)]

   i. 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. [NEV] [TBD]

B. The Safety Analysis Report shall include: (11) A description of design considerations that are intended to facilitate permanent closure and decontamination or dismantlement of surface facilities. [10 CFR 60.21(c)(11)]

   i. The pad shall be designed so when the facility is decommissioned the ground can be restored to a contour compatible with its initial conditions. [NEV]

C. 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)]

   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. [NEV] [TBD]

   ii. The main pad 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 to facilitate investigation and monitoring of such effects during and after construction. [NEV] [TBD]

iii. The Exploratory Shaft facility main 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. [NEV]

D. 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]

i. 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. [NEV]

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]

Although not explicitly required by Part 60, DOE will provide the following safety features that will help achieve the performance objectives:

i. Pad operation and construction should limit adverse chemical changes by controlling the use of hydrocarbons, solvents, and chemicals. [NEV] [TBD]

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

i. Construction water shall be limited to that required for addition to fill material for proper compaction, dust control, and proper equipment operation consistent with performance objectives. [NEV] [TBD]

ii. The amount of water used by operations on the main pad shall be limited consistent with performance objectives. [NEV] [TBD]

iii. Water use in pad construction shall not adversely impact goals to limit the increase in average percent saturation of the repository horizon to less than [TBD] percent and limit the

increase in local percent saturation to less than [TBD] percent in waste emplacement areas. [NEV]

iv. 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. [NEV] [TBD]

v. MPBHs or other surface drilled exploratory boreholes associated with the ESF shall be drilled dry. [NEV]

vi. 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. [TBD] [NEV]

vii. Construction procedures shall enable removal of excess water. [NEV]

viii. Operating procedures shall be developed to ensure that water entering the ESF is managed appropriately, including quantity, location, and water balance. [NEV]

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

H. 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. [NEV] [TBV]

I. Access to the ESF site pad from the east shall be controlled by a gate across the roadway. [NEV]

J. Flood protection shall be utilized for appropriate surface facilities as applicable. [NEV]

K. Runoff and erosion during decommissioning shall be controlled in accordance with applicable State of Nevada and local regulations. [NEV] [GR Appendix C] [SR1.2.6CA]

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 during the design process. [NEV]

2. The natural terrain will provide a barrier to vehicle access, except from the east which will be controlled by a chain link fence and gates. [NEV]

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

1.2.6.1.1 MAIN PAD
(Generic Physical Subsystem Account Code: 4.1.1)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The main pad accommodates structures, systems, and components for direct construction of and access to the underground site characterization areas but does not include initial construction and test support facilities. [NEV]

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project 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 1.2.6.1.1 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 Pads
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	FIRST SHAFT
1.2.6.5	SECOND SHAFT
1.2.6.6	UNDERGROUND EXCAVATIONS
1.2.6.8.2	Geological Testing
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.1	Surface Facilities

FUNCTIONAL REQUIREMENTS

1. The main pad shall provide an area of adequate size and shape to support all anticipated structures, systems, and components that will be located near the shafts. Analysis to determine which items should be included on the main pad, shall consider the following: [NEV]

   i. Roads (muck haulage and access). [NEV]
   ii. ES-1 (plus standoff distances). [NEV]
   iii. ES-2 (plus standoff distances). [NEV]
   iv. Permanent hoist house(s), (plus standoff distances). [NEV]
   v. Headframes and back legs. [NEV]
   vi. Muck handling facilities. [NEV]
   vii. Ventilation fans (plus standoff distances) as required. [NEV]
   viii. Utilities (power, water, sewage, communications). [NEV]
   ix. Shaft sinking facilities. [NEV]

x. Parking. [NEV]
xi. Communications/Data building. [NEV]
xii. Multipurpose boreholes. [NEV]
[NEV]

PERFORMANCE CRITERIA

1a. Site roads shall meet the requirements of site security, safety, and expected loads during ESF construction and operations. [E6.2PC4c] (D,O,S) [E89]

1b. The main pad shall be designed to be protected from a probable maximum flood. [NEV] (D,O,S,M) [TBD]

1c. Buildings shall be so spaced as to allow sufficient room for construction and maintenance of the facilities. [NEV] (D,O,M)

1d. The main pad shall be constructed in such a manner as to limit adverse effects on the long-term performance of the geologic repository to the extent practical. [RL-2] [NEV] (D) [TBD]

1e. The layout of the main pad shall facilitate the safe and efficient flow of material and personnel within the ESF site. [NEV] (D,O)

CONSTRAINTS

None.

ASSUMPTIONS

None

1.2.6.1.2 AUXILIARY PADS
(Generic Physical Subsystem Account Code: 4.1.2)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The auxiliary pads consist of the areas prepared to support the ESF construction and operation. These pads include the existing G-4 laydown pad, explosives magazine pad, muck storage pad, topsoil storage pad, batch plant pad, water tank pad, lower storage pads, substation pad with standby generators, compressor pad, warehouse pad, and other areas defined as the design progresses. [NEV] emc6

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project 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 1.2.6.1.2 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 Pad
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 FIRST SHAFT
1.2.6.5 SECOND SHAFT
1.2.6.9 ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.1 Surface Facilities

FUNCTIONAL REQUIREMENTS

1. The auxiliary pads shall provide areas of adequate size and shape to support anticipated functions. Analysis to determine which items should be included on the auxiliary pads, shall consider the following: [NEV]

   i. Construction Utilities [NEV]

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

      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. Mine wastewater disposal.

g. Air compressor system.

ii. Construction surface storage. [NEV]

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. [NEV]

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

iv. Access to other facilities. [NEV]

a. Roads.

v. Site characterization surface storage. [NEV]

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.

vi. Site characterization support facilities. [NEV]

a. Shop(s).
b. First aid station.

c. Offices.
d. Change house(s).
e. Utilities mb18
[NEV]

PERFORMANCE CRITERIA

1a. 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. [E6.3PC1h] (D,O,S) [E89]

1b. The rock-handling system 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 General ESF Requirements Section PC1a. [E6.2PC4k] (O) [E89] [TBD]

1c. The capacity of surface rock storage shall include allowance for overbreak and swell of broken rock from shafts and underground development. [E6.2PC41] (O) [E89]

1d. 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(d)(1)]

i. The auxiliary pads shall be constructed in such a manner as to limit adverse effects on the long-term performance of the geologic repository to the extent practical. [NEV] (D) [TBD]

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

i. Batch Plant pad, 10-year storm;

ii. Lower Storage Pads, 10-year storm;

iii. G-4 pad, 10-year storm;

iv. Booster Pump Building pad, 50-year storm;

v. Compressor pad, 50 year storm.
[NEV] (D,O,S,M)

CONSTRAINTS

A. The auxiliary pads shall facilitate the safe and efficient flow of material and personnel within and around their respective areas. [NEV]

ASSUMPTIONS

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

2. The muck storage pad must provide equipment or facilities for dust control when muck storage begins. [NEV]

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

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The access roads include all of the roads and associated features constructed to provide vehicular access to all surface areas designated and required to support ESF site characterization. [NEV]

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project 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 1.2.6.1.3 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 Pad
1.2.6.1.2 Auxiliary Pads
1.2.6.1.4 Site Drainage
1.2.6.2 SURFACE UTILITIES
1.2.6.3 SURFACE FACILITIES
1.2.6.4 FIRST SHAFT
1.2.6.5 SECOND SHAFT
1.2.6.9 ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.1 Surface Facilities

FUNCTIONAL REQUIREMENTS

1. The access roads shall accommodate all anticipated services in a safe and effective manner. [NEV]

PERFORMANCE CRITERIA

1a. Necessary access roads shall meet the requirements of ESF construction and operations. [E6.2PC4a] (D,O) [E89] [TBD]

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. [NEV] (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. [NEV] (D,O,S,M)

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. [NEV] (D,O,M)

CONSTRAINTS

A. Access roads used for hauling excavated rock or other heavy loads shall not exceed a grade that permits safe operation. [NEV]

B. Access roads used by normal vehicle traffic to reach facilities such as the water storage tank, main pad, or explosive magazines shall not exceed a grade that permits safe operation. [NEV]

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

D. The design for access roads shall include considerations to minimize dust and other environmental impacts. [NEV]

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

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

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

ASSUMPTIONS

None.

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. [NEV]

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project 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 1.2.6.1.4 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 Pad
1.2.6.1.2	Auxiliary Pads
1.2.6.1.3	Access Roads
1.2.6.3	SURFACE FACILITIES
1.2.6.4	FIRST SHAFT
1.2.6.5	SECOND SHAFT
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. [NEV] edit (See PC2 below)

PERFORMANCE CRITERIA

1. All storm-water runoff shall be controlled in an environmentally acceptable manner. [E6.2PC4e] (D,O,S,M) [TBD]

2. The areas around the shaft collar shall be designed and constructed to prevent water inflow from the probable maximum flood. [NEV, 10 CFR 60.133(a)(2)]

CONSTRAINTS

A. Site drainage shall not reduce the ability of the site to meet the performance objectives of the approved SCP. [NEV] [TBD]

ASSUMPTIONS

None.

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

Subparts are
- 1.2.6.2.1 Power Systems
- 1.2.6.2.2 Water Systems
- 1.2.6.2.3 Sewage Systems
- 1.2.6.2.4 Communication System
- 1.2.6.2.5 Mine Wastewater System
- 1.2.6.2.6 Compressed Air System

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The surface utilities systems, subsystems, structures, and components include provisions for power, water, sewage, communications, mine wastewater, and compressed air. [NEV]

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project 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 1.2.6.2 necessitates an evaluation and understanding, by the designer, of the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.0 GENERAL (EXPLORATORY SHAFT FACILITY)
1.2.6.1 ESF SITE
1.2.6.1.1 Main Pad
1.2.6.1.2 Auxiliary Pads
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 for Temporary Structures (Buildings and/or Trailers)
1.2.6.3.4 Parking Areas
1.2.6.3.5 Materials Storage Facilities
1.2.6.3.6 Shop
1.2.6.3.7 Warehouse
1.2.6.3.8 Temporary Structures (Buildings and/or Trailers)
1.2.6.3.9 Communications/Data Building
1.2.6.4 FIRST SHAFT
1.2.6.4.1 Collar
1.2.6.4.4 Furnishings
1.2.6.4.5 Hoist System
1.2.6.5 SECOND SHAFT
1.2.6.5.1 Collar
1.2.6.5.5 Hoist system
1.2.6.6 UNDERGROUND EXCAVATIONS
1.2.6.7 UNDERGROUND SUPPORT SYSTEMS

1.2.6.7.1 Power Distribution System
1.2.6.7.3 Lighting System
1.2.6.7.4 Ventilation Distribution System
1.2.6.7.5 Water Distribution System
1.2.6.7.6 Mine 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 Handling Systems
1.2.6.7.10 Sanitary Facilities
1.2.6.7.11 Monitoring and Warning Systems
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 Shafts and Underground Facilities

APPLICABLE REGULATIONS, CODES, AND SPECIFICATIONS

The power systems shall be designed in accordance with the following: [NEV]

Electrical Power [NEV]

1. DOE 6430.1A, dated April 6, 1989, Division 16-Electrical. [NEV]

2. NFPA-70. [NEV]

3. ANSI C 2. [NEV]

Lighting [NEV]

1. DOE 6430.1A, dated April 6, 1989, Division 16-Electrical.

Stand-by Power [NEV]

1. DOE 6430.1A, dated April 6, 1989, Division 16-Electrical

2. NRS Chapter 445, paragraphs .401 through .601.

Uninterruptible Power

1. DOE 6430.1A, dated April 6, 1989, Division 16-Electrical.

2. IEEE-485.

3. IEEE-650.

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

1. DOE 6430.1A, dated April 6, 1989, Division 2-Site and Civil Engineering and Division 15-Mechanical.

2. NRS Chapter 445, paragraphs .361 through .399.

3. NFPA 20, 22, and 24.

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

1. DOE 6430.1A, dated April 6, 1989, Division 2-Site and Civil Engineering.

2. NRS Chapter 445, paragraph .131 through .354.

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

1. DOE 6430.1A, dated April 6, 1989, Division 16-Electrical.

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

1. 30 CFR, Chapter I.

2. NRS Chapter 445, paragraph .131 through .354.

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

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

1. DOE 6430.1A, dated April 6, 1989, Division 2-Site and Civil Engineering.

2. 30 CFR, Chapter I.

3. NRS Chapter 512.

In addition, see Section 1.2.6.0, Applicable Regulations, Codes, and Specifications.

FUNCTIONAL REQUIREMENTS

1. Provide surface utility systems, subsystems, and facilities for the ESF that will be adequate to support site preparation, construction, operations, and testing during site characterization; including electrical power, water, sewer, mine wastewater disposal, telephone, communications, compressed air, and area lighting.

PERFORMANCE CRITERIA

1a. Necessary utility services, such as power, water, and communications systems, shall be constructed and made available to meet the requirements of ESF construction and operations. [E6.2PC4b] (D,O,S,P,M,T,I) [E89]

1b. A suitable system for treating, pumping, and disposing of credible water inflows into the ESF shall be provided. [E6.2PC4f] (D,O) [E89]

1c. Safety and security lighting shall be available. [E6.2PC4i] (D,O,S) [E89]

1d. Utilities such as electric power, compressed air, and water systems shall be provided to underground construction, operations, and in situ site characterization areas. [E6.2PC4j] (D,O,S,P,M,T,I) [E89]

1e. When installed, these systems shall not unnecessarily restrict foot, vehicular, or shaft conveyance traffic; obstruct ventilation; or cause health and safety concerns. [NEV] (D,O,S)

INTERFACE CONTROL REQUIREMENTS

1. The A/E 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. [TBD] [NEV]

2. 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. [TBD]

See Section 1.2.6.0, Interface Control Requirements.

CONSTRAINTS

A. 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. [NEV, 10 CFR 60.15(d)(1)] [TBD]

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. [NEV]

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

D. Piping shall be designed to preclude or limit possible water inflow to the ESF following a pipe rupture. [NEV] [TBD]

E. Fluids recovered from sanitary uses or construction operations shall be disposed of in such a way as to avoid potential for performance impacts, for example in lined ponds. [NEV]

ASSUMPTIONS

1. Solid refuse may be hauled to an existing landfill on the NTS or a new landfill may be built on the Yucca Mountain Project Site. [NEV]

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

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The power systems are 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, 5kV distribution system, extension of the existing 69-kV overhead power line, a secondary power line (to the booster pump station), surface lighting, a stand-by power generation system, and an uninterruptible power system (UPS).

The subsurface facilities power distribution system shall be defined in Section 1.2.6.7.1. [NEV]

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project 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 1.2.6.2.1 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
1.2.6.2.2 Water Systems
1.2.6.2.3 Sewage Systems
1.2.6.2.4 Communication Systems
1.2.6.2.5 Minewaste Water Systems
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 Sites for Temporary Structures (Buildings and/or Trailers)
1.2.6.3.4 Parking Areas
1.2.6.3.5 Materials Storage Facilities
1.2.6.3.7 Warehouse
1.2.6.3.8 Temporary Structures (Buildings and/or Trailers)
1.2.6.3.9 Communications/Data Building
1.2.6.4 FIRST SHAFT
1.2.6.5 SECOND SHAFT
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

FUNCTIONAL REQUIREMENTS

1. The electrical system shall provide: a standard electrical power distribution system, a standby electrical power system, and an uninterruptible electrical power system(s) (UPS) for the ESF. [NEV]

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. [E6.2PC4m] (D,O,S,P,M,T,I) [E89]

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. [NEV] (D,O,S,P,M,T,I)

1c. An overhead power line shall be routed from the existing 69-kV line (at the NTS boundary) to a main substation at the ESF site. [NEV] (D,O,S,P,M,T,I)

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 Canyon Substation and the main substation to be located at the ESF site. [NEV] (D,O,M)

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

1f. The power distribution system shall provide adequate services from the main ESF substation to the surface and subsurface facilities. [NEV] (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

v. Main water supply pump(s)

vi. Shaft-work-deck winches and miscellaneous motors

vii. Temporary facilities

viii. Shops

ix. Lights
[TBV] [NEV] (D,O,S,P,M,T,I)

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

1i. The standby power system shall include generators, buried fuel tanks, transfer switches, necessary fuel piping, conduit and wire, cutouts, concrete work, and weatherproof enclosures. The 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. [NEV] (D,O,S,P,M,T,I)

i. Standby power shall support only those systems essential to evacuation, fire control, flood control, and critical in situ site characterization testing. [E6.3PC11] (D,O,S,P) [E89]

1j. 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 time allowed), ventilation, area lighting, and surface computer equipment that would be damaged by a power failure. The allowable delay time between the loss of primary power and the availability of standby power will be dictated by safety considerations of the mining operation. [NEV] (D,O,S,M)

1k. 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. [E6.3PC1M] (D,O,S,P,M,T,I) [E89]

1l. An UPS shall provide all of the necessary power to systems and subsystems that cannot tolerate a loss of power incident. [NEV] (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 construction. [E6.2CB] [E89]

B. The minimal critical standby power requirements shall be determined by analysis. [E6.3CC] [E89]

C. The normal supply of electrical power shall be provided by a substation to be constructed at the ESF site. Power for this substation shall be supplied from an existing 69-kV overhead power

line extending from Canyon Substation in Jackass Flats to the NTS boundary. [TBV] [NEV]

D. The design shall incorporate existing Yucca Mountain Project transformers and switchgear as much as practicable. [NEV]

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

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

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. [NEV]

ASSUMPTIONS

None.

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

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The water system is defined by those systems, subsystems, and components that supply and distribute the potable, fire protection, and process water for ESF surface facilities and provides a non-chlorinated source for the water supply system underground. [NEV]

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project 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 1.2.6.2.2 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
1.2.6.2.1	Power Systems
1.2.6.2.3	Sewage Systems
1.2.6.2.4	Communication Systems
1.2.6.2.5	Minewaste Water 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	FIRST SHAFT
1.2.6.5	SECOND SHAFT
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. **The water supply, storage, and distribution system shall provide the potable, fire protection, and process water throughout the ESF during construction and operations of the ESF. [NEV]**

PERFORMANCE CRITERIA

1a. **The water supply, storage, and distribution systems, subsystems, and components shall be adequately sized with sufficient capacity to supply and distribute the potable, fire protection, and process surface water; and the non-potable mine supply water underground in accordance with all anticipated needs and services for the construction, operation, and testing of the ESF. [NEV] (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 the existing 6-inch water main. [NEV] (D,O,M)

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. [NEV] (D,O,S,P,M,T)

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

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

1g. The potable water system shall provide water to the trailers, change houses, administrative support buildings, warehouse, shop building, and hoist house(s). The system shall provide adequate treatment systems to ensure that water quality is appropriate for its intended use. [NEV] (D,O,S,M)

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

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

CONSTRAINTS

A. When practical, a single water storage and distribution system shall be employed for fire, industrial, and personnel needs. [E6.2CA] [E89]

B. The water supply will be pumped from existing Well J-13 on the NTS if suitable. The design shall incorporate the pumping station at Well J-13 and ensure that a booster pumping station, located approximately at the halfway point (based on elevation), will provide the necessary flow requirements to the ESF . [NEV]

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

D. Nonpotable water lines shall be clearly marked to prevent consumption by personnel. [NEV]

E. 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. [NEV]

F. 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. [NEV] [TBD]

G. Tracers added to the water system will be of a composition and concentration such that potable water will remain potable. [NEV]

H. The water supply shall not detract from the performance of the site as described in the approved SCP. [NEV] [TBD]

ASSUMPTIONS

None.

1.2.6.2.3 SEWAGE SYSTEMS
(Generic Physical Subsystem Account Code: 4.2.3)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The sewage system is defined by those systems, subsystems, and components that provide for the collection, treatment, and disposal of sanitary sewage generated at the facility. [NEV]

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project 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 1.2.6.2.3 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
1.2.6.2.1	Power Systems
1.2.6.2.2	Water Systems
1.2.6.2.4	Communication Systems
1.2.6.2.5	Minewaste Water 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. The sewage system shall provide for the collection, treatment, and disposal of sanitary sewage during the ESF construction, operations, and in situ site characterization for all ESF facilities. [NEV]

PERFORMANCE CRITERIA

1a. Sewage effluent discharges shall not adversely affect site characterization activities. [E6.2PC4g] (D,O,M,P,T) [E89]

1b. The sewage system shall accommodate ESF construction, operations, and in situ site characterization. [E6.2PC4h] (D,O,M,P,T) [E89]

1c. The sanitary waste system shall collect the wastes from all buildings and trailers with the necessary lines to discharge the wastes into the sanitary waste disposal system. [NEV] (D,O,M,P,T)

1d. The sanitary waste disposal system shall accommodate the sewage for 200 individuals in a 24-hour period. [NEV] (D,O,M,P,T) [TBV]

1e. Tracers added to the water system will be of a composition and concentration compatible with the sanitary waste disposal system. [NEV] (D,O,M,P,T)

CONSTRAINTS

A. Sewage systems shall use septic tanks or offsite disposal unless precluded by applicable State or local codes and/or economic analysis. These systems shall be reviewed with respect to impacts on testing. [E6.2CC] [E89]

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. [NEV] [TBD]

C. The sewage system shall not detract from the ability of the site to meet the performance objectives as stated in the approved SCP. [NEV] [TBD]

ASSUMPTIONS

None.

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

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The communications system is defined by those systems, subsystems, and components that provide equipment and services for linking the surface areas, the underground areas, and the facility with all outside commercial communications systems. [NEV]

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project 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 1.2.6.2.4 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
1.2.6.2.1	Power Systems
1.2.6.2.2	Water Systems
1.2.6.2.3	Sewage Systems
1.2.6.2.5	Minewaste Water Systems
1.2.6.2.6	Compressed Air System
1.2.6.3	SURFACE FACILITIES
1.2.6.3.9	Communications/Data Building
1.2.6.4	FIRST SHAFT
1.2.6.4.3	Stations
1.2.6.4.5	Hoist System
1.2.6.5	SECOND SHAFT
1.2.6.5.3	Stations
1.2.6.5.5	Hoist 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	Shafts and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. The communications system shall supply the communications link within and external to the ESF during construction and operation. [NEV]

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. [NEV] (D,O,S,P,M,T)

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

1c. The system shall provide for effective communications capability between surface facilities and between the surface and underground facilities. [NEV] (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 in the event of emergencies. [NEV] (D,O,S,P,M,T)

1e. Closed-circuit television monitoring shall be provided for primary hoisting at critical locations. [NEV] (D,O,M)

1f. 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. [NEV] (D,O,S,P,M,T)

1g. 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 the telephone system. [NEV] (D,O,S,P,M,T)

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

CONSTRAINTS

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

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. [NEV]

C. An Intercom system shall have provisions for a multichannel connection as required in Appendix B. [NEV]

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

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. [NEV]

F. Provide phone jacks as required for communication service as indicated in Appendix B. [NEV]

G. Provide phone service as specified in Appendix B. [NEV]

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

I. The underground test areas shall have limited-access commercial service, with shaft cabling provided. [NEV]

J. There shall be a phone jack in each intercom station. [NEV]

ASSUMPTIONS

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

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

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The mine wastewater system is defined by those systems, subsystems, and components that provide equipment for collection and disposal of liquid non-sanitary wastes generated in the ESF during construction and operations. [NEV]

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project 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 1.2.6.2.5 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
1.2.6.2.1 Power Systems
1.2.6.2.2 Water Systems
1.2.6.2.3 Sewage Systems
1.2.6.2.4 Communication Systems
1.2.6.2.6 Compressed Air System
1.2.6.3 SURFACE FACILITIES
1.2.6.4 FIRST SHAFT
1.2.6.4.1 Collar
1.2.6.4.5 Hoist System
1.2.6.4.6 Sump
1.2.6.5 SECOND SHAFT
1.2.6.5.1 Collar
1.2.6.5.5 Hoist System
1.2.6.5.6 Sump
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. The mine wastewater system shall collect and dispose of liquid non-sanitary wastes generated in the ESF during construction and operations. [NEV]

PERFORMANCE CRITERIA

1a. Facilities for treating water discharged from underground areas shall conform to applicable Federal, State, and local regulations. [E6.3PC1o] (D,O) [E89]

1b. The mine wastewater system shall provide for the collection, transfer, treatment (e.g., oil-water separator), and disposal of liquid wastes. [NEV] (D,O,M,T)

1c. A suitable mine wastewater system shall be provided for collection, pumping, treatment, and disposing of expected water and credible water inflows. The Mine Wastewater Collection System, 1.2.6.7.6, shall be designed to pump and collect all mine wastewater to the surface. The Mine Wastewater System, 1.2.6.2.5, shall collect and pump mine wastewater off the repository block in such a manner as to limit adverse effects on the long-term performance of the geologic repository to the extent practical . [TBD] [NEV] (D,O,S,M,T)

CONSTRAINTS

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. [NEV] [TBD]

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

C. The mine wastewater system shall not detract from the ability of the site to meet the performance objectives as stated in the approved SCP. [NEV]

ASSUMPTIONS

None.

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 by those systems, subsystems, and components that provide for the production and distribution of compressed air throughout the ESF. [NEV]

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project 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 1.2.6.2.6 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
1.2.6.2.1	Power Systems
1.2.6.2.2	Water Systems
1.2.6.2.3	Sewage Systems
1.2.6.2.4	Communication Systems
1.2.6.2.5	Minewaste Water Systems
1.2.6.3	SURFACE FACILITIES
1.2.6.4	FIRST SHAFT
1.2.6.4.1	Collar
1.2.6.5	SECOND SHAFT
1.2.6.5.1	Collar
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 for compressed air production and distribution. [NEV]

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 the construction and operations of the facilities. [NEV] (D,O,M,P,T)

1b. Compressed air shall be conditioned and maintained at a quantity to meet drilling and test apparatus requirements. Air pressure and quantity shall be maintained within limits required to meet operational excavation and test requirements. [NEV] (D,O,M,P,T)

1c. The compressed air supply shall be conditioned as required, and suitable filtering shall be provided where oil-free air is required. [NEV] (D,O,M,P,T)

1d. The design shall include air compressor(s) that are sized to perform the requirements of the ESF construction, testing, and operations. The design shall consider modularity of the system for accommodating variable loads and system maintenance. [NEV] (D,O,M,P,T)

CONSTRAINTS

None.

ASSUMPTIONS

None.

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	Sites for Temporary Structures (Buildings and/or Trailers)
1.2.6.3.4	Parking Areas
1.2.6.3.5	Materials Storage Facilities
1.2.6.3.6	Shop
1.2.6.3.7	Warehouse
1.2.6.3.8	Temporary Structures (Buildings and/or Trailers)
1.2.6.3.9	Communications/Data Building

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. Radioactive wastes will not be handled or stored at the ESF surface facilities unless specifically directed by the Nuclear Regulatory Commission for the purpose of site characterization testing. [NEV] ag12 cp68 edit

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project 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 1.2.6.3 necessitates an evaluation and understanding, by the designer, of the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.0	**GENERAL (EXPLORATORY SHAFT FACILITY)**
1.2.6.1	**ESF SITE**
1.2.6.1.1	**Main Pad**
1.2.6.1.2	**Auxiliary Pads**
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 Systems**
1.2.6.2.2	**Water Systems**
1.2.6.2.3	**Sewage Systems**
1.2.6.2.4	**Communication System**
1.2.6.2.5	**Mine Wastewater System**
1.2.6.2.6	**Compressed Air System**
1.2.6.4	FIRST SHAFT
1.2.6.4.1	Collar

1.2.6.4.4 Furnishings
1.2.6.5 SECOND SHAFT
1.2.6.5.1 Collar
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 TESTS
1.2.6.8.1 Integrated Data System (IDS)
1.2.6.8.2 Geological Tests
1.2.6.8.3 Geomechanics Tests
1.2.6.8.4 Near-Field and Thermally Perturbed Tests
1.2.6.8.5 Hydrologic and Transport Phenomena Tests
1.2.6.9 ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.1 Surface Facilities

APPLICABLE REGULATIONS, CODES, AND SPECIFICATIONS

The designs shall be in accordance with:

1. DOE 6430.1A, dated April 6, 1989, except for seismic requirements O111.2.7 Earthquake Loads.

2. DOE Order 5480.7

In addition, see Section 1.2.6.0, Applicable Regulations, Codes, and Specifications.

FUNCTIONAL REQUIREMENTS

1. Provide buildings and/or supporting facilities for the following functions:

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). rj289
xiv. Compressed air.
xv. Computer control system.
xvi. Drill pads and mud ponds (as required).
xvii. Shaft collars.
xviii. Surface mobile equipment (as required).
xix. Standby power.
xx. Treatment of underground water.
xxi. Communications. [E6.3FR1] [E89]

2. Provide air quality monitoring. [E6.3FR2] [E89]

3. Provide water quality monitoring (which includes the physical, chemical, and biological characteristics of ESF waste waters, the receiving water body, and any other water bodies that could be affected by ESF operations). [E6.3FR3] [E89]

4. Provide dust control and/or collection facilities. [E6.3FR4] [E89]

5. Provide for the detection of fires and explosions. [E6.3FR5] [E89]

6. Provide onsite transportation facilities for personnel, equipment, materials, and rock. [E6.3FR6] [E89]

PERFORMANCE CRITERIA

1a. 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. [E6.3PC1a] (D,O,S,P,M,T,I) [E89]

1b. Administrative facilities shall have space, supporting equipment, and furniture as necessary and appropriate to satisfy the needs of ESF operations and in situ site characterization. [E6.3PC1b] (D,O,P) [E89]

1c. Space and facilities shall support the training, certification, and requalification of operating and supervisory personnel. [E6.3PC1c] (D,O,S,P,M,T,I) [E89]

1d. Security facilities shall protect the ESF in accordance with applicable DOE Orders. [E6.3PC1d] (O) [E89]

1e. 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. [E6.3PC1i] (D,O) [E89] [TBV]

1f. Surface facilities shall combine functions when the combinations are cost effective. [E6.3PC1j] (D,O,M) [E89]

1g. 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. [SR1.2.1PC3c] (S)

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

1i. 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. [NEV] (D,O,S,P,M,T,I)

2a. 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 codes. [E6.3PC2a] (D,O,S,P,M,T,I) [E89]

2b. The underground ventilation system shall be monitored for radon, methane, oxygen, carbon monoxide, temperature, humidity, air speed, and volume, as required by applicable Federal, State, and local regulations. [E6.3PC2b] (D,O,S,P,M,T,I) [E89]

2c. The underground ventilation system shall be continuously monitored for environmental conditions (such as temperature, humidity, and volume) as required by the Testing Program. [NEV] (D,O,S,P,M,T,I)

3. The water quality monitoring system shall have the capability to sample, measure, and analyze physical, chemical, and biological conditions consistent with the requirements of applicable Federal, State, and local codes. [E6.3PC3] (D,O,S,P,M,T,I) [E89]

4a. Dust control/collection facilities at potential dust-generation areas such as rock-handling transfer points and processing areas on the surface shall control airborne particulates as required by applicable Federal, State, and local regulations. [E6.3PC4] (D,O) [E89]

4b. 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. Dust control collection facilities shall control airborne particles as required by Federal, State, and local codes and regulations. (See SDRD Appendix E) [NEV] (O)

4c. The surface facilities shall be located away from potential dust generating areas to the extent practicable. [NEV] (D,O,M) [TBD]

5. Detection equipment for fires and explosions shall be in accordance with DOE Order 5480.7 ; DOE Order 6430.1A and any other applicable Federal, State, and local regulations. [E6.3PC5] (D,O,S,M) [E89]

6. Transportation facilities shall be of sufficient size to sustain ESF construction, operations, and testing. [E6.3PC6] (D,O,S,P,M,T,I) [E89]

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. [TBD] [NEV]

See Section 1.2.6.0, Interface Control Requirements.

CONSTRAINTS

A. The ESF system shall comply with the applicable Federal environmental regulations and with State and local environmental regulations consistent with DOE's responsibilities under the Nuclear Waste Policy Act of 1982 (NWPA). Such compliance shall include the following:

   i. All stationary sources (point sources) of air emissions shall comply with the provisions of the Clean Air Act, as amended which could include Prevention of Significant Deterioration (PSD) permitting, or offset policy review, or both. Federal regulations pertaining to compliance with the Clean Air Act include National Primary and Secondary Ambient Air Quality Standards and Standards of Performance for New Stationary Sources. [NEV]

   ii. All fugitive air emissions (nonpoint sources) shall be controlled in accordance with the provisions of the Clean Air Act, as amended, as well as all applicable State and local air quality regulations. [NEV]

[E6.3CA] [E89]

B. To the extent practicable and economical, modular, relocatable, or portable structures shall be considered for surface facilities. [E6.3CB] [E89]

C. Structures exceeding 200 ft in height shall meet the safety provisions implemented under the Federal Aviation Act (49 U.S.C. 1501). [TBV] [SR1.2CS] [NEV]

D. The general layout of the surface facilities shall be designed to limit disturbance to the existing area to a reasonable amount. [NEV] [TBD]

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

F. Similar functions (i.e., change house(s) for construction, site characterization, and visitors) shall be combined wherever practicable. [NEV]

G. The constructor may be required to furnish temporary construction support facilities (i.e., change houses(s)) during the initial stages of shaft construction. [NEV]

H. Dust control shall be provided at the Muck Storage Pile. [NEV]

I. An ESF population study to determine the expected numbers of personnel on site during the ESF construction, operation, and testing phases will be performed by the responsible AE(s) and approved by the Yucca Mountain Project Office. [NEV]

ASSUMPTIONS

None.

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 for supplying fresh air, conditioned if required, to the underground workings and for exhausting the air at the surface. The ESF ventilation system will not serve the completed repository. The system will be replaced after the NRC authorizes the construction of a repository. [NEV]

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project 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 1.2.6.3.1 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
1.2.6.2	SURFACE UTILITIES
1.2.6.2.1	Power Systems
1.2.6.3.9	Communications/Data Building
1.2.6.4	FIRST SHAFT
1.2.6.4.1	Collar
1.2.6.4.4	Furnishings
1.2.6.4.5	Hoist System
1.2.6.5	SECOND SHAFT
1.2.6.5.1	Collar
1.2.6.5.5	Hoist System
1.2.6.6	UNDERGROUND EXCAVATIONS
1.2.6.7	UNDERGROUND SUPPORT SYSTEMS
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.1	Surface Facilities

FUNCTIONAL REQUIREMENTS

1. Provide mine ventilation systems, subsystems, and components at the ESF surface to supply and exhaust ventilation air to the subsurface workings to meet the needs of construction and operation of the underground site characterization and testing program. [NEV,E6.3FR1] [E89]

PERFORMANCE CRITERIA

1a. Necessary ventilation/exhaust and distribution facilities shall supply and exhaust adequate quantities of air to and from underground

working areas such that operator safety, health and productivity requirements are maintained. [NEV,E6.3PC1K] (D,O,S,P,M,T,I) [E89]

1b. All main ventilation fans shall be sized to provide the ventilation air movement required for that particular shaft. The fan system will 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. [NEV,SR1.2.1PC3g] (S)

1c. The anticipated noise levels and appropriate measures to reduce the noise levels, as applicable, for personnel protection and to allow voice communications where required, shall be considered in the design specifications and when determining the fans' location as well as installation. [NEV] (D,O,S,M)

1d. The ventilation system shall dilute and/or remove particulate matter, blasting fumes, and flammable and noxious gases from the working areas, and divert polluted air to the exhaust opening(s) in conformance with applicable federal, state, and local regulations. (See SDRD Appendix E.) [NEV] (D,O,S,P,M,T,I)

1e. 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. (See SDRD Appendix E.) [NEV] (D,O,S,P,M,T,I)

1f. Ventilation for the underground working areas shall be monitored for radon/radon daughters, methane, oxygen, carbon dioxide, nitrous oxides, carbon monoxide, sulfur dioxide, and environmental conditions (such as temperature, humidity, air speed, and volume flow) as required by applicable federal, state, and local regulations. (See SDRD Appendix E.) [NEV] (D,O,S,P,M,T,I)

1g. 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. [NEV] (D,O,S,P,M,T,I)

1h. The ventilation system shall minimize leakage and undesirable recirculation to the extent practicable. [NEV] (D,O,S,P,M,T,I) [TBD]

CONSTRAINTS

A. The mine ventilation system shall be sized, designed, and constructed for underground operations and in situ site characterization. Additional capacities that will support additional excavations beyond those planned shall be provided as indicated by the uncertainty allowance. [NEV]

B. The ventilation system for the ESF underground facility 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 of 260 w/m^2. [NEV] [TBV]

ASSUMPTIONS

1. 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. [NEV]

2. 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. [NEV]

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. [NEV]

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project 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 1.2.6.3.2 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
1.2.6.2	SURFACE UTILITIES
1.2.6.2.1	Power Systems
1.2.6.3.3	Sites for Temporary Structures (Buildings and/or Trailers)
1.2.6.3.4	Parking Areas
1.2.6.3.5	Materials Storage Facilities
1.2.6.3.6	Shop
1.2.6.3.7	Warehouse
1.2.6.3.8	Temporary Structures (Buildings and/or Trailers)
1.2.6.6	UNDERGROUND EXCAVATIONS
1.2.6.6.2	Test Areas
1.2.6.8	UNDERGROUND TESTS
1.2.6.8.1	Integrated Data System (IDS)
1.2.6.8.2	Geological Tests
1.2.6.8.3	Geomechanics Tests
1.2.6.8.4	Near-Field and Thermally Perturbed Tests
1.2.6.8.5	Hydrologic and Transport Phenomena Tests
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.1	Surface Facilities

FUNCTIONAL REQUIREMENTS

1. **The test support facilities shall provide the necessary area(s) where the test apparatus, under the direction of the PIs, can be assembled, repaired and tested for use in the ESF site characterization testing. [NEV]**

PERFORMANCE CRITERIA

1a. **The test support facilities shall be designed to meet the operational requirements of the PIs. [NEV] (D,O,S,P,M,T,I) [TBD]**

CONSTRAINTS

None.

ASSUMPTIONS

None.

1.2.6.3.3 SITES FOR TEMPORARY STRUCTURES (BUILDINGS AND/OR TRAILERS) (Generic Physical Subsystem Account Code: 4.3.3)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The temporary structure sites include all of the facilities, systems, and services for the temporary structures, see 1.2.6.3 FR1, during construction and operation of the ESF. [NEV]

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project 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 1.2.6.3.3 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
1.2.6.2	SURFACE UTILITIES
1.2.6.2.1	Power Systems
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	Temporary Structures (Buildings and/or Trailers)
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.1	Surface Facilities

FUNCTIONAL REQUIREMENTS

1. Provide temporary structure sites with the required services. [NEV]

PERFORMANCE CRITERIA

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

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

CONSTRAINTS

None.

ASSUMPTIONS

None.

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

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The parking area(s) includes all of the space and allowances for vehicle parking that are required to support construction, operation, and testing of the ESF. [NEV]

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project 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 1.2.6.3.4 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
1.2.6.2 SURFACE UTILITIES
1.2.6.2.1 Power Systems
1.2.6.2.2 Water Systems
1.2.6.2.3 Sewage Systems
1.2.6.3.2 Test Support Facilities
1.2.6.3.3 Sites for Temporary Structures (Buildings and/or Trailers)
1.2.6.3.5 Materials Storage Facilities
1.2.6.3.6 Shop
1.2.6.3.7 Warehouse
1.2.6.3.8 Temporary Structures (Buildings and/or Trailers)
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. 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 mine rescue truck.)

   [TBV] [NEV]

PERFORMANCE CRITERIA

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

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

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

1d. Dedicated parking for emergency vehicles shall be located such that they can be quickly accessed. [NEV] (O)

CONSTRAINTS

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

ASSUMPTIONS

None.

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

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The materials storage facilities include all areas, structures, and services to store equipment, supplies, and vehicles in a yard type environment. [NEV]

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project 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 1.2.6.3.5 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
1.2.6.2	SURFACE UTILITIES
1.2.6.2.1	Power Systems
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	Temporary Structures (Buildings and/or Trailers)
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.1	Surface Facilities

FUNCTIONAL REQUIREMENTS

1. The materials storage facilities shall provide storage for the anticipated equipment that will be used during construction and operation of the ESF. This equipment (active and inactive) includes, but is not limited to, equipment, pipe and pipe racks, sheet steel, steel shapes, cement, course and fine aggregate, reinforcing steel, admixes, wire and cable reels, and gas bottles. [NEV]

PERFORMANCE CRITERIA

1a. The material storage facilities shall be capable of being secured (fence and gates) and integrated with the overall site security. [NEV] (D,O,M)

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

CONSTRAINTS

None.

ASSUMPTIONS

None.

1.2.6.3.6 SHOP
(Generic Physical Subsystem Account Code: 4.3.6)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The shop includes all of the facilities, systems, and services for the routine maintenance and repair of the equipment and grounds designated for the ESF. [NEV]

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project 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 1.2.6.3.6 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
1.2.6.2 SURFACE UTILITIES
1.2.6.3.2 Test Support Facilities
1.2.6.3.3 Sites for Temporary Structures (Buildings and/or Trailers)
1.2.6.3.4 Parking Areas
1.2.6.3.5 Materials Storage Facilities
1.2.6.3.7 Warehouse
1.2.6.3.8 Temporary Structures (Buildings and/or Trailers)
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 facilities and equipment for the routine maintenance and repair of the ESF equipment, systems, structures, and components. [NEV]**

PERFORMANCE CRITERIA

1a. **Facilities shall support the maintenance of the roads, structures, equipment, grounds, and buildings, if not available off the site. [E6.3PC1f] (D,O,M) [E89]**

1b. **The facilities and equipment shall accommodate the following types of activities and services: equipment maintenance and repair, maintenance equipment storage, and operations spare parts storage. [NEV,E6.3PC1f] (D,O,M)**

1c. **The shop facility shall meet the operational requirements of the users. [NEV] (D,O,S,P,M,T,I) [TBD]**

1d. The shop shall include cranes and shop machinery that is consistent with maintenance needs. [NEV] (D,O,M)

CONSTRAINTS

A. 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. [E6.0PC1d] [E89]

B. The shop will be designed and constructed as a prefabricated metal building. [NEV]

C. The shop shall contain restrooms and an office. [NEV]

D. The shop shall be insulated and heated. In addition, the office area and restrooms shall be air conditioned. [NEV]

E. 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. [NEV]

F. The shop shall have an electrical bay, a mechanical bay, a lubrication bay, office space, storage space for maintenance supplies, and locker/change space. [NEV]

ASSUMPTIONS

1. Non-routine maintenance of equipment will be performed offsite. [NEV]

1.2.6.3.7 WAREHOUSE
(Generic Physical Subsystem Account Code: 4.3.7)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The warehouse shall include all the facilities, systems, and services for the safe storage and dispensing of materials within the ESF. [NEV]

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project 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 1.2.6.3.7 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
1.2.6.2	SURFACE UTILITIES
1.2.6.2.1	Power Systems
1.2.6.3.2	Test Support Facilities
1.2.6.3.3	Sites for Temporary Structures (Buildings and/or Trailers)
1.2.6.3.4	Parking Areas
1.2.6.3.5	Materials Storage Facilities
1.2.6.3.6	Shop
1.2.6.3.8	Temporary Facilities (Buildings and/or Trailers)
1.2.6.4	FIRST SHAFT
1.2.6.5	SECOND SHAFT
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 facilities for general warehousing in support of the ESF construction and operations. [NEV,E6.3FR1]**

PERFORMANCE CRITERIA

1a. **Space and equipment 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. [E6.3PC1e] (D,O,P,M,T) [E89]**

1b. **The warehouse shall meet the operational requirements of the users. [NEV,E6.3PC1e] (D,O,M)**

1c. Temporary warehouse space shall be provided to support initial shaft construction and hoist and hoist house construction by the contractor. [NEV] (C)

CONSTRAINTS

A. The warehouse shall be designed and constructed as a prefabricated metal building. [NEV]

B. The warehouse shall contain restrooms and offices. [NEV]

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

D. Storage of critical components shall be under controlled access. [NEV]

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

ASSUMPTIONS

None

1.2.6.3.8 TEMPORARY STRUCTURES (BUILDINGS AND/OR TRAILERS)
(Generic Physical Subsystem Account Code: 4.3.8)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The 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, and test support required to support ESF construction, operations, and maintenance personnel for the site characterization program including site preparation. [NEV]

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project 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 1.2.6.3.8 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
1.2.6.2	SURFACE UTILITIES
1.2.6.2.1	Power Systems
1.2.6.3.2	Test Support Facilities
1.2.6.3.3	Sites for Temporary Structures (Buildings and/or Trailers)
1.2.6.3.4	Parking Areas
1.2.6.3.5	Materials 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 for the following functions:

   i. Offices.
   ii. Change rooms.
   iii. First aid and mine rescue apparatus center.
   iv. Test support functions.
   v. Temporary IDS.
   vi. Construction support functions.

   [NEV]

PERFORMANCE CRITERIA

1a. 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. [E6.3PC1g] (D,O,S,P,M,T,I) [E89]

1b. Sufficient personnel office space shall be provided. [NEV] (D,O,S,P,M,T,I) [TBD]

1c. 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. [NEV] (D,O,S,P,M,T,I)

CONSTRAINTS

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

B. The first aid structure shall provide at least 200 square feet for the first aid facility, plus 50 square feet for storage. [TBV] [NEV]

ASSUMPTIONS

1. Trailers may be provided for office spaces. [NEV]

2. A single trailer may be provided for the first aid center. [TBV] [NEV]

3. A sufficient number of trailers shall be provided for test support functions. [NEV]

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 and data collection and transmissions that are required to support construction and testing. [NEV]

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project 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 1.2.6.3.9 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
1.2.6.2	SURFACE UTILITIES
1.2.6.2.1	Power Systems
1.2.6.2.4	Communication 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 TESTS
1.2.6.8.1	Integrated Data System (IDS)
1.2.6.8.2	Geological Tests
1.2.6.8.3	Geomechanics Tests
1.2.6.8.4	Near-Field and Thermally Perturbed Tests
1.2.6.8.5	Hydrologic and Transport Phenomena Tests
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.1	Surface Facilities

FUNCTIONAL REQUIREMENTS

1. The communications/data building(s) shall support the communications/data collection and transmission equipment during the ESF operation and underground site characterization. [NEV]

PERFORMANCE CRITERIA

1a. The building(s) and foundations shall be designed to meet the operational requirements of the users. [NEV] (D,O,S,P,M,T,I)

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

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

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.
[NEV] (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. [NEV] (T,P)

CONSTRAINTS

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

ASSUMPTIONS

None.

1.2.6.4 FIRST SHAFT
(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

The first shaft system is defined by those systems, subsystems, and components that are comprised of the vertical engineered openings within a circular zone, whose radius is defined as the sum of the radius of the shaft, the liner thickness, and a nominal 5 feet beyond the liner, that connect the surface with the targeted horizons [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. The first shaft will serve as the primary testing and testing access shaft.
[NEV,E6.4DEFINITION]

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project 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 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:

- 1.2.6.0 GENERAL (EXPLORATORY SHAFT FACILITY)
- 1.2.6.1 ESF SITE
- 1.2.6.1.1 Main Pad
- 1.2.6.1.2 Auxiliary Pads
- 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 Systems
- 1.2.6.2.2 Water Systems
- 1.2.6.2.4 Communication System
- 1.2.6.2.5 Mine 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 SECOND SHAFT

1.2.6.5.3	Station
1.2.6.5.5	Hoist System
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	Distribution System
1.2.6.7.5	Water Distribution System
1.2.6.7.6	Mine 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 Handling Systems
1.2.6.7.10	Sanitary Facilities
1.2.6.7.11	Monitoring and Warning Systems
1.2.6.8	UNDERGROUND TESTS
1.2.6.8.1	Integrated Data System (IDS)
1.2.6.8.2	Geological Tests
1.2.6.8.3	Geomechanics Tests
1.2.6.8.4	Near-Field and Thermally Perturbed Tests
1.2.6.8.5	Hydrologic and Transport Phenomena Tests
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.2	Shafts and Underground Facilities

APPLICABLE REGULATIONS, CODES, AND SPECIFICATIONS

See Section 1.2.6.0, Applicable Regulations, Codes, and Specifications.

FUNCTIONAL REQUIREMENTS

1. Provide access to the candidate repository horizon and the underground portion of the ESF. [E6.4FR1] [E89]

2. Provide for testing in the shaft as required. [E6.4FR2] [E89]

3. Provide means for emergency egress. [E6.4FR3] [E89]

4. Provide facilities, utilities, and equipment for shaft construction and operations. [E6.4FR4] [E89]

5. Provide for water drainage and/or control in the shaft. [E6.4FR5] [E89]

PERFORMANCE CRITERIA

1a. The shaft shall be designed and constructed such that it meets the requirements of personnel, equipment, materials, utilities, excavated rock, and ventilation. [E6.4PC1a] (D,O,S,P,M,T,I) [E89]

1b. 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. [10 CFR 60.15(b)]

1c. 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(d)(1)]

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. [NEV] (O,W,S) [TBD]

1d. 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)] cp104

i. Rock support and other structural anchoring materials shall be compatible with waste isolation. [E6.4PC1e] (O,W,S) [E89] [TBD]

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

1e. 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)]

i. The size and depth of the shaft shall be sufficient for in situ site characterization needs in terms of testing, personnel, materials, equipment, utilities, and schedule. [E6.4PC1k] (O,S,T) [E89]

ii. The size and layout of the shaft shall be adequate for in situ site characterization needs and capable of supporting the excavation allowances determined under General ESF requirements, Section 1.2.6.0 Performance Criteria items 1a and 1b . [E6.4PC1l] (D,O,S,T) [E89]

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

1f. 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)]

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)]

i. Techniques used for shaft excavation shall control overbreak of rock and minimize disturbance to the integrity of the adjoining rock mass. [E6.4PC1c] (D,O) [E89]

ii. The 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. [E6.4PC1d] (O,W,S) [E89]

iii. The openings for rock handling shall be constructed in such a way as to minimize effects on the integrity of any other openings. [E6.4PC1g] (O,D,W,S) [E89]

iv. Techniques used for shaft excavation shall control overbreak of rock and minimize disturbance to the integrity of the adjoining rockmass. The following are repository design goals for limiting the damage to the intact rock mass. These design goals are presented as guidance for the ESF design and may be modified if warranted by results of site characterization or future analyses:

a. Blast induced fracture extent into the intact rock to be generally less than 3 meters. [NEV,E6.4PC1c] (D,O,W,S) [TBV]

b. Blast induced changes to the in situ permeability beyond one shaft radius (approximately 3 meters) shall average less than one order of magnitude. [NEV] [TBV]

c. Excavation overbreak shall average less than 6 inches. This overbreak limit may be exceeded, with approval, for short intervals where blast designs are being adjusted. [NEV] [TBV]

v. The 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. 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. Diametrical closure rate in the first shaft to average less than 1 millimeter per year. This closure rate goal applies to the rate after the first year of closure has occurred. [NEV] [TBV]

b. The total diametrical closure in the first shaft is to be less than 3 inches at 100 years. [NEV,E6.4PC1d] (O,W,S) [TBV]

1g. The 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. [NEV]

1h. The shaft shall serve as the primary testing and testing access shaft. [NEV] (D,O)

1i. The shaft shall be excavated and structurally lined using methods and materials based upon conventional shaft construction technology for the shaft diameter and depth under consideration. [NEV] (D,O,S)

1j. Shaft instrumentation shall be protected from physical damage. [NEV] (O,T)

2a. 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. [10 CFR 60.15(b)]

i. Shaft design and construction shall provide for ESF design and construction testing, performance confirmation testing, and in situ site characterization testing to the extent necessary. [E6.4PC2] (D,O,P,T) [E89]

2b. The location of openings for rock handling shall be selected to minimize effects on testing. [NEV] (D,S)

3. 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. [10 CFR 60.131(b)(4)(i)]

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, and N will give rise to rebuttable presumption that this requirement has not been met. [10 CFR 60.131(b)(9)]

i. Emergency egress systems shall be designed and constructed for the evacuation of all underground personnel to safety within 1 hour. [E6.4PC3] (D,O,S) [E89] [TBV]

ii. Hoisting systems shall be designed and constructed for the evacuation of all underground personnel to safety within 1 hour. [NEV] (O,S) [TBV]

4a. 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)]

i. Necessary shaft facilities and equipment required for handling excavated rock, materials, equipment, and supplies shall support construction, operations, and in situ site characterization testing. Functional requirements of the shafts may be reassigned. [E6.4PC4] (D,O,S,T,) [E89]

ii. Functional requirements of the shafts may be assigned by the designer to either of the shafts. [NEV] (N/A)

Note: Applies to muck handling as required.

iii. Muck handling systems shall be sized and designed for ESF operation and in situ site characterization needs and shall minimize the spillage of rock during rock handling. This system shall provide capabilities for gathering and cleaning out rock spillage from the shaft bottom. [E6.4PC1f] (D,S) [E89]

iv. Support facilities, utilities, and equipment shall be designed and constructed to accommodate conventional shaft sinking techniques (i.e., drill and blast). [NEV] (D,S)

v. 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 and local regulations. [SR] (S)

4b. 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]

i. Capacity of rock and materials handling equipment and facilities shall be compatible with mining and rock hoisting and the design of the facilities shall meet applicable requirements of DOE Orders 5480.4 and 6430.1A, except seismic criteria. Ventilation capacity, shaft design and air velocities in the shaft shall be optimized with respect to project objectives. [SR] (D,O)

ii. Dust control/collection facilities shall be provided at potential dust generation areas such as working faces, rock handling transfer points, and processing areas underground in order to minimize airborne particulates. [SR] (O,S)

4c. The design of the underground facility shall provide for control of water or gas intrusion. [10 CFR 60.133(d)]

i. The shaft and its drainage systems shall control standing water and air/water contact surfaces where ventilation air will be flowing through in order to optimize humidity in air and to maintain the quality of the ventilation air being supplied. [E6.4PC1i] (O,S) [E89] [TBV]

a. The shaft and its drainage systems shall control standing water and air/water contact surfaces where ventilation air will be flowing through in order to control humidity in air and to maintain the quality of the ventilation air being supplied. [NEV,E6.4PC1i] (O,S) [TBV]

ii. Control of humidity in the underground ventilation air shall be accomplished by reduction of all shaft and main test level air/water contacts to the lowest technically feasible level. [NEV]

4d. The ventilation system shall be designed to (1) Control the transport of radioactive particulates and gases within and releases from the underground facility in accordance with the performance objectives of § 60.111(a). (2) Assure continued function during normal operations and under accident conditions; and (3) separate the ventilation of excavation and waste emplacement areas. [10 CFR 60.133(g)]

i. The size, shape, and construction of the shaft shall be adequate to supply and/or exhaust the required volumes of air for underground construction, operation, and in situ site characterization. [E6.5PC1g,NEV,E6.4PC1j] (D,O,P,T) [E89]

ii. Necessary ventilation and distribution facilities shall be provided to supply and/or exhaust adequate quantities of air to and from working areas such that operator safety and productivity are maximized. [SR] (D,O,S)

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

i. 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. [E6.4PC1h] (O,S,P,T) [E89]

ii. Water handling and control in the shaft shall be sized for credible water inflows. [E6.4PC5] (D,O,S) [E89] [TBD]

iii. The drainage and pumping systems shall accommodate measurement of the water as required. [NEV] (O,S,P,T)

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. [TBD]

See Section 1.2.6.0, Interface Control Requirements.

CONSTRAINTS

A. 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)]

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

ii. For planning purposes, the breakout for the main test level shal be at 3,075 feet above MSL (see drawing RO7072 in SDRD Appendix A.2). [NEV] [TBV]

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. [NEV]

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(d)(1)]

i. The design of the 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 shaft shall be performed in a manner that limits the potential for adverse impacts on the long term performance of the repository. [NEV] [TBD]

ii. Shaft operation and construction shall limit adverse chemical changes (type, quantity and location), particularly to pH and organic content of groundwater, by controlling the use of hydrocarbons, solvents, and chemicals. [NEV] [TBD]

iii. Shaft construction and operations shall limit concrete, shotcrete, and grout for bolt anchors or other rock mass support to that required for proper construction. [NEV]

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

v. The chemistry of any water used in shaft construction or operation shall be compatible with postclosure requirements to isolate and contain waste. [NEV] [TBD]

vi. 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 (performance assessment), and appropriate controls instituted. [NEV]

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

viii. 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. [NEV]

ix. Construction and operations shall, to the extent practicable, limit adverse effects on the long term performance of the repository; for example by limiting organics in drilling fluids and explosive residues from blasting. [NEV]

x. The use of blasting agents and explosives shall be controlled so that in situ site characterization is not adversely affected. [E6.4CC] [E89] [TBD]

xi. 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. [NEV,E6.4CC]

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

D. 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(d)(3)]

i. The exploratory shafts shall be located, to the extent practicable, where shafts are planned for the repository facility. [NEV]

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

E. 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. [10 CFR 60.16]

F. The [Safety Analysis Report shall include an assessment containing an evaluation of 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. [10 CFR 60.21(c)(1)(ii)(D)]

i. The exploratory shaft locations shall be selected, consistent with other goals of site characterization, to limit impacts on isolation. [NEV]

ii. The exploratory shaft ground support system shall be designed, consistent with other goals of site characterization, to limit impacts on isolation. If the ground support system is determined to be important to waste isolation, a comparative evaluation of alternatives shall be performed. [NEV] [TBD]

iii. The exploratory shaft diameter shall 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. [NEV] [TBD]

iv. The exploratory shaft liner shall 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. [NEV] [TBD]

v. The exploratory shaft operational seals shall (if required) 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. [NEV] [TBD]

G. [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. [10 CFR 60.21(c)(11)]

i. The capability to enhance postclosure performance by removing the shaft liner shall be retained. [NEV]

ii. Furnishings in the shafts shall be designed to be removable, if necessary, prior to permanent closure. [NEV]

H. 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)]

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)]

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

I. 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. [10 CFR 60.112]

J. 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]

i. The centerline coordinate location of ES-1 (science shaft) shall be as determined by Sandia and listed in the RIB, Chapter 2, Section 4, Item 1, as amended, and defined by the Nevada Coordinate System. [NEV] [TBV]

ii. The nominal finished inside diameter of the first shaft, ES-1, and the second shaft, ES-2, shall be as determined by Sandia and

listed in the RIB, Chapter 2, Section 2, Subsection 8, as amended. [NEV]

iii. Utility lines, shaft steel, etc., shall be electrically bonded and reliably connected to the surface electrical "safety" grounding network. [NEV]

iv. At any point within the repository boundary, the distance from the bottom of the first shaft to the water table, provided the option to extend the shaft into the Calico Hills formation is not exercised, shall not be less than the minimum vertical distance between the repository and the water table . [NEV] [TBV]

K. The structures, systems, and components important to safety shall be designed to perform their safety functions during and after credible fires or explosions in the geologic repository operations area. [10 CFR 60.131(b)(3)(i)]

To the extent practicable, the geologic repository operations area shall be designed to incorporate the use of noncombustible and heat resistant materials. [10 CFR 60.131(b)(3)(ii)]

The geologic repository operations area shall be designed to include explosion and fire detection alarm systems and appropriate suppression systems with sufficient capacity and capability to reduce the adverse effects of fires and explosions on structures, systems, and components important to safety. [10 CFR 60.131(b)(3)(iii)]

The geologic repository operations area shall be designed to include means to protect systems, structures, and components important to safety against the adverse effects of either the operation or failure of the fire suppression systems. [10 CFR 60.131(b)(3)(iv)]

L. 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. [10 CFR 60.131(b)(4)(i)]

i. The personnel hoisting and ventilation capacity of the first shaft shall be maintained to provide emergency egress during initial repository construction. [NEV]

M. 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)]

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

ii. Location of shafts relative to each other shall be such that testing in either shaft will not be adversely affected by activities in the other. [E6.4CE] [E89] [TBD]

iii. The flexibility to sink the first shaft (ES-1) 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. [NEV]

N. 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)]

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

ii. The exploratory 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 is not adversely affected. [NEV] [TBD]

O. 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)]

i. 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. [NEV]

ii. The 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 the shaft, in response to actual site conditions encountered during construction. [NEV]

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. [NEV]

iv. For planning purposes, the breakout for the upper demonstration breakout room shall be at an elevation of 3,530 feet above Mean Sea Level (MSL) (see drawing RO7072 in SDRD Appendix A.2.) [NEV] [TBV]

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

i. Structures, systems, and components shall be provided for effective water and ground control. [E6.4CA] [E89]

ii. 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 implemented. [NEV]

iii. 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. [NEV]

iv. 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. [NEV]

v. Fluids recovered during construction operations shall be disposed of in such a way to avoid potential for performance impacts. [NEV] [TBD]

vi. The drainage plan for underground work shall be consistent with repository operations and postclosure sealing concerns. Specifically, drainage in the dedicated test area as defined by points C1, D, H, and J on Drawing RO7061 in SDRD Appendix A.1 shall be toward ES-1, and drainage in long drifts should be compatible with repository grades. [NEV]

x. The shafts shall 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. [NEV]

xi. 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. [NEV]

xii. Operating procedures shall be developed to ensure water entering the ESF is managed appropriately, including quantity, location, and water balance. [NEV]

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

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

xv. Shaft construction and operating procedures shall require the removal of excess water to preclude interference with tests. [NEV] [TBD]

xvi. 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. [NEV]

xvii. 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. [NEV]

xviii. 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. [NEV]

Q. Openings in the underground facility shall be designed so that operations can be carried out safely and the retrievability option maintained. [10 CFR 60.133(e)(1)]

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)]

i. Shaft permanent structures shall be designed and constructed to withstand the effects of seismic events. The seismic loads to be used to design the first shaft are defined in SDRD Appendix A.4. [NEV]

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

R. 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)]

i. The exploratory shaft construction method shall be selected, consistent with other goals of site characterization, to limit impacts on isolation. [NEV]

ii. 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 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. [NEV] [TBD]

iii. 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. [NEV] [TBD]

S. The ventilation system shall be designed to (1) Control the transport of radioactive particulates and gases within and releases from the underground facility in accordance with the performance objectives of § 60.111(a). (2) Assure continued function during normal operations and under accident conditions; and (3) separate the ventilation of excavation and waste emplacement areas. [10 CFR 60.133(g)]

i. The shaft and its furnishings shall be designed to minimize air resistance to the extent practicable. [E6.4CB] [E89]

ii. Personnel in the shaft shall not be exposed to air velocities greater than 2,000 feet per minute. [E6.4CD] [E89] [TBV]

iii. Personnel working in the shaft shall not be exposed to ventilation air velocities exceeding 2,000 feet per minute. [NEV] [TBV]

T. Engineered barriers shall be designed to assist the geologic setting in meeting the performance objectives for the period following permanent closure. [10 CFR 60.133(h)]

i. Engineered barriers in the shafts shall assist the geologic setting in limiting the release of radionuclides to the accessible environment. [NEV]

U. 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)]

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 . [SR]

ii. The predicted loads imposed on the shafts by heating of the repository waste disposal formation are defined in SDRD Appendix

A.3. These loads shall be considered in the analyses performed to predict the long-term response of the shaft. [NEV]

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. [NEV]

V. 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)]

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, declines, or drifts in order to ensure that seals do not become preferential pathways for groundwater or radioactive waste migration. In addition, techniques used to seal inflow during access construction shall not preclude, or reduce the effectiveness of future access seals. [SR]

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

iii. Design, construction, and materials used in the construction of the 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 Yucca Mountain Project Office. 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. [NEV] [TBV]

b. At the interface between the nonwelded tuff (PTn) and the Topopah spring tuff (TSw). [NEV] [TBV]

c. In the extension of the shaft below the Main ESF Test Level. [NEV] [TBV]

Note: The above limitations are not intended to constrain the locations of the radial borehole tests. [NEV]

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 as shown on drawing RO7072 in SDRD Appendix A.2. [NEV] [TBV]

v. 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. [NEV] [TBV]

W. 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]

The performance confirmation program shall have been started during site characterization and it will continue until permanent closure. [10 CFR 60.140(b)]

The performance confirmation 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. [10 CFR 60.140(c)]

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. [NEV]

ii. The configuration of the 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. [NEV]

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. [NEV]

X. Subsurface conditions shall be monitored and evaluated against design assumptions. [10 CFR 60.141(b)]

i. 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. [NEV]

Y. As a minimum, measurements shall be made of rock deformations and displacement, changes in rock stress and strain, rate and location of water inflow into subsurface areas, changes in groundwater conditions, rock pore water pressures including those along fractures and joints, and the thermal and thermomechanical response of the rock mass as a result of development and operations of the geologic repository. [10 CFR 60.141(c)]

   i. Underground facility design and construction shall allow measurement of water inflow into subsurface areas. [SR]

Z. These measurements and observations shall be compared with the original design bases and assumptions. If significant differences exist between the measurements and observations and the original design bases and assumptions, the need for modifications to the design or in construction methods shall be determined and these differences and the recommended changes reported to the Commission. [10 CFR 60.141(d)]

   i. The shafts of the ESF shall be designed so that baseline performance configuration 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. [NEV]

ASSUMPTIONS

None

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. [NEV]

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project 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 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
1.2.6.2	SURFACE UTILITIES
1.2.6.2.5	Mine Wastewater System
1.2.6.3	SURFACE FACILITIES
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 TESTS
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.2	Shafts and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. The shaft collar shall provide during construction and operation periods an adequate foundation for the headframe and shall accommodate penetrations and structural mountings for conveyance systems, ventilation, utilities, instrumentation, and space for adding additional utilities at a later date. (See Section 1.2.6.0, Performance Criteria, items 1a, 1b, 1c, and 1d for Uncertainty Allowance.) [NEV]

PERFORMANCE CRITERIA

1a. Water intrusion, if any, into the entry openings shall be controlled by suitable measures such that flooding of the entries and/or underground openings will not reach the point of endangering worker safety and waste emplacement operations or objectives. [SR] (O) [TBD]

1b. Shaft collar shall be designed and constructed to prevent significant water inflow from a flooding event. [NEV] (D,O,S)

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

1d. Collar shall provide support for shaft-sinking equipment and construction stages over the range of conditions encountered during construction. [NEV] (D,S)

1e. Collar shall support equipment and materials handling during operations. [NEV] (O,S)

1f. Collar shall provide safe access and egress. [NEV] (O,S)

CONSTRAINTS

A. The surface elevation above mean sea level at the shaft collar for ES-1 shall be contained in the RIB. [TBV] [NEV]

B. The shaft collar shall be founded in rock. [NEV]

ASSUMPTIONS

None

1.2.6.4.2 LINING
(Generic Physical Subsystem Account Code: 4.4.1.2)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The lining system is defined by those components (e.g., concrete) which are provided to maintain the integrity of the intended opening. [NEV]

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project 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 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:

1.2.6.4.1	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 TESTS
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.2	Shafts and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. The lining system shall provide structural and mechanical integrity for the shaft, mounting for conveyance guide supports, utilities, and shaft instrumentation during construction and operations. [NEV]

PERFORMANCE CRITERIA

1a. The shaft liner shall withstand pressures exerted along its length and around the entire perimeter under anticipated conditions, including reaction to thermally induced stresses as defined in SDRD Appendix A.3. The provisions for thermally induced stresses can be installed at a later date. [NEV] (D,O,S)

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

1c. The liner shall include provisions for shaft instrumentation penetrations and data collection units. [NEV] (O,S,M,T)

1d. All concrete activities shall conform to the applicable American Concrete institute (ACI) standards for furnishing, delivery, and placement of structural concrete. (See SDRD Appendix E.) [NEV] (D)

1e. All forming and reinforcements utilized shall conform to applicable ACI and ASTM standards. (See SDRD Appendix E.) [NEV] (D)

CONSTRAINTS

A. The shaft liner shall be protected from damage due to blasting and other activities. [TBD] [NEV]

B. The shaft liner placement shall be coordinated with science needs such as testing and mapping. [NEV]

C. The methodology used to analyze the shaft liner shall be in accordance with the methodology presented in the Sandia National Laboratories document SAND88-7060, "Preliminary Shaft Liner Design Criteria and Methodology Guide". This document is ESF SDRD Appendix A.5. [NEV]

ASSUMPTIONS

None

1.2.6.4.3 STATIONS
(Generic Physical Subsystem Account Code: 4.4.1.3)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The stations are defined as the initial underground opening at predetermined horizons adjacent to the shaft. [NEV]

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project 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 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
1.2.6.4.2	Lining
1.2.6.4.4	Furnishings
1.2.6.4.5	Hoist System
1.2.6.4.6	Sump
1.2.6.5	SECOND SHAFT
1.2.6.5.3	Stations
1.2.6.6	UNDERGROUND EXCAVATIONS
1.2.6.7	UNDERGROUND SUPPORT SYSTEMS
1.2.6.8	UNDERGROUND TESTS
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.2	Shafts and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. The stations shall provide excavated space of adequate size and appropriate geometry to provide support for underground construction and site characterization testing activities. [NEV]

PERFORMANCE CRITERIA

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

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

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

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

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. [NEV] (D,O,S) wk26

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

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

1h. The design of the shaft stations shall consider the physical characteristics of the material and equipment as identified in the basis for design documents. [NEV] (D)

CONSTRAINTS

None

ASSUMPTIONS

None.

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 other structural members. Also included are the shaft guides, fixed guide brackets and backers, utility brackets, conveyance chairs, crash beams and various enclosures or blockouts required to support instrumentation and cabling, shaft utilities consisting of electrical power, communications, compressed air, water, and mine wastewater. [NEV]

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project 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 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
1.2.6.4.1	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 TESTS
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.2	Shafts and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. The furnishings shall 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. [NEV]

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. [NEV] (D,O,S)

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. [NEV] (D,O,S)

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

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

1e. Shaft furnishings shall be designed and constructed to facilitate shaft sinking equipment and operations, in-shaft site characterization testing and personnel activities. [NEV] (D,O,S,M,T)

1f. Utility distribution lines and cables shall be designed to withstand the expected underground environment. [NEV] (O,M)

1g. Utilities and cables mounted in the shaft shall include

i. Electrical power.
ii. Compressed air.
iii. Water.
iv. Communications.
v. Underground instrumentation.
vi. Instrumentation and IDS cabling.
vii. Mine wastewater handling system.
viii. Provision for ventilation.
[NEV] (D,O,S,M,T)

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. [NEV] [TBD]

B. All brackets shall be designed and constructed to provide adequate strength and isolation for all cables and other devices. [NEV]

C. All shaft furnishings shall be designed to be removed in a manner that will leave the shaft liner 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. [NEV]

ASSUMPTIONS

None.

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 sinking, 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), and 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. [NEV]

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project 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 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	Communication System
1.2.6.2.5	Mine Wastewater Systems
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	SECOND SHAFT
1.2.6.5.5	Hoist 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	Shafts and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. The hoist system shall provide for the transport and support of personnel, materials, and construction equipment, and serve as the emergency egress from the underground during shaft sinking, ESF construction (mining operations), and underground testing. [NEV]

PERFORMANCE CRITERIA

1a. Hoisting systems shall have a rated capacity sufficient for emergency egress. [E6.5PC1i] (S) [E89] [TBD]

1b. ESF hoisting systems shall be consistent with the requirements of operation and in-situ site characterization unless it is more economical to use construction hoists. [E6.4PC1m] (D,O,S,M) [E89]

1c. The ESF hoisting system capacities shall be consistent with the requirements of ESF construction, operation, and underground site characterization needs. [NEV] (D,O,S,P,M,T)

1d. The hoisting conveyance shall be designed to permit the inspection of shaft performance monitoring instrumentation, as well as other shaft inspection and maintenance activities. [NEV] (O,S,P,M,T)

1e. The headframe shall elevate the hoist sheaves sufficiently above the collar level to provide room for normal conveyance unloading and over-travel allowances. [NEV] (D,O,S)

1f. A hoist foundation shall be provided to accommodate the hoist dimensions and mounting details, independent of the hoist house foundation. [NEV] (O,S)

1g. The headframe shall provide sufficient facilities for dumping buckets during shaft construction. [NEV] (D,S)

1h. The headframe shall be designed and constructed to serve subsurface construction and underground test operations. [NEV] (D,S,T)

1i. Clearances in the headframe directly above the collar shall be designed to accommodate the rigging of all anticipated underground equipment. [NEV] (D,O,S,M)

1j. The hoisting systems shall be designed and constructed for the evacuation of all underground personnel to safety within one hour. [NEV] (S)

1k. Area floodlighting, obstruction lighting, and lightning protection shall be provided atop the shaft headframe. [NEV] (D,O,S)

CONSTRAINTS

A. The hoisting system shall be designed to have all necessary safety features. [NEV]

B. The hoist shall be designed to accommodate the uncertainty allowance (see Section 1.2.6.0, Performance Criteria item 1a, 1b. 1c, and 1d.) [NEV]

C. The hoist house control and operator's room shall be complete with a heating and air conditioning system. [NEV]

D. The hoisting system shall be designed, constructed, tested, operated, and maintained in conformance with applicable regulations. [NEV]

E. The hoist shall be designed with an independent power feeder from the primary switchgear and a dedicated standby power feeder. [NEV]

F. The primary fire protection for hoist electrical gear shall not be a water flow or spray design. [NEV]

G. The sinking bucket shall be replaced with an enclosed conveyance for transporting non-shaft sinking personnel. [NEV]

H. The ES-1 hoist shall not convey radioactive waste unless specifically directed by the Nuclear Regulatory Commission for the purpose of site characterization testing. [NEV]

ASSUMPTIONS

1. The existing GFE 900 HP hoist with updated and modernized control equipment may be used, if proved practical and economical, for shaft sinking and ESF construction and operation activities. [TBV] [NEV]

2. A single building may contain both ESF hoists. [NEV]

3. The hoist system has a 9400-lb payload. [TBV] [NEV]

1.2.6.4.6 SUMP
(Generic Physical Subsystem Account Code: 4.4.1.6)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The sump system is defined as the area at the bottom of the shaft, below the mine level, that contains collection and transfer equipment for the mine wastewater system. [NEV]

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project 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 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	Mine Wastewater System
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	Mine Wastewater Collection System
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.2	Shafts and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. The sump shall provide adequate space at the bottom of the shaft to accommodate in-shaft testing, shaft operation, wastewater, and wastewater handling and transfer equipment. [NEV] edit

PERFORMANCE CRITERIA

1a. The size and depth of the shaft sump shall be sufficient to accommodate the required operation of the shaft equipment. [NEV] (D,O,S,M)

1b. The sump shall be equipped with mine wastewater collection and transfer facilities. [NEV] (D,O,S)

1c. Pumping facilities with adequate redundant capacity shall be available for controlling underground water inflow such that worker protection is ensured . [SR] (O)

CONSTRAINTS

A. Constraints identified with the shaft also apply to the shaft sump. [NEV]

B. The extension of the shaft below the main test level shall provide a minimum water storage capacity of 150 cubic meters [TBV] after removal of the shaft liner and placement of backfill. (Assume backfill porosity equals 0.3) [TBV] [NEV]

C. The sump shall not penetrate the Calico Hills unit unless authorization to do so is given by the Project Office. [NEV]

ASSUMPTIONS

None.

1.2.6.5 SECOND SHAFT
(Generic Physical Subsystem Account Code: 4.4.2)

Subparts are
1.2.6.5.1 Collar
1.2.6.5.2 Lining
1.2.6.5.3 Station
1.2.6.5.4 Furnishings
1.2.6.5.5 Hoist System
1.2.6.5.6 Sump

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The second shaft system is defined by those systems, subsystems, and components that are comprised of vertical engineered openings within a circular zone, whose radius is defined by the sum of the radius of the shaft, the liner thickness, and a nominal 5 feet beyond the liner, that connects the surface with the targeted repository horizon [TBV]. The system provides safe and controlled access to the targeted repository horizon for personnel, equipment, underground service systems, and materials required for development of the underground drifts and excavations, as well as underground testing operations. The second shaft will serve as the primary muck hoisting shaft for test area development. [NEV,E6.5DEFINITION]

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project Interface Control Document(s). Boundaries and interfaces internal to a participating organization's design shall be controlled by the procedures of that organization. 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:

1.2.6.0 GENERAL (EXPLORATORY SHAFT FACILITY)
1.2.6.1 ESF Site
1.2.6.1.1 Main Pad
1.2.6.1.2 Auxiliary Pads
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 Systems
1.2.6.2.2 Water Systems
1.2.6.2.4 Communication System
1.2.6.2.5 Mine 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 FIRST SHAFT

1.2.6.4.3 Stations
1.2.6.4.5 Hoisting Systems
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 Mine 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 Handling Systems
1.2.6.7.10 Sanitary Facilities
1.2.6.7.11 Monitoring and Warning Systems
1.2.6.8 UNDERGROUND TESTS
1.2.6.8.1 Integrated Data System (IDS)
1.2.6.8.2 Geological Tests
1.2.6.8.3 Geomechanics Tests
1.2.6.8.4 Near-Field and Thermally Perturbed Tests
1.2.6.8.5 Hydrologic and Transport Phenomena Tests
1.2.6.9 ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.2 Shafts and Underground Facilities

APPLICABLE REGULATIONS, CODES, AND SPECIFICATIONS

See Section 1.2.6.0, Applicable Regulations, Codes, and Specifications.

FUNCTIONAL REQUIREMENTS

1. Provide primary emergency egress from underground. [E6.5FR1]

2. Provide for testing in the shaft, as required. [E6.5FR2]

3. Support requirements for access, ventilation, and other service-related systems between the surface and the candidate repository horizon. [E6.5FR3]

4. Provide for water drainage and/or control in the shaft. [E6.5FR4]

PERFORMANCE CRITERIA

1. 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. [10 CFR 60.131(b)(4)(i)]

   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, and N will give rise to rebuttable presumption that this requirement has not been met. [10 CFR 60.131(b)(9)]

i. The shaft shall be designed and constructed such that it meets emergency-egress and ventilation requirements. [E6.5PC1a]

ii. Hoisting systems shall have a rated capacity sufficient for emergency egress. [E6.5PC1i]

iii. The shaft shall provide for evacuation and shall be capable of evacuating all underground personnel to safety within 1 hour. [E6.5PC1j]

2a. 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)]

i. Shaft design and construction shall include allowances for construction testing, performance testing, and in situ site characterization testing to the extent necessary. [E6.5PC2] (D,O,P,T)

2b. The location of openings for rock handling shall be selected to minimize effects on testing. [NEV] (D,S)

3a. The shaft shall be designed and constructed such that it meets the requirements of personnel, equipment, materials, utilities, excavated rock, and ventilation. [E6.4PC1a] (D,O,S,P,M,T,I) [E89]

3b. 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)]

i. Necessary shaft facilities and equipment required for handling excavated rock, materials, equipment, and supplies shall support construction, operations, and in situ site characterization testing. Functional requirements of the shafts may be reassigned. [E6.5PC3] [E89]

ii. Functional requirements of the shafts may be assigned by the designer to either of the shafts. [NEV] (N/A)

Note: Applies to muck handling as required.

iii. Muck handling systems shall be sized and designed for ESF operations and in situ site characterization needs and shall

minimize the spillage of rock during rock handling. This system shall provide capabilities for gathering and cleaning out rock spillage from the shaft bottom. [NEV,E6.5PC3] (D,S)

iv. Support facilities, utilities, and equipment shall be designed and constructed to accommodate conventional shaft sinking techniques (i.e., drill and blast). [NEV,E6.5PC3a,E6.0PC6a] (D,S)

v. 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 and local regulations. [SR] (S)

3c. 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(d)(1)]

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 first shaft shall be performed, in a manner that limits the potential for adverse impacts on the long term performance of the repository. [NEV] (O,W,S) [TBD]

3d. 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]

i. Capacity of rock and materials handling equipment and facilities shall be compatible with mining and rock hoisting and the design of the facilities shall meet applicable requirements of DOE Orders 5480.4 and 6430.1A, except seismic criteria. Ventilation capacity, shaft design and air velocities in the shaft shall be optimized with respect to project objectives. [SR] (D,O)

ii. Dust control/collection facilities shall be provided at potential dust generation areas such as working faces, rock handling transfer points, and processing areas underground in order to minimize airborne particulates. [SR] (S)

3e. 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)]

i. Rock support and other structural anchoring materials shall be compatible with waste isolation [E6.5PC1d] [E89]

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

3f. The design of the underground facility shall provide for control of water or gas intrusion. [10 CFR 60.133(d)]

i. The shaft and its drainage systems shall control standing water and air/water contact surfaces where ventilation air will be flowing through in order to optimize humidity in air and to maintain the quality of the ventilation air being supplied. [E6.5PC1f] [TBV]

a. The shaft and its drainage systems shall control standing water and air/water contact surfaces where ventilation air will be flowing through in order to control humidity in air and to maintain the quality of the ventilation air being supplied. [NEV,E6.5PC1f] (O,S) [TBV]

ii. Control of humidity in the underground ventilation air shall be accomplished by reduction of all shaft and main test level air/water contacts to the lowest technically feasible level. [NEV]

3g. 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)]

i. The size and depth of the shaft shall be sufficient for in situ site characterization needs in terms of testing, personnel, materials, equipment, utilities, and schedule. [E6.4PC1k] (D,O,S,T)

ii. The size and layout of the shaft shall be adequate for in situ site characterization needs and capable of supporting the excavation allowances determined under General Exploratory Shaft Facility requirements Section 1.2.6.0, Performance Criteria 1a and 1b. [E6.5PC1k] (D,O,S,T)

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

3h. 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)]

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)]

i. Techniques used for shaft excavation shall control overbreak of rock and minimize disturbance to the integrity of the adjoining rock mass. [E6.5PC1b]

ii. The 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. [E6.5PC1c]

iii. The openings for rock handling shall be constructed in such a way as to minimize effects on the integrity of any other openings. [E6.4PC1g] (O,D,W,S) [E89]

iv. Techniques used for shaft excavation shall control overbreak of rock and minimize disturbance to the integrity of the adjoining rock mass. The following are repository design goals for limiting damage to the intact rock mass. These design goals are presented as guidance for the ESF design and may be modified, if warranted, by results of site characterization or future analysis:

a. Blast induced fracture extent into the intact rock shall be generally less than 3 meters. [NEV,E6.5PC1b] [TBV] (D,O,S)

b. Blast induced changes to the in situ permeability beyond one shaft radius (approximately 3 meters) [TBV] shall average less then one order of magnitude. [NEV]

c. Excavation overbreak shall average less than 6 inches. This overbreak limit may be exceeded, with approval, for short intervals where blast designs are being adjusted. [NEV] [TBV]

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

a. Diametrical closure rate in the second shaft shall average less than 1 millimeter per year [TBV]. This closure rate goal applies to the rate after the first year of closure has occurred. [NEV]

b. The total diametrical closure in the second shaft is to be less than 3 inches at 100 years [TBV]. [NEV,E6.5PC1c] (O,W,S)

3i. The ventilation system shall be designed to (1) Control the transport of radioactive particulates and gases within and releases from the underground facility in accordance with the performance objectives of § 60.111(a). (2) Assure continued function during normal operations

and under accident conditions; and (3) separate the ventilation of excavation and waste emplacement areas. [10 CFR 60.133(g)]

i. The size, shape, and construction of the shaft shall be adequate to supply and/or exhaust the required volumes of air for underground construction, operations, and in situ site characterization. [E6.5PC1g]

ii. Necessary ventilation and distribution facilities shall be provided to supply and/or exhaust adequate quantities of air to and from working areas such that operator safety and productivity are maximized. [SR] (D,O)

3j. The shaft 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. [NEV,E6.5FR1,E6.5FR3,E6.4FR1]

3k. The shaft shall serve as the primary rock hoisting and construction support shaft. [NEV,E6.5PC3] (D,O,S)

3l. The shaft shall be excavated and structurally lined using methods and materials based upon conventional shaft construction technology for the shaft diameter and depth under consideration. [NEV,E6.0PC6a] (D,O,S)

3m. Shaft instrumentation shall be protected from physical damage. [NEV] (O,T)

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

i. 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. [E6.5PC1e] (O,S,P,T)

ii. Water handling and control in the shaft shall be sized for credible water inflows. [E6.5PC4] (D,O,S) [E89]

iii. The drainage and pumping systems shall accommodate measurement of the water as required. [NEV] (O,S,P,T)

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. [TBD]

See Section 1.2.6.0, Interface Control Requirements.

CONSTRAINTS

A. 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)]

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

ii. For planning purposes, the breakout for the main test level shal be at an elevation of 3,079 feet above MSL (see drawing RO7073 in Appendix A.2). [NEV] [TBV]

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 hole drilled ahead of the shaft face in portions of the shaft), with respect to explicit horizon criteria. [NEV,E6.0PC3b]

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(d)(1)]

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. [NEV] [TBD]

ii. Shaft operation and construction shall limit adverse chemical changes (type, quantity and location) particularly to pH and organic content of groundwater, by controlling the use of hydrocarbons, solvents, and chemicals. [NEV] [TBD]

iii. Shaft construction and operations shall limit concrete , shotcrete, and grout for bolt anchors or other rock mass support to that required for proper construction. [NEV]

iv. To the extent feasible or practical, liner 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] [NEV]

v. The chemistry of any water used in shaft construction, or operation shall be compatible with postclosure requirements to isolate and contain waste. [TBD] [NEV]

vi. 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 (performance assessment), and appropriate controls instituted. [NEV]

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

viii. 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.

ix. Construction and operations shall, to the extent practicable, limit adverse effects on the long term performance of the repository; for example by limiting organics in drilling fluids and explosive residues from blasting. [10 CFR 60.15(d)(1)]

x. The use of blasting agents and explosives shall be controlled so that in situ site characterization is not adversely affected. [E6.5CB]

xi. 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. [NEV,E6.5CB]

C. 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(d)(2)]

D. 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(d)(3)]

i. The exploratory shafts shall be located, to the extent practicable, where shafts are planned for the repository facility. [NEV]

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

E. 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. [10 CFR 60.16]

F. The [Safety Analysis Report shall include an assessment containing an evaluation of 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. [10 CFR 60.21(c)(1)(ii)(D)]

i. The exploratory shaft locations shall be selected, consistent with other goals of site characterization, to limit impacts on isolation. [NEV]

ii. The exploratory shaft ground support system shall be designed, consistent with other goals of site characterization, to limit impacts on isolation. If the ground support system is determined to be important to waste isolation, a comparative evaluation of alternatives shall be performed. [NEV] [TBD]

iii. The exploratory shaft diameter shall 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. [NEV] [TBD]

iv. The exploratory shaft liner shall 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. [NEV] [TBD]

v. The exploratory shaft 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. [TBD] [NEV]

G. [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. [10 CFR 60.21(c)(11)]

i. The capability to enhance postclosure performance by removing shaft liners shall be retained.

ii. Furnishings in the shafts shall be designed to be removable, if necessary, prior to permanent closure. [NEV]

H. 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)]

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)]

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

I. 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. [10 CFR 60.112]

J. 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]

i. The centerline coordinate location of ES-2 (second shaft) shall be as determined by Sandia and listed in the RIB, Chapter 2, Section 4, Item 1, as amended, and defined by the Nevada Coordinate System. [NEV] [TBV]

ii. The nominal finished inside diameter of the first shaft, ES-1, and the second shaft, ES-2, shall be determined by Sandia and listed in the RIB, Chapter 2, Section 2, Subsection 8, as amended. [TBV] [NEV]

iii. Utility lines, shaft steel, etc., shall be electrically bonded and reliably connected to the surface electrical "safety" grounding network. [NEV, E6.2PC4m]

iv. At any point within the repository boundary, the distance from the bottom of the second shaft to the water table shall not be less than the minimum vertical distance between the repository and the water table. [NEV] [TBV]

K. The structures, systems, and components important to safety shall be designed to perform their safety functions during and after credible fires or explosions in the geologic repository operations area. [10 CFR 60.131(b)(3)(i)]

To the extent practicable, the geologic repository operations area shall be designed to incorporate the use of noncombustible and heat resistant materials. [10 CFR 60.131(b)(3)(ii)]

The geologic repository operations area shall be designed to include explosion and fire detection alarm systems and appropriate suppression systems with sufficient capacity and capability to reduce the adverse effects of fires and explosions on structures, systems, and components important to safety. [10 CFR 60.131(b)(3)(iii)]

The geologic repository operations area shall be designed to include means to protect systems, structures, and components important to safety against the adverse effects of either the operation or failure of the fire suppression systems. [10 CFR 60.131(b)(3)(iv)]

L. 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. [10 CFR 60.131(b)(4)(i)]

   i. The man and material hoisting, ventilation, and muck handling capacity of the second shaft shall be maintained to support the initial development of the repository until these functions can be assumed by the repository facilities. [NEV]

M. 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)]

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

   i. Location of shafts relative to each other shall be such that testing in either shaft will not be adversely affected by activities in the other. [E6.5CE] [E89]

N. 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)]

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

   ii. The exploratory 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 is not adversely affected. [NEV]

O. 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)]

i. Sufficient flexibility and redundancy for sustaining production shall be built into the rock handling system to cope with problems/breakdowns (e.g., equipment failure, hoisting problems, etc.) in the underground development and operations activities. [SR]

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. [NEV]

iii. The 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 the shaft, in response to actual site conditions encountered during construction. [NEV]

iv. 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. [NEV,E6.0PC3b]

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

i. Structures, systems, and components shall be provided for effective water and ground control. [E6.5CA]

ii. 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. [NEV]

iii. 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. [NEV] [TBD]

iv. 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 <[TBD] percent, and limit the increase in the local percent saturation to <[TBD] percent in waste emplacement areas. [NEV]

v. Fluids recovered during construction operations shall be disposed of in such a way to avoid potential for performance impacts. [NEV]

vi. The drainage plan for underground work shall be consistent with repository operations and postclosure sealing concerns. Specifically, drainage in the dedicated test area as defined by points C1, D, H, and J on Drawing RO7061 in SDRD Appendix A.1 shall be toward ES-1 and drainage in long drifts shall be compatible with repository grades. [NEV]

v. The shafts shall 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. [NEV]

vi. 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. [NEV]

vii. Operating procedures shall be developed to ensure that water entering the ESF is managed appropriately, including quantity, location, and water balance. [NEV]

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

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

x. Shaft construction and operating procedures shall require the removal of excess water to preclude interference with tests. [NEV]

xi. 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. [NEV]

xii. 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. [NEV]

xiii. 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. [NEV]

Q. Openings in the underground facility shall be designed so that operations can be carried out safely and the retrievability option maintained. [10 CFR 60.133(e)(1)]

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)]

i. Shaft permanent structures shall be designed and constructed to withstand the effects of seismic events. The seismic loads to be used to design the shaft are as defined in SDRD Appendix A.4. [NEV]

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

R. 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)]

i. The exploratory shaft construction method shall be selected, consistent with other goals of site characterization, to limit impacts on isolation. [NEV]

ii. 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 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. [NEV]

iii. 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. [NEV]

S. The ventilation system shall be designed to (1) Control the transport of radioactive particulates and gases within and releases from the underground facility in accordance with the performance objectives of § 60.111(a). (2) Assure continued function during normal operations and under accident conditions; and (3) separate the ventilation of excavation and waste emplacement areas. [10 CFR 60.133(g)]

i. The shaft and its furnishings shall be designed to minimize air resistance to the extent practicable. [E6.5CD]

ii. Personnel working in the shaft shall not be exposed to air velocities greater than 2,000 feet per minute. [TBV] [E6.5CC]

T. Engineered barriers shall be designed to assist the geologic setting in meeting the performance objectives for the period following permanent closure. [10 CFR 60.133(h)]

i. Engineered barriers in the shafts shall assist the geologic setting in limiting the release of radionuclides to the accessible environment. [NEV]

U. 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)]

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. [SR]

ii. The predicted loads imposed on the shafts by heating of the repository waste disposal formation are defined in SDRD Appendix A.3. These loads shall be considered in the analysis performed to predict the long term response of the shaft. [NEV,E6.0CN]

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. [NEV]

V. 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)]

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, declines, or drifts in order to ensure that seals do not become preferential pathways for groundwater, or radioactive waste migration. In addition, techniques used to seal inflow during access construction shall not preclude, or reduce the effectiveness of future access seals. [SR]

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

iii. Design, construction, and materials used in the construction of the second 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 post-closure repository sealing. Specific banned items and activities are to be determined at the direction of the Yucca Mountain Project Office. The major areas in which these limitations apply are as follows: [NEV]

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

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

c. In the extension of the shaft below the main ESF test level. [NEV]

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 as shown on drawing RO7073 in Appendix A.2. [TBV] [NEV]

v. 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. [NEV] [TBV]

W. 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]

The performance confirmation program shall have been started during site characterization and it will continue until permanent closure. [10 CFR 60.140(b)]

The performance confirmation 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. [10 CFR 60.140(c)]

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. [NEV]

ii. The configuration of the shaft 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 shaft without adversely affecting testing that is planned or ongoing. [NEV]

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. [NEV]

X. Subsurface conditions shall be monitored and evaluated against design assumptions. [10 CFR 60.141(b)]

i. The shafts of the ESF shall be designed so that baseline performance configuration 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. [NEV]

Y. As a minimum, measurements shall be made of rock deformations and displacement, changes in rock stress and strain, rate and location of water inflow into subsurface areas, changes in groundwater conditions, rock pore water pressures including those along fractures and joints, and the thermal and thermomechanical response of the rock mass as a result of development and operations of the geologic repository. [10 CFR 60.141(c)]

i. Underground facility design and construction shall allow measurement of water inflow into subsurface areas. [SR]

Z. These measurements and observations shall be compared with the original design bases and assumptions. If significant differences exist between the measurements and observations and the original design bases and assumptions, the need for modifications to the design or in construction methods shall be determined and these differences and the recommended changes reported to the Commission. [10 CFR 60.141(d)]

i. The shafts of the ESF shall be designed so that baseline performance configuration 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. [NEV]

ASSUMPTIONS

None.

1.2.6.5.1 COLLAR
(Generic Physical Subsystem Account Code: 4.4.2.1)

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 organization designs are identified in the Project 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 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
1.2.6.2	SURFACE UTILITIES
1.2.6.2.5	Mine 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	Furnishings
1.2.6.5.5	Hoist System
1.2.6.6	UNDERGROUND EXCAVATIONS
1.2.6.7	UNDERGROUND SUPPORT SYSTEMS
1.2.6.8	UNDERGROUND TESTS
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.2	Shafts and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. The shaft collar shall provide during construction and operation periods an adequate foundation for the headframe and shall accommodate penetrations and structural mounting for conveyance systems, ventilation, utilities, instrumentation, and space for adding utilities at a later date (see Section 1.2.6.0, Performance Criteria items 1a, 1b, 1c, and 1d for Uncertainty Allowance). [NEV,E6.5FR3]

PERFORMANCE CRITERIA

1a. Water intrusion, if any, into the entry openings shall be controlled by suitable measures such that flooding of the entries and/or underground openings will not reach the point of endangering worker safety and waste emplacement operations or objectives. [SR] (S) [TBD]

1b. Shaft collar shall be designed and constructed to prevent significant water inflow from a flooding event. [NEV,E6.2PC3c] (D,O,S)

1c. The collar shall provide support for the headframe and hoisting system over the entire range of hoisting system functions, operations, and requirements. [NEV,E6.5PC2,E6.5PC3] (D,O,S)

1d. The collar shall provide support for shaft-sinking equipment and construction stages over the range of conditions encountered during construction. [NEV,E6.5PC3] (D,S)

1e. The collar shall support equipment and materials handling during operations. [NEV,E6.5PC3] (O,S,M)

1f. Collar shall provide safe access and egress. [NEV] (O,S)

CONSTRAINTS

A. The surface elevation at the shaft collar for ES-2 shall be 4,130 feet above mean sea level. [NEV] [TBV]

B. The shaft collar shall be founded in rock. [NEV]

ASSUMPTIONS

None

1.2.6.5.2 LINING
(Generic Physical Subsystem Account Code: 4.4.2.2)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

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

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project 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 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:

1.2.6.5.1	Collar
1.2.6.5.3	Station
1.2.6.5.4	Furnishings
1.2.6.5.5	Hoist System
1.2.6.5.6	Sump
1.2.6.6	UNDERGROUND EXCAVATIONS
1.2.6.7	UNDERGROUND SUPPORT SYSTEMS
1.2.6.8	UNDERGROUND TESTS
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.2	Shafts and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. The lining system shall provide structural and mechanical integrity for the shaft, mounting for conveyance guide supports utilities, and shaft instrumentation during construction and operations. [NEV,E6.5FR3]

PERFORMANCE CRITERIA

1a. The shaft liner shall withstand pressures exerted along its length and around the entire perimeter under anticipated conditions, including reaction to thermally induced stresses as defined in SDRD Appendix A.3. The provisions for thermally induced stresses can be installed at a later date. [NEV,E6.5PC1h] (D,O,S)

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

1c. All concrete activities shall conform to the applicable ACI standards for furnishing, delivery, and placement of structural concrete. (See SDRD Appendix E.) [NEV,E6.0PC6a] (D)

1d. All forming and reinforcements utilized shall conform to applicable ACI and ASTM standards. (See SDRD Appendix E.) [NEV,E6.0PC6a] (D)

CONSTRAINTS

A. The shaft liner shall be protected from damage due to blasting and other activities. [NEV,E6.5CB]

B. The shaft liner placement shall be coordinated with science needs such as testing and mapping. [NEV]

C. The methodology used to analyze the shaft liner shall be in accordance with the methodology presented in the Sandia National Laboratories document SAND88-7060, "Preliminary Shaft Liner Design Criteria and Methodology Guide". This document is ESF SDRD Appendix A.5. [NEV]

ASSUMPTIONS

None.

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 shaft.

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project 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 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	FIRST SHAFT
1.2.6.4.3	Station
1.2.6.5.2	Lining
1.2.6.5.4	Furnishings
1.2.6.5.5	Hoist System
1.2.6.5.6	Sump
1.2.6.6	UNDERGROUND EXCAVATIONS
1.2.6.7	UNDERGROUND SUPPORT SYSTEMS
1.2.6.8	UNDERGROUND TESTS
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.2	Shafts and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. The station shall provide excavated space of adequate size and appropriate geometry to provide support for underground construction and site characterization testing activities. [NEV,E6.6FR1]

PERFORMANCE CRITERIA

1a. The shaft station shall allow sufficient room for safe loading/unloading of personnel, materials, and equipment from the shaft, and provide areas for laydown and assembly of equipment, and transition of the utility distribution to the underground workings. [NEV,E6.5PC3,E6.6PC1a,E6.6PC1i] (D,O,S,M,T)

1b. The station shall have the capacity to accommodate all rock handling requirements from the Main Test Level. [NEV,E6.5PC3] (D,S)

1c. The shaft station shall accommodate devices (e.g., forklift) for handling heavy and large materials. [NEV,E6.5PC3,E6.6PC1a,E6.6PC1i] (O,S,M,T)

1d. The design of the station shall ensure unobstructed access to both sides of the shaft conveyance, complete with a protected walkway. [NEV,E6.5PC3,E6.6PC1a,E6.6PC1i] (D)

1e. The stations shall be provided with landings complete with safety devices, that shall include as a minimum, signals, clear areas, barriers, gates. [NEV,E6.5PC3,E6.6PC1a] (O,S)

1f. The design of the station shall ensure adequate unobstructed room for ventilation air flow. [NEV,E6.5PC1a,E6.6PC1a,E6.6PC1j] (D,O,S)

1g. The design of the shaft station shall consider the physical characteristics of the material and equipment as identified in the basis for design documents. [NEV] (D)

CONSTRAINTS

None

ASSUMPTIONS

None.

1.2.6.5.4 FURNISHINGS
(Generic Physical Subsystem Account Code: 4.4.2.4)

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 other structural members. Also included are the shaft guides, fixed guide brackets and backers, utility brackets, conveyance chairs, loading blocks, crash beams, provisions to facilitate ventilation, and shaft utilities consisting of electrical power, communications, compressed air, water, mine wastewater, etc. [NEV]

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project 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 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
1.2.6.5.1	Collar
1.2.6.5.2	Lining
1.2.6.5.3	Station
1.2.6.5.5	Hoist System
1.2.6.5.6	Sump
1.2.6.5	SECOND SHAFT
1.2.6.5.5	Hoist System
1.2.6.6	UNDERGROUND EXCAVATIONS
1.2.6.7	UNDERGROUND SUPPORT SYSTEMS
1.2.6.8	UNDERGROUND TESTS
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.2	Shafts and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. The furnishings shall 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. [NEV]

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 by the conveyance when at rest and in motion. [NEV,E6.5PC3] (D,O,S)

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. [NEV,E6.5PC3] (D,O,S)

1c. All furnishings shall be designed and constructed to allow readily performed inspection and maintenance. [NEV,E6.5PC3] (M,T)

1d. Operational shaft guides shall be fixed and positioned to extend up to the underside of the crash beams. [NEV,E6.5PC3] (D,O,S)

1e. Shaft furnishings shall be designed and constructed to facilitate ESF underground layout construction after shaft construction is complete. [NEV,E6.5PC2,E6.5PC3] (D,O,S,M,T)

1f. Utility distribution lines and cables shall be designed to withstand the expected underground environment. [NEV,E6.5PC3] (O,M)

1g. Utilities and cables mounted in the shaft shall include the following:

i. Electrical power.
ii. Compressed air.
iii. Water.
iv. Communications.
v. Underground instrumentation.
vi. Instrumentation and IDS Cabling.
vii. Mine wastewater handling system.
viii. Provision for ventilation.

[NEV,E6.5PC3] (D,O,S,M,T)

CONSTRAINTS

A. All brackets shall be designed and constructed to provide adequate strength and isolation for all cables and other devices. [NEV,E6.5PC3]

B. 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. [NEV] [TBD]

C. All shaft furnishings shall be designed to be removed in a manner which will leave the shaft liner free of appendages that will restrict airflow after the shaft is converted to serve as a downcast repository ventilation shaft. [NEV]

ASSUMPTIONS

None.

1.2.6.5.5 HOIST SYSTEM
(Generic Physical Subsystem Account Code: 4.4.2.5)

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 sinking, construction, and underground site characterization testing. The hoist system includes rope winding equipment (hoist), conveyance, headframe, rope, dumping system, and hoist house. [NEV]

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. [NEV]

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project 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 requirements and criteria of Section 1.2.6.5.5 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	Mine Wastewater System
1.2.6.4	FIRST SHAFT
1.2.6.4.5	Hoist System
1.2.6.5.1	Collar
1.2.6.5.2	Lining
1.2.6.5.3	Station
1.2.6.5.4	Furnishings
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	Shafts and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. The hoist system shall provide for the transport and support of personnel, material, and construction equipment, and serve as the emergency egress from the underground during shaft sinking, ESF construction (mining operations), and underground testing. [NEV,E6.5FR1,E6.5FR2]

PERFORMANCE CRITERIA

1a. The ESF hoisting system capacities shall be consistent with the requirements of ESF construction, operation, and underground site characterization needs. [NEV,E6.5PC3] (D,O,S,P,M,T)

1b. The hoisting conveyance shall be designed to permit the inspection of shaft performance monitoring instrumentation, as well as other shaft inspection and maintenance activities. [NEV,E6.5PC3] (O,S,P,M,T)

1c. Hoisting systems shall have a rated capacity sufficient for emergency egress. [E6.5PC1i] (S) [TBD]

1d. The headframe shall elevate the hoist sheaves sufficiently above the collar level to provide room for normal conveyance unloading and over-travel allowances. [NEV,E6.5PC3] (D,O,S)

1e. A hoist foundation shall be provided to accommodate the hoist dimensions and mounting details independent of the hoist house foundation. [NEV,E6.5PC3] (O,S)

1f. The headframe shall provide sufficient facilities for dumping buckets during shaft construction and dumping a skip during ESF operation. [NEV,E6.5PC3] (D,S)

1g. The headframe shall be designed and constructed to serve shaft construction, subsurface construction, and underground test operations. [NEV,E6.5PC2,E6.5PC3] (D,S,T)

1h. Clearances in the headframe directly above the collar shall be designed to accommodate the rigging of all anticipated underground equipment. [NEV,E6.5PC2,E6.5PC3] (D,O,S,M)

1i. Area floodlighting, obstruction lighting, and lightning protection shall be provided atop the shaft headframe(s). [NEV,E6.2PC4i,E6.2PC4n] (D,O,S)

1j. The hoisting system shall be designed and constructed for the evacuation of all underground personnel to safety within one hour. [NEV,E6.5PC1i,E6.5PC1j] (S)

CONSTRAINTS

A. The hoisting system shall be designed to have all necessary safety features. [NEV]

B. The hoist shall be designed to accommodate the uncertainty allowance (see Section 1.2.6.0, Performance Criteria item 1a, 1b. 1c, and 1d.) [NEV]

C. The hoist shall be designed with a separate and independent power distribution system. [NEV]

D. The hoist house control and operator's room shall be complete with a heating and air conditioning system. [NEV]

E. The hoisting system shall be designed, constructed, tested, operated, and maintained in conformance with applicable regulations. [NEV]

F. The hoist shall be designed with an independent power feeder from the primary switchgear and a dedicated standby power feeder. [NEV]

G. The primary fire protection for hoist electrical gear shall not be a water flow or spray design. [NEV]

H. The sinking bucket shall be replaced with an enclosed conveyance for transporting non-shaft sinking personnel. [NEV]

I. The ES-2 hoist shall not convey radioactive waste unless specifically directed by the Nuclear Regulatory Commission for the purpose of site characterization testing. [NEV]

ASSUMPTIONS

1. A single building may contain both ESF hoists. [NEV]

2. The hoist system has a 20,000-lb payload [TBV]. [NEV]

1.2.6.5.6 SUMP
(Generic Physical Subsystem Account Code: 4.4.2.6)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The sump system is defined as the area at the bottom of the shaft that contains the wastewater system collection and transfer equipment as well as provisions for spilled muck. [NEV]

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project 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 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	Mine Wastewater System
1.2.6.5.2	Lining
1.2.6.5.3	Stations
1.2.6.5.4	Furnishings
1.2.6.5.5	Hoist 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	Shafts and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. The sump shall provide adequate space at the bottom of the shaft to accommodate in-shaft testing, shaft operation, wastewater, and wastewater handling and transfer equipment. [NEV,E6.5FR4]

PERFORMANCE CRITERIA

1a. The size and depth of the shaft sump shall be sufficient to accommodate the required operation of the shaft equipment. [NEV,E6.5PC3] (D,O,S)

1b. The sump shall be equipped with mine wastewater collection and transfer facilities. [NEV,E6.5PC4] (D,O,S)

1c. As part of the muck handling system, provisions shall be made for the cleaning out of the sump area. [NEV,E6.5PC3] (S,M)

1d. Pumping facilities with adequate redundant capacity shall be available for controlling underground water inflow such that worker protection is ensured . [SR] (S)

CONSTRAINTS

A. Constraints identified with the shaft shall also apply to the shaft sump. [NEV]

ASSUMPTIONS

None.

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 shaft and which comprise the excavations at the proposed test levels and the preferred repository horizon, based on the needs for underground site characterization. [NEV, E6.6DEF] [TBV]

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project 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 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:

1.2.6.0	GENERAL (EXPLORATORY SHAFT FACILITY)
1.2.6.1	ESF SITE
1.2.6.1.1	Main Pad
1.2.6.2	SURFACE UTILITIES
1.2.6.2.1	Power Systems
1.2.6.2.2	Water Systems
1.2.6.2.4	Communication System
1.2.6.2.5	Mine 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	FIRST SHAFT
1.2.6.4.1	Collar
1.2.6.4.2	Lining
1.2.6.4.3	Station
1.2.6.4.4	Furnishings
1.2.6.4.5	Hoist System
1.2.6.4.6	Sump
1.2.6.5	SECOND SHAFT
1.2.6.5.1	Collar
1.2.6.5.2	Lining
1.2.6.5.3	Station
1.2.6.5.4	Furnishings

1.2.6.5.5 Hoist System
1.2.6.5.6 Sump
1.2.6.7 UNDERGROUND SUPPORT SYSTEMS
1.2.6.8 UNDERGROUND TESTS
1.2.6.8.1 Integrated Data System (IDS)
1.2.6.8.2 Geological Tests
1.2.6.8.3 Geomechanics Tests
1.2.6.8.4 Near-Field and Thermally Perturbed Tests
1.2.6.8.5 Hydrologic and Transport Phenomena Tests
1.2.6.9 ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.2 Shafts and Underground Facilities

APPLICABLE REGULATIONS, CODES, AND SPECIFICATIONS

See Section 1.2.6.0, Applicable Regulations, Codes, and Specifications.

FUNCTIONAL REQUIREMENTS

1. Provide underground openings for in situ site characterization and support maintenance of in situ site characterization. [E6.6FR1]

2. Provide a system for removing excavated rock to the shaft. [E6.6FR2]

PERFORMANCE CRITERIA

1a. Underground openings shall be designed and constructed to meet the safety requirements for personnel, equipment, and ventilation. [E6.6PC1a] [E89]

1b. 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]

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. [E6.6PC1n]

ii. A refuge chamber(s) shall be provided with sufficient capacity and facilities to accommodate personnel underground. [E6.6PC1o]

iii. The testing requirements outlined in SDRD Appendix B and C shall serve as the basis for the test level development. [NEV,E6.6PC1i] (O,T)

1c. 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)]

i. Rock support and other structural anchoring materials shall be compatible with waste isolation and shall neither interfere with radionuclide containment, nor enhance radionuclide migration. [E6.6PC1e]

1d. 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)]

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. [NEV,E6.6PC1p] (D)

ii. Provide the specific excavation required for shaft 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 function, and other areas as determined by the in situ site characterization program. [NEV,E6.6PC1i,E6.6PC1k] (D,O,S,P,M,T,I)

iii. The size and layout of the openings excavated on the test levels shall be adequate for in situ site characterization needs and capable of supporting additional excavation beyond the initially planned test areas (see Section 1.2.6.0, Performance Criteria items 1a and 1b.). [NEV,E6.6PC1k,E6.0PC1a,E6.0PC1b] (D,O,P,T)

iv. The size, shape, excavation and support of underground openings shall be adequate to meet transfer requirements for excavated rock, personnel, equipment, ventilation, utilities and the underground test plan. [NEV,E6.6PC1m] (D,O,S,P,M,T,I)

v. 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. [E6.6PC1m]

vi. Develop underground openings in welded high lithophysal/low lithophysal tuff for in situ site characterization construction, operations, and maintenance. [NEV,E6.6FR1]

1e. The design of the underground facility shall provide for control of water or gas intrusion. [10 CFR 60.133(d)]

i. 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. [E6.6PC1f]

ii. 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. [E6.6PC1g]

iii. Underground openings and drainage systems shall control standing water where ventilation air will be flowing through in order to optimize humidity in air and to maintain the quality of the ventilation air being supplied. [E6.6PC1h] [TBV]

iv. Underground openings and drainage systems shall control standing water where ventilation air will be flowing through in order to control humidity in air and to maintain the quality of the ventilation air being supplied. [NEV,E6.6PC1h] [TBV]

v. 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. [E6.6PC1p]

vi. Adequate subsurface facilities shall be provided to control expected underground water inflow and nonroutine water intrusion events having a reasonably high probability of occurrence during the preclosure period, and to ensure personnel safety and minimum disruption to waste disposal operations. [SR] (S)

1f. Openings in the underground facility shall be designed so that operations can be carried out safely and the retrievability option maintained. [10 CFR 60.133(e)(1)]

i. The number and the size of openings shall satisfy in situ site characterization needs in terms of testing, personnel, materials, equipment, utilities, and schedule. [E6.6PC1i]

ii. The size and layout of openings shall be adequate for in situ site characterization needs and capable of supporting the excavation allowances determined under General ESF Requirements Section 6.0 Performance Criteria 1.a. and 1.b. [E6.6PC1k]

iii. 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. [E6.6PC1l]

iv. Underground openings shall be designed and constructed to meet testing, personnel, equipment, utility, and ventilation requirements as well as safety requirements during operations. [NEV,E6.6PC1a,E6.6PC1j] (D,O,S,M,T) [RL-25]

v. Necessary ventilation/exhaust and distribution facilities shall be provided to supply and exhaust adequate quantities of air to and from working areas such that operator safety and productivity are maximized. [SR] (S)

vi. In the event backfilling is required, underground handling capacity for processing, receiving, transporting, and, where necessary, emplacing backfill material shall be adequate and compatible with required backfill receiving and emplacement rates. [SR] (O)

vii. Dust control/collection facilities shall be provided at potential dust generation areas such as working faces, rock handling transfer points, and processing areas underground in order to minimize airborne particulates. [SR] (S)

1h. 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)]

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)]

i. Excavation techniques shall control overbreak of rock and minimize disturbance to the integrity of the adjoining rock mass. [E6.6PC1c]

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. [E6.6PC1d]

iii. The drifts 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. 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: [NEV]

a. The closure rate in the underground excavations shall average less than 1 millimeter per year. This closure rate applies after the first year of closure has occurred. [NEV] [TBV]

b. The total closure of the underground excavations shall be less than six inches for the 100 year life of the repository. [NEV] [TBV]

c. The rock support system is to limit the average rockfall in the underground excavations to less than five tons/1000 feet of drifting per year. [NEV] [TBV]

d. The design and spacing of the rock support system shall be based on a goal of limiting the maximum slab size to less than 2 tons. [NEV] [TBV]

e. All rock fall greater than 4 inches in any dimension from the back of the underground excavations shall be retained by the support system. [NEV,E6.6PC1d] [TBV] (D)

iv. Techniques used for drift excavation shall control overbreak of rock and minimize disturbance to the integrity of adjoining rock mass. The following are repository design goals for limiting damage to the intact rock mass. These design goals are presented as guidance for the ESF design and may be modified if warranted by results of site characterization or future analyses: [NEV]

a. Blast induced change 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. [NEV] [TBV]

b. Excavation overbreak is to average less than 12 inches. This overbreak limit may be exceeded, by approval, for short intervals where blast designs are being adjusted. [NEV] [TBV] (D)

1i. The ventilation system shall be designed to (1) Control the transport of radioactive particulates and gases within and releases from the underground facility in accordance with the performance objectives of § 60.111(a). (2) Assure continued function during normal operations and under accident conditions; and (3) separate the ventilation of excavation and waste emplacement areas. [10 CFR 60.133(g)]

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. [E6.6PC1j]

1j. The necessary access openings shall be available for use of their specific purposes within the time frame specified in the repository schedule. [SR] (O)

2a. The excavation facilities and equipment required for handling 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 1a. and 1b. [E6.6PC2] (D,O,S,T)

2b. Excavated rock processing and storage capacity underground shall be compatible with the required excavation and handling rates. [SR] (O)

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 [TBD]. [NEV]

See Section 1.2.6.0, Interface Control Requirements.

CONSTRAINTS

A. 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)]

   i. 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. [NEV,10 CFR 60.133(a)(1), 10 CFR 60.60.15(b)]

   ii. The proposed Main Test Level floor shall be within the Topopah Spring Unit. [NEV]

   iii. Exploratory drifting outside of the designated test area shall be constrained by adequate and reliable stratigraphic information obtained from exploratory drilling in order that the repository grades used in locating the drifts are consistent with actual stratigraphic variations in the repository block. [NEV]

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(d)(1)]

   i. The design 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, and construction and operation of the main test level shall be performed in a manner that limits the potential for adverse impacts on the long term performance of the repository. [NEV] [TBD]

   ii. Underground facility operation and construction shall limit adverse chemical changes (type, quantity, and location) particularly to pH and organic content of groundwater, by controlling the use of hydrocarbons, solvents, and chemicals. [NEV] [TBD]

   iii. Underground facility construction and operation shall limit concrete, shotcrete, and grout for bolt anchors or other rock mass support to that required for proper construction. [NEV]

   iv. The chemistry of any water used in underground excavation construction or operation shall be compatible with postclosure requirements to isolate and contain waste. [NEV] [TBD]

v. 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. [NEV]

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

vii. 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. [NEV]

viii. Construction and operations shall to the extent practicable, lim adverse effects on the long term performance of the geologic repository; for example, by limiting organics in drilling fluids and explosive residues from blasting. [NEV]

ix. The use of blasting agents and explosives shall be controlled to preclude adverse effects on in situ site characterization. [E6.6CD]

x. 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. [NEV,E6.6CD]

C. 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(d)(2)]

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. [NEV,10 CFR 60.133(a)(1)]

ii. The area of the ESF underground excavations shall be limited to that necessary for conducting the needed site characterization and performance confirmation tests. [NEV]

D. 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(d)(3)]

i. Exploratory boreholes drilled from the ground surface may intersect openings within the ESF dedicated testing areas defined by points C, O, H, & J on Drawing RO7061 in SDRD Appendix A.1. The number of boreholes should be kept to the

minimum required to perform the experiments needed. The location of any such boreholes must be reidentified on the "as-built" maps of the ESF. [NEV]

ii. In areas outside the ESF dedicated testing areas defined by Points C', D, H, & J on drawing RO7061 in SDRD Appendix A.1, no portion of an exploratory borehole drilled from the ground surface shall be located within 15 m of any underground opening. [NEV] [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: [NEV]

a. The holes shall be collared no less than 3 feet above the floor of the drift or alcove from which they are drilled. [TBV] [NEV]

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. [NEV]

c. All borehole alignments and locations shall be monitored, surveyed, and included on all underground as-built maps. [NEV]

E. 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(d)(4)]

i. 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. [NEV]

ii. The Dedicated Test Area and the Dedicated Shop Area openings, as defined on Drawing RO7061 in SDRD Appendix A.1, 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.). [NEV]

iii. The future repository access drift shown crossing the ESF Dedicated Shop Area on Drawing RO7064 in SDRD Appendix A.1 may be incorporated into the design of the ESF support shop facility. [NEV]

iv. 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. [NEV]

v. The ESF shall be designed to be consistent with the repository design goal to limit the extraction ratio to less than 30 percent. [TBV] [NEV]

F. The [Safety Analysis Report shall include an assessment containing an evaluation of 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. [10 CFR 60.21(c)(1)(ii)(D)]

i. The Exploratory Shaft Underground Facility layout, including drift size, shall 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. [NEV]

ii. The Exploratory Shaft Underground Facility ground support system shall be designed, consistent with the other goals of site characterization, to limit the impacts on isolation. If the ground support system is determined to be important to waste isolation, a comparative evaluation of alternatives shall be performed. [NEV]

iii. The exploratory shaft operational seals shall (if required) 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. [NEV] [TBD]

G. [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. [10 CFR 60.21(c)(11)]

i. Nonpermanent components in the underground openings shall be designed to be removable, if necessary, prior to permanent closure. [NEV]

ii. To the extent practiable, remove all underground support systems associated with equipment and hardware (hangers,brackets, etc.) following final use. [NEV]

H. 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)]

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)]

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. [NEV]

I. 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. [10 CFR 60.112]

J. In satisfying the preceding requirement, the engineered barrier system shall be designed, assuming anticipated processes and events, so that: (A) Containment of HLW [High-Level Waste] within the waste packages will be substantially complete for a period to be determined by the Commission taking into account the factors specified in § [10 CFR] 60.113(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. [10 CFR 60.113(a)(1)(ii)]

i. 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. [NEV]

ii. 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 minimum period (not less than 300 years nor more than 1000 years) after the permanent closure of the repository. [TBV] [NEV]

iii. Excavation methods shall limit the potential for creating a preferential pathway for radionuclide migration to the accessible environment. [NEV]

K. 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]

i. Dry air coring will be required for some tests. [NEV]

ii. Instrument cables shall be separated from power cables in drifts to minimize electrical interference. Instrument and IDS cables shall be contained in overhead runs to protect them from damage. [NEV]

L. The structures, systems, and components important to safety shall be designed to perform their safety functions during and after credible fires or explosions in the geologic repository operations area. [10 CFR 60.131(b)(3)(i)]

To the extent practicable, the geologic repository operations area shall be designed to incorporate the use of noncombustible and heat resistant materials. [10 CFR 60.131(b)(3)(ii)]

The geologic repository operations area shall be designed to include explosion and fire detection alarm systems and appropriate suppression systems with sufficient capacity and capability to reduce the adverse effects of fires and explosions on structures, systems, and components important to safety. [10 CFR 60.131(b)(3)(iii)]

The geologic repository operations area shall be designed to include means to protect systems, structures, and components important to safety against the adverse effects of either the operation or failure of the fire suppression systems. [10 CFR 60.131(b)(3)(iv)]

i. The extent of drifting on the main test level prior to connection of the shafts shall be determined by a safety

analysis. The emphasis of the safety analysis shall be on early of the long drifts. [NEV,E6.9CE]

ii. The maintenance, refueling, and equipment storage areas shall be designed and located to minimize the fire and safety risks. [NEV,E6.0CI] (S)

M. 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)]

i. Overburden must be > 200m for the main test level of the ESF. [NEV,10 CFR 960.4-2-5(d),10 CFR 60.122(b)(5)]

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. [NEV,10 CFR 60.133(f),10 CFR 60.133(a)(1)]

iii. Flexibility to sink the first shaft (ES-1) into, and/or drift into, the Calico Hills formation, shall be maintained. Such flexibility shall consider aspects of hoisting capacity, underground utilities, ground support, and muck handling. [NEV]

iv. 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. [NEV]

v. 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 by points D, H, J, C1, S1, S2, and S3 on Drawing RO7061 in SDRD Appendix A.1. No drifting shall be closer than 75 feet from this boundary. Small diameter boreholes are excepted, provided they meet the requirements pertaining to boreholes stated in 6.6CD . [NEV] [TBV]

vi. 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 RO7062 and RO7063 in SDRD Appendix A.1. [NEV]

vii. 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 RO7064 and RO7065 in SDRD Appendix A.1. [NEV]

viii. 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 RO7066 in SDRD Appendix A.1. [NEV]

N. 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)]

i. The Exploratory Shaft Underground Facility shall be designed so that the effects of credible disruptive events (e.g., flooding, fires, and explosions) shall not spread through the facility. [NEV] [TBD]

ii. Materials shall be selected such that effects of fire do not produce geochemical effects that impact waste isolation capabilities of the site. [NEV]

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. [NEV]

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. Specifically, drainage in the dedicated test area shall be toward ES-1 and drainage in long drifts should be compatible with repository grades. [NEV,10 CFR 60.133(a)(1),10 CFR 60.133(d),10 CFR 60.21(c)(11)]

v. The presence of combustible materials in the underground facility shall be controlled and limited such that testing in the ESF is not adversely affected. [NEV]

O. 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)]

i. A station landing and test drifts shall be constructed as part of the ES-1 shaft at the Upper Demonstration Breakout Room (DBR) and the Main Test Level. The flexibility to drift in the Calico Hills formation will be maintained. [NEV]

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. [NEV]

iii. Underground layout arrangements, excavation methods, and equipment shall have the flexibility to adjust to varying site conditions during the excavation process. [SR]

iv. The ESF shall be designed so as not to interfere with the flexibility of the repository to accommodate specific site conditions. [NEV]

v. 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. [TBV] [NEV]

vi. 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 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), (4) accommodate schedule changes as needed, and (5) limit interference between ESF construction and operation activities and testing activities. [NEV,10 CFR 60.141(c) & (d)]

vii. 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. [NEV]

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

i. Structures, systems, and components shall be provided for effective water and ground control. [E6.6CA]

ii. Facilities for plugging or grouting water inflow areas shall be available if water is known to exist in the vicinity of subsurface workings. [SR]

iii. 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 by Points C1, D, H, and J on Drawing R07061 in SDRD Appendix A.1, shall be toward ES-1 and drainage in long drifts shall be compatible with repository grades. [NEV]

iv. 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 R07061 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 RO7073 in SDRD Appendix A.2. These provisions impose no restrictions on ESF construction. [NEV]

v. 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 implemented. [NEV]

vi. 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. [NEV] [TBD]

vii. 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 < [TBD] percent and to limit increase in the local percent saturation to < [TBD] percent in areas of waste emplacement. [NEV] rj44

viii. Fluids recovered during construction operations shall be disposed of in such a way as to avoid potential for performance impacts. [NEV]

ix. Operating procedures shall be developed to ensure water entering the ESF is managed appropriately, including quantity, location, and water balance. [NEV]

x. 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. [NEV]

xi. 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. [NEV] [TBV]

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

xiii. The amount of water used in construction and operations of the underground facility shall be limited to preclude interference with tests. [TBD] [NEV]

xiv. Underground facility construction and operating procedures shall require the removal of excess water to preclude interference with tests. [NEV]

xv. 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. [NEV]

xvi. 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. [NEV]

xvii. 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. [NEV]

Q. Openings in the underground facility shall be designed so that operations can be carried out safely and the retrievability option maintained. [10 CFR 60.133(e)(1)]

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)]

i. Underground openings shall be designed and constructed to minimize impacts on in situ site characterization. [E6.6CF]

ii. The design of underground openings and their supports shall consider pillar and openings geometries that limit excessive stress concentrations. [E6.6CG]

iii. Underground excavated areas shall be designed for safe and maintainable ground support and control where required. [NEV,E6.6CA] (S,M)

iv. 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. [SR]

v. Underground permanent structures shall be designed and constructed to withstand the effects of seismic events. The predicted seismic loads to be used in the design the underground excavations are defined in SDRD Appendix A.4. [NEV]

vi. 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. [NEV]

vii. 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. [NEV,E6.6CG]

R. 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)]

i. Excavation methods shall limit the potential for creating a preferential pathway for groundwater to contact waste packages. [NEV]

ii. Mechanical excavation methods may be used if technically feasible and economically justified. [E6.6CE] [E89]

iii. The test level development shall be accomplished by conventional mining (drill, blast, muck). [NEV,E6.6CE]

iv. Full face, blast hole drilling shall be accomplished by using a multi-boom drill jumbo where practical. [NEV,E6.3CE]

v. The enlarged sections originating from point C as shown on Drawing RO7061 to investigate the Ghost Dance Fault, the Drill Hole Wash structures, and the suspected imbricate faults shall be driven at full dimension. [NEV]

vi. The enlarged sections in the drifts driven to the Ghost Dance Fault and the suspected imbricate (excluding the enlarged portions beginning at Point C on Drawing RO7061 in SDRD Appendix A.1) 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. (includes the drifting through these geologic features). [TBV] [NEV]

vii. The enlarged section in the drift driven to the Drill Hole Wash structures (excluding the enlarged portions beginning at Point C on Drawing RO7061 in SDRD Appendix A.1) 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 (includes the drifting through the drill hole wash structures). [TBV] [NEV]

viii. The methodology used to design and analyze the underground excavations of the ESF shall be consistent with the methodology presented in SDRD Appendix A.6. This methodology will be expanded in the future to include specific detailed information on the methods to be used for the analysis of underground excavations. [NEV]

ix. The design of the underground excavation shall incorporate aspects specifically directed at limiting, to the extent practicable, adverse effects on the repository long term performance,. and construction and operation of the underground excavation shall be performed in a manner that limits, to the

extent practicable, adverse effects on the repository long term performance. [NEV,10 CFR 60.15(d)(1)]

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. [NEV]

xi. 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 investigation and monitoring of excavation effects during and after construction. [NEV]

S. The ventilation system shall be designed to (1) Control the transport of radioactive particulates and gases within and releases from the underground facility in accordance with the performance objectives of § 60.111(a). (2) Assure continued function during normal operations and under accident conditions; and (3) separate the ventilation of excavation and waste emplacement areas. [10 CFR 60.133(g)]

i. Underground openings shall be designed to minimize air resistance to the extent practicable. [E6.6CB]

ii. 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. [E6.6CC]

iii. Personnel in underground openings shall not be exposed to ventilation velocities that exceed 1,500 feet per minute. The ventilation volume shall not be less than 200 cubic feet per minute per person. [E6.6CH] [TBV]

iv. The effective temperature in working areas shall be designed not to exceed 80 degrees wet-bulb globe temperature. [E6.6CI] [TBV]

v. The ventilation system shall be designed to handle the required volume of air in order to provide an air cooling power equal to or greater than 260 w/m^2 of personnel skin surface area. [NEV,E6.6CI] [TBV]

T. Engineered barriers shall be designed to assist the geologic setting in meeting the performance objectives for the period following permanent closure. [10 CFR 60.133(h)]

i. The engineered barriers in the underground excavation shall be designed such that other systems, structures, and components of the ESF and the candidate repository do not eventually become

groundwater flow paths and do not promote the release of radionuclides to the accessible environment. (MOD,E6.CF)

ii. 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. [NEV]

iii. Engineered barriers in the underground excavation shall assist the geologic setting in limiting the release of radionuclides to the accessible environment. [NEV]

U. 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)]

In situ monitoring of the thermomechanical response of the underground facility shall be conducted until permanent closure to ensure that the performance of the natural and engineering features are within design limits. [10 CFR 60.141(e)]

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. [SR]

ii. The predicted loads imposed on the underground excavations by the heating of the repository waste disposal formation are defined in SDRD Appendix A.3. These loads shall be considered in the analyses performed to predict the long-term response of the underground excavations. [NEV]

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 and do not significantly increase the saturation of the host rock in the waste emplacement area. [NEV] [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. [NEV]

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. [TBD] [NEV]

V. 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)

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, 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 inflow during access construction shall not preclude or reduce the effectiveness of future access seals. [SR]

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. [NEV]

iii. The 150-foot long, full-sized drift driven from Point C on Drawing RO7061 toward the Ghost Dance Fault shall be driven consistent with the requirements imposed by the sealing program. See note 6 on Drawing RO7071. [TBV] [NEV]

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. [NEV]

v. Operational seals shall be provided where necessary to control the spread of water through the facility. [NEV,10 CFR 60.134(a)(2)]

vi. Grouting during ESF construction shall have the following constraints: [NEV]

a. Pressure grouting is not permitted during or after construction in the ESF dedicated test area connection drifts and shaft station drift for a distance of 50 feet from the panel access drift as shown on Drawing RO7073 in SDRD Appendix A.2. [TBV] [NEV]

b. In the drift driven to investigate the Drill Hole Wash fault, 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 RO7071 in SDRD Appendix A.2.) [TBV] [NEV]

c. No pressure grouting is to be used in the 150-ft long full sized drift driven from POINT C ON DRAWING RO7061 toward the Ghost Dance Fault. [TBV] [NEV]

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 RO7071 in SDRD Appendix A.2). [NEV]

W. 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]

The [performance confirmation] program shall have been started during site characterization and it will continue until permanent closure. [10 CFR 60.140(b)]

The [performance confirmation] 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. [10 CFR 60.140(c)]

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. [NEV]

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. [NEV,10 CFR 60.141(c) and 60.141(d)]

iii. The shaft breakouts and main test level 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. [NEV,10 CFR 60.140 (b) & (c)]

Y. During repository construction and operation, a continuing program of surveillance, measurement, testing, and geologic mapping shall be conducted to ensure that geotechnical and design parameters are confirmed and to ensure that appropriate action is taken to inform the Commission of changes needed in design to accommodate actual field conditions encountered. [10 CFR 60.141(a)]

Subsurface conditions shall be monitored and evaluated against design assumptions. [10 CFR 60.141(b)]

i. 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.
[NEV,10 CFR 60.141(a)&(b)]

Z. As a minimum, measurements shall be made of rock deformations and displacement, changes in rock stress and strain, rate and location of water inflow into subsurface areas, changes in groundwater conditions, rock pore water pressures including those along fractures and joints, and the thermal and thermomechanical response of the rock mass as a result of development and operations of the geologic repository.
[10 CFR 60.141(c)]

These measurements and observations shall be compared with the original design bases and assumptions. If significant differences exist between the measurements and observations and the original design bases and assumptions, the need for modifications to the design or in construction methods shall be determined and these differences and the recommended changes reported to the Commission.
[10 CFR 60.141(d)]

i. 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.
[NEV,10 CFR 60.141(a) & (b)]

ASSUMPTIONS

1. Mucking shall be accomplished by using rubber-tired, diesel-powered equipment. [NEV]

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 by underground openings that include the drift(s), refuge room(s), operation administration area, underground shop(s), lunch room(s), storage facility(ies), maintenance shop(s), power distribution, fuel storage, equipment storage, and other underground openings, not including 1.2.6.6.2 Test Areas. [NEV]

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project 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 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	FIRST SHAFT
1.2.6.5	SECOND SHAFT
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	Shafts and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. Operations support areas shall provide excavated space of adequate size and appropriate geometry to support underground site characterization test activities on multiple levels. This shall include facilities for the administration and maintenance of ESF underground systems, structures, and components as well as underground testing equipment and instrumentation, equipment storage space, power distribution, fuel storage and distribution, and lunch room. [NEV,E6.6FR1]

PERFORMANCE CRITERIA

1a. The openings required for rock handling and for support facilities (e.g., maintenance shop(s), electrical substation(s), pump station(s), refuge chamber(s), lunch room(s), and storage facility(ies) for supplies and consumables) shall be located away from in situ site characterization testing to minimize interruptions. [NEV,E6.6PC11] (D,O,S,P,M,T,I)

1b. Openings for operating equipment shall be sized and equipment positioned to provide adequate clearance for maintenance, inspection, and repair or replacement. [NEV,E6.6PC1a] (D,O,M)

1c. Underground maintenance facilities shall be designed and sized to maintain subsurface equipment, instrumentation, and systems. [NEV] (D,O,M)

CONSTRAINTS

A. The maintenance areas/facilities shall be separated into a construction maintenance area and an underground test maintenance area. [NEV]

B. Underground excavations for Operations Support Areas shall conform to all requirements of underground excavations. [NEV]

C. Fuel storage areas shall comply with applicable Federal, State of Nevada, and local requirements. [NEV]

ASSUMPTIONS

None.

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 in ES-1 (science shaft) 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). [NEV,E6.6DEF]

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project 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 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	FIRST SHAFT
1.2.6.5	SECOND SHAFT
1.2.6.6.1	Operations Support Areas
1.2.6.7	UNDERGROUND SUPPORT SYSTEMS
1.2.6.8	UNDERGROUND TESTS
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.2	Shafts and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. The test areas shall 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. [NEV,E6.6FR1]

PERFORMANCE CRITERIA

1a. The number and the size of openings shall satisfy underground testing needs in terms of personnel, materials, equipment, and utilities as found in the Underground Test Requirements in SDRD Appendices B and C. [NEV,E6.6PC1i] (D,O,M,T)

1b. ESF structures, systems, components, and operations shall accommodate additional tests and monitoring if required (see Section 1.2.6.0, Performance Criteria items 1a and 1b.). [NEV,E6.6PC1k,E6.0PC1a,E6.0PC1b] (P,T)

1c. The test area layout shall be such that individual tests are sufficiently isolated from the effects of other tests and from construction activities. [NEV] (T)

1d. Areas shall be provided for the storage of testing support equipment such as forms, scaffolds, cable runs, support structures and utilities. [NEV] (T)

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. [NEV,E6.0CN,E6.9CA]

B. Test areas shall conform to all requirements of underground excavations. [NEV]

C. Use of hydrocarbons and solvents underground shall be limited to comply with criteria to be determined by Performance Assessment. [NEV] [TBD]

D. To the extent practicable, clean up spills of hydrocarbons, solvents and other materials. [NEV]

E. To the extent practicable, limit or avoid the use of concrete and cementitious materials in or near geochemical test areas and emplacement holes. [NEV]

F. To the extent practicable, remove instrumentation following final use. [NEV]

G. To the extent feasible or practicable, liner 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. [NEV]

ASSUMPTIONS

None.

1.2.6.7 UNDERGROUND SUPPORT SYSTEMS
(Generic Physical Subsystem Account Code: 4.6)

Subparts are

1.2.6.7.1	Power Distribution System
1.2.6.7.3	Lighting System
1.2.6.7.4	Ventilation Distribution System
1.2.6.7.5	Water Distribution System
1.2.6.7.6	Mine 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 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, mine wastewater, compressed air, fire protection, excavation and muck handling, sanitary, and monitoring and warning systems required to meet the needs of the underground site characterization testing program during construction and operation. [NEV,E6.7DEF]

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project 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 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:

1.2.6.0	GENERAL (EXPLORATORY SHAFT FACILITY)
1.2.6.1	ESF SITE
1.2.6.2	SURFACE UTILITIES
1.2.6.2.1	Power Systems
1.2.6.2.2	Water Systems
1.2.6.2.3	Sewage Systems
1.2.6.2.4	Communication System
1.2.6.2.5	Mine 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
1.2.6.4	FIRST SHAFT

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 SECOND SHAFT
1.2.6.5.1 Collar
1.2.6.5.2 Lining
1.2.6.5.3 Station
1.2.6.5.4 Furnishings
1.2.6.5.5 Hoist System
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 TESTS
1.2.6.8.1 Integrated Data System (IDS)
1.2.6.8.2 Geological Tests
1.2.6.8.3 Geomechanics Tests
1.2.6.8.4 Near-Field and Thermally Perturbed Tests
1.2.6.8.5 Hydrologic and Transport Phenomena Tests
1.2.6.9 ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.2 Shafts and Underground Facilities

APPLICABLE CODES, REGULATIONS, AND SPECIFICATIONS

General

1. 30 CFR, Chapter I .
2. Nevada Revise Statutes, Chapter 512.

Electrical

1. DOE 6430.1A, dated April 6, 1989, Division 16-Electrical.
2. NFPA-70.
3. ANSI C-2.

Lighting

1. DOE 6430.1A, dated April 6, 1989, Division 16-Electrical.

Uninterruptible Power

1. DOE 6430.1A, dated April 6, 1989, Division 16-Electrical.
2. IEEE-485.
3. IEEE-650.

Water Systems

1. DOE 6430.1A, dated April 6, 1989, Division 2-Site and Civil Engineering and Division 15-Mechanical.
2. NRS Chapter 445, paragraphs .361 through .399.
3. NFPA 20, 22, and 24.

Mine Wastewater Collection System

1. DOE 6430.1A, dated April 6, 1989, Division 2-Site and Civil Engineering.
2. NRS Chapter 445, paragraphs .131 through .354.

Ventilation System and Dust Control

1. American Conference of Governmental Industrial Hygienists, Industrial Ventilation, A Manual of Recommended Practices, 19th Edition.
2. NRS Chapter 445, paragraphs .401 through .601.

In addition, see Section 1.2.6.0, Applicable Codes, Regulations, and Specifications.

FUNCTIONAL REQUIREMENTS

1. Provide utilities for underground ESF construction, operations, in situ site characterization, and monitoring activities. [E6.7FR1]

2. Provide facilities and equipment for the installation, operation, and maintenance of the underground services. [E6.7FR5]

3. Provide underground transport services for personnel, equipment, and materials. [E6.7FR6]

PERFORMANCE CRITERIA

1a. The system shall have suitable utilities, including power, lights, water and compressed air, as required for construction, operations, and in situ site characterization and shall be capable of supporting the allowances determined under General ESF Requirements Section 1.2.6.0, Performance Criteria 1a. and 1b. [E6.7PC1a]

1b. The utility services shall include minimal backup units for primary power lines, primary pumps, shaft conveyances, primary ventilation fans, and primary communications and testing equipment to allow testing continuity based upon Project analysis. [E6.7PC1b]

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 at critical locations. [E6.7PC1c]

1d. The underground support systems and service facilities shall have suitable utilities, including power, lights, water and compressed air, as required for construction, operations, and in situ site characterization, and shall be capable of supporting the uncertainty allowances as defined in Section 1.2.6.0, Performance Criteria 1a. and 1c. [NEV,E6.7PC1a,E6.0PC1a,E6.0PC1b] (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. [NEV]

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 supporting the excavation allowances determined under General ESF Requirements Section 1.2.6.0, Performance Criteria 1a. and 1b. [E6.7PC5]

2b. Cranes, lifting equipment, and shop machinery shall be consistent with maintenance needs. [NEV] (M)

3a. The underground transport facilities shall be sufficiently sized to sustain construction, operations, and testing. [E6.7PC6a]

3b. The transport system(s) shall be designed with appropriate safety features as required by Project analysis and applicable Federal, State, and local regulations. [E6.7PC6b]

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, [TBD]

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 conveyance traffic; obstruct ventilation; or cause safety hazards. [E6.7CA]

B. Personnel in underground openings shall not be exposed to air velocities that exceed 1,500 feet per minute. Ventilation volumes shall not be less than 200 cubic feet per minute per person. [TBV] [E6.7CB]

C. 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(d)(1)]

   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 . [NEV]

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)]

i. 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. [NEV]

E. 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)]

i. Utility systems, including the water distribution and mine wastewater collection systems, shall be designed so that, in the event of seismic activity, safe operation is ensured. [NEV,10 CFR 60.130]

ii. Water lines in ESF shall be outfitted to limit water inflow to ESF following a possible line rupture. [NEV]

iii. Effective redundant mine wastewater discharge systems shall be provided to limit possible impacts on repository operations. [NEV]

iv. Fire suppression agents shall be selected such that they do not produce geochemical effects that adversely affect repository operations. [NEV]

v. The ESF shall have redundant mine wastewater discharge systems to control and limit the impact of water intrusion on testing in the ESF. [NEV]

vi. 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. [NEV]

vii. 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. [NEV]

viii. The groundwater and mine wastewater collection, control, and removal system shall be designed with capacity for expected inflows and 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. [NEV]

F. 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)]

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. [NEV]

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. [NEV]

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. [NEV]

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

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. [NEV]

ii. Structures, systems, and components shall be provided for effective water and ground control. [NEV]

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. [NEV]

H. 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]

i. The design of underground utilities for the ESF shall be capable of supporting the performance confirmation testing. [NEV]

I. During repository construction and operation, a continuing program of surveillance, measurement, testing, and geologic mapping shall be conducted to ensure that geotechnical and design parameters are

confirmed and to ensure that appropriate action is taken to inform the Commission of changes needed in design to accommodate actual field conditions encountered. [10 CFR 60.141(a)]

J. All ESF underground support (utility) systems and associated hardware (hangers, brackets, etc.) shall be removed, to the extent practicable, following final use. [TBD] [NEV]

K. 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. [NEV]

ASSUMPTIONS

None.

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 all underground systems. [NEV]

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project 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 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	Communication System
1.2.6.4	FIRST SHAFT
1.2.6.5	SECOND SHAFT
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	Mine 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 Handling Systems
1.2.6.7.10	Sanitary Facilities
1.2.6.7.11	Monitoring and Warning Systems
1.2.6.8	UNDERGROUND TESTS
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.2	Shafts and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. The underground electrical system shall accommodate all of the normal and peak demands for the construction and operation of the ESF. [NEV,E6.7FR1]

2. 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. [NEV]

3. A UPS shall provide all of the necessary power to systems and subsystems that cannot tolerate a loss of power incident. [NEV,6.9PC1g]

PERFORMANCE CRITERIA

1. The underground electrical system shall be sized to meet all construction, operating, and site characterization requirements of the subsurface facility. [NEV,E6.7PC1a] (D,O)

2. 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. [NEV,E6.7PC1b] (D,O)

3. The underground UPS shall ensure continuity of power to the Integrated Data System (IDS), sensor systems, safety instruments and controls, and communications that cannot tolerate a power interruption (See SDRD Appendix B). [NEV,E6.7PC1b,E6.9PC3] (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 shaft, and adequate switching shall be provided. [NEV]

B. Underground feeders shall have a ground check circuit to continuously monitor the grounding circuit to ensure continuity. [NEV]

C. Underground substations supplying power to 480 volt, three phase loads shall be resistance grounded. [TBV] [NEV]

D. The UPS shall consist of batteries and inverters and shall be in a location separate from the main power distribution center. [NEV]

ASSUMPTIONS

None.

[1.2.6.7.2 COMMUNICATIONS SYSTEM Combined with Section 1.2.6.2.4 by previous Project ECR]

1.2.6.7.3 LIGHTING SYSTEM
(Generic Physical Subsystem Account Code: 4.6.3)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The lighting system is those systems, subsystems, and components that provide for the illumination of the ESF underground areas (shafts, stations, alcoves, test areas, and shop areas). [NEV,E6.7DEF]

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project 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 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	FIRST SHAFT
1.2.6.5	SECOND SHAFT
1.2.6.7.1	Power Distribution System
1.2.6.7.11	Monitoring and Warning Systems
1.2.6.8	UNDERGROUND TESTS
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.2	Shafts and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. The lighting system shall provide adequate lighting of the ESF shafts stations, alcoves, test areas, and shop areas during underground site characterization testing. Emergency lighting with battery backup shall be provided in each shop, testing area, and shaft station area. [NEV,E6.7FR1]

PERFORMANCE CRITERIA

1a. 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. [NEV] (O,T)

1b. Adequate exit lighting shall be provided to identify direction of evacuation to refuge area(s) and/or shaft stations. [NEV]

CONSTRAINTS

A. Lighting shall be provided at each testing area and the shaft station areas. Lighting shall also be provided in the mechanical, electrical, and utility shops. [NEV]

B. The lighting provided in each testing area shall also be based upon any specific test requirements for that area. (See SDRD Appendix B and C.) [NEV]

C. The lighting in the shop areas shall be based on the specific maintenance requirements. [NEV]

D. Lighting fixtures for test areas shall be selected for low electrical noise as applicable. [NEV]

E. Uniform lighting, based on DOE Order 6430.1A and existing mining industry standards, shall be provided in drifts and crosscuts in the UDBR and MTL of the ESF underground. [NEV]

ASSUMPTIONS

None.

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 supply fresh air, conditioned if required, throughout the underground workings and exhausts return air to meet the needs of underground construction and site characterization testing. [NEV,E6.7DEF]

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project 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 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	FIRST SHAFT
1.2.6.4.4	Furnishings
1.2.6.5	SECOND SHAFT
1.2.6.5.4	Furnishings
1.2.6.7.1	Power Distribution System
1.2.6.7.11	Monitoring and Warning Systems
1.2.6.8	UNDERGROUND TESTS
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.2	Shafts and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. Provide a distribution system for ventilation air. [E6.7FR3]

2. Provide dust-control equipment and/or facilities. [E6.7FR4]

PERFORMANCE CRITERIA

1a. Underground ventilation shall dilute and/or remove particulate matter, blasting fumes, and other flammable and noxious gases from the working areas and divert polluted air to the exhaust opening(s) in conformance with applicable Federal, State, and local regulations. [E6.7PC3a]

1b. The underground ventilation system shall supply and exhaust adequate quantities of conditioned air in accordance with applicable Federal, State, and local regulations. [TBD] [E6.7PC3b]

1c. The ventilation system shall minimize leakage and recirculation to the extent practicable. [E6.7PC3c]

1d. The ESF shall be designed so as not to preclude separate ventilation of repository excavation and waste emplacement. [E6.7PC3d]

1e. The ventilation distribution system shall provide a distribution system for ventilating air with special ventilation devices as required to control airflow to the heated test areas and other specified underground areas during ESF underground construction, operations, and site characterization. [NEV,E6.7FR3]

1f. The ventilation distribution system shall be designed to support the drift excavation and underground test operations. [NEV,E6.7PC3a] (D,O,S,T)

1g. Airflow distribution shall be controlled, as required, to supply air to all underground areas. [NEV,E6.7PC3b] (O)

1h. The ventilation distribution system shall minimize leakage and undesirable recirculation to the extent practicable. [NEV,E6.7PC3c] (D,O,S)

1i. The underground ventilation distribution system shall supply and exhaust adequate quantities of air of acceptable temperature and humidity in accordance with applicable federal, state, and local regulations to support all underground activities. (See SDRD Appendix E.) [NEV,E6.7PC3b] (D,O,S)

1j. The ventilation system shall be designed to (1) Control the transport of radioactive particulates and gases within and releases from the underground facility in accordance with the performance objectives of § 60.111(a). (2) Assure continued function during normal operations and under accident conditions; and (3) separate the ventilation of excavation and waste emplacement areas. [10 CFR 60.133(g)]

2a. Dust control equipment and/or facilities at potential dust-generation areas (e.g., working faces, rock-handling transfer points, etc.) shall be capable of controlling airborne particulates. [E6.7PC4] (D,O,S)

2b. The transfer points shall include systems for control of fugitive dust. [NEV,E6.7FR4,E6.7PC4] (D,O,S)

CONSTRAINTS

A. The effective temperature in working areas shall be designed not to exceed 80 degrees wet-bulb globe temperature. [TBV] [E6.7CC]

B. 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 SDRD Appendix E.) [NEV]

C. Personnel working in the shaft shall not be exposed to ventilation air velocities exceeding 2,000 feet per minute. [TBV] [NEV,E6.4CD,E6.5CC]

D. Ventilation air velocities in the active underground openings shall not be greater than 1,500 feet per minute nor less than 60 feet per minute. The ventilation volume shall not be less than 200 cubic feet per minute per person. [TBV] [NEV,E6.6CH,E6.7CB]

E. The ventilation distribution system shall be designed to provide an air cooling power greater than or equal to 260 w/m^2 of personnel skin surface area. [NEV,E6.6CI,E7.4CD] [TBV]

F. The subsurface data building ventilation system shall be designed to be compatible with the Halon fire protection system. [NEV,E6.9CC]

G. Shaft heaters, if required, shall conform to standard industry design. [NEV]

H. maximum allowable noise levels produced by the underground ventilation distribution system shall allow the understanding of face-to-face and alarm-voice communications. [NEV]

ASSUMPTIONS

1. Auxiliary fans may be allowed, if required, during the construction and operation of the ESF to supplement the normal ventilation system. [NEV]

2. Ventilation capacity, shaft design, and air velocities in the shaft shall be optimized with respect to safety, design objectives, and cost. [NEV]

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 by the systems, subsystems, and components that distribute water within the underground facility. [NEV]

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project 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 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	FIRST SHAFT
1.2.6.5	SECOND SHAFT
1.2.6.6	UNDERGROUND EXCAVATIONS
1.2.6.7.1	Power Distribution System
1.2.6.7.6	Mine 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 TESTS
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.2	Shafts and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. Provide for underground water handling and treatment as required. [E6.7FR2]

PERFORMANCE CRITERIA

1a. The water distribution system shall meet the needs of fire protection, construction, testing, operational, and site characterization requirements. [NEV,E6.7FR1,E6.7FR2]

1b. The underground water supply and distribution systems shall be adequately sized with sufficient capacity to supply and distribute the water necessary for fire protection, and process water throughout the ESF in accordance with all anticipated needs and services for the construction, testing, and operation of the ESF. [NEV,E6.7PC1a] (D,O,S)

1c. The underground system shall have the capability to meet the needs of fire protection during construction and operations under routine emergency and maximum credible firewater demand conditions. [NEV] (D,O,S)

CONSTRAINTS

A. 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(d)(1)]

i. Use of water underground shall, to the extent practicable, limit adverse effects on the performance of the geologic repository. [NEV]

ii. All joints in fluid carrying columns shall be sealed and proof tested. [NEV]

B. All water used during operation and construction of the ESF shall be provided with chemical tracers as required by testing. [NEV]

C. All substances and tracers intended to be added to water to be piped underground for such purposes as drilling and dust controls shall first be evaluated for potential effects to site characterization testing, water quality repository testing or monitoring, and waste isolation; and may be added only after review and approval (See test B-HYD-9, ESF SDRD Appendix B). [NEV]

ASSUMPTIONS

1. The water distribution system will not be suitable for drinking purposes (i.e., nonpotable). Bottled water will be provided underground for drinking purposes. [NEV]

1.2.6.7.6 MINE WASTEWATER COLLECTION SYSTEM
(Generic Physical Subsystem Account Code: 4.6.6)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The mine wastewater collection system is defined by those systems, subsystems, and components that collects and transfers to the surface system, the wastewater that flows into the shafts and underground facilities. [NEV,E6.7DEF]

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project 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 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
1.2.6.4	FIRST SHAFT
1.2.6.5	SECOND SHAFT
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 Handling Systems
1.2.6.7.11	Monitoring and Warning Systems
1.2.6.8	UNDERGROUND TESTS
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.2	Shafts and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. Provide for underground water handling and treatment as required. [E6.7FR2]

PERFORMANCE CRITERIA

1a. Pumping systems with adequate capacity and control measure shall be designed and constructed for the control of underground water to ensure worker protection and preclude adverse effects on in situ site characterization testing. [E6.7PC2a]

1b. Adequate piping shall be provided to carry water from underground pump station(s) to the surface. [E6.7PC2b]

1c. Monitoring and treatment facilities for underground water shall be available to control possible contamination and to prevent damage to pumping/piping systems from erosion or corrosion by waterborne particulates. [E6.7PC2c]

1d. The mine wastewater collection system shall provide for control, handling, collection, treatment (as required), and transfer of mine wastewater and groundwater inflow to the surface disposal facility. [NEV,E6.7FR2]

1e. Gravity drainage, storage, and pumping systems, with adequate capacity and control measures, shall be designed and constructed for the control and transfer to the surface of underground water 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. [NEV,E6.7PC2a] (D,O,S)

1f. The mine wastewater collection system shall control standing water where ventilation air will be flowing in order to control humidity in air and to maintain the quality of the ventilation air being supplied and to preclude loss of capability of the site to meet performance objectives or conformance to siting criteria. [NEV,E6.6PC1h] (D,O,S)

1g. The mine wastewater collection system shall have full operating redundancy, or storage capacity to allow installation of spares. [NEV,E6.7PC1b] (D,O,S)

1h. The mine 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. [NEV,E6.7PC2c] (D,O,S)

1i. Adequate piping system shall be provided to carry water from underground pump station(s) to surface. [SR] (O)

CONSTRAINTS

A. The mine wastewater collection system shall be designed to prevent damage caused by water hammer and other destructive events. [NEV]

B. The mine wastewater collection and control system shall be designed to characterize and collect inflow from penetrations of fault structures during geologic drifting or from perched water horizons during shaft sinking and facility development. [NEV]

C. The storage and pumping system shall be designed to provide the capacity to handle emergency situations such as unexpected inflow of groundwater, use of fire protection sprinklers, or water line breakage. [NEV]

D. All joints in fluid carrying columns shall be sealed and proof tested. [NEV]

ASSUMPTIONS

None.

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. [NEV,E6.7DEF]

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project 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 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	FIRST SHAFT
1.2.6.5	SECOND SHAFT
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 TESTS
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.2	Shafts and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. The compressed air distribution system provides compressed air for underground ESF construction, operations, and site characterization testing. [NEV,E6.7FR1]

PERFORMANCE CRITERIA

1. Compressed air shall be conditioned and maintained at a quantity and pressure sufficient to meet underground ESF construction, operations, and site characterization testing requirements. The compressed air system shall also be sufficient to meet drilling requirements during ESF operations to support additional drift excavation. [NEV,E6.7FR1,E6.7PC1a] (D,O,T)

CONSTRAINTS

A. The compressed air supply pressure shall be adequate to meet pressure requirements of site characterization testing at specific locations. [NEV]

ASSUMPTIONS

None.

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 provides detection, alarm, and corrective response, as required, to extinguish fire(s) within the underground facilities. [NEV,E6.7DEF]

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project 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 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	FIRST SHAFT
1.2.6.5	SECOND SHAFT
1.2.6.7.1	Power Distribution System
1.2.6.7.5	Water Distribution System
1.2.6.7.6	Mine Wastewater Collection System
1.2.6.7.11	Monitoring and Warning Systems
1.2.6.8	UNDERGROUND TESTS
1.2.6.8.1	Integrated Data System
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.2	Shafts and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. The fire protection system shall be provided for the electronic fire detection, warning, and suppression of fires in the ESF underground. [NEV,E6.0CD,6.0CI]

PERFORMANCE CRITERIA

1a. The fire suppression system shall have the capability to be operated automatically and/or manually. [NEV] (D,O,S)

1b. Portable extinguishers shall be located in the subsurface areas. [NEV] (D,O,S)

CONSTRAINTS

A. Suppression agents shall be selected for their compatibility with their intended use. These agents shall be approved for use based on

their impacts on underground safety, the in situ site characterization testing program, and performance objectives as stated in 10 CFR 60. [NEV]

B. As a minimum, fire hose outlets shall be located at all shaft stations. [NEV]

C. Fire protection consisting of an automatic Halon system with a water sprinkler system back up shall be provided for the subsurface data building and IDS surface facility. [NEV,E6.9PC1e,E6.9CC]

D. All joints in fluid carrying columns shall be sealed and proof tested. [NEV]

ASSUMPTIONS

None.

1.2.6.7.9 MUCK HANDLING SYSTEMS
(Generic Physical Subsystem Account Code: 4.6.9)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The muck handling systems are defined as those systems, subsystems, structures, equipment, and components that transfer excavated rock from the shaft station to the surface. This includes the muck pockets, skip loaders, shaft bottom cleanout systems, and the appropriate shaft conveyances. [NEV]

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project 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 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	FIRST SHAFT
1.2.6.5	SECOND SHAFT
1.2.6.5.3	Station
1.2.6.5.4	Furnishings
1.2.6.5.5	Hoist System
1.2.6.7.1	Power Distribution System
1.2.6.7.6	Wastewater Collection System
1.2.6.7.11	Monitoring and Warning Systems
1.2.6.8	UNDERGROUND TESTS
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.2	Shafts and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. The muck handling systems shall provide for collecting excavated rock at the shaft station, surge capacity, measuring, and loading the rock into a skip for hoisting. The hoist system will transfer loaded skips to the surface for muck disposal. [NEV,E6.6FR2]

PERFORMANCE CRITERIA

1a. The excavation facilities and equipment required for loading, conveying, and dumping excavated rock shall meet the needs of construction and testing activities and shall be capable of supporting the underground uncertainty allowances (see Section 1.2.6.0, Performance Criteria item #1c). [NEV,E6.6PC2] (D,O,S,T)

1b. Muck 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. This system shall provide capabilities for gathering and removing spillage from the shaft bottom. [NEV,E6.4PC1f,E6.5PC3] (D,O,S)

1c. The location of openings for handling muck shall be selected to minimize effects on the integrity of any other openings. [NEV,E6.6PC1m] (D,O)

1d. The openings required for handling excavated rock shall be of sufficient size to allow equipment movement in such a way that interference with underground site characterization is minimized. [NEV,E6.6PC1m] (D,O,P,T)

CONSTRAINTS

A. The muck handling system design shall accommodate handling of oversize material at the transfer points. [NEV]

ASSUMPTIONS

None.

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. [NEV]

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project 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 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	Sewage Systems
1.2.6.4	FIRST SHAFT
1.2.6.5	SECOND SHAFT
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 TESTS
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.2	Shafts and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. Provide portable toilet facilities at convenient locations throughout the underground facilities for the underground work force. [NEV]

PERFORMANCE CRITERIA

1. The underground toilets shall be dry chemical, portable type. [NEV] (D,O)

CONSTRAINTS

A. Toilet facilities shall be located at convenient, noninterfering locations relative to operations, site characterization testing, and monitoring. [NEV]

B. The portable toilets shall be sized to be compatible with the conveyance equipment. [NEV]

C. Sanitary facilities shall be provided to accommodate the collection of wastes from a maximum occupancy underground per shift. [NEV]

ASSUMPTIONS

None.

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 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. [NEV]

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project 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 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	Communication System
1.2.6.3	SURFACE FACILITIES
1.2.6.3.9	Communications/Data Building
1.2.6.4	FIRST SHAFT
1.2.6.4.6	Sump
1.2.6.5	SECOND SHAFT
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	Mine 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 Handling Systems
1.2.6.7.10	Sanitary Facilities
1.2.6.8	UNDERGROUND TESTS
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.2	Shafts and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. The underground ventilation system shall be monitored, as a minimum, for noise, dust, radon/radon daughters, carbon monoxide, nitrous oxides, sulfur dioxide, hydrogen sulfide, methane, oxygen, carbon dioxide, temperature, humidity, air velocity and volume flow, as required by federal, state and local regulations. (See SDRD Appendix E.) [NEV,E6.0PC5b]

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. [NEV,E6.0PC5b] (D,O,S)

1b. A life safety alarm system shall be provided between the underground and surface. [NEV,E6.0PC5a,E6.7PC1a] (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; ventilation fans; Monitoring and Warning System; and mine waste water system [NEV,E6.0PC5a,E6.0PC5b,E6.8PC1c] (D,O,S)

1d. The underground ventilation distribution system shall be monitored for items such as oxygen deficiency, carbon monoxide, carbon dioxide, oxides of nitrogen, sulfur dioxide, hydrogen sulfide, methane, temperature, humidity, and air velocity in accordance with federal, state, and local regulations. [NEV,E6.0PC5b] (O)

1e. Concentrations of radon/radon daughters in underground work areas shall be monitored in accordance with 30 CFR 57.5037 (2). [NEV,E6.0PC5b] (O)

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. [NEV,E6.0PC5a]

ASSUMPTIONS

None.

1.2.6.8 UNDERGROUND TESTS
(Generic Physical Subsystem Account Code: 4.7)

Subparts are
- 1.2.6.8.1 Integrated Data System (IDS)
- 1.2.6.8.2 Geological Tests
- 1.2.6.8.3 Geomechanics Tests
- 1.2.6.8.4 Near-Field and Thermally Perturbed Tests
- 1.2.6.8.5 Hydrologic and Transport Phenomena Tests

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The underground test systems are defined by those activities associated with test equipment installation, 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 the underground tests are described in SDRD Appendix B. [NEV,E6.9DEF]

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project 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 1.2.6.8 necessitates an evaluation and understanding, by the designer, of the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.0	GENERAL (EXPLORATORY SHAFT FACILITY)
1.2.6.2	SURFACE UTILITIES
1.2.6.2.4	Communication System
1.2.6.3	SURFACE FACILITIES
1.2.6.3.2	Test Support Facilities
1.2.6.3.9	Communications/Data Building
1.2.6.4	FIRST SHAFT
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	SECOND SHAFT
1.2.6.5.1	Collar
1.2.6.5.2	Lining
1.2.6.5.3	Station
1.2.6.5.4	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 Mine 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 Handling Systems
1.2.6.7.10 Sanitary Facilities
1.2.6.7.11 Monitoring and Warning Systems
1.2.6.9 ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.1 Surface Facilities
1.2.6.9.2 Shafts and Underground Facilities

APPLICABLE REGULATIONS, CODES, AND SPECIFICATIONS

See Section 1.2.6.0, for additional Applicable Regulations, Codes, and Specifications.

FUNCTIONAL REQUIREMENTS

1. Provide the means for the implementation of site characterization testing plans. [E6.9FR1]

2. Support performance confirmation testing. [E6.9FR2]

PERFORMANCE CRITERIA

1a. In situ site characterization shall be guided by the Site Characterization Plan. [E6.9PC1a] [E89]

1b. In situ site characterization shall meet the applicable requirements of the Site Characterization Plan. [E6.9PC1b]

1c. Testing plans shall provide for feedback and modification as a result of initial and ongoing test and monitoring results. [E6.9PC1c]

1d. Reports shall contain adequate visual and diagrammatic information to make the conduct, setup, and objectives of all the tests clear to readers outside the Project. [E6.9PC1d]

1e. In situ site characterization shall provide reliable information with specified accuracy and uncertainty as determined by the Project. [E6.9PC1e]

1f. Measurements, tests, and analyses shall be sufficient to determine the performance of the ESF and the effects of ESF construction on in situ site characterization. [E6.9PC1f]

1g. An uninterruptible power supply system shall be available to ensure continuous operation of equipment and instrumentation related to critical testing as determined by the Project through analysis. [E6.9PC1g]

1h. Written procedures shall be developed for the procurement, construction, installation, maintenance, and operation of testing instruments and data collection facilities. [E6.9PC1h]

1i. Where potential gassy mine conditions exist, instrumentation appropriate to the catagory (30CFR57) shall be provided, as required. [E6.9PC1i] [E89]

1j. See ESF SDRD Appendix B for a summary of the ESF requirements of the IDS. [NEV] (D)

1k. In situ site characterization shall meet requirements of 10 CFR part 60.15(b), 60.15(d), 60.74(b) 60.137, 60.140(b), 60.140(c), 60.140(d)(1), 60.141, 60.142, and Subpart G. [NEV,E6.9PC1a] (T,W)

1l. In situ site characterization shall provide reliable information having accuracy and uncertainty as specified by the Yucca Mountain Project. [NEV,E6.9PC1e] (T,P)

1m. Testing instrumentation/hardware, cables, computer equipment, and data acquisition and monitoring systems, shall be designed to withstand the expected underground environment. [NEV,E6.9PC1e] (T,P)

1n. Experiments and tests controls shall be secure from unauthorized access. [NEV]

1o. All operational and procedural changes during the course of an experiment or test shall be monitored and recorded. Provisions shall be made to identify control of test parameters which are outside the constraints identified in experiment and test procedures. [NEV]

1p. Interfaces to assure system security and recording of changes as noted in Section 1.2.6.8, Performance criteria 1o. and 1p. shall be established for all monitoring and control systems, including the organizational computers of project participants. [NEV]

2a. 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]

   i. Performance confirmation testing shall be carried out to meet the requirements of 10 CFR Part 60 Subpart F, including confirmation of geotechnical and design parameters, design testing, and monitoring and testing of waste packages (as appropriate). [E6.9PC2] [E89]

2b. Subsurface conditions shall be monitored and evaluated against design assumptions. [10 CFR 60.141(b)]

   i. Performance confirmation testing plans must provide for feedback and modification as a result of initial and ongoing tests and monitored results. [NEV,E6.9PC1c,E6.9PC2] (T)

2c. Performance confirmation testing shall be carried out to meet the requirements of 10 CFR 60.140(b), 60.140(c), 60.140(d)(1), 60.141, and 60.142. [NEV,E6.9PC2] (P)

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. [E6.9CA] [E89]

B. Testing equipment requirements, including design life, shall be based on the performance goals of the tests. [E6.9CC]

C. Tests shall be prioritized through a performance allocation process and defined with respect to duration, scale, and space requirements. Such priority shall be the basis for instrumentation design; testing layout; and ventilation, personnel, and utility requirements. [TBD] [E6.9CD] [E89]

D. The ESF shafts shall be connected prior to initiation of full-scale in situ testing on main test level. [E6.9CE]

   i. Tests or parts of tests which can be initiated prior to shaft connection shall be determined on the basis of the information contained in SDRD Appendix B and C. [TBD] [NEV]

E. 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)]

   i. Underground testing shall be conducted in a facility constructed at the planned repository horizon. [NEV]

F. 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(d)(1)]

   i. 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. [NEV]

   ii. 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. [NEV]

   iii. 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. [NEV]

iv. Fluids and materials planned for use underground shall be evaluated with respect to intended use for possible effects on the capability of the site to isolate waste, and appropriate controls instituted. [NEV]

v. The testing program shall limit adverse chemical changes (type, quantity and location) particularly to pH and organic content of groundwater, by controlling the use of hydrocarbons, solvents, and chemicals. [NEV]

vi. The testing program shall to the extent practicable limit adverse effects on the long term performance of the geologic repository; for example, by limiting organics in drilling fluids and explosive residues from blasting. [NEV]

vii. The chemistry of any water used in the testing program shall be compatible with isolation and containment objectives. [NEV]

G. 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(d)(2)]

i. 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. [NEV]

H. 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(d)(3)]

i. MPBH boreholes shall be located in pillars to the extent practicable. [NEV]

ii. MPBH boreholes should be surveyed as drilling proceeds and the option to cease drilling may be invoked if insufficient separation from the proposed shaft location is observed. [TBD] [NEV]

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. [TBD] [NEV]

iv. 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. [NEV]

I. 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)]

i. 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. [NEV]

ii. The underground test program shall be designed to accommodate the requirements of 10 CFR 60.74. [NEV]

iii. 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. [NEV]

iv. The area set aside for future site characterization of 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.] [NEV,E6.8PC3c]

J. 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. [10 CFR 60.112]

i. Testing shall not affect overall site integrity of the Mined Geologic Disposal System as required by 10 CFR 60.112. [E6.9CB]

ii. 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 60.112. [NEV]

K. In satisfying the preceding requirement, the engineered barrier system shall be designed, assuming anticipated processes and events, so that: (A) Containment of HLW [High-Level Waste] within the waste packages will be substantially complete for a period to be determined by the Commission taking into account the factors specified in § [10 CFR] 60.113(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. [10 CFR 60.113(a)(1)(ii)(A)]

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)]

i. The underground testing program shall be designed, implemented, operated, and performed in a manner that shall assist or not detract from the capability of the repository to ensure substantially complete containment for a minimum period (not less than 300 years nor more than 1,000 years) after the permanent closure of the repository. [NEV]

ii. The underground testing system 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 1,000 years following permanent closure. [TBV] [NEV]

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

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. [NEV]

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] [NEV]

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. [NEV]

iv. MPBHs or other surface drilled exploratory boreholes associated with the ESF shall be drilled dry. [NEV]

v. Fluids recovered during testing operations shall be disposed of in such a way as to avoid potential for performance impacts. [NEV]

vi. Testing procedures shall require removal of excess water. [NEV]

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. [NEV]

viii. Test procedures shall be developed to ensure water entering the ESF is managed appropriately, including quantity, location, and water balance. [NEV]

ix. Gaseous products used in characterization shall not produce geochemical effects that impact waste isolation capabilities of site. [NEV]

M. 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)]

i. 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. [NEV]

N. 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]

i. The testing program shall accommodate the performance confirmation tests required by 60.140(b),(c), and (d)(1), and 60.141 , and take into account any potentially adverse impacts these tests could have on the waste isolation capabilities of the site. [NEV]

O. The [performance confirmation 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. [10 CFR 60.140(c)]

P. The [performance confirmation] program shall be implemented so that: It does not adversely affect the ability of the natural and engineered elements of the geologic repository to meet the performance objectives. [10 CFR 60.140(d)(1)]

i. 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. [NEV]

Q. The ESF shafts shall be connected prior to initiation of full-scale in situ testing on the main test level. [E6.9CE]

R. The flexibility to sink the first shaft (ES-1) into, and drift in, the Calico Hills formation shall be maintained. [NEV]

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. [TBD]

   See Section 1.2.6.0, Interface Control Requirements.

ASSUMPTIONS

1. Planned testing and monitoring will be conducted in the ES-1 (science) shaft, the Upper Demonstration Breakout Room, and the Main Test Level. Limited testing, to be identified by the Yucca Mountain Project Office, may take place in ES-2. [NEV]

2. The development of the underground testing program at the ESF has been based upon the qualitative derivation of information needs to satisfactorily address key issues in the Issues Hierarchy. The number of tests may change as site characterization proceeds and more variable or unexpected conditions are encountered. See Section 1.2.6.0, Performance Criteria item 1c. [NEV,E6.9PC1a]

3. The underground utility system at the Main Test Level will be sufficient to accommodate drifting and testing at any point surrounding the immediate operations area. [NEV,E6.7PC1a,E6.7PC1b]

4. Testing will conform to the requirements contained in Section 1.2.6.6 Underground Excavations. [NEV]

1.2.6.8.1 INTEGRATED DATA SYSTEM (IDS)
(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 provide acquisition of data collected in connection with testing operations in the ESF. [NEV]

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project 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 IDS design with Section 1.2.6.8.1 and the instrumentation and data requirements of the tests in SDRD 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: jm6

1.2.6.3	SURFACE FACILITIES
1.2.6.3.2	Test Support Facilities
1.2.6.3.9	Communications/Data Building
1.2.6.4	FIRST SHAFT
1.2.6.5	SECOND SHAFT
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	Geological Tests
1.2.6.8.3	Geomechanics Tests
1.2.6.8.4	Near-Field and Thermally Perturbed Tests
1.2.6.8.5	Hydrologic and Transport Phenomena Tests
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.1	Surface Facilities
1.2.6.9.2	Shafts and Underground Facilities

APPLICABLE REGULATIONS, CODES, AND SPECIFICATIONS

The design shall be in accordance with:

1. Draft DOE Order 1330.1B, dated February 8, 1989, Management of Automated Information Systems and Data Resources.

2. DOE Order 1360.1A, dated May 30, 1986, Acquisition and Management of Computing Resources.

3. DOE Order 1360.2A, dated May 20, 1988, Unclassified Computer Security Program.

4. DOE Order 1360.3A, dated July 11, 1983, Automated Data Processing Standards.

5. DOE Order 1360.4A, dated October 7, 1987, Scientific and Technical Computer Software.

6. DOE Order 1450.1C, dated September 3, 1986, Acquisition, Utilization, and Administration of Teleprocessing Services.

7. DOE Order 1450.2, dated March 6, 1985, Teleprocessing Services Program Points of Contact.

8. DOE Order 5300.1B, dated December 2, 1988, Telecommunications.

All relevant codes and standards specified in the above documents.

In addition see section 1.2.6.0, Applicable Regulations, Codes, and specifications.

FUNCTIONAL REQUIREMENTS

1. The IDS for the ESF shall provide the acquisition, storage, and dissemination of electronically generated test data collected in the ESF. [NEV]

PERFORMANCE CRITERIA

1a. The IDS shall be designed to provide flexibility for accomodating changes in capacity to suit the needs of the Project. [NEV]

1b. The maintainable life of the data acquisition capability shall be sufficient to meet the life expectancy of the tests. [TBD]

1c. The data storage life shall be sufficient to meet the users' requirements for dissemination of data. [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. [TBD]

   See Section 1.2.6.0, interface control requirements.

2. Interface control will be established between the following:

   i. The User and the IDS designers for the electrical requirements between the instruments and the IDS.

   ii. The Users and the IDS designers for the resolution and scaling of instrument signals.

iii. The Users and the IDS designers for the sampling rates and scaling of instrument signals.

iv. The Users and the IDS designers for the data dissemination requirements.

v. The Facility designers and the IDS designers for the electrical and mechanical cable and terminating requirements between the Instruments and the IDS.

vi. The IDS designers and the Facility designers for the support requirements for the IDS facility.

CONSTRAINTS

A. The IDS shall utilize proven data acquisition technology which can provide an easily operated and maintained system. [NEV]

B. The IDS will utilize Time and Voltage references traceable to the National Institute of Standards and Technology. [TBD]

ASSUMPTIONS

None

1.2.6.8.2 GEOLOGICAL TESTS
(Generic Physical Subsystem Account Code: 4.7.2)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The geological 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 SDRD Appendix B; B-GEO-1 through B-GEO-3, and B-MPBH-1. [NEV]

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project 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 1.2.6.8.2 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 Pad
1.2.6.3	SURFACE FACILITIES
1.2.6.3.2	Test Support Facilities
1.2.6.3.9	Communications/Data Building
1.2.6.4	FIRST SHAFT
1.2.6.5	SECOND SHAFT
1.2.6.6	UNDERGROUND EXCAVATIONS
1.2.6.7	UNDERGROUND SUPPORT SYSTEMS
1.2.6.8.1	Integrated Data System (IDS)
1.2.6.8.3	Geomechanics Tests
1.2.6.8.4	Near-Field and Thermally Perturbed Tests
1.2.6.8.5	Hydrologic and Transport Phenomena Tests
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.2	Shafts and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. Provide for adequate facilities, support, controls, access, and layouts to allow effective execution of geological tests (See section definition.) described in the ESF SDRD Appendix B and C, Volume 2B. [NEV]

PERFORMANCE CRITERIA

1. Performance criteria for geological tests are described in ESF SDRD Appendix B. [NEV]

CONSTRAINTS

None

ASSUMPTIONS

1. Testing will conform to the requirements contained in 1.2.6.6, Underground Excavations. [NEV]

1.2.6.8.3 GEOMECHANICS TESTS
(Generic Physical Subsystem Account Code: 4.7.3)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

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 SDRD Appendix B; B-MECH-1 through B-MECH-3, B-MECH-9 through B-MECH-17 and B-SEAL-1. [NEV]

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project 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 1.2.6.8.3 necessitates an evaluation and understanding, by the designer, of the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.3	SURFACE FACILITIES
1.2.6.3.2	Test Support Facilities
1.2.6.3.9	Communications/Data Building
1.2.6.4	FIRST SHAFT
1.2.6.5	SECOND SHAFT
1.2.6.6	UNDERGROUND EXCAVATIONS
1.2.6.7	UNDERGROUND SUPPORT SYSTEMS
1.2.6.8.1	Integrated Data System (IDS)
1.2.6.8.2	Geological Tests
1.2.6.8.4	Near-Field and Thermally Perturbed Tests
1.2.6.8.5	Hydrologic and Transport Phenomena Tests
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.2	Shafts and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. Provide for adequate facilities, support, controls, access, and layouts to allow effective execution of geomechanics tests (See section definition.) described in the ESF SDRD Appendix B and C, Volume 2B. [NEV]

PERFORMANCE CRITERIA

1. Performance criteria for geomechanics tests are described in ESF SDRD Appendix B. [NEV]

CONSTRAINTS

None.

Assumptions

1. Testing will conform to the requirements contained in 1.2.6.6 Underground Excavations. [NEV]

1.2.6.8.4 NEAR-FIELD AND THERMALLY PERTURBED TESTS
(Generic Physical Subsystem Account Code: 4.7.4)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

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 SDRD Appendix B; B-MECH-4 through B-MECH-8 and B-WP-1. [NEV]

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project 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 1.2.6.8.4 necessitates an evaluation and understanding, by the designer, of the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.3	SURFACE FACILITIES
1.2.6.3.2	Test Support Facilities
1.2.6.3.9	Communications/Data Building
1.2.6.4	FIRST SHAFT
1.2.6.5	SECOND SHAFT
1.2.6.6	UNDERGROUND EXCAVATIONS
1.2.6.7	UNDERGROUND SUPPORT SYSTEMS
1.2.6.8.1	Integrated Data System (IDS)
1.2.6.8.2	Geological Tests
1.2.6.8.3	Geomechanical Tests
1.2.6.8.5	Hydrologic and Transport Phenomena Tests
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.2	Shafts and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. Provide for adequate facilities, support, controls, access, and layouts to allow effective execution of near-field and thermally perturbed tests (See section definition.) described in the ESF SDRD Appendix B and C, Volume 2B. [NEV]

PERFORMANCE CRITERIA

1. Performance criteria for near-field and thermally perturbed tests are described in ESF SDRD Appendix B. [NEV]

CONSTRAINTS

None.

ASSUMPTIONS

1. Testing will conform to the requirements contained in 1.2.6.6 Underground Excavations. [NEV]

1.2.6.8.5 HYDROLOGIC AND TRANSPORT PHENOMENA TESTS
(Generic Physical Subsystem Account Code: 4.7.5)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

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 SDRD Appendix B; B-HYD-1 through B-HYD-12. [NEV]

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project 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 1.2.6.8.5 necessitates an evaluation and understanding, by the designer, of the boundary and interface impacts of the requirements and criteria in the following sections:

1.2.6.3	SURFACE FACILITIES
1.2.6.3.2	Test Support Facilities
1.2.6.3.9	Communications/Data Building
1.2.6.4	FIRST SHAFT
1.2.6.5	SECOND SHAFT
1.2.6.6	UNDERGROUND EXCAVATIONS
1.2.6.7	UNDERGROUND SUPPORT SYSTEMS
1.2.6.8.1	Integrated Data System (IDS)
1.2.6.8.2	Geological Tests
1.2.6.8.3	Geomechanics Tests
1.2.6.8.4	Near-Field and Thermally Perturbed Tests
1.2.6.9	ESF DECOMMISSIONING AND CLOSURE
1.2.6.9.2	Shafts and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. Provide for adequate facilities, support, controls, access, and layouts to allow effective execution of hydrologic and transport phenomena tests (See section definition.) described in the ESF SDRD Appendix B and C, Volume 2B. [NEV]

PERFORMANCE CRITERIA

1. Performance criteria for hydrologic and transport phenomena tests are described in ESF SDRD Appendix B. [NEV]

CONSTRAINTS

None.

ASSUMPTIONS

1. Testing will conform to the requirements contained in 1.2.6.6 Underground Excavations. [NEV]

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 Shafts and Underground Facilities

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

Decommissioning and closure is defined as those activities enacted to place the ESF facilities (systems and subsystems) into a permanently non-operable and safe condition if Yucca Mountain is determined to be unsuitable as a repository, or, as a part of the repository decommissioning if Yucca Mountain is utilized as the repository. [NEV]

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project 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 1.2.6.9 necessitates an evaluation and understanding, by the designer, of the boundary and interface impacts of the requirements and criteria in the following Sections:

1.2.6.0 GENERAL (EXPLORATORY SHAFT FACILITY)
1.2.6.1 ESF SITE
1.2.6.1.1 Main Pad
1.2.6.1.2 Auxiliary Pads
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 Systems
1.2.6.2.2 Water Systems
1.2.6.2.3 Sewage Systems
1.2.6.2.4 Communication System
1.2.6.2.5 Mine 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 Sites for Temporary Structures (Buildings and/or Trailers)
1.2.6.3.4 Parking Areas
1.2.6.3.5 Materials Storage Facilities
1.2.6.3.6 Shop
1.2.6.3.7 Warehouse
1.2.6.3.8 Temporary Structures (Buildings and/or Trailers)
1.2.6.3.9 Communications/Data Building
1.2.6.4 FIRST SHAFT
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 SECOND SHAFT
1.2.6.5.1 Collar
1.2.6.5.2 Lining
1.2.6.5.3 Station
1.2.6.5.4 Furnishings
1.2.6.5.5 Hoist System
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 Mine 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 Handling Systems
1.2.6.7.10 Sanitary Facilities
1.2.6.7.11 Monitoring and Warning Systems
1.2.6.8 UNDERGROUND TESTS
1.2.6.8.1 Integrated Data System (IDS)
1.2.6.8.2 Geological Tests
1.2.6.8.3 Geomechanics Tests
1.2.6.8.4 Near-Field and Thermally Perturbed Tests
1.2.6.8.5 Hydrologic and Transport Phenomena Tests

APPLICABLE REGULATIONS, CODES, AND SPECIFICATIONS

No specific regulation, codes, or specifications have been defined for decommissioning and closure other than those contained in section 1.2.6.0, applicable regulations, codes, and specifications.

FUNCTIONAL REQUIREMENTS

1. Provide for decommissioning and closure of the ESF. [E6.10FR1]

PERFORMANCE CRITERIA

1a. The ESF shall be designed, constructed, and operated to meet decommissioning and closure requirements of applicable Federal, BLM, State, and local codes. [E6.10PC1a]

1b. Decommissioning and closure shall be in accordance with the Site Characterization Plan. [E6.10PC1b]

1c. Decommissioning and closure shall be planned for two scenarios:

i. The site is chosen for repository development, and

ii. The site is not chosen for repository development. [E6.10PC1c] (D,O)

1d. The ESF shall be designed, constructed, and operated to meet decommissioning and closure requirements of applicable federal, state, and local codes, including, but not limited to, 10 CFR 60.112, .113(a)(2), and .113(b). [NEV,E6.10PC1a] (D,O,T)

1e. Decommissioning and closure shall be in accordance with the baselined site characterization plan. [NEV,E6.10PC1b] (D,O)

1f. Repository decommissioning requirements imposed on the ESF are generally shown on drawings RO7071, RO7072, RO7073, and RO7074 in SDRD Appendix A.2. [NEV]

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. [NEV] [TBD]

See section 1.2.6.0, interface control requirements.

CONSTRAINTS

A. The ESF and repository designs shall be integrated to ensure that decommissioning and closure requirements are consistent. [E6.10CA]

B. Engineered barriers shall be designed to assist the geologic setting in meeting the performance objectives for the period following permanent closure. [10 CFR 60.133(h)]

i. 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. [NEV]

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. [NEV]

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; First Shaft Collar; First Shaft Hoist System; Second Shaft Collar; and Second Shaft Hoist System. Radioactive waste will not be handled or stored at the ESF surface facility unless specifically directed by the Nuclear Regulatory Commission for the purpose of site characterization testing. [NEV]

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project 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 1.2.6.9.1 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
1.2.6.1.1	Main Pad
1.2.6.1.2	Auxiliary Pads
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 Systems
1.2.6.2.2	Water Systems
1.2.6.2.3	Sewage Systems
1.2.6.2.4	Communication System
1.2.6.2.5	Mine 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	Sites for Temporary Structures (Buildings and/or Trailers)
1.2.6.3.4	Parking Areas
1.2.6.3.5	Materials Storage Facilities
1.2.6.3.6	Shop
1.2.6.3.7	Warehouse
1.2.6.3.8	Temporary Structures (Buildings and/or Trailers)
1.2.6.3.9	Communications/Data Building
1.2.6.8	UNDERGROUND TESTS
1.2.6.8.1	Integrated Data System (IDS)
1.2.6.9.2	Shafts and Underground Facilities

FUNCTIONAL REQUIREMENTS

1. Provide for decommissioning and closure of the ESF. [E6.10FR1]

PERFORMANCE CRITERIA

1a. Near term decommissioning of the surface facilities shall place the facilities in a permanently non-operable, and safe condition. [NEV,E6.10PC1a,E6.10PC1b,E6.10PC1c] (O,S)

1b. Permanent decommissioning of the surface facilities shall restore the ESF site and the immediate surrounding areas. [NEV,E6.10PC1a,E6.10PC1b,E6.10PC1c] (O)

CONSTRAINTS

A. Systems, subsystems, and facilities may be utilized in other repository programs or salvaged in accordance with the Nuclear Waste Policy Act (NWPA) funding requirements. [NEV]

B. Facilities shall be removed by the most practical and cost-effective methods:

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 will be dismantled and removed from the site.

iii. Buried water, electricity, and sewage lines may be disconnected below the surface and left in the ground.
[NEV]

C. Any significant adverse environmental impacts associated with the ESF decommissioning will be minimized through the use of good engineering practices, Reclamation Guidelines, and the Reclamation Implementation Plan (when completed) [reference TBD]. The Reclamation Guidlines and the Reclamentation Implementation Plan will be implemented to the extent practicable. Conformance to the Reclamation Guidelines (and the Reclamation Implementation Plan, when completed) shall be established during the design review process in accordance with the Yucca Mountain Project Administrative procedure AP-5.14Q. [NEV]

ASSUMPTIONS

None.

1.2.6.9.2 SHAFTS AND UNDERGROUND FACILITIES
(Generic Physical Subsystem Account Code: 4.8.2)

DEFINITION OF SUBSYSTEM ELEMENTS

DEFINITION

The shafts and underground facilities includes all of the facilities, systems, and subsystems as described in previous section: First Shaft; Second Shaft; Underground Excavations; Underground Utility Systems; and Underground Tests (excluding Collar and Hoist Systems). [NEV]

Boundaries and Interfaces

Specific boundaries and interfaces between participating organization designs are identified in the Project 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 1.2.6.9.2 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 Communication System
1.2.6.4 FIRST SHAFT
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 SECOND SHAFT
1.2.6.5.1 Collar
1.2.6.5.2 Lining
1.2.6.5.3 Station
1.2.6.5.4 Furnishings
1.2.6.5.5 Hoist System
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 Mine 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 Handling Systems
1.2.6.7.10 Sanitary Facilities
1.2.6.7.11 Monitoring and Warning Systems
1.2.6.8 UNDERGROUND TESTS

1.2.6.8.1 Integrated Data System (IDS)
1.2.6.8.2 Geological Tests
1.2.6.8.3 Geomechanics Tests
1.2.6.8.4 Near-Field and Thermally-Perturbed Tests
1.2.6.8.5 Hydrologic and Transport Phenomena Tests
1.2.6.9.1 Surface Facilities

FUNCTIONAL REQUIREMENTS

1. Provide for decommissioning and closure of the ESF site. [E6.10FR1]

PERFORMANCE CRITERIA

1a. Near term decommissioning of the shaft(s) and underground excavations shall place the facilities, systems, and subsystems in a permanently non-operable, and safe condition.
[NEV,E6.10PC1a,E6.10PC1b,E6.10PC1c] (O,S)

1b. Permanent decommissioning of the shaft(s) and underground excavations shall restore the ESF site and the immediate surrounding areas.
[NEV,E6.10PC1a,E6.10PC1b,E6.10PC1c] (O)

CONSTRAINTS

A. Systems, subsystems, and facilities may be utilized in other repository programs or salvaged in accordance with the Nuclear Waste Policy Act (NWPA) funding requirements. [NEV]

B. Facilities shall be removed by the most practical and cost-effective methods:

i. Horizontal and vertical drillholes extending from the exploratory shaft(s) and rooms shall be sealed;

ii. Subsurface drifts and rooms shall be backfilled with the material that was removed during excavation and/or with other suitable engineered material;

iii. Shaft(s) shall be stripped of equipment and structures;

iv. Shaft liners may be left in place;

v. Shaft(s) shall be backfilled with the material that was removed during excavation and/or with other suitable engineered material.

[NEV]

ASSUMPTIONS

None.