received with letter dtd. 1/21/93

YMP/CM-0019

U.S. DEPARTMENT OF ENERGY

OCRWM YUCCA MOUNTAIN

YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT

PROJECT BASELINE DOCUMENT

CONTROLLED NO. 73 THIS IS A RED STAMP COPY

EXPLORATORY STUDIES FACILITY DESIGN REQUIREMENTS VOLUME 1

WM-11
102.8
NH03
0/1

Change Original
To: Charlotte Abrams
AH-35

190043

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

1028

UNITED STATES DEPARTMENT OF ENERGY
YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT OFFICE

VOL 1

EXPLORATORY STUDIES FACILITY DESIGN REQUIREMENTS

VOL 2

EXPLORATORY STUDIES FACILITY DESIGN REQUIREMENTS

YMP/CM-0019

U.S. DEPARTMENT OF ENERGY

OCRWM

YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT

Document No. YMP/CM-0019
Revision 7/2/92
CI No. N/A
Date 7/22/9
WBS No. 1.2.6
QA Level Yes

PROJECT BASELINE DOCUMENT

EXPLORATORY STUDIES FACILITY DESIGN REQUIREMENTS

VOLUME 1

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

DEPARTMENT OF ENERGY · UNITED STATES OF AMERICA

UNITED STATES DEPARTMENT OF ENERGY
YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT OFFICE

YMP-035-R0
4/22/91

YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT
DOCUMENT CHANGE NOTICE (DCN) RECORD

[1] Document Title:

Exploratory Studies Facility Design Requirements (ESFDR)

[2] Document Number:
YMP/CM- 0019

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

[3] DCN NO.	[4] CR NO.	[5] DOCUMENT Rev./ICN #	[6] CR TITLE	[7] AFFECTED PAGES	CHANGE	ADD	DELETE	[8] DATE
001	91/068	5/31/91*	Revision to ESFDR Document					5/31/91
			Minor editorial changes	marked by bar	X			
			Supplement Appendix B w/Testing Requirements	Appendix B		X		
			Appendix C				X	
* NOTE: Submitted as YMP/CC-0013, Revision 1. Change Control Board approved as date revision to accomodate dynamic changes to the document.								
002	91/076	7/01/91	Revision to ESFDR Document					7/01/91
			Minor editorial changes	marked by bar	X			
			Additional testing requirements added	Appendix B		X		
003	91/095	7/29/91	Revision to ESFDR Document					
			Changes to Appendix B	marked by bar	X			
			Add Appendix J	Appendix J		X		
004	92/098	7/02/92	Complete Revision to ESFDR Document					7/22/92
			Add TBD/TBV Log	TBD/TBV Log		X		
			Delete Sec. 1.2.6.5.3	6.5.3-1 to 6.5.3-2			X	
			Delete Appendix H - Responsibility Matrix	H-1 to H-34			X	
			Add Appendix H - Requirements Traceability Matrix	H-1 to H-27		X		
			Oversized Drawing	All			X	

YMP-035-R0
4/22/91

YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT
DOCUMENT CHANGE NOTICE (DCN) RECORD

1 Document Title:

Exploratory Studies Facility Design Requirements (ESFDR)

2 Document Number:
YMP/CM-0019

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

3 DCN NO.	4 CR NO.	5 DOCUMENT Rev./ICN #	6 CR TITLE	7 AFFECTED PAGES	CHANGE	ADD	DELETE	8 DATE
* NOTE: A complete ESFDR Document was assigned Document Number YMP/CM-0019. The ESFDR was revised per CR 92/098 and again revised per CR 92/103. Therefore, the Formal distribution being released at this time is a combination of Change Request 92/098 and 92/103.								
005	92/103	7/02/92	ESFDR YMP/CC-0013	All	X			7/22/92

YMP-034-R2
11/13/91

YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT
CHANGE DIRECTIVE (CD)

1 CR No. 92/103
Page 1 of 2

SECTION I. IDENTIFICATION

2 Title of Change:
ESFDR (YMP/CC-0013)

3 Change Classification:
☐ 0 ☒ 2
☐ 1 ☐ 3

SECTION II. DISPOSITION

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

5 Conditions: *(if applicable)*
None

(See Change Documentation Continuation Page ___)

6 Implementation Direction: *(if applicable)*

1. This CR for the ESFDR (YMP/CC-0013) is approved as a Project Baseline Document and is assigned Document Number YMP/CM-0019, Revision 7/2/92.

   NOTE: The ESFDR, Document Number YMP/CC-0013, was previously released and issued as a Project CCB Controlled document.

2. The CCB Secretary shall ensure that the Cover and Title pages for Document Number YMP/CM-0019, Revision 7/2/92 are prepared.

(See Change Documentation Continuation Page 2)

SECTION III. CONCURRENCE

All signatures below constitute procedural compliance. I have read, understood, and complied with Procedure QMP-03-09 Rev. 3, ICN # 2 in accomplishing my responsibilities in this procedure.

7 Quality Assurance Organization Concurrence

Name: R. E. Spence (Print) Org.: YMQAD (Print)
Signature: James Blanchard for Date: 7/10/92

8 Disposition Authority

for
Name: M. B. Blanchard (Print) Title: CCB Chrprsn (Print)
Signature: Robert M. Barton Date: 7/15/92

9 CD Effective Date
7/15/92

6 Implementation Direction (continued)

3. Within 10 working days of the signature of this CD, the Document Custodian shall:

   a. Provide a print ready copy of the Document YMP/CM-0019, Revision 7/2/92 with the Document Number and revision date identified on each page of the publication ready copy.

   b. Prepare a Document Change Notice (DCN) to accompany these pages.

   c. Provide the above items to the CCB Secretary.

4. The CCB Secretary shall ensure that the Document YMP/CM-0019, Revision 7/2/92, is prepared in accordance with this change directive. The CCB Secretary shall prepare a Controlled Document Issuance Authorization (CDIA) to transmit this CD and YMP/CM-0019, Revision 7/2/92 to the Project Document Control Center (DCC) in accordance with AP-1.5Q.

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

6. The CCB Secretary shall ensure that the Configuration Information System (CIS) and the CCB Register are updated to reflect the approved status change of this Document YMP/CM-0019, Revision 7/2/92.

7. Any changes to Document YMP/CM-0019, Revision 7/2/92 will require submittal of a CR to the Project CCB.

8. Upon release of YMP/CM-0019, Revision 7/2/92 all Project Participants will be required to use YMP/CM-0019, Revision 7/2/92 in performing duties applicable to this document.

YMP-034-R2
11/13/91

YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT
CHANGE DIRECTIVE (CD)

1 CR No. 92 [illegible]
Page 1 of 2

SECTION I. IDENTIFICATION

2 Title of Change:
ESFDR (YMP/CC-0013)

3 Change Classification:
☐ 0 ☒ 2
☐ 1 ☐ 3

SECTION II. DISPOSITION

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

5 Conditions: *(if applicable)*
NONE

(See Change Documentation Continuation Page ___)

6 Implementation Direction: *(if applicable)*

1. This Change Request (CR) is approved to revise the Exploratory Studies Facility Design Requirements Document, YMP/CC-0013, Revision 7/2/92.

2. The CCB Secretary shall ensure that the Cover Page and the Title Page for Document YMP/CC-0013, Revision 7/2/92, are prepared.

3. The Document Originator shall provide a Print Ready Copy of YMP/CC-0013, Revision 7/2/92, to the CCB Secretary. The document number and revision

(See Change Documentation Continuation Page 2)

SECTION III. CONCURRENCE

All signatures below constitute procedural compliance. I have read, understood, and complied with Procedure AMP-3.2Q, Rev. 3, ICN # 2, in accomplishing my responsibilities in this procedure.

7 Quality Assurance Organization Concurrence

Name: R. E. Spence (Print) Org.: YMQAD (Print)
Signature: R. E. Spence Date: 6/30/92 (AR) 6/30/92

8 Disposition Authority

Name: M. B. Blanchard (Print) Title: CCB Chrprsn (Print)
Signature: M B Blanchard Date: MBB 7-1-92

9 CD Effective Date
7/1/92

6 Implementation Direction (continued)

number will be identified on each page of the Publication Ready Document YMP/CC-0013. The Document Originator shall also provide a Document Change Notice (DCN) identifying changes made to Revision 7/2/92 of Document YMP/CC-0013.

4. The CCB Secretary shall ensure that YMP/CC-0013, Revision 7/2/92, is prepared in accordance with this Change Directive (CD). The CCB Secretary shall prepare a Controlled Document Issuance Authorization (CDIA) to transmit this CD and YMP/CC-0013, Revision 7/2/92, to the Project Document Control Center (DCC) in accordance with AP-1.5Q.

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

6. The CCB Secretary shall ensure that the Configuration Information System (CIS) and the CCB Document Register are updated to reflect this approved revision of document YMP/CC-0013, Revision 7/2/92.

7. Any changes to Document YMP/CC-0013, Revision 7/2/92, will require submittal of a CR to the Project CCB.

8. Upon release of YMP/CC-0013, Revision 7/2/92, all Project Participants will be required to use YMP/CC-0013, Revision 7/2/92, in performing duties applicable to this document.

Y-AD-057
9/90

YUCCA MOUNTAIN PROJECT
CHANGE DIRECTIVE (CD)

[1] CR No. 91/076
Page 1 of 2

SECTION I. IDENTIFICATION

[2] Title of Change:

Revision to Exploratory Studies Facility Design Requirements Documents (ESFDR)

[3] Change Classification:

☐ Class 1 ☐ Class 3
☒ Class 2

SECTION II. DISPOSITION

[4] CR Disposition:

☒ Approved ☐ Disapproved
☐ Approved with Conditions

[5] Conditions: *(if applicable)*

None.

(See Change Documentation Continuation Page ___)

[6] Implementation Direction: *(if applicable)*

1. This Change Request (CR) is approved to revise the Exploratory Shaft Facility Design Requirements Document, YMP/CC-0013, Revision 7/1/91.

2. The CCB Secretary shall ensure that the Cover Page and the Title Page for document YMP/CC-0013, Revision 7/1/91, are prepared.

3. The Document Originator shall provide a Print Ready Copy of YMP/CC-0013, Revision 7/1/91, to the CCB Secretary. The document number and revision number will be identified on each page of the Publication Ready Document

(See Change Documentation Continuation Page 2)

SECTION III. CONCURRENCE

[7] Quality Assurance Organization Concurrence

Name: D. G. Horton (print) Org.: PQA (print)
Signature: [signature] Date: 7/9/91

[8] Disposition Authority

Name: M. B. Blanchard (print) Title: CCB Chrprsn (print)
Signature: [signature] Date: 7/10/91

[9] Effective Date:

7/10/91

6 Implementation Direction (continued)

YMP/CC-0013. The Document Originator shall also provide a Document Change Notice (DCN) identifying changes made to Revision 7/1/91 of document YMP/CC-0013.

4. The CCB Secretary shall ensure that YMP/CC-0013, Revision 7/1/91, is prepared in accordance with this Change Directive (CD). The CCB Secretary shall prepare a Controlled Document Issuance Authorization (CDIA) to transmit this CD and YMP/CC-0013, Revision 7/1/91, to the Project Document Control Center (DCC) in accordance with AP-1.5Q.

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

6. The CCB Secretary shall ensure that the Configuration Information System (CIS) and the CCB Document Register are updated to reflect this approved revision of document YMP/CC-0013, Revision 7/1/91.

7. Any changes to document YMP/CC-0013, Revision 7/1/91, will require submittal of a CR to the Project CCB.

8. Upon release of YMP/CC-0013, Revision 7/1/91, all Project Participants will be required to use YMP/CC-0013, Revision 7/1/91, in performing duties applicable to this document.

YMP-034-R0
4/22/91

YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT
CHANGE DIRECTIVE (CD)

[1] CR No. 91/095
Page 1 of 2

SECTION I. IDENTIFICATION

[2] Title of Change:

Revision to Exploratory Studies Facilities Design Requirements Document

[3] Change Classification:

☐ Class 1 ☐ Class 3
☒ Class 2

SECTION II. DISPOSITION

[4] CR Disposition:

☐ Approved ☐ Disapproved
☒ Approved with Conditions

[5] Conditions: *(if applicable)*

Change Request (CR) 91/095 is approved with the following condition:

1. The Third Phase Submittal Description shall be removed from the Exploratory Studies Facility Design Requirements Document.

(See Change Documentation Continuation Page ___)

[6] Implementation Direction: *(if applicable)*

1. Change Request (CR) 91/095 is approved with the condition listed in Block 5 of this Change Directive (CD) as CCB Controlled Document YMP/CC-0013, Revision 7/29/91, Exploratory Studies Facility Design Requirements Document (ESFDRD).

2. The CCB Secretary shall ensure that the Title Page and Table of Contents for Document YMP/CC-0013, Revision 7/29/91, are revised to reflect these changes.

3. The Document Originator shall provide a Print Ready Copy of YMP/CC-0013, Revision 7/29/91, to the CCB Secretary. The document number and revision

(See Change Documentation Continuation Page 2)

SECTION III. CONCURRENCE

[7] Quality Assurance Organization Concurrence

Name: D. G. Horton *(print)* Org.: PQA *(print)*

Signature: for Date: 7-29-91

[8] Disposition Authority

Name: M. B. Blanchard *(print)* Title: CCB Chrprsn. *(print)*

Signature: M Blanchard Date: 7-29-91

[9] CD Effective Date

6 Implementation Direction (continued)

date will be identified on each page of the Print Ready Document YMP/CC-0013. The Document Change Notice (DCN) shall be revised to reflect changes made to Revision 7/29/91, of document YMP/CC-0013.

4. The CCB Secretary shall ensure that YMP/CC-0013, Revision 7/29/91, is prepared in accordance with this CD. The CCB Secretary shall prepare a Controlled Document Issuance Authorization (CDIA) to transmit this CD and YMP/CC-0013, Revision 7/29/91, to the Project Document Control Center (DCC) in accordance with AP-1.5Q.

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

6. The CCB Secretary shall ensure that the Configuration Information System (CIS) an the CCB Document Register are updated to reflect this approved addition of Document YMP/CC-0013, Revision 7/29/91.

7. Any changes to Document YMP/CC-0013, Revision 7/29/91, will require submittal of a CR to the Project CCB.

8. Upon release of YMP/CC-0013, Revision 7/29/91, all Project Participants will be required to use YMP/CC-0013, Revision 7/29/91, in performing duties applicable to this document.

INFORMATION COPY

Y-AD-057
9/90

YUCCA MOUNTAIN PROJECT
CHANGE DIRECTIVE (CD)

[1] CR No. 31 068
Page 1 of 2

SECTION I. IDENTIFICATION

[2] Title of Change:

Revision of Exploratory Shaft Facility Design Requirements (ESFDR) Document

[3] Change Classification:
☐ Class 1 ☐ Class 3
☒ Class 2

SECTION II. DISPOSITION

[4] CR Disposition:

☒ Approved ☐ Disapproved
☐ Approved with Conditions

[5] Conditions: *(if applicable)*

None

(See Change Documentation Continuation Page ___)

[6] Implementation Direction: *(if applicable)*

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

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

(See Change Documentation Continuation Page 2)

SECTION III. CONCURRENCE

[7] Quality Assurance Organization Concurrence

Name: D. G. Horton (print) Org.: PQA (print)
Signature: /for/ D G Horton Date: 5/31/91

[8] Disposition Authority

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

[9] Effective Date: 5/31/91

4 Implementation Direction (continued)

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

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

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

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

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

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

YMP/CM-0019, Rev. 7/2/92

YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT

EXPLORATORY STUDIES FACILITY (ESF)

DESIGN REQUIREMENTS

(ESFDR)

VOLUME 1

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

Prepared for:

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

YMP/CM-0019
not ~~YMP/CC-0013~~, Rev. 7/2/92
7/20/92

YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT

EXPLORATORY STUDIES FACILITY (ESF)

DESIGN REQUIREMENTS

(ESFDR)

Dennis C. Kaya for — Date : 6/26/92

William B. Simecka, Director
Yucca Mountain Engineering and
Development Division
Yucca Mountain Site Characterization
Project Office

R. C. Spence — Date : 6/30/92

R. E. Spence, Director
Yucca Mountain Quality Assurance Division

for Maxwell Blanchard — Date : 7-1-92

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

YMP/CM-0019, Rev. 7/2/92

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VOLUME 2

APPENDICES

YMP/CM-0019, Rev. 7/2/92

TBD LOG

DOCUMENT/REVISION NUMBER YM/CC-0013

STATEMENT	RESPONSIBLE ORGANIZATION	SCHEDULED RESOLUTION DATE	BRIEF DESCRIPTION
++++++++++			
1.2.6.0 C C.iii	LANL	6/1/92	All substances and tracers to be reviewd for possible effect on site characterization and waste isolation.
1.2.6.0 C C.iv	LANL	6/1/92	Use of hydrocarbons and solvents underground.
1.2.6.1 C E.	LANL	6/1/92	Use of hydrocarbons and solvents shall be controlled to limit adverse chemical changes.
1.2.6.2.6 PC 1d.	LANL	6/1/92	Tracers added to all compressed air used.
=====			
1.2.6.4 PC 2a.ii	LANL	>10/1/92	Effect of materials in shaft on engineered barriers and waste isolation.
1.2.6.5 PC 2a.ii	LANL	6/1/92	Effect of materials in ramps on engineered barriers and waste isolation.
1.2.6.6 PC 2a.ii	LANL	>10/1/92	Effect of materials used underground on engineered barriers and waste isolation.
=====			
++++++++++			
1.2.6.1 C C.iii	SNL	6/1/92	Foundations not to create pathways that compromise repository performance.
1.2.6.1 C F.v	SNL	6/1/92	"Excess water shall be removed".
1.2.6.2 C A.	SNL	6/1/92	Surface utilities shall limit potential for adverse impacts on repository performance.
1.2.6.2.5 C A.	SNL	6/1/92	Disposal of liquid wastes.
1.2.6.8 C E.vi	SNL	6/1/92	"Excess water shall be removed."

YMP/CM-0019, Rev. 7/2/92

STATEMENT	RESPONSIBLE ORGANIZATION	SCHEDULED RESOLUTION DATE	BRIEF DESCRIPTION
1.2.6.3 PC 1d.	T&MSS	6/1/92	Size of temporary facilities for visitors.
1.2.6.6 PC 1e.i	T&MSS	>10/1/92	Size of temporary facilities for visitors.
1.2.6.4 PC 1b.iii	RSED	>10/1/92	Elevation of UDBR.
1.2.6.5 PC 1a.ii	RSED	>10/1/92	Elevation of main test level.
1.2.6.6 PC 1a.ii	RSED	6/1/92	Location of repository within TSw1 or TSw2.
1.2.6.1 C D.	LANL	6/1/92	ESF site designed to facilitate performance confirmation testing.
1.2.6.4 PC 1b.iv	RSED	>10/1/92	Extent of performance confirmation testing to be provided for.
1.2.6.5 PC 1c.iii	TESS	>10/1/92	Extent of performance confirmation testing to be provided for.
1.2.6.4 C B.ii	TESS	>10/1/92	Shaft configuration to support performance confirmation testing.
1.2.6.5 C B.ii	LANL	6/1/92	Ramp configuration to support performance confirmation testing.
1.2.6.6 C B.ii	TESS	>10/1/92	Test area configuration to support performance confirmation testing.

YMP/CM-0019, Rev. 7/2/92

STATEMENT	RESPONSIBLE ORGANIZATION	SCHEDULED RESOLUTION DATE	BRIEF DESCRIPTION
1.2.6.4 PC 1c.ii	SNL	>10/1/92	Water intrusion into a shaft to be controlled.
1.2.6.5 PC 1d.ii	SNL	6/1/92	Water intrusion into ramps to be controlled.
1.2.6.6 PC 1d.iii	SNL	>10/1/92	Water intrusion into underground openings to be controlled.
1.2.6.4 PC 1c.vii	LANL	>10/1/92	Evaluate planned use of fluids and materials in a shaft for impacts on site characterization.
1.2.6.5 PC 1d.vii	LANL	6/1/92	Evaluate planned use of fluids and materials in ramps for impacts on site characterization.
1.2.6.6 PC 1d.viii	LANL	>10/1/92	Evaluate planned use of fluids and materials in excavation for impacts on site characterization.
1.2.6.8 C E.i	LANL	>10/1/92	Evaluate planned use of fluids and materials in testing for impacts on site characterization.
1.2.6.4 PC 1c.viii	LANL	>10/1/92	Fluids and materials injected into rock to contain tracers.
1.2.6.5 PC 1d.viii	LANL	6/1/92	Fluids and materials injected into rock to contain tracers.
1.2.6.6 PC 1d.ix	LANL	>10/1/92	Fluids and materials injected into rock to contain tracers.

YMP/CM-0019, Rev. 7/2/92

STATEMENT	RESPONSIBLE ORGANIZATION	SCHEDULED RESOLUTION DATE	BRIEF DESCRIPTION
1.2.6.4 PC 1c.xi	LANL	>10/1/92	Chemical content of blasting agents used in shaft.
1.2.6.5 PC 1d.xi	LANL	6/1/92	Chemical content of blasting agents used in ramps.
1.2.6.6 PC 1d.xii	LANL	>10/1/92	Chemical content of blasting agents used underground.
1.2.6.4 PC 2a.iii	LANL	>10/1/92	Consider material chemical interactions with groundwater.
1.2.6.5 PC 2a.iii	LANL	6/1/92	Consider material chemical interactions with groundwater.
1.2.6.6 PC 2a.iii	LANL	>10/1/92	Consider material interactions with groundwater.
1.2.6.4 PC 2a.iv	LANL	>10/1/92	Materials control program to be implemented in shaft.
1.2.6.5 PC 2a.iv	LANL	>10/1/92	Materials control program to be implemented in ramps.
1.2.6.6 PC 2a.iv	LANL	>10/1/92	Materials control program to be implemented in underground excavation.
1.2.6.4 PC 2a.v	SNL	>10/1/92	Shaft is to allow flexibility in closure so a seismic event does not affect isolation capability.
1.2.6.5 PC 2a.v	SNL	6/1/92	Ramp is to allow flexibility in closure so a seismic event does not affect isolation capability.

YMP/CM-0019, Rev. 7/2/92

STATEMENT	RESPONSIBLE ORGANIZATION	SCHEDULED RESOLUTION DATE	BRIEF DESCRIPTION
1.2.6.6 PC 2a.v	SNL	>10/1/92	Excavation is to allow flexibility in closure so a seismic event does not affect isolation capability.
=====			
=====			
1.2.6.4 PC 2b.iii	RSED	>10/1/92	Shaft centerline coordinates listed in RIB.
1.2.6.5 PC 2b.iii	RSED	6/1/92	Ramp portal coordinates listed in RIB.
=====			
++++++++++			
=====			
1.2.6.4 PC 2b.iv	RSED	>10/1/92	Shaft diameter listed in RIB.
=====			
=====			
1.2.6.4 PC 2c.ii	SNL	>10/1/92	Select shaft diameter to limit impacts on waste isolation.
1.2.6.5 PC 2c.ii	SNL	6/1/92	Select ramp diameter to limit impacts on waste isolation.
1.2.6.6 PC 2c.i	SNL	>10/1/92	Design underground facility layout, including drift diameter to limit impacts on waste isolation.
=====			
++++++++++			
=====			
1.2.6.4 PC 2c.i	SNL	>10/1/92	Design shaft ground support system to limit impacts on waste isolation.
1.2.6.5 PC 2c.i	SNL	6/1/92	Design ramp ground support system to limit impacts on waste isolation.
1.2.6.6 PC 2c.ii	SNL	>10/1/92	Design underground facility ground support system to limit impacts on waste isolation.
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STATEMENT	RESPONSIBLE ORGANIZATION	SCHEDULED RESOLUTION DATE	BRIEF DESCRIPTION
1.2.6.4 PC 2e.i	LANL	>10/1/92	Rock support compatible with waste isolation.
1.2.6.5 PC 2e.i	LANL	6/1/92	Rock support compatible with waste isolation.
1.2.6.6 PC 2f.iv	LANL	>10/1/92	Rock support compatible with waste isolation.
1.2.6.4 PC 2e.ii	LANL	>10/1/92	Rock support not to affect radionuclide containment or migration.
1.2.6.5 PC 2e.ii	LANL	6/1/92	Rock support not to affect radionuclide containment or migration.
1.2.6.6 PC 2f.iv	LANL	>10/1/92	Rock support not to affect radionuclide containment or migration.
1.2.6.4 PC 2c.iii	SNL	>10/1/92	Design shaft liner to limit impacts on waste isolation.
1.2.6.5 PC 2c.iii	SNL	6/1/92	Design ramp liner to limit impacts on waste isolation.
1.2.6.4 PC 2c.iv	SNL	>10/1/92	Design shaft operational seals to limit impacts on waste isolation.
1.2.6.5 PC 2c.iv	SNL	6/1/92	Design ramp operational seals to limit impacts on waste isolation.
1.2.6.6 PC 2c.iii	SNL	>10/1/92	Design underground facility operational seals to limit impacts on waste isolation.

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STATEMENT	RESPONSIBLE ORGANIZATION	SCHEDULED RESOLUTION DATE	BRIEF DESCRIPTION
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1.2.6.4 PC 2e.iii	SNL	>10/1/92	Shaft configuration vs. isolation capability of site.
1.2.6.5 PC 2e.iii	SNL	6/1/92	Ramp configuration vs. isolation capability of site.
1.2.6.6 PC 2f.v	SNL	>10/1/92	Underground facility configuration vs. isolation capability of site.
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1.2.6.4 PC 2f.ii	LANL	>10/1/92	Materials to not produce geochemical effects if they burn.
1.2.6.5 PC 2f.ii	LANL	6/1/92	Materials to not produce geochemical effects if they burn.
1.2.6.6 PC 2g.ii	LANL	>10/1/92	Materials to not produce geochemical effects if they burn.
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1.2.6.8 C E.ix	LANL	>10/1/92	Gaseous products not to produce geochemical effects that impact waste isolation.
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1.2.6.4 PC 2h.ii	SNL	>10/1/92	Water use in shaft vs. percent saturation increase of repository horizon.
1.2.6.5 PC 2i.iii	SNL	6/1/92	Water use in ramps vs. percent saturation increase of repository horizon.
1.2.6.6 PC 2j.v	SNL	>10/1/92	Water use underground vs. percent saturation increase of repository horizon.

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STATEMENT	RESPONSIBLE ORGANIZATION	SCHEDULED RESOLUTION DATE	BRIEF DESCRIPTION
1.2.6.8 C E.iii	SNL	>10/1/92	Water use in testing vs. percent saturation increase of repository horizon.
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1.2.6.8 C E.ii	SNL	>10/1/92	Limit amount of water used in testing to limit effects on isolation capability of site.
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1.2.6.4 PC 2j.v.a	SNL	>10/1/92	Shaft diametrical closure rate with no thermal load.
1.2.6.5 PC 2k.vi.a	SNL	6/1/92	Ramp diametrical closure rate with no thermal load.
1.2.6.6 PC 2l.vi.a	SNL	>10/1/92	Openings diametrical closure rate with no thermal load.
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1.2.6.4 PC 2j.v.b	SNL	>10/1/92	Shaft diametrical closure rate with thermal load.
1.2.6.5 PC 2k.vi.b	SNL	6/1/92	Ramp diametrical closure rate with thermal load.
1.2.6.6 PC 2l.vi.b	SNL	>10/1/92	Openings diametrical closure rate with thermal load.
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1.2.6.4 PC 2j.v.c	TESS	>10/1/92	Size of rockfalls in unlined shaft.
1.2.6.5 PC 2k.vi.c	TESS	>10/1/92	Size of rockfalls in unlined ramp.
1.2.6.6 PC 2l.vi.c	TESS	>10/1/92	Size of rockfalls in unlined openings.
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STATEMENT	RESPONSIBLE ORGANIZATION	SCHEDULED RESOLUTION DATE	BRIEF DESCRIPTION
1.2.6.4 PC 2j.v.d	TESS	>10/1/92	"Access shall be maintainable".
1.2.6.5 PC 2k.vi.d	TESS	6/1/92	"Access shall be maintainable".
1.2.6.6 PC 2l.vi.d	TESS	>10/1/92	"Access shall be maintainable".
1.2.6.4 PC 2k.i	SNL	>10/1/92	Shaft response to thermal effects is to meet performance objectives.
1.2.6.5 PC 2l.i	SNL	6/1/92	Ramp response to thermal effects is to meet performance objectives.
1.2.6.6 PC 2m.i	SNL	>10/1/92	Subsurface facilities response to thermal effects is to meet performance objectives.
1.2.6.4 PC 2k.iii	SNL	>10/1/92	Provisions for thermally induced stresses in shaft liner.
1.2.6.5 PC 2l.iii	SNL	6/1/92	Provisions for thermally induced stresses in excavation support system.
1.2.6.6 PC 2m.iv	SNL	>10/1/92	Provisions for thermally induced stresses in excavation support system.
1.2.6.6 PC 2m.iii	SNL	>10/1/92	Thermal and mechanical effects of operations and testing to not affect repository performance.

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STATEMENT	RESPONSIBLE ORGANIZATION	SCHEDULED RESOLUTION DATE	BRIEF DESCRIPTION
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1.2.6.4 PC 21.i	SNL	>10/1/92	Shaft shall allow for future sealing so it does not become a preferential pathway.
1.2.6.5 PC 2m.i	SNL	6/1/92	Ramps shall allow for future sealing so they do not become a preferential pathway.
1.2.6.6 PC 2n.i	SNL	>10/1/92	Drifts shall allow for future sealing so they do not become a preferential pathway.
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1.2.6.4 PC 21.iii	SNL	>10/1/92	Materials used in shaft construction shall not interfere with or prevent postclosure sealing.
1.2.6.5 PC 2m.iii	SNL	6/1/92	Materials used in ramp construction shall not interfere with or prevent postclosure sealing.
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1.2.6.4 PC 21.v	SNL	>10/1/92	Materials and placement methods for seals shall not create preferential pathways or shall reduce radionuclide migration through existing pathways.
1.2.6.5 PC 2m.v	SNL	6/1/92	Materials and placement methods for seals shall not create preferential pathways or shall reduce radionuclide migration through existing pathways.
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STATEMENT	RESPONSIBLE ORGANIZATION	SCHEDULED RESOLUTION DATE	BRIEF DESCRIPTION
1.2.6.4 PC 21.iii.a 1.2.6.4 PC 21.iii.b 1.2.6.4 PC 21.iii.c	SNL	>10/1/92	Locations of restrictions on construction materials in vicinity of planned seals.
1.2.6.5 PC 2m.iii.a 1.2.6.5 PC 2m.iii.b 1.2.6.5 PC 2m.iii.c	SNL	6/1/92	Locations of restrictions on construction materials in vicinity of planned seals.
1.2.6.4 C A.i	TESS	>10/1/92	Shaft shall accommodate additional testing by NRC.
1.2.6.5 C A.i	TESS	6/1/92	Ramp shall accommodate additional testing by NRC.
1.2.6.6 C A.i	TESS	>10/1/92	Test area shall accommodate additional testing by NRC.
1.2.6.7 C C.i	TESS	>10/1/92	Components to accommodate additional testing required by NRC for site characterization and performance confirmation.
1.2.6.4.1 C A.	USGS	>10/1/92	Shaft collar elevation to be above the probable maximum flood as listed in RIB.
1.2.6.5.1 C A.	USGS	3/1/92	Ramp portal to be above the probable maximum flood as listed in RIB.
1.2.6.5 PC 2i.i	TESS	>10/1/92	Ramp drainage compatible with repository grades.
1.2.6.7.8 C A.	LANL	>10/1/92	Selection of fire suppression agents must consider impacts on their use.
1.2.6.8 C D.ii	SNL	>10/1/92	Penetration of boreholes below TSw2.

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STATEMENT	RESPONSIBLE ORGANIZATION	SCHEDULED RESOLUTION DATE	BRIEF DESCRIPTION
Appendix A.3	SNL	6/1/92	ESF sealing requirements imposed by repository sealing plan.
Appendix A.4	SNL	>10/1/92	Thermal design basis loads for the ESF.
Appendix A.5	RSED	6/1/92	Seismic design basis loads for the ESF.
The following are all in Appendix B			
B-2.2.1 PC 1f	LANL	>10/1/92	Tracer requirements and constraints.
B-2.2.1 PC 1h	RSN	>10/1/92	Definition of standard ESF utilities.
B-2.2.1 A 1	LANL	9/1/92	Consolidated sampling program requirements.
B-2.2.2 PC 1a	USGS	>10/1/92	Requirements for possible alcoves.
B-2.2.2 PC 1e	RSN	>10/1/92	Definition of standard ESF utilities.
B-2.2.2 PC 1f	USGS	>10/1/92	Flexibility and timing of matrix sampling.
B-2.2.2 C E	USGS	>10/1/92	Blasting requirements for block samples.
B-2.2.3 PC 1b	USGS	>10/1/92	Requirements for possible alcoves.
B-2.2.3 PC 1e	RSN	>10/1/92	Definition of standard ESF utilities.
B-2.2.4 PC 1b	USGS	>10/1/92	Final test geometry and dimensions.
B-2.2.4 PC 1c	USGS/RSN	>10/1/92	Requirements for design of block support system.
B-2.2.5 PC 1d	USGS	>10/1/92	Selection of test locations.

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STATEMENT	RESPONSIBLE ORGANIZATION	SCHEDULED RESOLUTION DATE	BRIEF DESCRIPTION
B-2.2.5 PC 1e	RSN	>10/1/92	Definition of standard ESF utilities.
B-2.2.5 C C	USGS	>10/1/92	Test interference analysis and constraint definition.
B-2.2.6 PC 1d	USGS	>10/1/92	Selection of anisotropy and contact test locations.
B-2.2.6 PC 1e	RSN	>10/1/92	Definition of standard ESF utilities.
B-2.2.7 PC 1c	USGS	>10/1/92	Geometry of instrumentation holes.
B-2.2.7 PC 1h	RSN	>10/1/92	Definition of standard ESF utilities.
B-2.2.9 PC 1a	USGS	>10/1/92	Possible alcove requirements for perched water.
B-2.2.9 PC 1f	RSN	>10/1/92	Definition of standard ESF utilities.
B-2.2.10 PC 1a.iv	USGS	>10/1/92	Space and possible alcove requirements.
B-2.2.10 PC 1e	RSN	>10/1/92	Definition of standard ESF utilities.
B-2.2.10 PC 1i	USGS	>10/1/92	Exact test locations.
B-2.2.10 C A	LANL/USGS	>10/1/92	ESF water tracer requirements.
B-2.2.10 C B	LANL/USGS	>10/1/92	ESF gas tracer requirements
B-2.2.11 PCs,Cs	USGS	>10/1/92	MPBH design requirements and constraints.
B-2.2.12 PC 1a	USGS	>10/1/92	Alcove requirements and test geometry.
B-2.2.12 PC 1e.i	USGS	>10/1/92	Borehole geometry and space requirements.
B-2.2.12 PC 1f	RSN	>10/1/92	Definition of standard ESF utilities.

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STATEMENT	RESPONSIBLE ORGANIZATION	SCHEDULED RESOLUTION DATE	BRIEF DESCRIPTION
B-2.2.12 C D	USGS	>10/1/92	Test interference and zone of influence.
B-2.2.12 C E	USGS	>10/1/92	Gas tracer for dry drilling.
B-2.2.13 PC 1g	RSN	>10/1/92	Definition of standard ESF utilities.
B-2.2.14 PC 1e	RSN	>10/1/92	Definition of standard ESF utilities.
B-2.2.14 A 3	LANL	9/1/92	Consolidated sampling program requirements.
B-2.2.15 PC 1e	RSN	>10/1/92	Definition of standard ESF utilities.
B-2.2.15 A 3	LANL	9/1/92	Consolidated sampling program requirements.
B-2.2.16 PC 1d	RSN	>10/1/92	Definition of standard ESF utilities.
B-2.2.16 A 3	LANL	9/1/92	Consolidated sampling program requirements.
B-2.2.17 PC 1d	RSN	>10/1/92	Definition of standard ESF utilities.
B-2.2.17 C C	LANL	9/1/92	Consolidated sampling program requirements.
B-2.2.18 PC 1f	RSN	>10/1/92	Definition of standard ESF utilities.
B-2.2.18 A 1	LANL	9/1/92	Consolidated sampling program requirements.
B-2.2.19 PC 1a	LANL	>10/1/92	Final test geometry and test locations.
B-2.2.19 PC 1e	RSN	>10/1/92	Definition of standard ESF utilities.
B-2.2.19 C D.ii	LANL	>10/1/92	Stand-off distance from excavations.

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STATEMENT	RESPONSIBLE ORGANIZATION	SCHEDULED RESOLUTION DATE	BRIEF DESCRIPTION
B-2.2.19 C D.iii	LANL	>10/1/92	Definition of test zone of influence.
B-2.2.19 C E.ii	LANL	>10/1/92	Fluid/material constraints.
B-2.2.20 PC 1f	USGS/USBR	>10/1/92	Final excavation face washdown procedure.
B-2.2.20 C C	USGS/USBR	>10/1/92	Design requirements for mapping jumbo (platform).
B-2.2.21 PC 1f	RSN	>10/1/92	Definition of standard ESF utilities.
B-2.2.22 PC 1c	SNL	>10/1/92	Flexibility requirements for test locations.
B-2.2.22 PC 1d	RSN	>10/1/92	Definition of standard ESF utilities.
B-2.2.22 A 1	LANL	9/1/92	Consolidated sampling program requirements.
B-2.2.23 PC 1e	RSN	>10/1/92	Definition of standard ESF utilities.
B-2.2.24 PC 1a	SNL	>10/1/92	Exact test location and orientation.
B-2.2.24 PC 1e	SNL	>10/1/92	Test layout and geometry.
B-2.2.24 PC 1f	RSN	>10/1/92	Definition of standard ESF utilities.
B-2.2.25 PC 1d	SNL	>10/1/92	Orientation of drift and instrumentation rooms.
B-2.2.25 PC 1e	SNL	>10/1/92	Cross-sections and test layout.
B-2.2.25 PC 1f	RSN	>10/1/92	Definition of standard ESF utilities.
B-2.2.26 PC 1g	SNL	>10/1/92	Layout and configuration of test instrumentation.
B-2.2.26 PC 1h	RSN	>10/1/92	Definition of standard ESF utilities.

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STATEMENT	RESPONSIBLE ORGANIZATION	SCHEDULED RESOLUTION DATE	BRIEF DESCRIPTION
B-2.2.26 C D	SNL	>10/1/92	Zone of influence and interference constraints.
B-2.2.27 PC 1a	SNL	>10/1/92	Test alcove location (TSw2).
B-2.2.27 PC 1e	SNL	>10/1/92	Layout and test instrument configuration.
B-2.2.27 PC 1f	RSN	>10/1/92	Definition of standard ESF utilities.
B-2.2.27 C D	SNL	>10/1/92	Zone of influence and interference constraints.
B-2.2.27 C E	SNL	>10/1/92	Fluid/material and test controls.
B-2.2.28 PC 1d	SNL	>10/1/92	Test layout and instrument configuration.
B-2.2.28 PC 1e	RSN	>10/1/92	Definition of standard ESF utilities.
B-2.2.28 A 2	SNL	>10/1/92	Modification of interference envelope.
B-2.2.29 PC 1c	SNL	>10/1/92	Specification of test locations on MTL.
B-2.2.29 PC 1d	SNL	>10/1/92	Test layout and instrumentation configuration.
B-2.2.29 PC 1e	RSN	>10/1/92	Definition of standard ESF utilities.
B-2.2.29 PC 1e	SNL	>10/1/92	Power requirements for heater and IDS.
B-2.2.29 C D	SNL	>10/1/92	Zone of influence.
B-2.2.30 PC 1e	SNL	>10/1/92	Test layout and instrument configuration.
B-2.2.30 PC 1f	RSN	>10/1/92	Definition of standard ESF utilities.
B-2.2.30 C D	SNL	>10/1/92	Zone of influence.

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STATEMENT	RESPONSIBLE ORGANIZATION	SCHEDULED RESOLUTION DATE	BRIEF DESCRIPTION
B-2.2.31 PC 1d	SNL	>10/1/92	Test layout and instrument configuration.
B-2.2.31 PC 1e	RSN	>10/1/92	Definition of standard ESF utilities.
B-2.2.32 PC 1d	SNL	>10/1/92	Test layout and instrument configuration.
B-2.2.32 PC 1e	RSN	>10/1/92	Definition of standard ESF utilities.
B-2.2.34 PC 1a	SNL	>10/1/92	Test location definition.
B-2.2.34 PC 1f	RSN	>10/1/92	Definition of standard ESF utilities.
B-2.2.35 PC 1d	SNL	>10/1/92	Layout and instrument configuration.
B-2.2.35 PC 1e	RSN	>10/1/92	Definition of standard ESF utilities.
B-2.2.36 PC 1e	RSN	>10/1/92	Definition of standard ESF utilities.
B-2.2.36 C D	SNL	>10/1/92	Define acceptable amounts of thermal and hydrological change.
B-2.2.37 PC 1d	RSN	>10/1/92	Definition of standard ESF utilities.
B-2.2.37 C B	SNL	>10/1/92	Required stand-off and zone of influence.
B-2.2.38 PC 1a	SNL	>10/1/92	Need for possible alcoves.
B-2.2.38 PC 1b	SNL	>10/1/92	Drilling requirements.
B-2.2.38 PC 1e	SNL	>10/1/92	General test configuration.
B-2.2.38 PC 1f	RSN	>10/1/92	Definition of standard ESF utilities.
B-2.2.39 PC 1b.viii	SNL	>10/1/92	Compressed air and tracer requirements.

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STATEMENT	RESPONSIBLE ORGANIZATION	SCHEDULED RESOLUTION DATE	BRIEF DESCRIPTION
B-2.2.39 PC 1g	SNL	>10/1/92	Surface location for simulation of rockfill placement testing.
B-2.2.39 PC 1i	RSN	>10/1/92	Definition of standard ESF utilities.
B-2.2.39 Constraints	SNL	>10/1/92	Performance constraints, including rock support system.
B-2.2.40 PC 1f	RSN	>10/1/92	Definition of standard ESF utilities.
B-2.2.40 PC 1h	LLNL	>10/1/92	Compressed air and tracer requirements.
B-2.2.40 C D	LLNL	>10/1/92	Stand-off and zone of influence determination.
B-2.2.41 PC 1j	LLNL	>10/1/92	Test locations and test geometry.
B-2.2.41 PC 1k	RSN	>10/1/92	Definition of standard ESF utilities.
B-2.2.41 PC 1l	LLNL	>10/1/92	Water requirements for infiltration studies.
B-2.2.41 C F	LLNL	>10/1/92	Stand-off and zone of influence determinations.
B-2.2.42 PC 1e	RSN	>10/1/92	Definition of standard ESF utilities.
B-2.2.42 A 3	LANL/LLNL	9/1/92	Consolidated ESF sampling program requirements.
B-2.3.1 PCs,Cs	LANL	Prioritized sequence	Scientific Manpower requirements for ESF.
B-2.3.2 PCs,Cs	LANL	>10/1/92	Laboratory/office/storage requirements for ESF testing organizations.
B-2.3.3 PCs,Cs	LANL	Prioritized sequence	Electrical power requirements for ESF testing.

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STATEMENT	RESPONSIBLE ORGANIZATION	SCHEDULED RESOLUTION DATE	BRIEF DESCRIPTION
B-2.3.4 PCs,Cs	LANL	>10/1/92	Water system design requirements for ESF testing.
B-2.3.4 PC 1c	LANL	>10/1/92	ESF water tracer requirements.
B-2.3.4 PC 1d	LANL	9/1/92	Methods of monitoring and recording water usage.
B-2.3.4 C B	LANL/SNL TESS	Prioritized sequence	Performance evaluation of ESF water usage.
B-2.3.5 PCs,Cs	LANL	Prioritized sequence	Compressed air system design requirements for ESF testing.
B-2.3.5 PC 1c	LANL	Prioritized sequence	Compressed air tracer requirements.
B-2.3.5 C B	LANL/SNL TESS	Prioritized sequence	Performance evaluation of air and gas tracer usage in ESF.
B-2.3.6 PCs,Cs	LANL	9/1/92	Common (consolidated) ESF sampling program requirements.
B-2.3.7 PCs,Cs	LANL	>10/1/92	Communications system design requirements for ESF testing.
B-3.0 PC 1a.iv	LANL	>10/1/92	Surface IDS facility uninterruptable power requirements.
B-3.0 PC 1a.v	LANL	>10/1/92	Surface IDS facility normal power distribution requirements.
B-3.0 PC 1b	LANL	>10/1/92	Individual DAS facility support requirements.
B-3.0 PC 1b.ii	LANL	>10/1/92	DAS enclosure and environmental requirements.
B-3.0 PC 1d	LANL	>10/1/92	IDS underground repair facility UPS and normal power distribution system requirements.

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DATA TO BE VERIFIED LOG

DOCUMENT/REVISION NUMBER YMP/CM-0019

STATEMENT	VERIFICATION ORGANIZATION	SCHEDULED VERIFICATION DATE	BRIEF DESCRIPTION
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1.2.6.0 PC 2b.i	TESS	6/1/92	Maintainable life of "permanent" ESF features.
1.2.6.0 PC 2c.i	TESS	6/1/92	Life of liners for waste water ponds and rock storage.
1.2.6.0 PC 2c.ii	TESS	6/1/92	Maintainable life of shaft collars and ramp portals.
1.2.6.0 PC 2c.iii	TESS	6/1/92	Maintainable life of sites for shaft collars and ramp portals.
1.2.6.0 PC 2c.iv	TESS	6/1/92	Maintainable life of permanent shaft and ramp features.
1.2.6.0 PC 2c.v	TESS	6/1/92	Maintainable life of permanent ESF features.
1.2.6.0 PC 2c.vi	TESS	6/1/92	Maintainable life of nonpermanent ESF features.
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1.2.6.3 PC 1d.	T&MSS	6/1/92	Facilities for visitors during ESF testing.
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1.2.6.4 DEF	TESS	>10/1/92	Radial distance beyond shaft excavation included as part of shaft; distance beyond shaft station included as part of shaft.
1.2.6.5 DEF	TESS	6/1/92	Radial distance beyond ramp excavation included as part of ramp.
1.2.6.6 DEF	TESS	>10/1/92	Distance beyond accesses to not be included as part of the accesses.
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STATEMENT	VERIFICATION ORGANIZATION	SCHEDULED VERIFICATION DATE	BRIEF DESCRIPTION
1.2.6.6 PC 1e.ii	T&MSS	>10/1/92	Size of facilities for visitors underground during ESF testing.
1.2.6.6 PC 2b.ii	SNL	>10/1/92	Location of surface boreholes relative to waste emplacement drifts.
1.2.6.6 PC 2d.ii	SNL	6/1/92	Proximity of excavation and drilling relative to repository block.
1.2.6.6 PC 2d.v	TESS	>10/1/92	Mining extraction ratio of 30 per cent.
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1.2.6.4 PC 2j.i.b	SNL	>10/1/92	Overbreak limit of 12 inches.
1.2.6.5 PC 2k.i.b	SNL	6/1/92	Overbreak limit of 12 inches.
1.2.6.6 PC 2l.i.b	SNL	>10/1/92	Overbreak limit of 12 inches.
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1.2.6.4 PC 2l.ii	SNL	>10/1/92	No pressure grouting allowed within 50 feet of ground surface and Pah Canyon/Topopah Spring contact or below MTL.
1.2.6.5 PC 2m.ii	SNL	6/1/92	No pressure grouting allowed within 50 feet of ground surface and Pah Canyon/Topopah Spring contact or below MTL.
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1.2.6.4 PC 2l.iv	SNL	>10/1/92	No pressure grouting allowed within 50 feet of anchor to bedrock seals or below the MTL.
1.2.6.5 PC 2m.iv	SNL	6/1/92	No pressure grouting allowed within 50 feet of anchor to bedrock seals or below the MTL.
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1.2.6.6 PC 2n.v.a	SNL	>10/1/92	No pressure grouting allowed within 50 feet of boundary of ESF Main Test Area.

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BACKGROUND

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

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

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

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

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

PRIMARY GUIDELINES

The primary guidelines for the YMP ESF are as follows:

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

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

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

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

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

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

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

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

The ESFDR translates the OCRWM requirements into the site specific requirements relevant to the Design Organization (DO). Some requirements may also apply to other participants.

The technical content of this document was developed by various Participants who remain responsible for the technical adequacy of the data they provided. All changes to Appendix B must have the concurrence of Los Alamos National Laboratory.

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EXPLANATION OF ESFDR VOLUME 1 NOTATIONS AND ORGANIZATION

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

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

This document conforms to this outline within each subsystem section. The organization of Volume 2 of the ESFDR down to the subsystem level is shown in Figure 1.

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

The DEFINITION OF SUBSYSTEM ELEMENTS division is further divided into two parts, Definition and Boundaries and Interfaces. The definition identifies the general purpose of the section. The boundaries and interfaces identify other documents which may affect the satisfaction of the requirements in the section of interest. Those boundaries and interfaces which are internal to the DO are not identified in this section.

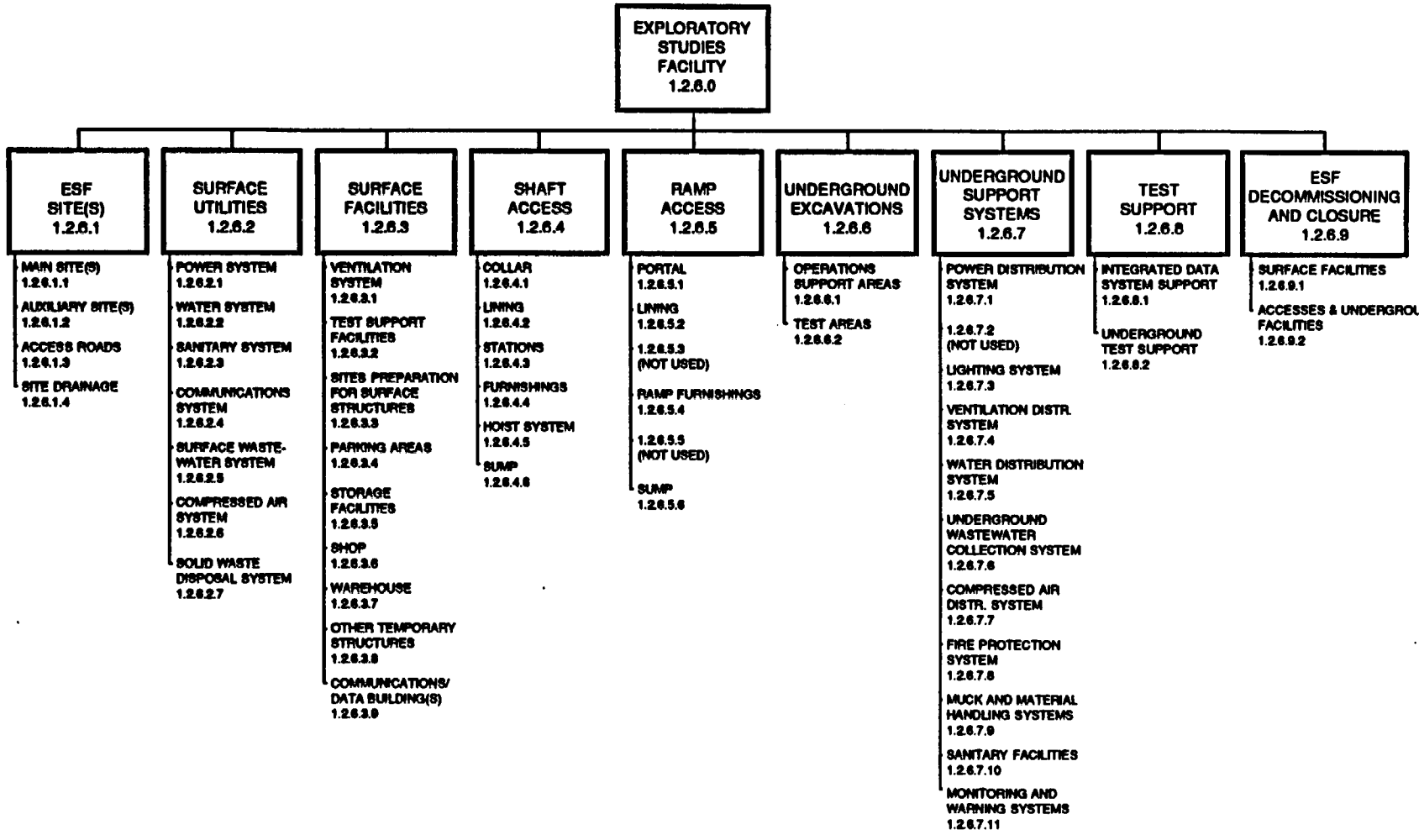
The APPLICABLE REGULATIONS, CODES, STANDARDS AND DOE ORDERS division identifies those regulatory documents associated with the subject of the section. This division is only found in the primary part of the sections; subsections do not contain this division.

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

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

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

ESFDR ORGANIZATION DIAGRAM



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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, or C, is followed by a bracketed citation which identifies the source of the statement or the higher statement which it supports. Specific examples of these citations and their meanings are as follows:

- [10 CFR 60.122]--This citation identifies the statement's source is Paragraph 122 of 10 CFR Part 60.

- [SR3.B]--This citation identifies a quote of Constraint B in Section 3.0 of the Yucca Mountain Mined Geologic Disposal System Requirements (SR-ESF) Document developed to support ESF.

- [SRY.E]--This citation identifies a quote of Constraint E in Section YMMGDS of the Yucca Mountain Mined Geologic Disposal System Requirements (SR-ESF) Document developed to support ESF.

- [6.0FR1]--This citation identifies the statement was derived from a higher level statement in section 1.2.6.0 of the ESFDR, Functional Requirement 1. PC2a identifies the statement was derived from Performance Criteria 2a; C B identifies the statement was derived from Constraint B.

- [DAA 1.4.6.1]--This citation identifies that the statement was derived from 1.4.6.1 in the Design Acceptability Analysis.

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

Pages are numbered using a two-part system. The first part is a truncation of the subsystem number; the second part is the consecutive page number within the subsystem. For example, the page numbered 6.2.4-3 is page 3 within Subsystem 1.2.6.2.4.

10 CFR 60 REQUIREMENTS

Appendix E of the WMSR Volume IV lists requirements from 10 CFR 60 which, according to the Nuclear Regulatory Commission (NRC) staff, must be considered in the ESF design. The NRC views the determination of which Part 60 requirements need to be considered in the ESF as a two-step process: 1) since some or all of the ESF may be incorporated as part of the repository, then all Part 60 requirements are applicable to the ESF; and 2) DOE must then evaluate which of these requirements actually have an impact on the design of the ESF. We believe that DOE's approach is not inconsistent with NRC's approach. All requirements have been considered in the ESFDR and nothing in

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this document will later preclude the potential repository complying with the requirements listed in WMSR IV. However, some of the listed 10 CFR 60 requirements do not directly influence the ESF design and are not quoted in the ESFDR. See Appendix F for an explanation and listing of WMSR IV requirements usage in the ESFDR.

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

The ESFDR provides some sub-tier requirements, criteria or constraints which are subordinate to 10 CFR 60 requirements. The subtier statements elaborate on 10 CFR 60 and orient a Part 60 provision to the circumstances to which it will be applied.

DESIGN ACCEPTABILITY ANALYSIS (DAA)

The DAA contains explicit design criteria which were developed from specific 10 CFR 60 requirements related to three major NRC concerns. These concerns include: (1) maintaining the long-term waste isolation capability of the site, (2) not compromising the ability to characterize the site, and (3) obtaining data that are representative of site behavior.

The design criteria developed in the DAA are a subset of the total design requirements which have been developed for the ESF. The DAA does not, nor was it intended to, represent all applicable 10 CFR 60 requirements. The ESFDR contains only those technical design requirements with which the Design Organization must comply (other organizations may also need to comply). The 10 CFR 60 requirements which directly influence the ESF are identified in Appendix F. Some DAA criteria which have been developed from these same 10 CFR 60 requirements are considered not applicable to the Design Organization, and thus are not presented in the ESFDR (see Appendix K for more information). ESFDR requirements which reference or are related to DAA criteria are followed by a citation such as {DAA 1.10.4.2} which identifies the DAA criteria.

UNDERGROUND TESTING SUPPORT

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

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

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EXPLANATION OF ESFDR VOLUME 2 ORGANIZATION

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

- Appendix A.1--This appendix contains general repository/ESF interface constraints. The ESF Title I design, as documented in the ESF Title I Design Summary Report, is the basis for ESF Title II design. This appendix will continue to be developed and expanded to support the interface relationship as directed by DOE.

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

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

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

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

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

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

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

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

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

- Appendix G--This appendix contains the logic tree which graphically maps the systems, functions and requirements for the ESF.

- Appendix H--This appendix contains the ESF Requirements Traceability Matrix whose purpose is to identify those requirements in Volume 1 which have been traced to ESFDR Rev. 0. Those requirements which have been traced have their ESFDR Rev. 0 location given in Column 2. Those requirements that have not been traced will have their source given in column 2.

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- Appendix I--This appendix contains the overall relationship among the 10 CFR 60 requirements, ESFDR requirements, and performance assessment analyses. It also contains summaries of analyses performed to date and recommendations derived from the results of the analyses.

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

- Appendix K--This appendix shows where the criteria developed by the DAA are incorporated into the ESFDR. It also gives reasons for the DAA criteria which have not been incorporated into the ESFDR.

YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT QUALITY ASSURANCE

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

ESFDR QUALITY ASSURANCE

The review and approval of the ESFDR, Revision 0 was performed in accordance with Sandia National Laboratories Procedure DOP 3-13, "Independent Technical and Management Reviews of Documents," and YMP Quality Management Procedure QMP-06-04, "YMPO Document Development, Review, Approval, and Revision Process." The review and approval of the 5/31/91 revision, revision of 7/1/91, revision of 7/29/91, and this revision was performed in accordance with QMP-06-04. The assignment of quality assurance criteria to individual items and activities described in this document will be accomplished by Quality Assurance grading for specific items and activities. The ESFDR does not assign quality assurance criteria. All revisions of the ESFDR shall be performed under QA controls in accordance with DOE/RW 0214 criteria. The ESFDR is expected to be revised on an as-needed basis.

ESFDR REQUIREMENTS TO BE DETERMINED (TBD) AND TO BE VERIFIED (TBV)

Some of the requirements contained in Sections 1.2.6.0 through 1.2.6.9 and the Appendices need to be determined (TBD) or to be verified (TBV). Requirements needing a quantified value are [TBD] (to be determined). Requirements are identified as [TBD] only if they are expected to be revised following determination of the quantity. If a requirement needs a quantified value, but the quantified value will be determined by the Design Organization without subsequent revision to the ESFDR, the requirement is not identified as [TBD]. Requirements that have bounds, conditions, or values that must be verified are [TBV]. Requirements are identified as [TBV] only if they will be verified by someone other than the Design Organization. Requirements which are [TBD] or [TBV] are tabulated in the TBD/TBV Log at the front of the ESFDR. The log also shows the organizations responsible for resolving the [TBD] or [TBV] and the schedule for doing so.

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ESFDR NUMERIC VALUES

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

ESFDR VALUES STATED AS GOALS

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

CHANGE PROCESS

All technical changes to this document must have approval of the Project Change Control Board. Editorial corrections or changes may be made without CCB approval. The organization requesting the change is responsible for pursuing the change.

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1.2.6.0 EXPLORATORY STUDIES FACILITY

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

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The Exploratory Studies Facility (ESF) is defined as those systems, subsystems, and components used for in situ site characterization and performance confirmation testing of the Yucca Mountain site for a potential repository. Some or all of the ESF may be incorporated into the potential repository. The ESF is defined as the surface and underground facilities (including accesses and connecting drifts) and supporting systems required to support site characterization testing at depth. The underground limits for ESF (the main test area, drifts and ramps) use are defined in the ESF-Repository interface drawings referenced in ESFDR Appendix A.2. The main test level (MTL) is defined as the ESF development within the planned repository horizon, which currently is the TSw2 rock unit within the Topopah Member of the Paintbrush Tuff. Radioactive wastes will not be handled or stored at the ESF unless specifically requested by the U. S. Nuclear Regulatory Commission (NRC) for the purpose of site characterization testing. The definitions in 10 CFR 60.2 shall apply to the ESFDR.

Boundaries and Interfaces

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

APPLICABLE REGULATIONS, CODES, STANDARDS, AND DOE ORDERS

ESFDR Appendix E contains a listing of known applicable regulations, codes, standards, and DOE orders. ESFDR Appendix J contains a listing of environmental-related requirements that apply to ESF activities. General references to these are made in the beginning of each major section of this

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document. It is the responsibility of the Design Organization (DO) to apply the applicable portions of these to the ESF design. The latest edition or revision in effect at the time of initiation of an ESF design phase shall be used. Subsequent revisions of a regulation, code, standard, or DOE Order during a design phase shall be evaluated, using the applicable YMP-approved change control process, to determine the expected impacts of the revision on the design process and when implementation of the revision shall be invoked.

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

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

FUNCTIONAL REQUIREMENTS

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

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

PERFORMANCE CRITERIA

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

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

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

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

   i. All major systems for ventilation, utilities, emergency egress, rock handling, personnel support, and others shall be analyzed to determine the need for the uncertainty allowance. If it can be demonstrated that critical parts of the allowance would require excessive costs, or have schedule,

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test disruption, or other adverse program impacts if designed, procured, and/or constructed 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. All allowances for uncertainty of the major ESF systems are to be determined as soon as possible after the start of Title II design.

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. [SR3.B and E]

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

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

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

1i. All coordinates shall be in accordance with the Nevada State Plane Coordinate System. [SRY.F and G]

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

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

ii. Detection equipment for fires and explosions shall meet the requirements of DOE Order 5480.7 and DOE Order 6430.1A, Division 15, Mechanical; and any other applicable local, State of Nevada, and Federal regulations.

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

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i. ESF facilities shall provide for retention and safeguarding of records in accordance with 10 CFR 60.4(b).

11. All project land surveys shall comply with the following:

i. Be traceable to existing first order control points in or around Area 25.

ii. Comply with the accuracy requirements established by the requester of the surveying services.

iii. Verified by the surveying organization that the survey originated from suitable control points and the accuracy requirements are satisfied.

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

2b. 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)]

For purposes of this paragraph, a reasonable schedule for retrieval is one that would permit retrieval in about the same time as that devoted to construction of the geologic repository operations area and the emplacement of wastes. [10 CFR 60.111(b)(3)] [SR3.C and E]

i. The items listed below are the "ESF permanent systems, structures, and components" which shall be designed, procured, and constructed so they can be incorporated into a repository:

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

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

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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 if 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.

The above items shall be designed to have a maintainable life of 100 years. [TBV] {DAA 1.2.4.1, 1.2.5.1}

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

i. Liners for waste water ponds and rock storage areas shall be designed and constructed for a maintainable 25-year life. [TBV]

ii. Shaft collars and ramp portals shall be designed and constructed for a maintainable 100-year life. [TBV]

iii. Sites prepared for shaft collars and ramp portals shall be designed and constructed for a maintainable 100-year life. [TBV]

iv. Permanent shaft and ramp structures, systems, and components shall be designed and constructed for a maintainable 100-year life. [TBV]

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

vi. The maintainable design life for those nonpermanent ESF structures, systems, and components which may be used for initial repository construction shall be 15 years. [TBV]

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

i. 10 CFR 60.21(c)(1)(ii)(E), Content of License Application: Safety Analysis Report; Assessment of Items Important to Safety.

ii. 10 CFR 60.111(a), Performance of the Geologic Repository Operations Area Through Permanent Closure: Protection Against Radiation Exposures and Releases of Radioactive Material.

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iii. 10 CFR 60.113(a)(1)(i), Performance of Particular Barriers after Permanent Closure: Engineered Barrier System.

iv. 10 CFR 60.113(a)(1)(ii)(A),(B), Performance of Particular Barriers after Permanent Closure: Engineered Barrier System.

v. 10 CFR 60.131(b)(4)(i), General Design Criteria for the Geologic Repository Operations Area: Structures, Systems, and Components Important to Safety; Emergency Capability.

vi. 10 CFR 60.133(g), Additional Design Criteria for the Underground Facility: Underground Facility Ventilation.

vii. 10 CFR 60.133(h), Additional Design Criteria for the Underground Facility: Engineered Barriers.

viii. 10 CFR 60.140, Performance Confirmation Program: General Requirements.

ix. 10 CFR 60.141, Performance Confirmation Program: Confirmation of Geotechnical and Design Parameters.

x. 10 CFR 60.142, Performance Confirmation Program: Design Testing.

xi. 10 CFR 60.151, Quality Assurance: Applicability.

xii. 10 CFR 60.152, Quality Assurance: Implementation.

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

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

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

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

INTERFACE CONTROL REQUIREMENTS

1. ESF design interfaces shall be maintained with all work performed by participating organizations and contractors including surface-based testing design, Integrated Data System (IDS), and repository design in compliance with AP-5.19Q, Interface Control.

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CONSTRAINTS

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

B. To the extent practicable and consistent with procurement regulations, surplus government equipment shall be considered for fulfilling the requirements of the ESF facilities, support services, and equipment. [SRY.A]

C. Facility design for site characterization activities shall comply with the following: [SR3.C]

Regulatory Constraints

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

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

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

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

Project Constraints

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

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

iii. All substances and tracers intended to be added to water and compressed air to be used underground, for such purposes as drilling and dust control, shall first be reviewed for potential to affect site characterization testing, repository testing or monitoring, and waste isolation. They may be added only following review, approval and having received the appropriate permits. [TBD]

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

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

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

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

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

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

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

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

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

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

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

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

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

F. 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)] (SRY.F)

G. 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)] (SRY.F)

H. 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)] (SRY.F)

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)] (SRY.F)

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)] (SRY.F)

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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)] (SRY.F)

I. The structures, systems, and components important to safety shall be designed to permit periodic inspection, testing, and maintenance, as necessary, to ensure their continued functioning and readiness. [10 CFR 60.131(b)(6)] (SRY.F)

J. 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)] [SR3.E]

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

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

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

M. The ESF shall comply with environmental requirements (see ESFDR Appendix J). [SRY.B]

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

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

P. Facilities and utilities shall accommodate the number of personnel present during the ESF construction, operation, and testing phases. An ESF population study to determine the number of such personnel shall be performed by the DO and approved by the YMPO. (SRY.C)

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

R. In accordance with 10 CFR 60.21(c)(11), the ESF design will include a description of design considerations that are intended to facilitate permanent closure and decontamination or dismantlement of surface facilities. (SRY.CA)

ASSUMPTIONS

None.

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1.2.6.1 ESF SITE(S)

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

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

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

Boundaries and Interfaces

For repository/ESF interface constraints, see ESFDR Appendix A.1. For repository/ESF interface drawings, see ESFDR Appendix A.2.

APPLICABLE REGULATIONS, CODES, STANDARDS, AND DOE ORDERS

The design shall be in accordance with:

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

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

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

4. Bureau of Land Management Manual (BLM Manual) Reg. 9-247, Section 9113 Road.

5. 30 CFR Part 57, Safety and Health Standards-Underground Metal and Nonmetal Mines.

6. 29 CFR Part 1910, Occupational Safety and Health Standards.

7. DOE 5480.4, Environmental Protection, Safety, and Health Protection Standards.

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

FUNCTIONAL REQUIREMENTS

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

PERFORMANCE CRITERIA

1a. Sites shall be surveyed and locations identified in sufficient detail for construction needs and to allow the conduct of an environmental analysis and assessment (archaeological, biological and soil pre-activity surveys, etc.). [6.0PC1l]

1b. In accordance with 10 CFR 60.133(a)(2), ramp and ramp-portal and shaft and shaft-collar areas shall be located and/or graded to protect them, and prevent water inflow to the underground facilities, from the probable maximum flood. [6.0PC2e] (DAA 1.12.1.1, 2.3.1.1)

1c. Sites shall be cleared of unusable roads, utilities, and structures that interfere with the ESF. [6.0PC1k]

1d. Roads, building sites, utility corridors, and storage areas for excavated rock shall be cleared, graded, and stabilized. Topsoil shall be stored in an environmentally acceptable manner (see ESFDR Appendix J). [6.0PC1k]

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

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

1g. All storm-water runoff shall be controlled in an environmentally acceptable manner (see ESFDR Appendix J). [6.0PC1k, CI]

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

INTERFACE CONTROL REQUIREMENTS

1. The ESF designers shall interface with surface-based testing and repository designers on ESF site location and layout, and on permanent ESF structures, systems, and components.

   See Section 1.2.6.0, Interface Control Requirements.

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CONSTRAINTS

A. In accordance with 10 CFR 60.15(c)(1), the location, design, construction, and operation of the main site and auxiliary sites shall incorporate aspects specifically directed at limiting the potential for adverse effects on the long term performance of a repository. [6.0PC2d] {DAA 1.1.1.1}

B. The ground at each site shall be restored to a contour compatible with its initial condition. This shall be done after all use for a site is completed and all facilities have been removed. [6.0CM] {DAA 1.4.1.1}

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

   i. 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 SCPB. Refer to ESFDR Appendix I, Analysis 5 for specific guidance.

   ii. Foundations for equipment, buildings, and structures shall be constructed using excavation methods such as controlled blasting to limit damage to the underlying rock mass, to the extent that it could affect the adequacy or reliability of information from site characterization. Methods shall be designed by the responsible organization to facilitate investigation and monitoring of such effects during and after construction. Refer to ESFDR Appendix I, Analysis 5 for specific guidance. {DAA 1.16.1.1, 2.7.1.1}

   iii. The ESF equipment, buildings, and foundations for structures shall be designed and constructed so that their excavation does not lead to creation of pathways that compromise the repository's capability to meet the performance objective of 10 CFR Part 60.112. [TBD] {DAA 1.6.1.1}

D. In accordance with 10 CFR 60.137, the ESF site shall be designed to facilitate appropriate performance confirmation measurement and monitoring to obtain adequate and reliable information about the site. The performance confirmation program shall include measurement and monitoring of the performance of the ESF site to the extent that aspects of the site are part of the geologic setting that could contribute to the waste isolation performance of a repository.
[TBD] [6.0PC2d] {DAA 2.8.1.1}

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E. In accordance with 10 CFR 60.130, the use of hydrocarbons, solvents, and chemicals shall be controlled during construction and operation of surface site(s) to limit adverse chemical changes. [6.0CC] [TBD] {DAA 1.10.1.1}

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

i. The amount of water used in site preparation and operations should be limited to that required for sanitation, dust control, compaction of engineered fill material, and proper equipment operation so as to limit the effects on the containment and isolation capability of the site. Refer to ESFDR Appendix I, Analysis 1 for specific guidance. {DAA 1.14.1.1, 1.14.1.6}

ii. Surface sites shall be designed to avoid blockage of natural surface water drainageways and avoid creation of surface water impoundments that could impact post-closure performance. {DAA 1.14.1.3}

iii. Multipurpose Boreholes (MPBH) or other surface drilled exploratory boreholes associated with the ESF and located within the repository block shall be drilled dry. {DAA 1.14.1.4}

iv. Any MPBHs drilled at ESF sites shall incorporate a standpipe or other measures appropriate and adequate for protection against the effects of maximum credible floods during the period when MPBHs are accessible prior to borehole plugging and sealing. The location of the maximum credible flood in relation to MPBHS shall be determined by the DO. {DAA 1.14.1.5}

v. Excess water shall be removed. [TBD] {DAA 1.14.1.7}

vi. Management of water entering the ESF shall include quantity, location, and water balance. {DAA 1.14.1.8}

G. Site preparation activities shall disturb only the amount of land necessary to support the construction and operation. [6.0PC2d, CI]

H. Where necessary to inhibit access, access to the ESF site shall be controlled by fencing and a gate across the roadway. [6.0PC2d]

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

J. Runoff and erosion during construction and operation and after decommissioning shall be controlled in accordance with applicable State of Nevada and local regulations (see ESFDR Appendix J). [6.0CM,CO]

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K. Dust control shall be provided at potential dust-generation areas such as roads and earth-moving sites in order to minimize airborne particulates, as required by applicable Federal, State, and local codes (see ESFDR Appendix J). [6.0CM]

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

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

N. The ESF shall allow for operation on a 3-shift-per-day, 7-day-per-week schedule throughout both the ESF construction and operation phases. [6.0PC1k]

O. Rock excavated from the underground facilities shall be deposited at a location on the surface that is not visible from U.S. Highway 95. [6.0CM]

ASSUMPTIONS

None.

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1.2.6.1.1 MAIN SITE(S)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

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

Boundaries and Interfaces

For repository/ESF interface constraints, see ESFDR Appendix A.1. For repository/ESF interface drawings, see ESFDR Appendix A.2.

FUNCTIONAL REQUIREMENTS

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

PERFORMANCE CRITERIA

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

i. Roads (muck haulage and access).
ii. Shaft Access (plus standoff distances).
iii. Ramp Access (plus standoff distances).
iv. Permanent hoist house(s) (plus standoff distances).
v. Headframes and back legs and/or ramp construction facilities.
vi. Muck handling facilities.
vii. Ventilation fans (plus standoff distances) as required.
viii. Utilities (power, water, sewage, communications).
ix. Access construction facilities.
x. Parking.
xi. Communications/Data buildings (includes IDS).
xii. Multipurpose boreholes.
xiii. Helicopter pad

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

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CONSTRAINTS

A. To the extent practical, exploratory boreholes and shafts [ramps] in the geologic repository operations area shall be located where accesses are planned for underground facility construction and operation; or where large, unexcavated pillars are planned. [10 CFR 60.15(c)(3)] [6.1CA]

B. Buildings shall be so spaced as to allow sufficient room for construction and maintenance of the facilities. [6.1CM]

ASSUMPTIONS

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

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1.2.6.1.2 AUXILIARY SITE(S)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The auxiliary site(s) consist of the areas prepared for ESF purposes not fulfilled by the main sites. Examples of the possible use of auxiliary sites include lay down area, explosives magazine, muck and rock storage, topsoil storage, batch plant, water tank, substation with standby generators, compressors, warehouse and other areas defined as the design progresses.

Boundaries and Interfaces

For repository/ESF interface constraints, see ESFDR Appendix A.1. For repository/ESF interface drawings, see ESFDR Appendix A.2.

FUNCTIONAL REQUIREMENTS

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

PERFORMANCE CRITERIA

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

i. Construction Utilities.

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

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

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

d. Sewage.

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e. Wastewater disposal.

f. Air compressor system.

ii. Construction surface storage.

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

iii. Construction support facilities.

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

iv. Access to other facilities.

a. Roads.

v. Site characterization surface storage.

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

vi. Site characterization support facilities.

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

1b. All auxiliary sites shall be protected against the flood caused by a 100-year storm except as otherwise specified below. [6.1CI]

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i. Batch plant site, 10-year storm;

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

iii. Compressor site, 50-year storm.

CONSTRAINTS

A. The auxiliary site(s) shall facilitate the safe and efficient flow of material and personnel within and around their respective areas. [6.1FR1]

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

C. The material-handling system(s) shall be capable of transporting and storing all excavated material in an environmentally acceptable manner (see ESFDR Appendix J). [6.1CK, CM, CO]

D. The storage area shall be capable of supporting the excavation allowance determined under 1.2.6.0 PC1d. [6.1CM]

E. The capacity of surface rock storage area(s) shall include allowance for overbreak and swell. [6.1CM]

F. The muck storage site must provide equipment or facilities for dust control when muck storage begins. [6.1CK]

ASSUMPTIONS

None.

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1.2.6.1.3 ACCESS ROADS

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

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

Boundaries and Interfaces

For repository/ESF interface constraints, see ESFDR Appendix A.1. For repository/ESF interface drawings, see ESFDR Appendix A.2.

FUNCTIONAL REQUIREMENTS

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

PERFORMANCE CRITERIA

1a. The access roads shall meet the requirements of all anticipated service during the site characterization phase. This includes site security, safety, and anticipated loads during construction and operation for site characterization. [6.1PC1f]

1b. The access roads shall include provisions for adequate drainage and flood control during inclement weather without sacrificing the structural integrity or safety of the road. [6.1PC1f,CI]

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

CONSTRAINTS

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

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

C. Muck haulage in the vicinity of the main site shall be separated from personnel access for safety considerations. [6.1PC1f]

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

E. Access to the USW G-4 borehole shall be preserved. [6.1PC1f]

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

G. Access roads on Bureau of Land Management and Air Force property shall comply with Bureau of Land Management requirements. [6.1PC1f]

ASSUMPTIONS

None.

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1.2.6.1.4 SITE DRAINAGE

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

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

Boundaries and Interfaces

For repository/ESF interface constraints, see ESFDR Appendix A.1. For repository/ESF interface drawings, see ESFDR Appendix A.2.

FUNCTIONAL REQUIREMENTS

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

PERFORMANCE CRITERIA

1. All storm-water runoff shall be controlled in an environmentally acceptable manner (see ESFDR Appendix J). [6.1PC1g]

CONSTRAINTS

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

ASSUMPTIONS

None

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1.2.6.2 SURFACE UTILITIES

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

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

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

Boundaries and Interfaces

For repository/ESF interface constraints, see ESFDR Appendix A.1. For repository/ESF interface drawings, see ESFDR Appendix A.2.

APPLICABLE REGULATIONS, CODES, STANDARDS, AND DOE ORDERS

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

Electrical Power

1. DOE 6430.1A, Division 16 Electrical
2. NFPA-70, National Electrical Code
3. ANSI C 2, National Electrical Safety Code

Lighting

1. DOE 6430.1A, General Design Criteria, Division 16 Electrical
2. NFPA-70, National Electrical Code

Stand-by Power

1. DOE 6430.1A, General Design Criteria, Division 16 Electrical
2. NAC Chapter 445, Water Controls, Air Pollution, paragraphs .430 through .732, Air Pollution

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Uninterruptible Power

1. DOE 6430.1A, General Design Criteria, Division 16 Electrical

2. IEEE-485, Recommended Practice for Sizing Large Lead Storage Batteries for Generating Stations and Substations

3. IEEE-650, Qualifications of Class 1E Battery Charged and Inverters for Nuclear Power Generating Stations

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

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

2. NAC Chapter 445, Water Controls, Air Pollution, paragraphs .244 through .420, Public Water Systems

3. NFPA 20, Centrifugal Fire Pumps

4. NFPA 22, Water Tanks for Private Fire Protection

5. NFPA 24, Installation of Private Fire Service Mains and their Appurtenances

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

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

2. NAC Chapter 445, Water Controls, Air Pollution, paragraphs .140 through .241, Water Pollution Control

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

1. DOE 6430.1A, Division 16 Electrical

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

1. NAC Chapter 445, Water Controls, Air Pollution, paragraphs .140 through .241, Water Pollution Control

2. DOE 5480.1, Chg. 1, 12-18-80, Chapter XII, Prevention, Control, and Abatement of Environmental Pollution

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

1. 30 CFR, Chapter I, Mine Safety and Health Administration

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

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FUNCTIONAL REQUIREMENTS

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

PERFORMANCE CRITERIA

1a. Necessary utility services shall meet the requirements of ESF construction and operations. [6.0PC1k]

1b. A suitable system for treating, pumping, and disposing of credible water inflows into the ESF shall be provided. [6.0PC1k,2e]

1c. Safety and security lighting shall be available. [6.0PC1k]

1d. When installed, surface utility systems shall not: unnecessarily restrict foot, vehicular, or ramp portal and/or shaft collar traffic; obstruct ventilation; or cause health and safety concerns. [6.0PC1k]

INTERFACE CONTROL REQUIREMENTS

1. The DO shall interface with the telephone system (NTS subcontractor) and the Nevada Test Site (NTS) utility supply.

2. The ESF designers shall interface with surface-based testing and repository designers on ESF site location and layout, and on permanent ESF structures, systems, and components.

See Section 1.2.6.0, Interface Control Requirements.

CONSTRAINTS

A. In accordance with 10 CFR 60.15(c)(1), the design, construction, and operation of the surface utilities, including the wastewater ponds and water handling system, shall incorporate aspects specifically directed at limiting the potential for adverse impacts on the long term performance of a repository, to the extent practical. Refer to ESFDR Appendix I, Analysis 3 for specific guidance. [6.0PC2d] [TBD] {DAA 1.1.2.1}

B. Water storage tanks shall be located, or protection provided, to preclude water inflow to ESF following a possible tank failure. [6.0 PC2d] {DAA 1.1.2.1, 1.12.2.1}

C. Piping shall limit possible water inflow to the ESF following a pipe rupture. [6.0PC2d, CO] {DAA 1.1.2.1, 1.12.2.2}

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D. In accordance with 10 CFR 60.133(d), fluids recovered from sanitary uses or construction operations shall be disposed of in such a way as to avoid potential performance impacts. Refer to ESFDR Appendix I, Analysis 3 for specific guidance. [6.0PC2d] {DAA 1.14.2.1}

E. The surface utilities shall be designed and constructed so that they do not affect the capability of the repository to meet the performance objective of 10 CFR 60.112. [6.0PC2d] {DAA 1.6.2.1}

ASSUMPTIONS

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

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

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1.2.6.2.1 POWER SYSTEM

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The power system is defined as those systems, subsystems, components, and structures that supply electrical power to the ESF site. These systems include, but are not limited to, the ESF site substation(s), distribution systems, extension and upgrading of the existing 69-kV overhead power line to 138-kV, secondary power lines to the muck conveying system and booster pump station, surface lighting, a stand-by power generation system, and an uninterruptible power supply (UPS) system(s).

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

Boundaries and Interfaces

For repository/ESF interface constraints, see ESFDR Appendix A.1. For repository/ESF interface drawings, see ESFDR Appendix A.2.

FUNCTIONAL REQUIREMENTS

1. Provide an electrical system consisting of a standard electrical power distribution system, a standby electrical power system, and an uninterruptible power supply (UPS) system(s) for the ESF. [6.2FR1]

PERFORMANCE CRITERIA

1a. Power distribution for the ESF, including the primary substation and secondary distribution systems, transmission lines, and feeder cables, shall have 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. Metering shall be provided to establish the demand and consumption of power. Surge protection and a grounding system shall be provided in order to maximize personnel and equipment safety. [6.2PC1a]

1b. Electrical power systems shall provide the necessary power, during both normal and peak demands, for the construction and operation of the ESF. [6.2PC1a]

1c. An overhead power line shall be routed from the nearest suitable power supply to the main substation(s) at the ESF site. [6.2PC1a]

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1d. The electrical system shall include the modifications that are required to accommodate the tie-in of the proposed transmission line between the connection to the nearest suitable existing power supply and the main substation to be located at the ESF site. [6.2PC1a]

1e. The power distribution system shall provide services from the main ESF substation(s) to the surface and subsurface facilities. [6.2PC1a]

1f. 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: [6.2PC1a]

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. Lights

ix. Muck discharge transport conveyers

x. Ventilation air heaters (if required)

1g. The electrical system shall withstand windblown dust and other natural phenomena. [6.2PC1a]

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

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

ii. The standby power generators shall have sufficient output to provide power for: the hoist to evacuate underground personnel within the one-hour time allowed, ventilation, area lighting, and to back up the UPS. The allowable delay time

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between the loss of primary power and the availability of standby power will be dictated by safety considerations of the underground operation.

iii. The minimum critical standby power requirements shall be determined by analysis.

1i. An uninterruptible power supply (UPS) system(s) shall provide necessary power to systems and subsystems that cannot tolerate a loss of power incident. [6.2PC1a]

i. A UPS system 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.

CONSTRAINTS

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

B. The normal supply of electrical power shall be provided by the main substation(s) to be constructed at the ESF site. Power for the main substation(s) shall be supplied from a connection to the nearest suitable existing power supply. [6.2PC1a]

C. Existing YMP transformers and switchgear shall be incorporated as much as practicable. [6.2PC1a]

D. A UPS system shall consist of standby batteries and inverters. [6.2PC1a]

E. The interconnection buss between the standby power and the main power distribution system shall allow the generating capacity of the standby system to be increased without modification to the interconnection buss. [6.2PC1a]

ASSUMPTIONS

None.

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1.2.6.2.2 WATER SYSTEM

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

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

Boundaries and Interfaces

For repository/ESF interface constraints, see ESFDR Appendix A.1. For repository/ESF interface drawings, see ESFDR Appendix A.2.

FUNCTIONAL REQUIREMENTS

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

PERFORMANCE CRITERIA

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

1b. The water system shall supply water to the storage tank(s) in addition to any services (tie-ins) to any suitable existing water main. [6.2PC1a]

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

1d. A water tank(s) shall have adequate volume for simultaneous normal peak usage and fire protection demands. [6.2PC1a]

1e. The pumping systems shall include the provisions for both manual and automatic operations. [6.2PC1a]

1f. The water system shall provide adequate resistance to water hammer and other destructive events as well as protective devices to prevent loss of water into the site. [6.2CA,CC,CE]

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

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1h. The non-potable water system shall provide water to the underground for construction, operation, and testing. [6.2PC1a]

1i. Protection shall be provided to ensure separation of potable and non-potable water systems. [6.2PC1a]

CONSTRAINTS

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

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

C. Non-potable water lines shall be clearly marked to prevent consumption of non-potable water by personnel. [6.2PC1a]

D. Except for potable drinking water, 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 Coordinator to ensure that they will not significantly compromise site characterization testing, repository testing, or waste isolation. [6.2PC1a]

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

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

   i. Tracers added to the water system shall be of a composition and concentration compatible with the sanitary waste disposal system.

G. The water supply shall not detract from the performance of the site as described in 10 CFR 60.112. [6.2CA, CE] {DAA 1.6.2.1}

ASSUMPTIONS

None.

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1.2.6.2.3 SANITARY SYSTEM

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

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

Boundaries and Interfaces

For repository/ESF interface constraints, see ESFDR Appendix A.1. For repository/ESF interface drawings, see ESFDR Appendix A.2.

FUNCTIONAL REQUIREMENTS

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

PERFORMANCE CRITERIA

1a. Sewage effluent discharges shall not adversely affect site characterization activities. [6.2PC1a]

1b. The sanitary waste disposal system shall accommodate the sewage for construction, operations and testing personnel at the ESF. [6.2PC1a]

CONSTRAINTS

A. Sanitary systems shall utilize an acceptable method of disposal, consistent with State or local codes, such as septic tanks or offsite disposal. [6.2PC1a,CA,CE]

B. Sanitary wastes shall be disposed of by means of collection piping from all buildings and trailers to a sanitary waste disposal system located beyond the perimeter of the potential repository subsurface facility Refer to ESFDR Appendix I, Analysis 3 for specific guidance. The sanitary system shall not interfere with site characterization activities. [6.2CA] {DAA 1.1.2.1}

C. The sanitary system shall not detract from the ability of the site to meet the performance objectives as stated in 10 CFR 60.112. [6.2CA, CE] {DAA 1.6.2.1}

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ASSUMPTIONS

None.

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1.2.6.2.4 COMMUNICATIONS SYSTEM

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

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

Boundaries and Interfaces

For repository/ESF interface constraints, see ESFDR Appendix A.1. For repository/ESF interface drawings, see ESFDR Appendix A.2.

FUNCTIONAL REQUIREMENTS

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

PERFORMANCE CRITERIA

1a. A hoist call-response signaling system and a battery powered telephone system shall be provided in each shaft station, shaft collar, bottom of shaft, and hoist operator's station. [6.2PC1a]

1b. A communications system shall be provided between the shaft cage and the hoist operator's station. [6.2PC1a]

1c. Communications capability in and between the surface and the underground facilities (ramps, shafts, and underground openings) shall be established and suitable safety alarm systems shall be provided where required. Closed-circuit television monitoring shall be provided at critical locations. [6.2PC1a]

1d. The system shall provide communications to NTS law enforcement, medical, fire-fighting, or emergency agencies in the local Nye County area. [6.2PC1a]

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

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

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

CONSTRAINTS

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

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

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

D. The communications system for the underground areas shall be tied into the hoisting system control room and ramp control buildings. [6.2PC1a]

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

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

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

H. The underground test areas shall have limited-access commercial service. [6.2PC1a]

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

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

ASSUMPTIONS

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

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1.2.6.2.5 SURFACE WASTEWATER SYSTEM

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

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

Boundaries and Interfaces

For repository/ESF interface constraints, see ESFDR Appendix A.1. For repository/ESF interface drawings, see ESFDR Appendix A.2.

FUNCTIONAL REQUIREMENTS

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

PERFORMANCE CRITERIA

1. A suitable surface wastewater system shall be provided for collection, transfer, pumping, treatment, and disposing of expected water and credible water inflows. The Underground Wastewater Collection System, 1.2.6.7.6, shall collect and pump all wastewater to the Surface Wastewater System, 1.2.6.2.5. The Surface Wastewater System, 1.2.6.2.5, shall receive underground wastewater and pump it off the repository block. [6.2PC1a,1b, CA, CE]

CONSTRAINTS

A. Liquid wastes that cannot be disposed on the ESF site in an environmentally acceptable manner shall be removed from the site for disposal in an appropriate facility or location. [6.2PC1a,1b] [TBD]

B. The surface wastewater collection system shall discharge to a wastewater pond consistent with location constraints. See ESFDR Appendix I, Analysis 3 for specific guidance. The surface wastewater system shall be designed, operated, and maintained in such a way as to prevent interference with the site characterization activities. [6.2CA, CE] (DAA 1.1.2.1)

C. The surface wastewater system shall not detract from the ability of the site to meet the performance objectives as stated in 10 CFR 60.112. [6.2CA, CE] (DAA 1.6.2.1)

ASSUMPTIONS

None.

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1.2.6.2.6 COMPRESSED AIR SYSTEM

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

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

Boundaries and Interfaces

For repository/ESF interface constraints, see ESFDR Appendix A.1. For repository/ESF interface drawings, see ESFDR Appendix A.2.

FUNCTIONAL REQUIREMENTS

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

PERFORMANCE CRITERIA

1a. The compressed air system shall provide compressed air throughout the designated areas of the ESF with the flow rates and pressures to support construction and operations of the facilities, site characterization testing requirements, and drilling requirements including additional drift excavation. [6.2PC1a]

1b. Compressed air shall be conditioned as required and maintained at a quantity to meet drilling and test apparatus requirements (see ESFDR Appendix B). Suitable filtering shall be provided where oil-free air is required. [6.2PC1d]

1c. The air compressor(s) shall be sized to meet the requirements of the ESF construction, testing, and operations. Modularity of the system to accommodate variable loads and system maintenance shall be considered. [6.2PC1a]

1d. All compressed air used during operation and construction of the ESF shall be provided with chemical tracers unless exempted by the ESF Test Coordinator. All tracers and substances added shall be approved per 1.2.6.0, Constraint C.iii. [6.2PC1a] [TBD]

CONSTRAINTS

A. As an energy conservation measure, designers will examine the use of electrical and/or electrohydraulic drives for underground construction equipment as an alternative to compressed air wherever possible and feasible. [6.2PC1a]

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ASSUMPTIONS

None.

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1.2.6.2.7 SOLID WASTE DISPOSAL SYSTEM

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The Solid Waste Disposal System is defined as those systems and subsystems required for collection, transport and disposal of solid waste during the ESF construction, operation, testing and closure activities. The system will handle only non-hazardous solid waste.

Boundaries and Interfaces

For repository/ESF interface constraints, see ESFDR Appendix A.1. For repository/ESF interface drawings, see ESFDR Appendix A.2.

FUNCTIONAL REQUIREMENTS

1. Provide for disposal of solid waste. [6.2FR1]

PERFORMANCE CRITERIA

1. Provide for collection, transport, and disposal of non-hazardous solid waste in accordance with the requirements of ESFDR Appendix J. [6.2PC1a]

CONSTRAINTS

None.

ASSUMPTIONS

None.

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1.2.6.3 SURFACE FACILITIES

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

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

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

Boundaries and Interfaces

For repository/ESF interface constraints, see ESFDR Appendix A.1. For repository/ESF interface drawings, see ESFDR Appendix A.2.

APPLICABLE REGULATIONS, CODES, STANDARDS, AND DOE ORDERS

The designs shall be in accordance with:

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

2. DOE 5480.4, Environmental Protection, Safety, and Health Protection Standards

3. DOE 5480.7, Fire Protection

4. 30 CFR 57, Safety and Health Standards - Underground Metal and Nonmetal Mines, Subparts E and G

5. 49 USC 1501, Federal Aviation Act

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

FUNCTIONAL REQUIREMENTS

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

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

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

PERFORMANCE CRITERIA

1a. Surface facilities shall support the following: [6.0PC1k]

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

1b. Surface facilities shall support the administration of records, including those of construction, operations, site characterization, security, permitting, personnel, personnel training and certification, visitors, compliance with regulations, safety, and other necessary records. [6.0PC1k]

1c. Security facilities shall be provided to protect the ESF in accordance with applicable DOE Orders. [6.0CO]

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

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

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

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

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

1i. The surface facilities shall be located away from potential dust generating areas to the extent practicable. [6.0PC1k,CO]

1j. The surface buildings shall have a unified architectural theme that presents an aesthetic appearance. [6.0PC1k]

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

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

3. Transportation facilities shall be of sufficient size to sustain ESF construction, operations, and testing. [6.0PC1k]

INTERFACE CONTROL REQUIREMENTS

1. The ESF designers shall interface with surface-based testing and repository designers on ESF site location and layout, and on permanent ESF structures, systems, and components.

   See Section 1.2.6.0, Interface Control Requirements.

CONSTRAINTS

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

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

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

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

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

ASSUMPTIONS

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

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

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1.2.6.3.1 VENTILATION SYSTEM

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

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

Boundaries and Interfaces

For repository/ESF interface constraints, see ESFDR Appendix A.1. For repository/ESF interface drawings, see ESFDR Appendix A.2.

FUNCTIONAL REQUIREMENTS

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

PERFORMANCE CRITERIA

1a. The ventilation system shall supply and exhaust adequate quantities of air to and from underground working areas such that operator safety, health and productivity requirements are maintained. [6.3PC1a]

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

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

1d. The ventilation fan system shall have electrical standby 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. [6.3PC1a]

1e. The ventilation system shall minimize leakage to the extent practicable. [6.3PC1a]

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CONSTRAINTS

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

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

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

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

ASSUMPTIONS

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

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1.2.6.3.2 TEST SUPPORT FACILITIES

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

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

Boundaries and Interfaces

For repository/ESF interface constraints, see ESFDR Appendix A.1. For repository/ESF interface drawings, see ESFDR Appendix A.2.

FUNCTIONAL REQUIREMENTS

1. Provide test support facilities to meet the operational requirements of the PIs. [6.3FR1]

PERFORMANCE CRITERIA

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

CONSTRAINTS

None.

ASSUMPTIONS

None.

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1.2.6.3.3 SITE PREPARATION FOR SURFACE STRUCTURES

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

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

Boundaries and Interfaces

For repository/ESF interface constraints, see ESFDR Appendix A.1. For repository/ESF interface drawings, see ESFDR Appendix A.2.

FUNCTIONAL REQUIREMENTS

1. Prepare sites with required services for surface structures. [6.3FR1]

PERFORMANCE CRITERIA

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

1b. Provide water drainage at each site. [6.3PC1a]

CONSTRAINTS

None.

ASSUMPTIONS

None.

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1.2.6.3.4 PARKING AREAS

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

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

Boundaries and Interfaces

For repository/ESF interface constraints, see ESFDR Appendix A.1. For repository/ESF interface drawings, see ESFDR Appendix A.2.

FUNCTIONAL REQUIREMENTS

1. Provide parking areas to support ESF construction, operation, and underground site characterization activities. [6.3FR3]

PERFORMANCE CRITERIA

1a. As a minimum, the parking areas shall accommodate the following types of vehicles: [6.3PC1a]

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

1b. Parking areas shall be sloped to allow water runoff control. [6.3PC1a]

1c. The parking areas shall ensure ease of access while limiting the amount of surface area required. [6.0CI], [6.3PC1a]

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

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

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CONSTRAINTS

A. As a minimum, all parking areas shall utilize a compacted gravel base and surface. [6.3PC1a]

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

ASSUMPTIONS

None.

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1.2.6.3.5 STORAGE FACILITIES

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

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

Boundaries and Interfaces

For repository/ESF interface constraints, see ESFDR Appendix A.1. For repository/ESF interface drawings, see ESFDR Appendix A.2.

FUNCTIONAL REQUIREMENTS

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

PERFORMANCE CRITERIA

1a. Space and facilities shall support the functions of purchasing, storing, and dispensing equipment and materials, and shall be sized to accommodate the inventory needed for ESF operations and in-situ site characterization. Storage facilities shall, as a minimum, accommodate the following: [6.3PC1a]

i. General equipment.
ii. Pipe and pipe racks.
iii. Sheet steel and steel shapes.
iv. Lumber.
v. Cement and admixtures.
vi. Coarse and fine aggregate.
vii. Reinforcing steel.
viii. Wire and cable reels.
ix. Compressed gas bottles.
x. Drilling rigs/construction equipment.
xi. Heavy Construction Equipment.

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

1c. The storage facilities shall have provisions for adequate protection from the environment for designated stored equipment and supplies. [6.3PC1a,1g]

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CONSTRAINTS

A. Provisions shall be made for the separate storage of private and DOE equipment. [6.3PC1a,1g]

B. Provisions shall be made for the separate storage of test equipment and construction/drilling equipment. [6.3PC1a,1g]

ASSUMPTIONS

None.

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1.2.6.3.6 SHOP

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

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

Boundaries and Interfaces

For repository/ESF interface constraints, see ESFDR Appendix A.1. For repository/ESF interface drawings, see ESFDR Appendix A.2.

FUNCTIONAL REQUIREMENTS

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

PERFORMANCE CRITERIA

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

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

1c. Shop facilities shall meet the operational requirements as defined by the users. [6.3PC1a]

1d. The shop shall include cranes and shop machinery which are consistent with maintenance needs. [6.3PC1a]

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

CONSTRAINTS

A. The shop shall be a prefabricated metal building. [6.3CA]

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

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

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

E. The shop shall provide for separate storage of chemicals and flammable materials in accordance with applicable Federal, State of Nevada, and local requirements. [6.3PC1a]

ASSUMPTIONS

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

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1.2.6.3.7 WAREHOUSE

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

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

Boundaries and Interfaces

For repository/ESF interface constraints, see ESFDR Appendix A.1. For repository/ESF interface drawings, see ESFDR Appendix A.2.

FUNCTIONAL REQUIREMENTS

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

PERFORMANCE CRITERIA

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

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

CONSTRAINTS

A. The warehouse shall be a prefabricated metal building. [6.3CA]

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

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

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

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

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ASSUMPTIONS

None.

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1.2.6.3.8 OTHER TEMPORARY STRUCTURES

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

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

Boundaries and Interfaces

For repository/ESF interface constraints, see ESFDR Appendix A.1. For repository/ESF interface drawings, see ESFDR Appendix A.2.

FUNCTIONAL REQUIREMENTS

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

PERFORMANCE CRITERIA

1a. Temporary structures and their supporting equipment provided under this section shall accommodate the following: [6.3PC1d]

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

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

1c. Sufficient personnel office space, as defined by the users, shall be provided for test support functions, and for scientific, maintenance, and construction personnel. [6.3PC1a]

1d. Overhead baskets and locker facilities in the change room facility shall be sized to accommodate the ESF personnel for operations, maintenance, and underground testing. [6.3PC1a, 1d, CE]

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

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CONSTRAINTS

A. The size of office spaces shall be based on a minimum of 100 square feet per office and an average per DOE Order 6430.1A. [6.3PC1a,1b]

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

ASSUMPTIONS

1. Trailers may be provided for office spaces.

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

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1.2.6.3.9 COMMUNICATIONS/DATA BUILDING(S)

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

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

Boundaries and Interfaces

For repository/ESF interface constraints, see ESFDR Appendix A.1. For repository/ESF interface drawings, see ESFDR Appendix A.2.

FUNCTIONAL REQUIREMENTS

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

PERFORMANCE CRITERIA

1a. The building(s) shall meet the operational requirements as defined by users. [6.3PC1a]

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

1c. The areas for housing IDS systems, as a minimum, shall be equipped as follows: [6.3PC1a]

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 System, 120/208 VAC, 3-phase capacity as required.

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

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CONSTRAINTS

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

ASSUMPTIONS

None.

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1.2.6.4 SHAFT ACCESS

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

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

A shaft access is defined as those systems, subsystems, and components which are comprised of: a) the vertical engineered opening within a circular zone whose radius is defined as the sum of the radius of the finished shaft, the lining thickness, and a nominal 5 [TBV] feet beyond the lining, that connects the surface with the targeted horizons; b) shaft stations, including a zone extending a nominal 5 [TBV] feet beyond the excavated station surfaces [TBV]. The system provides safe and controlled access to the targeted horizons for personnel, equipment, underground service systems, as well as underground in-shaft testing operations.

Boundaries and Interfaces

For repository/ESF interface constraints, see ESFDR Appendix A.1. For repository/ESF interface drawings, see ESFDR Appendix A.2.

APPLICABLE REGULATIONS, CODES, STANDARDS, AND DOE ORDERS

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

FUNCTIONAL REQUIREMENTS

1. Provide an underground opening for in situ site characterization at and above the repository horizon. [6.0FR1]

2. Provide for the incorporation of the shaft into a potential repository. [6.0FR2]

PERFORMANCE CRITERIA

1a. The number of exploratory boreholes and shafts shall be limited to the extent practical consistent with obtaining the information needed for site characterization. [10 CFR 60.15(c)(2)] [6.0PC2d] {DAA 3.2.4.1}

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1b. A shaft shall meet testing requirements. [6.0PC1d]

i. A shaft 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 criteria for each test in a shaft, in response to actual site conditions encountered during construction. {DAA 3.5.4.1}

ii. The configuration of a shaft shall be adequate to support site characterization testing and future testing that may be reasonably expected for site characterization. This shall include an allowance to accommodate site specific conditions encountered in the shaft without adversely affecting testing that is planned or ongoing. {DAA 2.4.4.2}

iii. The upper demonstration breakout room shall be at an elevation TBD. [TBD]

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

1c. Shaft construction and operations shall not adversely affect site characterization. [6.0PC1d]

i. Instrument and IDS cables shall be separated from power cables to minimize electrical interference. Instrument and IDS trunk cables shall be protected from damage.

ii. Water intrusion, if any, into the shaft shall be monitored and controlled by suitable measures such that the effects of expected water inflows (i.e., water, heat, gases) will not endanger worker safety and in situ site characterization. [TBD]

iii. 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. {DAA 1.14.4.5, 1.14.4.8, 2.5.4.2}

iv. The amount of water used in the construction and operation of the shaft shall be limited to preclude interference with tests. Refer to ESFDR Appendix B and to Appendix I, Analysis 2 for specific guidance. {DAA 2.5.4.1}

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v. 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.

vi. Construction methods shall be planned 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.

vii. Fluids and materials planned for use in a shaft shall be evaluated with respect to intended use and possible effects on site characterization or other testing, and appropriate controls shall be implemented. [TBD] {DAA 2.2.4.1}

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

ix. The presence of combustible materials in the shaft shall be controlled and limited such that testing in the ESF is not adversely affected. {DAA 2.3.6.3}

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

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. [TBD]

xii. The location of openings for rock handling shall be selected to minimize effects on testing.

xiii. Shaft instrumentation shall be protected from physical damage.

xiv. Location of a shaft relative to any other access shall be such that testing in either access will not be adversely affected by activities in the other. Refer to ESFDR Appendix I, Analysis 2 for specific guidance.

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

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

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

ii. Necessary shaft facilities and equipment required for handling excavated rock, materials, equipment, and supplies shall support construction, operations, and in situ site characterization testing.

1f. Shafts shall meet utility requirements. [6.0PC1d,1k,CP]

1g. Shafts shall meet ventilation requirements. [6.0PC1d,1k,CO]

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

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

iii. The ESF shall be designed so as not to preclude separate ventilation of repository excavation and waste emplacement in accordance with 10 CFR 60.133(g)(3).

1h. Shafts shall meet safety requirements. [6.0 CO]

i. A shaft shall provide safe access between the ground surface and the underground portion of the ESF.

ii. A shaft shall be excavated and supported using methods and materials based upon currently available shaft construction technology for the shaft diameter and depth under consideration. The need for a shaft lining shall be determined by a combination of analysis and observation during construction.

1i. Shafts shall meet access requirements. [6.0PC1d]

i. Subsurface openings shall remain stable during operating periods and retrieval periods to meet personnel, equipment, and ventilation access requirements.

ii. Support facilities, utilities, and equipment shall accommodate the selected shaft excavation method.

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

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i. The design, construction, and operation of a shaft shall incorporate aspects specifically directed at limiting the potential for adverse impacts on the long term performance of the repository. {DAA 1.1.4.1, 1.16.4.1}

ii. All construction materials or substances to be used underground shall first be reviewed for potential effects on engineered barriers and waste isolation. They may be used only following review and approval and only in those areas where use has been approved, and subject to whatever controls are established. Such materials or substances include, but are not limited to, the following [TBD]: {DAA 1.10.4.1, 1.10.4.2, 1.10.4.3, 1.10.4.4, 1.10.4.8}

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

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

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

   d. Hydrocarbons and solvents.

   e. Organic materials.

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

iii. To the extent feasible or practical, lining and grouting material selection shall consider material chemistry and take into account potential chemical interactions with groundwater that could affect waste package corrosion and radionuclide solubility. [TBD]
{DAA 1.10.4.1}

iv. A materials control program shall be implemented to enable establishment of limits on the inventory of materials left after decommissioning. [TBD] {DAA 1.10.4.5}

v. A shaft shall allow for flexibility in closure, such as the location of seals, so that a seismic event is unlikely to compromise the ability of the facility to isolate wastes. [TBD] {1.10.4.7}

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

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i. An ESF shaft shall be located, to the extent practicable, where a shaft is planned for the repository facility. {DAA 1.2.4.2}

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

iii. The centerline coordinate location of the shaft shall be as listed in the RIB. [TBD]

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

2c. 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)] [6.0PC2d]

i. The 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. [TBD] {DAA 1.3.4.2}

ii. The 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. [TBD] {DAA 1.3.4.3}

iii. The 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. [TBD] {DAA 1.3.4.4}

iv. The 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] {DAA 1.3.4.5}

2d. Sections [10 CFR] 60.131 through [10 CFR] 60.134 specify minimum criteria for the design of the geologic repository operations area. These design criteria are not intended to be exhaustive, however. Omissions in § § [10 CFR] 60.131 through 60.134 do not relieve DOE

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from any obligation to provide such safety features in a specific facility needed to achieve the performance objectives. All design bases must be consistent with the results of site characterization activities. [10 CFR 60.130] [6.0PC2d,CE]

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

i. Rock support and other structural anchoring materials shall be compatible with waste isolation. [TBD]

ii. Rock support and other structural anchoring materials shall neither interfere with radionuclide containment nor enhance radionuclide migration. [TBD]

iii. Shaft configuration (shaft location, shaft diameter, shaft separation, and shaft depth) shall contribute to or not detract from, the isolation capability of the site. [TBD] {DAA 1.11.4.1}

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

i. A shaft shall be designed so that the effects of credible disruptive events (e.g., flooding, fires, and explosions) shall not spread through the facility. {DAA 1.12.4.1}

ii. Materials shall be selected such that effects of fire do not produce geochemical effects that impact waste isolation capabilities of the site. [TBD] {DAA 1.12.6.3}

iii. A shaft collar shall prevent significant water inflow from a flooding event during site characterization and the planned period of repository operation, such that testing in the underground portion of the ESF and waste emplacement are not adversely affected. Refer to ESFDR Appendix I, Analysis 4 for specific guidance. {DAA 2.3.4.1}

2g. The underground facility shall be designed with sufficient flexibility to allow adjustments where necessary to accommodate specific site conditions identified through in situ monitoring, testing, or excavation. [10 CFR 60.133(b)] [6.0PC2d]

2h. The design of the underground facility shall provide for control of water or gas intrusion. [10 CFR 60.133(d)] [6.0PC2d, PC2e]

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i. The amount of water used in construction and operations shall be limited to that required for dust control and proper equipment operation so as to limit the effects on the containment and isolation capability of the site. Refer to ESFDR Appendix I, Analysis 2 for specific guidance. {DAA 1.14.4.1, 1.14.4.7}

ii. Water use in shaft construction shall be consistent with repository design goals to limit the increase in average percent saturation of the repository horizon to less than [TBD] percent and to limit the increase in local percent saturation to less than [TBD] percent in waste emplacement areas. [TBD] {DAA 1.14.4.2}

iii. Management of water entering the ESF shall include quantity, location, and water balance. {DAA 1.14.4.6}

iv. Operational seals shall be provided where necessary to control the intrusion of water into the facility. See ESFDR Appendix A.3 for additional information. {DAA 1.14.4.9}

v. Methods to control sudden inflows of water shall be provided.

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

/ i. Shaft structures shall withstand the effects of seismic events. Seismic criteria to be used to design the shaft are in the RIB. Refer also to ESFDR Appendix A.5 for additional information.

ii. An adequate distance between openings and accesses shall be provided to limit potential mechanical and hydrological interference between the accesses and to reduce the potential for deleterious rock movement so they do not impact the capability to reliably and adequately characterize the site. Refer to ESFDR Appendix I, Analysis 2 for specific guidance. {DAA 1.15.4.2, 2.6.4.2}

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

i. Techniques used for shaft excavation shall control overbreak of rock and minimize disturbance to the integrity of the adjoining rock mass to limit blast-induced changes to permeability. {DAA 1.16.4.2}

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

a. Blast-induced changes to the average in situ permeability of the rock beyond one half of the maximum opening dimension shall be less than one order of magnitude. Refer to ESFDR Appendix I, Analysis 5 for specific guidance {DAA 1.16.4.4}

b. Excavation overbreak is to average less than 12 inches. This overbreak limit is additive to the dimensional tolerances applied to the location and runout of the drill holes used for excavation explosives. This limit may be exceeded for short intervals where blast designs are being adjusted. [TBV]

ii. A shaft shall be stable and shall minimize the potential for deleterious rock movement or fracturing that may create a pathway for radionuclide migration or impact the capability to characterize the site. {DAA 1.15.4.1, 2.6.4.1}

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

a. Limit the disturbance of the surrounding rock mass.

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

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

iv. If drill-and-blast construction techniques are used, then controlled blasting shall be utilized to limit overbreak and damage to the surrounding rock mass which could affect the adequacy or reliability of information from site characterization. The methods shall be designed to provide for the requirements of specific site characterization tests, such as limitations on the extent of excavation-induced damage, or the type of ground support that may be installed. The methods shall be designed to facilitate investigation and monitoring of excavation effects during and after construction. Refer to ESFDR Appendix I, Analysis 5 for specific guidance. {DAA 1.16.4.3, 2.7.4.1}

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

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

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

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

d. Access shall be maintainable. [TBD]

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

i. A shaft 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. Refer to ESFDR Appendix I, Analysis 6 for specific guidance. [TBD]

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

iii. The shaft lining shall withstand pressures exerted along its length and around the entire perimeter under anticipated conditions, including reaction to thermally-induced stresses resulting from thermal loads. Refer to ESFDR Appendix I, Analysis 7 for specific guidance. The provisions for thermally induced stresses can be installed at a later date. [TBD] {DAA 1.18.4.1}

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

Materials and placement methods for seals shall be selected to reduce, to the extent practicable: (1) The potential for creating a preferential pathway for groundwater to contact the waste packages or (2) for radionuclide migration through existing pathways. [10 CFR 60.134(b)] [6.0PC2d, CK]

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i. Shaft design and construction shall allow for future sealing in order to ensure that a shaft does not become a preferential pathway for groundwater or radioactive waste migration and will meet the performance objectives as stated in 10 CFR 60.112. In addition, techniques used to seal aquifers during construction should not preclude use, or reduce the effectiveness, of future access seals. [TBD] {DAA 1.1.9.1, 1.4.9.1, 1.6.4.1, 1.6.9.1, 1.17.9.1}

ii. To prevent complications of seal evaluations and emplacement and limit chemical alteration in future seal environments, no pressure grouting shall take place during the construction period of the shaft at locations of potential seal testing or emplacement. Specifically, no pressure grouting shall be performed within 50 feet of the original ground surface and within 50 feet above and below the contact of the Pah Canyon and Topopah Spring tuffs or below the main test level. [TBV] {DAA 1.4.4.2}

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

   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. [TBD]

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

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

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

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

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

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INTERFACE CONTROL REQUIREMENTS

1. The ESF designers shall interface with surface-based testing and repository designers on ESF site location and layout, and on permanent ESF structures, systems, and components, and shall make available all design information pertaining to the permanent ESF components.

   See Section 1.2.6.0, Interface Control Requirements.

CONSTRAINTS

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

   The tests required under this section shall include a performance confirmation program carried out in accordance with Subpart F of this part [Part 60]. [10 CFR 60.74(b)] [6.0CD] {DAA 1.5.8.2}

   i. The structures, systems, components and operation of the shaft shall be designed to accommodate additional testing as may be required by the NRC for site characterization and performance confirmation. [TBD] {DAA 1.5.8.1, 2.1.4.1}

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

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

   ii. The configuration of a shaft shall be adequate to support performance confirmation testing, and future testing that may be reasonably expected for performance confirmation. This shall include an allowance to accommodate site specific conditions encountered in the shaft without adversely affecting testing that is planned or ongoing. [TBD] {DAA 2.8.4.1}

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iii. The accesses to the ESF underground facility shall be designed to facilitate performance confirmation testing to obtain adequate and reliable information about the site, during and after construction, as required for the geologic repository by 10 CFR 60, Subpart F. (DAA 2.8.4.2)

C. The optional shaft, if constructed, shall connect to the MTL. [6.0PC1k,CK]

ASSUMPTIONS

None

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1.2.6.4.1 COLLAR

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

For repository/ESF interface constraints, see ESFDR Appendix A.1. For repository/ESF interface drawings, see ESFDR Appendix A.2.

FUNCTIONAL REQUIREMENTS

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

PERFORMANCE CRITERIA

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

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

CONSTRAINTS

A. The surface elevation at the shaft collar shall be above the high water mark of the probable maximum flood (PMF), as contained in the RIB. [6.4PC2e] [TBD]

B. The shaft collar shall be founded in rock. [6.4PC1h,1i]

ASSUMPTIONS

None.

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1.2.6.4.2 LINING

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

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

Boundaries and Interfaces

For repository/ESF interface constraints, see ESFDR Appendix A.1. For repository/ESF interface drawings, see ESFDR Appendix A.2.

FUNCTIONAL REQUIREMENTS

1. Provide structural and mechanical integrity for the shaft if required (see 1.2.6.4 PC1h.ii), and mounting for conveyance guide supports, utilities, and shaft instrumentation during construction and operations. [6.4FR1]

PERFORMANCE CRITERIA

1a. The shaft lining shall provide adequate bearing support for the structural mounting of the conveyance system guide supports under both static and dynamic operational loading conditions. [6.4PC1e]

1b. The lining shall include provisions for shaft instrumentation penetrations and data collection units. [6.4PC1b,1c]

1c. All concrete activities shall conform to the applicable American Concrete institute (ACI) standards for furnishing, delivery, and placement of structural concrete. [6.4PC1h]

1d. All forming and reinforcements utilized shall conform to applicable ACI and ASTM standards. Refer to ESFDR Appendix E for additional information. [6.4PC1h]

CONSTRAINTS

A. The shaft lining shall be protected from damage due to blasting and other activities. To protect the lining from blasting damage, the minimum distance between the shaft bottom and the lining shall be determined by the contractor with concurrence from the design organization and the YMPO. [6.4PC1h]

B. The shaft lining placement shall be coordinated with science needs such as testing and mapping. [6.4PC1b]

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C. The capability to enhance postclosure performance by removing shaft linings shall be retained. [6.4PC21] {DAA 1.4.4.1, 1.10.4.6}

ASSUMPTIONS

None

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1.2.6.4.3 STATIONS

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

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

Boundaries and Interfaces

For repository/ESF interface constraints, see ESFDR Appendix A.1. For repository/ESF interface drawings, see ESFDR Appendix A.2.

FUNCTIONAL REQUIREMENTS

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

PERFORMANCE CRITERIA

1a. The shaft stations shall allow sufficient room for unloading of personnel and materials. [6.4PC1d,1e]

1b. The shaft stations shall accommodate devices (e.g., forklift) for handling heavy and large materials. [6.4PC1e]

1c. The design of the stations shall ensure unobstructed access to both sides of the shaft conveyance, complete with a protected walkway. [6.4PC1d,1h]

1d. The stations shall be provided with landings complete with safety devices that shall include as a minimum: signals, clear areas, barriers, gates. [6.4PC1d,1h]

1e. The stations shall ensure appropriate transitions of utilities through the shaft stations to the continuation of the shaft below as required. [6.4PC1f]

1f. Stations shall ensure, if applicable, an adequate means of handling excavated rock. [6.4PC1e]

1g. Stations shall ensure adequate unobstructed room for ventilation air flow. [6.4PC1g]

1h. The design of the shaft stations shall consider the physical characteristics of the material and equipment. [6.4PC1e]

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CONSTRAINTS

A. If an optional shaft is constructed, a shaft station shall be developed at the MTL. [6.4PC1h]

ASSUMPTIONS

None.

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1.2.6.4.4 FURNISHINGS

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

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

Boundaries and Interfaces

For repository/ESF interface constraints, see ESFDR Appendix A.1. For repository/ESF interface drawings, see ESFDR Appendix A.2.

FUNCTIONAL REQUIREMENTS

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

PERFORMANCE CRITERIA

1a. The in-shaft structural steel supports shall carry the conveyance guides and absorb the maximum forces imposed on the conveyance when at rest and in motion. [6.4PC1e,1h]

1b. The brackets, buntons, and attachments shall allow for final alignment of the sets and guides for the hoist conveyance to be used during ESF operation. [6.4PC1e,1h]

1c. All furnishings shall allow readily performed inspection and maintenance. [6.4PC1b,1f,1h]

1d. Operational shaft guides shall be fixed and positioned to extend up to the underside of the crash beams. [6.4PC1e,1h]

1e. Shaft furnishings shall facilitate shaft sinking equipment and operations, in-shaft site characterization testing, and personnel activities. [6.4PC1b,1d,1e,1h]

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1f. Furnishings shall provide for mounting the following utilities and cables in the shaft: [6.4PC1f]

i. Electrical power.
ii. Compressed air.
iii. Water.
iv. Communications.
v. Underground instrumentation.
vi. Instrumentation and IDS cabling.
vii. Underground wastewater handling system.
viii. Provision for ventilation.

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 and on site characterization testing. [6.4PC2d]

B. Brackets shall provide adequate support and isolation for all cables and other devices. [6.4PC1f]

C. Shaft furnishings shall be capable of being removed prior to permanent closure. [6.4PC21] {DAA 1.4.4.3}

D. Shaft furnishings shall be removable in a manner that would not restrict potential repository ventilation flow. [6.4PC1g]

ASSUMPTIONS

None.

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1.2.6.4.5 HOIST SYSTEM

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The hoist system is defined as those systems and components for the transportation of personnel and equipment between the surface and subsurface to meet the needs of shaft construction and underground site characterization testing. The hoist system includes the rope winding equipment (hoist), conveyance, headframe, rope, dumping system, and hoist house.

The hoist house is defined as those facilities to accommodate the hoist(s), the necessary equipment and instrumentation for the hoist, air compressor system, control room, electrical and motor control centers, and an area for repairs and lay down.

Boundaries and Interfaces

For repository/ESF interface constraints, see ESFDR Appendix A.1. For repository/ESF interface drawings, see ESFDR Appendix A.2.

FUNCTIONAL REQUIREMENTS

1. Provide for the transport of testing and construction personnel, materials, and construction equipment and serve as an emergency egress during shaft construction, operation,and testing. [6.4FR1]

PERFORMANCE CRITERIA

1a. Construction hoists shall be considered. [6.4PC1h]

1b. The hoisting system capacities shall be consistent with the requirements of shaft construction, operation, and site characterization and emergency egress needs. [6.4PC1b,1d,1e,1f,1g,1h]

1c. The hoisting conveyance shall permit the inspection of shaft performance monitoring instrumentation, as well as other shaft inspection and maintenance activities. [6.4PC1b,1e,1f,1h]

1d. The headframe shall elevate the hoist sheaves sufficiently above the collar level to provide room for normal conveyance unloading and over-travel allowances. [6.4PC1e]

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1e. A hoist foundation shall be provided to accommodate the hoist dimensions and mounting details, independent of the hoist house foundation. [6.4PC1e]

1f. The headframe shall provide sufficient facilities for dumping buckets during shaft construction. [6.4PC1e]

1g. The headframe shall serve both shaft construction and test operations. [6.4PC1b,1d,1e]

1h. Clearances in the headframe directly above the collar shall accommodate the rigging of all anticipated underground equipment. [6.4PC1e]

1i. The hoisting systems (emergency egress systems) shall provide for the evacuation of all shaft personnel to safety within one hour. [30 CFR 57.11050(b)] [6.4PC1d,1e,1h]

1j. Area floodlighting, obstruction lighting, and lightning protection shall be provided atop the shaft headframe. [6.4PC1h]

CONSTRAINTS

A. The hoisting and/or transport system shall incorporate fail-safe devices and be designed with adequate safety factors as per applicable requirements of 30 CFR 57 Subpart R and State of Nevada and local regulations. [6.4PC1h]

B. The hoist shall accommodate the uncertainty allowance (see Section 1.2.6.0, Performance Criteria 1d). [6.4PC1b]

C. The hoist house control and operator's room shall be equipped with a heating and air conditioning system. [6.4PC1d]

D. The hoisting system shall conform to applicable regulations. [6.4PC1h]

E. The hoist shall have an independent power feeder from the primary switchgear and a dedicated standby power feeder. [6.4PC1h]

F. The primary fire protection for hoist electrical gear shall not be a water flow or spray design. [6.4PC1h]

G. The sinking bucket, if used, shall be replaced with an enclosed conveyance for transporting non-shaft sinking personnel (i.e., visitors). [6.4PC1d,1h]

H. The hoist shall not convey radioactive waste unless specifically requested by the Nuclear Regulatory Commission for the purpose of site characterization testing. [6.4CA]

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ASSUMPTIONS

None.

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1.2.6.4.6 SUMP

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The sump is defined as the area at the bottom of the shaft, below the adjacent horizontal excavation, that contains, collects, and transfers underground wastewater to the underground wastewater collection system.

Boundaries and Interfaces

For repository/ESF interface constraints, see ESFDR Appendix A.1. For repository/ESF interface drawings, see ESFDR Appendix A.2.

FUNCTIONAL REQUIREMENTS

1. Provide adequate space at the bottom of the shaft to accommodate in-shaft testing, shaft operation, and to collect and transfer wastewater to the underground wastewater collection system. [6.4FR1]

PERFORMANCE CRITERIA

1a. The size and depth of the shaft sump shall be sufficient to accommodate the required operation of the shaft equipment. [6.4PC1e]

1b. The sump shall be equipped with wastewater collection and transfer facilities. [6.4PC1c,2h]

1c. Provisions shall be made for cleaning the sump [6.4PC1c,2h]

1d. The sump shall be designed to prevent exfiltration. [6.4PC1c,2h]

CONSTRAINTS

A. The sump shall not penetrate the Calico Hills unit unless authorization to do so is given by the YMPO. [6.4PC1a]

ASSUMPTIONS

None.

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1.2.6.5 RAMP ACCESS

Subparts are 1.2.6.5.1 Portal
1.2.6.5.2 Lining
1.2.6.5.3 (This number not used)
1.2.6.5.4 Ramp Furnishings
1.2.6.5.5 (This number not used)
1.2.6.5.6 Sump

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

A ramp access is defined as those systems, subsystems, and components which are comprised of an engineered opening, including a zone extending a nominal 5 [TBV] feet beyond the excavated surface, that connects the ground surface with the underground. The system provides safe and controlled access to the targeted horizons for personnel, equipment, underground service systems, and materials required for development of the underground drifts and excavations, as well as underground testing operations. A ramp access will serve as the primary muck removal opening for test area development and will include site characterization testing activities. [TBV]

Boundaries and Interfaces

For repository/ESF interface constraints, see ESFDR Appendix A.1. For repository/ESF interface drawings, see ESFDR Appendix A.2.

APPLICABLE REGULATIONS, CODES, AND DOE ORDERS

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

FUNCTIONAL REQUIREMENTS

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

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

PERFORMANCE CRITERIA

1a. Unless the Commission determines with respect to the site described in the application that it is not necessary, site characterization shall include a program of in situ exploration and testing at the depths that wastes would be emplaced. [10 CFR 60.15(b)] [6.0PC1d,1k]

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i. Ramp(s) shall provide access for site characterization activities to be performed at the planned waste emplacement horizon. {DAA 3.1.5.1}

ii. The main test level shall be located as identified in the RIB. [TBD]

iii. Selection of the horizon for the main test level shall be based on evaluation of stratigraphic information sources available before and during construction (e.g., from the geologic mapping of the ramp, and exploratory bore holes) with respect to explicit horizon criteria. The ramp shall provide access into the Calico Hills unit without adversely affecting other testing that may be ongoing. Such access shall consider aspects of underground utilities, ground support, and muck handling. {DAA 2.4.4.2, 3.1.5.2}

1b. The number of exploratory boreholes and shafts [ramps] shall be limited to the extent practical consistent with obtaining the information needed for site characterization. [10 CFR 60.15(c)(2)] [6.0PC2d] {DAA 3.2.5.1}

1c. Ramps shall meet testing requirements. [6.0PC1d]

i. Ramps 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 criteria for each test in a ramp, in response to actual site conditions encountered during construction. {DAA 3.5.5.1}

ii. The configuration of a ramp shall be adequate to support site characterization testing, and future testing that may be reasonably expected for site characterization. This shall include an allowance to accommodate site specific conditions encountered in the ramp without adversely affecting testing that is planned or ongoing. {DAA 2.4.5.1}

iii. Ramp design and construction shall provide for design and construction testing, performance confirmation testing, and in situ site characterization testing to the extent necessary. [TBD]

iv. The ramp roadway shall be designed to permit the inspection of ramp performance monitoring instrumentation, as well as inspection and maintenance activities.

v. Routes for the material handling system shall be selected to avoid active test areas wherever possible.

1d. Ramp construction and operations shall not adversely affect site characterization. [6.0PC1d]

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i. Instrument and IDS cables shall be separated from power cables to minimize electrical interference. Instrument and IDS trunk cables shall be protected from damage.

ii. Water intrusion, if any, into the ramps shall be monitored and controlled by suitable measures such that the effects of expected water inflows (i.e., water, heat, gases) will not endanger worker safety and in situ site characterization. [TBD]

iii. Appropriate gravity drainage and/or pumping systems shall be incorporated into the ramp for draining water away from testing and other working areas to suitable collection point(s) for further treatment and/or disposal. {DAA 1.14.5.4, 1.14.5.7, 2.5.5.2}

iv. The amount of water used in the construction and operation of the ramp shall be limited to preclude interference with tests. Refer to ESFDR Appendix B and to Appendix I, Analysis 2 for specific guidance. {DAA 2.5.5.1}

v. 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.

vi. Construction methods shall be planned 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.

vii. Fluids and materials planned for use in a ramp shall be evaluated with respect to intended use and possible effects on site characterization or other testing, and appropriate controls shall be implemented. [TBD] {DAA 2.2.5.1}

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

ix. The presence of combustible materials in the ramps shall be controlled and limited such that testing in the ESF is not adversely affected. {DAA 2.3.6.3}

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

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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. [TBD]

xii. The location of openings for rock handling shall be selected to minimize effects on testing.

xiii. Ramp instrumentation shall be protected from physical damage.

xiv. Location of accesses relative to each other shall be such that testing in either access will not be adversely affected by activities in the other. Refer to ESFDR Appendix I, Analysis 2 for specific guidance.

1e. Ramps and ramp operations shall meet personnel movement requirements. [6.0PC1d]

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

i. A ramp shall serve as the primary rock removal and construction support access.

ii. Surface rock and materials handling equipment and facilities shall meet required rates for excavation, rock removal, and backfilling of excavation; and the design of the facilities shall meet applicable requirements of DOE Orders 5480.4. and 6430.1A

iii. The ramp roadway shall be designed to sustain impact and heavy moving loads from equipment and material transport.

iv. The ramp and ramp roadway shall be provided with adequate width and clearance to permit the largest piece of equipment to be transported to and from the underground facility and to minimize the interference with underground site characterization to the extent practicable.

v. The ramp and ramp roadway shall provide a slope suitable for excavation, safe vehicular traffic, and material handling equipment requirements.

1g. Ramps shall meet utility requirements. [6.0PC1d,1k,CP]

1h. Ramps shall meet ventilation requirements. [6.0PC1d,1k,CO]

i. The size, shape, and construction of a ramp shall be adequate to supply and/or exhaust the required volumes of air for underground construction, operations, and in situ site characterization.

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

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iii. The ESF shall be designed so as not to preclude separate ventilation of repository excavation and waste emplacement in accordance with 10 CFR 60.133(g)(3).

1i. Ramps shall meet safety requirements. [6.0CO]

i. A ramp shall provide safe access between the ground surface and the underground to meet the needs of site characterization testing, emergency egress, ventilation intake and exhaust, major muck handling, fuel transfer, and primary transport of heavy equipment.

ii. A ramp shall serve as the emergency egress from the underground during the ESF construction and underground testing and shall be capable of evacuating all underground personnel to safety within one hour.

iii. A ramp shall be excavated and supported, using methods and materials based upon currently available ramp construction technology for the ramp diameter and depth under consideration. The need for a ramp lining shall be determined by a combination of analysis and observation during construction.

iv. The accesses shall be separated to maintain reasonable distances for power and instrument cabling and water piping as well as to provide for redundancy in wastewater discharge.

1j. Ramps shall meet access requirements. [6.0PC1d]

i. Ramps shall be designed and constructed such that they remain stable during operating periods and retrieval periods to meet personnel, equipment, and ventilation access requirements.

ii. Support facilities, utilities, and equipment shall be designed and constructed to accommodate ramp excavation techniques used (eg., tunnel boring machines, roadheaders, drill-and-blast).

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

i. The design, construction, and operation of the ramp shall incorporate aspects specifically directed at limiting the potential for adverse impacts on the long term performance of the repository. {DAA 1.1.5.1, 1.16.5.1}

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ii. All construction materials or substances to be used underground shall first be reviewed for potential effects on engineered barriers and waste isolation. They may be used only following review and approval, and only in those areas where use has been approved, and subject to whatever controls are established.

Such materials or substances include, but are not limited to, the following [TBD]: {DAA 1.10.5.1, 1.10.5.2, 1.10.5.3, 1.10.5.4, 1.10.5.8}

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

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

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

d. Hydrocarbons and solvents.

e. Organic materials.

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

iii. To the extent feasible or practical, lining and grouting material selection shall consider material chemistry and take into account potential chemical interactions with groundwater that could affect waste package corrosion and radionuclide solubility. [TBD] {DAA 1.10.5.1}

iv. A materials control program shall be implemented to enable establishment of limits on the inventory of materials left after decommissioning. [TBD] {DAA 1.10.5.5}

v. A ramp shall allow for flexibility in closure, such as the location of seals, so that a seismic event is unlikely to compromise the ability of the facility to isolate wastes. [TBD] {DAA 1.10.5.7}

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

i. Ramps shall be located, to the extent practicable, where accesses are planned for the repository facility. {DAA 1.2.5.2}

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

iii. The portal coordinate location of a ramp shall be as listed in the RIB. [TBD]

iv. The nominal finished inside diameter of a ramp shall be as listed in the RIB.

2c. 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)] [6.0PC2d]

i. The ramp 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. [TBD] {DAA 1.3.5.2}

ii. The ramp 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. [TBD] {DAA 1.3.5.3}

iii. The ramp 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. [TBD] {DAA 1.3.5.4}

iv. The ramp 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] {DAA 1.3.5.5}

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

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

i. Rock support and other structural anchoring materials shall be compatible with waste isolation. [TBD]

ii. Rock support and other structural anchoring materials shall neither interfere with radionuclide containment nor enhance radionuclide migration. [TBD]

iii. Ramp configuration (access location, access size, access separation, and access depth) shall contribute to, or not detract from, the isolation capability of the site. [TBD] {DAA 1.11.5.1}

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

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

i. A ramp shall be designed so that the effects of credible disruptive events (e.g., flooding, fires, and explosions) shall not spread through the facility. {DAA 1.12.5.1}

ii. Materials shall be selected such that effects of fire do not produce geochemical effects that impact waste isolation capabilities of the site. [TBD] {DAA 1.12.6.3}

iii. A ramp portal shall prevent significant water inflow from a flooding event during site characterization and the planned period of repository operation, such that testing in the underground portion of the ESF and waste emplacement are not adversely affected. {DAA 2.3.5.1}

2g. The underground facility shall be designed with sufficient flexibility to allow adjustments where necessary to accommodate specific site conditions identified through in situ monitoring, testing, or excavation. [10 CFR 60.133(b)] [6.0PC2d]

i. Methods shall be employed 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.

2h. The underground facility shall be designed to permit retrieval of waste in accordance with [10 CFR] 60.111. [10 CFR 60.133 (c)] [6.0PC2d]

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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)] [6.0PC2d]

i. The characteristics of at least one ramp shall not preclude retrieval of waste canisters.

2i. The design of the underground facility shall provide for control of water or gas intrusion. [10 CFR 60.133(d)] [6.0PC2d, PC2e]

i. The drainage plan for underground work shall be consistent with repository operations and postclosure sealing concerns. Drainage shall be as defined in ESFDR Appendix A.2. Drainage shall be compatible with repository grades. [TBD] {DAA 1.14.5.3}

ii. The amount of water used in construction and operations shall be limited to that required for dust control and proper equipment operation so as to limit the effects on the containment and isolation capability of the site. Refer to ESFDR Appendix I, Analysis 2 for specific guidance. {DAA 1.14.5.1, 1.14.5.6}

iii. Water use in ramp construction shall be consistent with repository design goals to limit the increase in average percent saturation of the repository horizon to less than [TBD] percent, and limit the increase in the local percent saturation to less than [TBD] percent in waste emplacement areas. [TBD] {DAA 1.14.5.2}

iv. Management of water entering the ESF shall include quantity, location, and water balance. {DAA 1.14.5.5}

v. Operational seals shall be provided where necessary to control the intrusion of water into the facility. See ESFDR Appendix A.3 for additional information. {DAA 1.14.5.8}

vi. Methods to control sudden inflow of water shall be provided.

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

i. Ramp structures shall withstand the effects of seismic events. Seismic criteria to be used to design the ramp are in the RIB. Refer also to ESFDR Appendix A.5 for additional information.

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ii. An adequate distance between accesses shall be provided to limit potential mechanical and hydrological interference between the two accesses and to reduce the potential for deleterious rock movement so they do not impact the capability to reliably and adequately characterize the site. Refer to ESFDR Appendix I, Analysis 2 for specific guidance. {DAA 1.15.5.2, 2.6.5.2}

iii. The openings for rock handling shall be constructed in such a way as to minimize effects on the integrity of any other openings.

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

i. Techniques used for ramp excavation shall control overbreak of rock and minimize disturbance to the integrity of the adjoining rock mass to limit blast-induced changes to permeability. {DAA 1.16.5.2}

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

a. Blast-induced changes to the average in situ permeability of the rock beyond one half of the maximum opening dimension shall be less than one order of magnitude. Refer to ESFDR Appendix I, Analysis 5 for specific guidance. {DAA 1.16.5.4}

b. Excavation overbreak is to average less than 12 inches. This overbreak limit is additive to the dimensional tolerances applied to the location and runout of the drill holes used for excavation explosives. This limit may be exceeded for short intervals where blast designs are being adjusted. [TBV]

ii. A ramp shall be stable and shall minimize the potential for deleterious rock movement or fracturing that may create a pathway for radionuclide migration or impact the capability to characterize the site. {DAA 1.15.5.1, 2.6.5.1}

iii. Mechanical excavation methods with machines that break the rock with disc cutters or picks (e.g. tunnel boring machines, roadheaders, or variations of these machines) should be used when feasible and practical. ESF ramp(s) shall be constructed using a tunnel boring machine.

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iv. The construction of ramp stations and other secondary excavations may not be amenable to use of mechanical excavation methods. Drill-and-blast excavation may be used in such circumstances if it is determined to be more effective (maneuverability, flexibility, schedule, or cost) and provided that pressurized drill water usage and the chemical by products of blasting do not disturb site characteristics related to waste isolation. Drill-and-blast excavation shall:

a. Limit the disturbance of the surrounding rock mass.

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

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

v. If drill-and-blast construction techniques are used, then controlled blasting shall be utilized to limit the damage to the surrounding rock mass which could affect the adequacy or reliability of information from site characterization. The excavation methods shall be designed to provide for the requirements of specific site characterization tests, such as limitations on the extent of excavation-induced damage, or the type of ground support that may be installed. The methods shall be designed to facilitate investigation and monitoring of such effects during and after construction. Refer to ESFDR Appendix I, Analysis 5 for specific guidance. {DAA 1.16.5.3, 2.7.5.1}

vi. The following are design goals relating to ramp stability. These design goals may be modified pending information obtained during site characterization, or from future analysis:

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

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

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

d. Access shall be maintainable. [TBD]

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

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i. Ramps 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. Refer to ESFDR Appendix I, Analysis 6 for specific guidance. [TBD]

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

iii. The excavation support system 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. Refer to ESFDR Appendix I, Analysis 7 for specific guidance. The provisions for thermally induced stresses can be installed at a later date. [TBD] {DAA 1.18.5.1}

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

Materials and placement methods for seals shall be selected to reduce, to the extent practicable: (1) The potential for creating a preferential pathway for groundwater to contact the waste packages or (2) for radionuclide migration through existing pathways. [10 CFR 60.134(b)] [6.0PC2d, CK]

i. Ramp design and construction shall allow for future sealing in order to ensure that ramps do not become preferential pathways for groundwater or radioactive waste migration and will meet the performance objectives as stated in 10 CFR 60.112. In addition, techniques used to seal aquifers during construction should not preclude use, or reduce the effectiveness, of future access seals. [TBD] {DAA 1.1.9.1, 1.4.9.1, 1.6.5.1, 1.6.9.1, 1.17.9.1}

ii. To prevent complications of seal evaluations and emplacement and limit chemical alteration in future seal environments, no pressure grouting shall take place during the construction period of the ramp at locations of potential seal testing or emplacement. Specifically, no pressure grouting shall be performed within 50 feet of the original ground surface and within 50 feet (above and below) the contact of the Pah Canyon and Topopah Spring tuffs, or below the main test level. [TBV] {DAA 1.4.5.2}

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

a. Immediately below the ramp portal structure in the area where an anchor to bedrock is planned to be installed at the time of ramp closure. [TBD]

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

c. In ramps extending below the main ESF test level. [TBD]

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

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

INTERFACE CONTROL REQUIREMENTS

1. The ESF designers shall interface with surface-based testing and repository designers on ESF site location and layout, and on permanent ESF structures, systems, and components.

See Section 1.2.6.0, Interface Control Requirements.

CONSTRAINTS

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

The tests required under this section shall include a performance confirmation program carried out in accordance with Subpart F of this part [Part 60]. [10 CFR 60.74(b)] [6.0CD] {DAA 1.5.8.2}

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i. The structures, systems, components, and operation of the ramp shall be designed to accommodate additional testing as may be required by the NRC for site characterization and performance confirmation. [TBD] {DAA 1.5.8.1, 2.1.5.1}

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

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

ii. The configuration of a ramp shall be adequate to support site performance confirmation testing, and future testing that may be reasonably expected for performance confirmation. This shall include an allowance to accommodate site specific conditions encountered in the ramp without adversely affecting testing that is planned or ongoing. [TBD] {DAA 2.8.5.1}

iii. Accesses to the ESF underground facility shall be designed to facilitate performance confirmation testing to obtain adequate and reliable information about the site, during and after construction, as required for the geologic repository by 10 CFR 60, Subpart F. {DAA 2.8.5.2}

ASSUMPTIONS

None.

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1.2.6.5.1 PORTAL

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The ramp portal is defined as the rock face and retaining structure at the surface entrance of the ramp. The structure provides ground and utility support and overhead protection for ingress and egress into the ramp during construction and operations.

Boundaries and Interfaces

For repository/ESF interface constraints, see ESFDR Appendix A.1. For repository/ESF interface drawings, see ESFDR Appendix A.2.

FUNCTIONAL REQUIREMENTS

1. Provide adequate protection for ingress and egress and accommodate penetrations and structural mountings. [6.5FR1]

PERFORMANCE CRITERIA

1. The portal shall provide access and support for the materials handling system and equipment over the entire range of the handling system functions, operations, and requirements. [6.5PC1]

CONSTRAINTS

A. The surface elevation at the portal shall be above the high water mark of the probable maximum flood (PMF), as identified in the RIB. [6.5PC2f] [TBD]

B. The portal shall be founded in rock. [6.5PC1i,1j]

ASSUMPTIONS

None.

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1.2.6.5.2 LINING

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

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

Boundaries and Interfaces

For repository/ESF interface constraints, see ESFDR Appendix A.1. For repository/ESF interface drawings, see ESFDR Appendix A.2.

FUNCTIONAL REQUIREMENTS

1. Provide structural and mechanical integrity for the ramp if required (see 1.2.6.5 PC1i.iii), and mounting for conveyance supports, utilities, and ramp instrumentation during construction and operations. [6.5FR1]

PERFORMANCE CRITERIA

1a. The ramp lining shall provide adequate bearing support for the structural mounting of conveyance system supports under both static and dynamic operational loading conditions. [6.5PC1f]

1b. The lining shall include provisions for ramp instrumentation penetrations and data collection units. [6.5PC1c,1d]

1c. All concrete activities shall conform to the applicable ACI standards for furnishing, delivery, and placement of structural concrete. [6.5PC1i]

1d. All forming and reinforcements utilized shall conform to applicable ACI and ASTM standards. [6.5PC1i]

CONSTRAINTS

A. The ramp lining shall be protected from damage due to blasting and other construction activities. [6.5PC1i]

B. The ramp lining placement shall be coordinated with science needs such as testing and mapping. [6.5PC1c]

C. The capability to enhance postclosure performance by removing ramp linings shall be retained. [6.5PC2m] {DAA 1.4.5.1, 1.10.5.6}

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ASSUMPTIONS

None.

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1.2.6.5.4 RAMP FURNISHINGS

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The furnishings are defined as fabricated brackets, which are fixed to the ramp wall or to other structural support members. Utility brackets include provisions to facilitate installation of ventilation and ramp utilities consisting of electrical power, communications, integrated data system, compressed air, water, underground wastewater, etc.

Boundaries and Interfaces

For repository/ESF interface constraints, see ESFDR Appendix A.1. For repository/ESF interface drawings, see ESFDR Appendix A.2.

FUNCTIONAL REQUIREMENTS

1. Provide for support of underground utility systems and the necessary services (e.g., pipe, conduit, wiring, ventilation ducting) in the ramp during ramp construction, operation, and site characterization activities. [6.5FR1]

PERFORMANCE CRITERIA

1a. All ramp furnishings shall allow readily performed inspection and maintenance. [6.5PC1c,1f,1i]

1b. Ramp furnishings shall facilitate ESF underground construction and testing after ramp construction is complete. [6.5PC1c]

1c. Furnishings shall provide for mounting the following utilities and cables in the ramp: [6.5PC1g]

i. Electrical power.
ii. Compressed air.
iii. Water.
iv. Communications.
v. Instruments.
vi. Cabling for instrumentation and IDS.
vii. Underground wastewater handling system.
viii. Provision for ventilation.

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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 and on site characterization testing. [6.5PC2e]

B. Brackets shall provide adequate support and isolation for all cables and other devices. [6.5PC1g]

C. Ramp furnishings shall be capable of being removed prior to permanent closure. [6.5PC2m] {DAA 1.4.5.3}

D. Ramp furnishings shall be removable in a manner that would not restrict potential repository ventilation flow. [6.5PC1h]

ASSUMPTIONS

None.

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1.2.6.5.6 SUMP

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The sump is defined as the area(s) within the ramp that collects underground wastewater for transfer to the underground wastewater collection system as defined in section 1.2.6.7.6.

Boundaries and Interfaces

For repository/ESF interface constraints, see ESFDR Appendix A.1. For repository/ESF interface drawings, see ESFDR Appendix A.2.

FUNCTIONAL REQUIREMENTS

1. Provide adequate space within the ramp(s) to collect wastewater for transfer to the underground wastewater collection system. [6.5FR1]

PERFORMANCE CRITERIA

1a. The sump(s) shall be equipped with underground wastewater collection facilities. [6.5PC1c,2i]

1b. Provisions shall be made for cleaning the sump. [6.5PC1c,2i]

1c. The sump shall be designed to prevent exfiltration. [6.5PC1c,2i]

CONSTRAINTS

None.

ASSUMPTIONS

None.

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1.2.6.6 UNDERGROUND EXCAVATIONS

Subparts are 1.2.6.6.1 Operations Support Areas
1.2.6.6.2 Test Areas

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The underground excavations are defined as those underground openings that extend more than five feet beyond the accesses and which comprise the excavations at the proposed test levels and the preferred repository horizon, based on the needs for underground site characterization. [TBV]

Boundaries and Interfaces

For repository/ESF interface constraints, see ESFDR Appendix A.1. For repository/ESF interface drawings, see ESFDR Appendix A.2.

APPLICABLE REGULATIONS, CODES, STANDARDS, AND DOE ORDERS

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

FUNCTIONAL REQUIREMENTS

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

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

PERFORMANCE CRITERIA

1a. Unless the Commission determines with respect to the site described in the application that it is not necessary, site characterization shall include a program of in situ exploration and testing at the depths that wastes would be emplaced. [10 CFR 60.15(b)] [6.0PC1d,1k]

i. Develop underground openings in welded high lithophysal/low lithophysal tuff for in situ site characterization construction, operations, and maintenance.

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ii. The ESF main test level shall be constructed at the planned repository horizon, which currently is the TSw2 rock unit, although TSw1 can be considered. [TBD] {DAA 1.11.6.3, 3.1.6.1}

iii. The underground design shall provide for drifts and rooms (alcoves) in the Calico Hills unit.

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

i. The number of connections between the underground excavations developed for the ESF and eventual repository drifting shall be kept to the minimum required to provide personnel safety and functional efficiency. {DAA 1.11.6.7, 1.13.6.2}

ii. The area of the ESF underground excavations shall be limited to that necessary for conducting the needed site characterization and performance confirmation tests. {DAA 1.13.6.3}

1c. Underground openings shall meet testing requirements. [6.0PC1d]

i. The testing requirements outlined in ESFDR Appendix B shall serve as the basis for the test level development.

ii. Shaft and ramp breakouts, and the layout of the main test level of the ESF, shall have the flexibility to ensure that the location, orientation, geometry, and configuration of each planned test can be modified, as necessary, to meet specific test location criteria, in response to actual site conditions encountered during construction. {DAA 3.5.6.1}

iii. The ESF underground excavation shall be of adequate size to support site characterization testing and future testing that may be reasonably expected for site characterization. This shall include an allowance to accommodate site specific conditions encountered in the dedicated test area without adversely affecting testing that is planned or ongoing. {DAA 2.4.6.5}

iv. Shaft and ramp breakouts and main test level shall have sufficient flexibility to: (1) relocate experiments as necessary to limit interference between tests and aid in ensuring that test location acceptance criteria are met, (2) incorporate additional tests, as needed, in the dedicated test area, (3) allow development and testing in other areas as needed and (4) limit interference between ESF construction and operation activities and testing activities. {DAA 2.4.6.2, 2.4.6.3, 2.8.6.4, 2.8.6.5}

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v. A station and test drifts shall be constructed as part of the selected access at the Upper Demonstration Breakout Room (UDBR).

vi. Excavations shall provide for access stations beyond initial breakout, muck storage, refuge chambers, power centers, shop and storage areas, fueling, sanitation, ventilation, utilities, drifts, test levels, test rooms and alcoves, communications, IDS, service, special functions, and other areas.

1d. Underground construction and operations shall not adversely affect site characterization. [6.0PC1d]

i. Instrument and IDS cables shall be separated from power cables to minimize electrical interference. Instrument and IDS trunk cables shall be protected from damage.

ii. Probe or pilot holes shall be drilled, as appropriate, in advance of drifting to detect and control sudden water and/or gas inrushes into openings.

iii. Water intrusion, if any, into the underground openings shall be monitored and controlled by suitable measures such that the effects of expected water inflows (i.e., water, heat, gases) will not endanger worker safety and in situ site characterization. [TBD]

iv. 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. {DAA 1.14.6.5, 1.14.6.6, 2.5.6.2}

v. The amount of water used in construction and operations of the underground facility shall be limited to preclude interference with tests. Refer to ESFDR Appendix B and to Appendix I, Analysis 2 for specific guidance. {DAA 2.5.6.1}

vi. 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. {DAA 2.5.6.5}

vii. Construction methods shall be planned 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. {DAA 2.5.6.4}

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viii. Fluids and materials planned for use in the ESF underground facility shall be evaluated with respect to intended use and possible effects on site characterization or other testing, and appropriate controls shall be implemented. [TBD] {DAA 2.2.6.1}

ix. Fluids, gases, and other materials used in underground construction and operations, and/or injected into the rock mass, shall be appropriately tagged. Selection of tracers shall consider, but not be limited to: (1) the possible future need to account for the mobility and disposition of all such materials as part of site characterization, and (2) the effects of tracers on site characterization. [TBD] {DAA 2.5.6.6}

x. The presence of combustible materials in the underground facility shall be controlled and limited such that testing in the ESF is not adversely affected. {DAA 2.3.6.3}

xi. The use of blasting agents and explosives shall be controlled to preclude adverse effects on in situ site characterization.

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

xiii. The ESF shall be designed so that ESF 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 main test area. {DAA 2.4.6.1}

xiv. 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.

xv. 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.

1e. Underground openings and operations shall meet specified personnel movement requirements. [6.0PC1d]

i. During ESF construction, temporary visitor facilities shall be provided as approved by the DOE. [TBD]

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ii. During in situ site characterization testing, facilities shall be provided for at least 10 visitors underground at any one time. [TBV]

1f. Underground openings shall meet equipment requirements. [6.0PC1d]

i. The excavation facilities and equipment required for handling excavated rock shall meet the needs of construction and testing activities and shall be capable of supporting the excavation allowances determined under General ESF Requirements Section 1.2.6.0 Performance Criteria 1d.

ii. In the event backfilling is required, underground handling capacity for processing, receiving, transporting, and, where necessary, emplacing backfill material shall be adequate.

iii. Excavated rock processing and storage capacity underground prior to further disposal shall be compatible with the required excavation and handling rates.

1g. Underground openings shall meet utility requirements. [6.0PC1d,1k,CL]

1h. Underground openings shall meet ventilation requirements. [6.0PC1d,1k,CK]

i. The size, shape, and construction of openings shall be adequate to supply and/or exhaust required volumes of air for underground operations and testing during normal and emergency conditions and shall minimize airborne dust during in situ site characterization.

ii. Underground openings shall be designed to minimize air resistance to the extent practicable.

iii. Underground openings shall be designed to handle required volumes of air in order to cope with potential high temperatures from rock or waste-package simulation tests with heaters.

iv. The ESF shall be designed so as not to preclude separate ventilation of repository excavation and waste emplacement in accordance with 10 CFR 60.133(g)(3).

1i. Underground openings shall meet safety requirements. [6.0CO]

i. The extent of drifting on the main test level and in the Calico Hills unit prior to connection of the accesses shall be determined by a safety analysis.

ii. The maintenance, refueling, and equipment storage areas shall be designed and located to minimize the fire and safety risks.

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iii. A refuge chamber(s) shall be provided with sufficient capacity and facilities to accommodate personnel underground.

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

i. The design, construction, and operation of the main test level shall incorporate aspects specifically directed at limiting the potential for adverse impacts on the long term performance of the repository. {DAA 1.1.6.1}

ii. All construction materials or substances to be used underground shall first be reviewed for potential effects on engineered barriers and waste isolation. They may be used only following review and approval, and only in those areas where use has been approved, and subject to whatever controls are established. Such materials or substances include, but are not limited to, the following [TBD]: {DAA 1.10.6.2, 1.10.6.3, 1.10.6.4, 1.10.6.5, 1.10.6.8}

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

b. Ground support materials, including chemical/resin anchorages

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

d. Hydrocarbons and solvents

e. Organic materials

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

iii. To the extent feasible or practical, lining and grouting material selection shall consider material chemistry and take into account potential chemical interactions with groundwater that could affect waste package corrosion and radionuclide solubility. [TBD] {DAA 1.10.6.2}

iv. A materials control program shall be implemented to enable establishment of limits on the inventory of materials left after decommissioning. [TBD] {DAA 1.10.6.6}

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v. The underground excavation shall allow for flexibility in closure, such as the location of seals, so that a seismic event is unlikely to compromise the ability of the facility to isolate wastes. [TBD] {DAA 1.10.6.7}

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

i. Exploratory boreholes drilled from the ground surface may intersect openings within the ESF main testing area which is defined in ESFDR Appendix A.2, subject to the following restrictions:

a. The number of boreholes should be kept to the minimum required to perform the experiments needed.

b. The location of any such boreholes must be identified by coordinates on the as-built maps of the ESF.

ii. In areas outside the ESF main test area which is defined in ESFDR Appendix A.2, no portion of an exploratory borehole drilled from the ground surface shall be located within 15 m of any underground opening. [TBV] {DAA 1.2.6.1, 1.2.6.2, 1.11.6.5}

iii. Horizontal boreholes, drilled from the Main Test Level for installation of experiments or instrumentation systems that penetrate areas where waste could eventually be stored, shall not be permitted unless performance evaluations have been completed and approved indicating such holes shall be acceptable. Unless alternate constraints are approved, all such horizontal holes are subject to the following restrictions:

a. The holes shall be collared no less than 3 feet above the floor of the drift or alcove from which they are drilled.

b. The holes shall be biased upward from the collar sufficiently to assure that any liquid that may enter the hole will drain toward the hole collar.

c. All borehole alignments and locations shall be monitored, surveyed, and included on all underground as-built maps. {DAA 1.2.6.3}

2c. 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

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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)] [6.0PC2d]

i. The 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. [TBD] {DAA 1.3.6.1}

ii. The 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. [TBD] {DAA 1.3.6.2}

iii. The underground facility 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. [TBD] {1.3.6.3}

2d. Subsurface exploratory drilling, excavation, and in situ testing before and during construction shall be planned and coordinated with geologic repository operations area design and construction. [10 CFR 60.15(c)(4)] [6.0PC2d]

i. Location of the underground facility shall stay within the conceptual perimeter drift boundary, except as needed to characterize areas outside that boundary, taking into account any potential impacts on the waste isolation capabilities of the site. {DAA 1.11.6.4}

ii. The facilities constructed to support the experimental program on the Main Test Level of the ESF, with the exception of the drifts driven laterally to investigate geological features, shall be within the boundary defined in ESFDR Appendix A.2. No drifting shall be closer than 75 feet from this boundary. Small diameter boreholes are exempted, provided they meet the requirements pertaining to boreholes stated in 1.2.6.6PC2b. [TBV] {DAA 1.10.6.1}

iii. Openings, within the main test area as defined in ESFDR Appendix A.2, shall be maintained for future use during repository operation. (Future uses include utilization as waste emplacement support shops, ventilation airways, access to performance confirmation areas, etc.).

iv. Exploratory drifts outside the ESF main test area on the Main Test Level shall be constructed such that they will not be precluded from use in a potential repository.

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v. The ESF shall be designed to be consistent with the repository design goal to limit the extraction ratio to less than 30 percent unless otherwise governed by test requirements. [TBV] {DAA 1.15.6.4}

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

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

i. The Main Test Level of the ESF shall be greater than 200m below the ground surface. {DAA 1.11.6.2}

ii. The spacing between adjacent ESF drifts shall be a minimum of two drift diameters (using the maximum diameter of either opening and considering the closest proximity of any part of each opening) consistent with obtaining reliable and adequate information from site characterization, except where required otherwise by specific test requirements. Refer to ESFDR Appendix I, Analysis 2 for specific guidance. {DAA 1.11.6.6, 1.15.6.3, 2.6.6.3}

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

iv. Rock support and other structural anchoring materials shall be compatible with waste isolation and shall neither interfere with radionuclide containment nor enhance radionuclide migration. [TBD]

v. The underground facility configuration (drift locations, orientation, geometry, and sizes) shall contribute to or not detract from, the isolation capability of the site. [TBD] {DAA 1.11.6.1}

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

i. The ESF shall be designed so that the effects of credible disruptive events (e.g., flooding, fires, and explosions) shall not spread through the facility. {DAA 1.12.6.1, 2.3.6.1}

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ii. Materials shall be selected such that effects of fire do not produce geochemical effects that impact waste isolation capabilities of the site. [TBD] {DAA 1.12.6.3}

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. {DAA 1.12.6.4}

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 caused by construction and operations water on testing in the ESF; and not impact the capability to characterize the site.

2h. The underground facility shall be designed with sufficient flexibility to allow adjustments where necessary to accommodate specific site conditions identified through in situ monitoring, testing, or excavation. [10 CFR 60.133(b)] [6.0PC2d]

i. Methods shall be employed 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.

ii. The ESF shall be designed so as not to interfere with the flexibility of the repository to accommodate specific site conditions. {DAA 1.13.6.1}

iii. A contingency plan shall be established for underground excavation to accommodate unexpected or site specific conditions that may be encountered, such as highly fractured zones, lithophysae-rich zones, perched water, or pathways for significant water movement. {DAA 2.4.6.4}

2i. The underground facility shall be designed to permit retrieval of waste in accordance with 10 CFR 60.111. [10 CFR 60.133(c)] [6.0PC2d]

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)] [6.0PC2d]

i. The characteristics of the main drift on the main test level shall not preclude retrieval of waste canisters.

2j. The design of the underground facility shall provide for control of water or gas intrusion. [10 CFR 60.133(d)] [6.0PC2d, PC2e]

i. Facilities for plugging or grouting water inflow areas shall be available if water is known to exist in the vicinity of subsurface workings.

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ii. The drainage plan for the ESF and long exploratory drifts shall be consistent with repository operations and postclosure sealing concerns. {DAA 1.4.6.1, 1.11.6.8, 1.12.6.2, 1.14.4.3, 1.14.6.3, 2.5.6.3}

iii. The general drainage design for the Main Test Area shall preclude water from the exploratory drifts or the ESF support area from flowing into the testing areas. {DAA 1.12.6.2, 2.3.6.2}

iv. The amount of water used in construction and operations shall be limited to that required for dust control and proper equipment operation so as to limit the effects on the containment and isolation capability of the site. Refer to ESFDR Appendix I, Analysis 2 for specific guidance. {DAA 1.14.6.1, 1.14.6.4}

v. Water used in construction and operations shall not adversely impact the repository design goals to limit the increase in average percent saturation of the repository horizon to less than TBD percent and to limit increase in the local percent saturation to less than TBD percent in areas of waste emplacement. [TBD] {DAA 1.14.6.2}

vi. Management of water entering the ESF shall include quantity, location, and water balance. {DAA 1.14.6.7}

vii. Operational seals shall be provided where necessary to control the intrusion of water into the facility. See ESFDR Appendix A.3 for additional information. {DAA 1.12.6.5, 1.14.6.8}

viii. Methods to control sudden inflows of water shall be provided.

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

i. Underground excavated areas shall be designed for safe and maintainable ground support and control.

ii. Facilities and equipment shall be available to deal effectively with subsurface ground control including emergencies such as rock falls, rock bursts, and squeezing and swelling rock.

iii. Underground structures shall withstand the effects of seismic events. Seismic criteria to be used to design the underground excavations are in the RIB. Refer also to ESFDR Appendix A.5 for additional information.

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iv. The main test level of the ESF shall limit overall response to excavation, including rock fall, considering all planned drifts and future drifting that may be constructed in the main test area, and consistent with obtaining adequate and reliable information from site characterization. {DAA 2.6.6.1}

v. 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. {DAA 1.15.6.2, 2.6.6.2}

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

i. Excavation techniques shall control overbreak of rock and minimize disturbance to the integrity of the adjoining rock mass to limit blast-induced changes to permeability. {DAA 1.16.6.1}

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

a. Blast-induced changes to the average in situ permeability of the rock beyond one half of the maximum opening dimension shall be less than one order of magnitude. Refer to ESFDR Appendix I, Analysis 5 for specific guidance. {1.16.5.4}

b. Excavation overbreak is to average less than 12 inches. This overbreak limit is additive to the dimensional tolerances applied to the location and runout of the drill holes used for excavation explosives. This limit may be exceeded for short intervals where blast designs are being adjusted. [TBV]

ii. Underground openings shall be stable and shall minimize the potential for deleterious rock movement or fracturing that may create a pathway for radionuclide migration or could impact the capability to adequately characterize the site. {DAA 1.15.6.1, 1.15.6.2}

iii. Mechanical excavation methods with machines that break the rock with disc cutters or picks (e.g., Tunnel Boring Machines, Roadheaders, or variations of these machines) should be used when feasible and practical.

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iv. The construction of test alcoves and other short drifts in the ESF facility may not be amenable to the use of mechanical excavation methods. Drill-and-blast excavation may be used in such circumstances if it is determined to be more effective (maneuverability, flexibility, cost, and schedule), and provided that pressurized drill water usage and the chemical by-products of blasting do not disturb site characteristics related to waste isolation. Drill-and-blast excavation shall:

a. Limit the disturbance of the surrounding rock mass.

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

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

v. If drill-and-blast construction techniques are used, then controlled blasting shall be utilized to limit overbreak and damage to the surrounding rock mass, which could affect the adequacy or reliability of information from site characterization. The methods shall be designed to provide for the requirements of specific site characterization tests, such as limitations on the extent of excavation-induced damage, or the type of ground support that may be installed. The methods shall be designed to facilitate investigation and monitoring of excavation effects during and after construction. Refer to ESFDR Appendix I, Analysis 5 for specific guidance. {DAA 1.16.6.2, 2.7.6.1}

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

a. In areas not affected by thermal load, the closure rate of underground openings shall decrease at all times after construction [TBD].

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

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

d. Opening shall be maintainable. [TBD]

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

i. The subsurface facilities shall be designed considering the predicted thermal and thermomechanical response of the host rock, surrounding strata, and groundwater system so that the performance objectives of the repository can be met. Refer to ESFDR Appendix I, Analysis 6 for specific guidance. [TBD] {DAA 1.18.6.1}

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

iii. The ESF shall be designed such that the thermal and thermomechanical effects of ESF operations and testing do not produce failure of intact rock, nor gross rock mass failure, along potential pathways from the repository to the accessible environment and do not significantly increase the saturation of the host rock in the waste emplacement area. [TBD] {DAA 1.18.6.2, 1.18.6.3, 1.18.8.1, 1.18.8.2}

iv. The excavation support system shall withstand pressures under anticipated conditions, including reaction to thermally induced stresses resulting from thermal loads. Refer to ESFDR Appendix I, Analysis 7 for specific guidance. The provisions for thermally induced stresses can be installed at a later date. [TBD] {DAA 1.18.6.4}

v. The ESF shall be designed so that the thermal effects of ESF testing do not result in temperatures in excess of 115°C in either the TSw3 or CHn units, compatible with the performance measure for the repository listed in the Site Characterization Program Baseline. Refer to ESFDR Appendix I, Analysis 8 for specific guidance. {DAA 1.18.8.3}

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

Materials and placement methods for seals shall be selected to reduce, to the extent practicable: (1) The potential for creating a preferential pathway for groundwater to contact the waste packages or (2) for radionuclide migration through existing pathways. [10 CFR 60.134(b)] [6.0PC2d, CH]

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i. Drift design and construction shall allow for future sealing in order to ensure that drifts do not become preferential pathways for groundwater or radioactive waste migration and will meet the performance objectives as stated in 10 CFR 60.112. In addition, techniques used to seal aquifers during construction should not preclude use, or reduce the effectiveness, of future seals. [TBD] {DAA 1.1.9.1, 1.4.9.1, 1.6.6.1, 1.6.9.1, 1.17.9.1}

ii. Any fill or other construction materials used in the floors of the drifts within the ESF in areas that may adversely impact implementation of post-closure sealing shall be removable.

iii. The ESF 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.

iv. Operational seals shall be provided where necessary to control the spread of water through the facility.

v. Grouting during ESF construction shall have the following limitations:

a. Pressure grouting is not permitted within 50 feet of the Boundary of the ESF Main Test Area. [TBV]

b. No pressure grouting is to be performed within fault zones.

INTERFACE CONTROL REQUIREMENTS

1. The ESF designers shall interface with surfaced-based testing and repository designers on ESF site location and layout, and on permanent ESF structures, systems, and components.

See Section 1.2.6.0, Interface Control Requirements.

CONSTRAINTS

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

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The tests required under this section shall include a performance confirmation program carried out in accordance with Subpart F of this part [Part 60]. [10 CFR 60.74(b)] [6.0CD] {DAA 1.5.8.2}

i. The structures, systems, components, and operation of the dedicated test area shall be designed to accommodate such additional testing as may be required by the NRC for site characterization and performance confirmation without disruption of, or interference with, testing in progress or planned testing. [TBD] {DAA 1.5.8.1, 2.1.6.1, 2.1.6.2}

ii. The area set aside for future site characterization and performance confirmation testing shall be representative of the overall designated test area with respect to rock characteristics and control. This determination shall be based on reasonable interpretation of available information on the variability of host rock characteristics throughout the ESF site area.

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

i. The underground excavations shall be designed to accommodate the performance confirmation tests required by 60.141 and 60.142, and taking into account any potentially adverse impacts these excavations could have on the waste isolation capabilities of the site. {DAA 1.19.6.1}

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 Main Test Area [TBD]. {DAA 2.8.6.3}

iii. The access breakouts and Main Test Level and Calico Hills level of the ESF shall be designed to permit performance confirmation testing to obtain adequate and reliable information about the site, during and after construction, as required for the geologic repository by 10 CFR 60, Subpart F. {DAA 2.8.6.1}

ASSUMPTIONS

None.

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1.2.6.6.1 OPERATIONS SUPPORT AREAS

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The operations support areas are defined as the following underground openings: drift(s); refuge room(s); operations administration area; underground shop(s); lunch room(s); storage facility(ies); maintenance shop(s); areas for power distribution, fuel storage, and equipment storage; and other underground openings, but excluding those included in 1.2.6.6.2 Test Areas.

Boundaries and Interfaces

For repository/ESF interface constraints, see ESFDR Appendix A.1. For repository/ESF interface drawings, see ESFDR Appendix A.2.

FUNCTIONAL REQUIREMENTS

1. Provide excavated space of adequate size and appropriate geometry to support underground site characterization test activities on multiple levels. [6.6FR1]

PERFORMANCE CRITERIA

1a. Operations support areas shall include facilities for the administration and maintenance of ESF underground systems, structures, and components, as well as space for underground testing equipment and instrumentation, equipment storage, power distribution, fuel storage and distribution, and lunch room. [6.6PC1c,1e,1f,1g]

1b. Openings for operating equipment shall be sized and equipment positioned to provide adequate clearance for maintenance, inspection, and repair or replacement of equipment. [6.6PC1f]

1c. Underground maintenance facilities shall be designed and sized to maintain subsurface equipment, instrumentation, and systems. [6.6PC1f]

CONSTRAINTS

A. The maintenance areas/facilities shall be separated into a construction maintenance area and an underground test maintenance area. [6.6PC1c,1f]
B. Fuel storage areas shall comply with applicable Federal, State of Nevada, and local requirements. [6.6PC1i]

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ASSUMPTIONS

None.

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1.2.6.6.2 TEST AREAS

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The test areas are defined as those openings excavated off the ESF access stations at the Upper Demonstration Breakout Room, the Main Test Level, Calico Hills, and other areas as required for conducting underground site characterization tests at the potential repository horizon and the other geologic horizon(s).

Boundaries and Interfaces

For repository/ESF interface constraints, see ESFDR Appendix A.1. For repository/ESF interface drawings, see ESFDR Appendix A.2.

FUNCTIONAL REQUIREMENTS

1. Provide excavated space of adequate size, appropriate layout, and appropriate opening geometry to conduct the necessary underground site characterization test activities and house the necessary construction, test, and testing support equipment. [6.6FR1]

PERFORMANCE CRITERIA

1. Areas shall be provided for the storage of test equipment and of testing support equipment such as forms, scaffolds, cable runs, support structures and utilities. [6.6PC1c]

CONSTRAINTS

A. Test areas shall be separated so they are not affected by the excavation disturbed zone and any thermal, mechanical, chemical, and hydrological interactions. See ESFDR Appendix B for specifics. [6.6PC1c,1d] {DAA 2.6.8.1}

B. To the extent practicable, limit or avoid the use of concrete and cementitious materials in or near geochemical test areas and emplacement holes. [6.6PC1d,2a]

ASSUMPTIONS

None.

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1.2.6.7 UNDERGROUND SUPPORT SYSTEMS

Subparts are
- 1.2.6.7.1 Power Distribution System
- 1.2.6.7.2 (This number not used)
- 1.2.6.7.3 Lighting System
- 1.2.6.7.4 Ventilation Distribution System
- 1.2.6.7.5 Water Distribution System
- 1.2.6.7.6 Underground Wastewater Collection System
- 1.2.6.7.7 Compressed Air Distribution System
- 1.2.6.7.8 Fire Protection System
- 1.2.6.7.9 Muck and Material Handling Systems
- 1.2.6.7.10 Sanitary Facilities
- 1.2.6.7.11 Monitoring and Warning Systems

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The underground support systems, subsystems, and components include the utilities and provisions for power, communications, lighting, ventilation, water, underground wastewater removal, compressed air, fire protection, materials and muck handling, sanitation, and safety monitoring and warning required to meet the needs of the underground site characterization testing program during construction and operation.

Boundaries and Interfaces

For repository/ESF interface constraints, see ESFDR Appendix A.1. For repository/ESF interface drawings, see ESFDR Appendix A.2.

APPLICABLE REGULATIONS, CODES, STANDARDS, AND DOE ORDERS

General

1. 30 CFR, Chapter I, Mine Safety and Health Administration
2. Nevada Administrative Code, Chapter 512, Inspection and Safety of Mines

Electrical

1. DOE 6430.1A, General Design Criteria, Division 16 Electrical
2. NFPA-70, National Electrical Code
3. ANSI C-2, National Electrical Safety Code

Lighting

1. DOE 6430.1A, General Design Criteria, Division 16 Electrical

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Uninterruptible Power

1. DOE 6430.1A, General Design Criteria, Division 16 Electrical
2. IEEE-485, Recommended Practice for Sizing Large Lead Storage Batteries for Generating Stations and Substations
3. IEEE-650, Qualifications of Class 1E Battery Chargers and Inverters for Nuclear Power Generating Stations

Water System

1. DOE 6430.1A, General Design Criteria, Division 2 Site and Civil Engineering and Division 15-Mechanical.
2. NAC Chapter 445, Water Controls, Air Pollution, paragraphs .244 through .420, Public Water Systems
3. NFPA 20, Centrifugal Fire Pumps
4. NFPA 22, Water Tanks for Private Fire Protection
5. NFPA 24, Installation of Private Fire Service Mains and Their Appurtenances

Underground Wastewater Collection System

1. DOE 6430.1A, General Design Criteria, Division 2 Site and Civil Engineering
2. NAC Chapter 445, Water Controls, Air Pollution, paragraphs .140 through .241, Water Pollution Controls

Ventilation System and Dust Control

1. American Conference of Governmental Industrial Hygienists, Industrial Ventilation, A Manual of Recommended Practices, 19th Edition.

2. NAC Chapter 512, Inspection and Safety of Mines, paragraph .154, Requirements for Fresh Air and Ventilation in Underground Mines

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

FUNCTIONAL REQUIREMENTS

1. Provide utilities for underground ESF construction, operations, in situ site characterization, and monitoring activities. [6.0FR1,2]

2. Provide facilities and equipment for the installation, operation, and maintenance of the underground services. [6.0FR1]

3. Provide underground transport services for personnel, equipment, and materials. [6.0FR1]

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PERFORMANCE CRITERIA

1a. The following underground needs shall be met: power, communications, lighting, ventilation, water, wastewater removal, compressed air, fire protection, sanitation, materials (including supplies and fuel) and muck handling, and safety monitoring and warning. [6.0PC1k]

1b. The utility services shall include minimal backup units for primary power lines, primary pumps, shaft and ramp conveyances, primary ventilation fans, and primary communications and testing equipment to allow testing continuity. Refer to ESFDR Appendix B for specific guidance. [6.0PC1k]

1c. Effective communications capability in and between the surface and the underground facilities shall be established, and suitable safety alarm systems shall be provided where required. Closed-circuit television monitoring shall be provided at critical locations. [6.0PC1k]

1d. The underground support systems and service facilities shall be capable of supporting the uncertainty allowances as defined in Section 1.2.6.0, Performance Criteria 1d. [6.0PC1k]

1e. The distribution of utilities around the operations area of the Main Test Level shall allow for flexibility in the siting and construction of the final testing locations. [6.0PC1k]

1f. Utilities shall meet the needs of construction, operations, and in situ site characterization. [6.0PC1k]

2. 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 defined in Section 1.2.6.0, Performance Criteria 1d. [6.0PC1k]

3a. The underground transport facilities shall be sufficiently sized to sustain construction, operations, and testing. [6.0PC1k]

3b. The transport system(s) shall have appropriate safety features, as required by analysis and applicable Federal, State of Nevada, and local regulations. [6.0PC1k,CO]

INTERFACE CONTROL REQUIREMENTS

1. The ESF designers shall interface with surface-based testing and repository designers on ESF site location and layout, and on permanent ESF structures, systems, and components.

   See Section 1.2.6.0, Interface Control Requirements.

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CONSTRAINTS

A. Utility systems (i.e., electric power, air, water, etc.), when installed, shall not restrict foot, vehicular, or shaft and ramp conveyance traffic; obstruct ventilation; or cause safety hazards. [6.0CO]

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

   i. The design, construction, and operation of the underground utilities shall incorporate aspects specifically directed at limiting, to the extent practicable, adverse effects on the repository's long term performance. {DAA 1.1.7.1}

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

   i. The structures, systems, components, and operation of the shaft and ramp breakouts and main test level of the ESF shall accommodate additional tests that may be required by the NRC for site characterization and performance confirmation. [TBD] {DAA 2.1.7.1}

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

   i. Utility systems, including the water distribution and underground wastewater collection systems, shall operate safely in the event of seismic activity. {DAA 1.10.7.1}

   ii. The impact of underground utility system failures caused by credible disruptive events such as fire, explosion, or seismic events, on site characterization and other testing shall be controlled and limited. {DAA 2.3.7.3}

E. The underground facility shall be designed with sufficient flexibility to allow adjustments where necessary to accommodate specific site conditions identified through in situ monitoring, testing, or excavation. [10 CFR 60.133(b)] [6.0PC2d]

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i. The underground utilities for the ESF shall not preclude monitoring and investigation of in situ conditions, and shall accommodate site specific conditions, construction, and operation of the ESF. {DAA 2.4.7.2, 2.8.7.2}

ii. The underground utilities shall provide the flexibility needed to support the uncertainty in the design of the ESF. {DAA 2.4.7.1, 3.5.7.1}

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

i. Appropriate gravity drainage and/or pumping systems shall be incorporated into the shaft, ramp, and underground facilities for draining water away from testing and other working areas to suitable collection point(s) for further treatment and/or disposal. {DAA 1.14.7.1}

ii. Structures, systems, and components shall be provided for effective water and ground control.

iii. The design of the ESF underground utility system, including ventilation, shall facilitate monitoring of moisture influx to the ESF from the rock mass and from ventilation, and moisture efflux from underground water removal and ventilation exhaust to limit possible impacts on the capability to adequately characterize the site. {DAA 2.5.7.2}

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

i. Underground utilities for the ESF shall be capable of supporting the performance confirmation testing. {DAA 2.8.7.1}

H. To the extent practicable, underground support (utility) systems and associated hardware (hangers, brackets, etc.) shall be removed following final use. [6.0PC2d] {DAA 1.4.6.2}

I. In the selection of equipment that will require maintenance, consider-ation shall be given to the availability and cost of replacement materials and parts, and the need for equipment manufacturer's technical services. [6.0PC1e]

J. Piping shall be designed to preclude or limit water inflow into the ESF following a pipe rupture. [6.0PC2d,CO] {DAA 1.12.7.1}

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K. All joints in fluid-carrying columns shall be sealed and proof-tested. [6.0PC2d,CO]

L. Fluid-carrying piping shall be designed to prevent damage caused by water hammer. [6.0PC2d,CO]

ASSUMPTIONS

None.

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1.2.6.7.1 POWER DISTRIBUTION SYSTEM

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The power distribution system for the underground is defined as the systems, subsystems, and components that distribute electrical power to underground systems.

Boundaries and Interfaces

For repository/ESF interface constraints, see ESFDR Appendix A.1. For repository/ESF interface drawings, see ESFDR Appendix A.2.

FUNCTIONAL REQUIREMENTS

1. Distribute electrical power to underground facilities. [6.0FR1]

PERFORMANCE CRITERIA

1a. The underground electrical power system shall provide the necessary power, during both the normal and peak demands, for construction, operation, and site characterization requirements of the subsurface facility. [6.7PC1a,1f]

1b. Underground power distribution for the ESF, including the transformers, and primary and secondary feeder cables, shall be adequately designed with sufficient redundancy to meet the load requirements at points of usage for the construction and operations areas of the facility. [6.7PC1a,1f]

1c. Stand-by power to the underground systems shall provide all necessary power to systems and subsystems that are required to operate in the event of a power outage based on safety or operational requirements for the construction and operation of the ESF. [6.7PC1b]

1d. Underground Uninterruptible Power Supply (UPS) System(s) shall ensure continuity of power to the Integrated Data System (IDS), sensor systems, safety instruments and controls, communications, and all systems and subsystems that cannot tolerate a power interruption (See ESFDR Appendix B). [6.7PC1b]

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CONSTRAINTS

A. The underground power distribution system shall have one primary power feed (steel or wire armored) and a second alternate power feed (steel or wire armored). One power feed shall be installed in each access, as necessary, and adequate switching shall be provided. [6.7PC1a]

B. Underground feeders shall have a ground check circuit to continuously monitor the grounding circuit to ensure continuity. [6.7PC1a]

C. Underground substations supplying power to 480 volt, three phase loads shall be resistance grounded. [6.7PC1a]

D. The UPS system(s) shall consist of batteries and inverters and shall be in a location separate from the main power distribution center. [6.7PC1b]

E. Utility lines, steel supports, etc., shall be electrically bonded and reliably connected to the surface electrical safety grounding network. [6.7PC1a]

F. The power distribution system shall be shielded so as to minimize interference with testing activities. [6.7PC1f]

ASSUMPTIONS

None.

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1.2.6.7.3 LIGHTING SYSTEM

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The lighting system is defined as those systems, subsystems, and components that provide for the illumination of the ESF underground areas (shafts, ramps, stations, refuge chamber(s), alcoves, test areas, and shop areas).

Boundaries and Interfaces

For repository/ESF interface constraints, see ESFDR Appendix A.1. For repository/ESF interface drawings, see ESFDR Appendix A.2.

FUNCTIONAL REQUIREMENTS

1. Provide underground lighting. [6.7FR1]

PERFORMANCE CRITERIA

1a. Lighting shall be provided at each testing area and alcove, refuge chamber(s), and at the shaft and ramp station areas. Lighting shall also be provided in the mechanical, electrical, and utility shops. [6.7PC1a,1f]

1b. Temporary lighting shall be provided for special needs; i.e., mapping, photography, and temporary work lights near the instrumentation junction boxes. [6.7PC1a,1f]

1c. Exit lighting shall be provided to identify direction of evacuation to refuge chamber(s), and/or shaft and ramp stations. [6.7PC1a,1b]

1d. Emergency lighting with battery backup shall be provided in each shop, testing area, refuge chamber(s), and shaft and ramp station area. [6.7PC1a,1b]

CONSTRAINTS

A. The lighting provided in each testing area shall be based upon any specific test requirements for that area. [6.7PC1a, 1f]

B. The lighting in the shop areas shall be based on the specific maintenance requirements. [6.7PC1a, 1f]

C. Lighting fixtures for test areas shall be selected for low electrical noise as applicable. [6.7PC1a, 1f]

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ASSUMPTIONS

None.

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1.2.6.7.4 VENTILATION DISTRIBUTION SYSTEM

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The ventilation distribution system is defined as those systems, subsystems, and components that allow fresh air, conditioned if required, to be supplied to, and exhaust air to be removed from, the underground areas to meet the needs of underground construction and site characterization testing. The ventilation distribution system distributes air supplied by the ventilation system (1.2.6.3.1).

Boundaries and Interfaces

For repository/ESF interface constraints, see ESFDR Appendix A.1. For repository/ESF interface drawings, see ESFDR Appendix A.2.

FUNCTIONAL REQUIREMENTS

1. Provide a distribution system for ventilation air. [6.7FR1]

PERFORMANCE CRITERIA

1a. Underground ventilation shall dilute and/or remove particulate matter, blasting fumes (if drill-and-blast is used), and other flammable and noxious gases from the working areas, and shall divert exhaust air to the exhaust opening(s), all in conformance with applicable Federal, State, and local regulations. [6.7PC1a,1f]

1b. The ventilation distribution system shall meet requirements for operator safety and productivity. [6.7PC1f]

1c. The ventilation distribution system shall provide 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. [6.7PC1a,1e,1f]

1d. Airflow distribution shall be controlled, as required, to supply air to all underground areas. [6.7PC1a,1e,1f]

1e. The ventilation distribution system shall minimize leakage and undesirable recirculation, to the extent practicable. [6.7PC1a]

1f. The ventilation distribution system shall supply adequate quantities of air of acceptable temperature and humidity in accordance with applicable federal, state, and local regulations to support all underground activities. [6.7PC1a,1f]

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1g. Dust control/collection facilities shall be provided at potential dust-generation areas (e.g., working faces, rock-handling transfer points, processing areas, etc.) underground in order to minimize airborne particulates. [6.7PC1a]

CONSTRAINTS

A. The ventilation distribution system shall contribute to the control of the expected high free-silica and zeolite content dust, in conformance with applicable federal, state, and local regulations. (See ESFDR Appendix E) [6.7PC1a]

B. Personnel working in the shaft and ramp shall not be exposed to ventilation air velocities exceeding those listed in the RIB. [6.7PC1a]

C. Ventilation air velocities in the active underground openings shall not be greater than those listed in the RIB. The ventilation volume shall not be less than the quantity per person as listed in the RIB. [6.7PC1a]

D. The ventilation distribution system shall provide an air cooling power equal to or greater than 260 W/m^2 of personnel skin surface area. [6.7PC1a]

E. The subsurface data building ventilation system shall be compatible with the fire protection system. [6.7PC1a]

F. Shaft or ramp heaters, if required, shall conform to standard industry design. [6.7PC1a]

G. Maximum allowable noise levels produced by the underground ventilation distribution system shall allow the understanding of face-to-face and alarm-voice communications. [6.7PC1a]

H. Ventilation capacity, shaft or ramp design, and air velocities in the shaft or ramp shall be optimized with respect to safety, design objectives, and cost. [6.7PC1a]

I. The ventilation distribution system shall be maintained to support initial repository construction until this can be replaced by repository facilities. [6.7PC1a]

ASSUMPTIONS

1. Auxiliary fans may be allowed, if required, during the construction and operation of the ESF to supplement the normal ventilation system.

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1.2.6.7.5 WATER DISTRIBUTION SYSTEM

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The water distribution system is defined as the systems, subsystems, and components that distribute water within the underground facility. The water distribution system receives water from the water system, 1.2.6.2.2.

Boundaries and Interfaces

For repository/ESF interface constraints, see ESFDR Appendix A.1. For repository/ESF interface drawings, see ESFDR Appendix A.2.

FUNCTIONAL REQUIREMENTS

1. Distribute water to underground facilities. [6.7FR1]

PERFORMANCE CRITERIA

1. The water distribution system shall be adequately sized, with sufficient capacity to simultaneously provide for fire protection and for process water throughout the ESF, in accordance with all anticipated needs and services for construction, testing, and operation of the ESF and to preclude adverse effects on in situ site characterization testing or the ability of the site to meet performance objectives as stated in 10 CFR 60.112. [6.7PC1a,1e,1f] {DAA 1.6.7.1}

CONSTRAINTS

A. All water used during operation and construction of the ESF shall be provided with chemical tracers as required by testing. [6.7PC1a]

ASSUMPTIONS

1. The water distribution system will not be suitable for drinking purposes (i.e., water will be nonpotable). Bottled water can be considered for drinking purposes.

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1.2.6.7.6 UNDERGROUND WASTEWATER COLLECTION SYSTEM

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The underground wastewater collection system is defined as those systems, subsystems, and components that collect, control, and transfer to the surface wastewater system (1.2.6.2.5), the wastewater that flows into the shaft(s)/ramps and underground facilities.

Boundaries and Interfaces

For repository/ESF interface constraints, see ESFDR Appendix A.1. For repository/ESF interface drawings, see ESFDR Appendix A.2.

FUNCTIONAL REQUIREMENTS

1. Provide underground water handling and treatment as required. [6.0FR1]

PERFORMANCE CRITERIA

1a. The underground wastewater collection system shall provide for control, handling, collection, treatment (as required), and transfer of wastewater and groundwater inflow to the surface wastewater system. [6.7PC1a]

1b. Gravity drainage, storage, and pumping systems, with adequate capacity and control measures, shall be designed and constructed for the control and transfer of underground water to the surface to ensure worker protection and to preclude adverse effects on in situ site characterization testing or the ability of the site to meet performance objectives as stated in 10 CFR 60.112. [6.7PC1a,CB] {DAA 1.6.7.1}

i. Water handling and control underground shall be designed for all credible inflows, including inflow from penetration of fault structures or from perched water horizons, use of fire protection sprinklers, and from water line breakage. {DAA 1.14.7.2, 2.3.7.4, 2.5.7.1}

ii. Piping shall be provided to carry water from underground pump station(s) to the surface.

iii. Pumping systems with adequate capacity shall be available.

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iv. The underground wastewater collection system shall have full operating redundancy or shall have storage capacity to allow installation of spares in order to limit possible impacts on the isolation capability of the site. {DAA 1.12.7.2, 2.3.7.1}

1c. The underground wastewater collection system shall control standing water and air/water contact surfaces where ventilation air will be flowing in order to control humidity in air and to maintain the quality of the ventilation air being supplied. [6.7PC1a]

i. Control of humidity in the underground ventilation air shall be facilitated by reducing all underground (shaft, ramp, and test level) air/water contacts to the lowest practical level.

1d. The underground wastewater collection system shall utilize materials of construction that are resistant to erosive and corrosive effects, if economically practicable; otherwise, suitable monitoring and treatment facilities for credible groundwater inflows shall be available to control possible contamination and to prevent damage to pumping/piping systems from erosion or corrosion by waterborne particulates. [6.7PC1a,CF]

1e. Fluids recovered during construction operations shall be disposed of in such a way to avoid potential for performance impacts as stated in 10 CFR 60.112. [6.7CB]

1f. The drainage and pumping systems shall provide for measurement of the water as required. [6.7PC1a,CF]

CONSTRAINTS

None

ASSUMPTIONS

None

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1.2.6.7.7 COMPRESSED AIR DISTRIBUTION SYSTEM

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The compressed air distribution system is defined as those systems, subsystems, and components that distribute compressed air throughout the underground ESF facility. The compressed air distribution system distributes compressed air from the compressed air system (1.2.6.2.6).

Boundaries and Interfaces

For repository/ESF interface constraints, see ESFDR Appendix A.1. For repository/ESF interface drawings, see ESFDR Appendix A.2.

FUNCTIONAL REQUIREMENTS

1. Distribute compressed air throughout the underground ESF facility. [6.7FR1]

PERFORMANCE CRITERIA

1. Compressed air shall be distributed at a quantity and pressure sufficient to meet all underground ESF construction, operations, and site characterization testing requirements. [6.7PC1a,1d,1e,1f,2a]

CONSTRAINTS

None.

ASSUMPTIONS

None.

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1.2.6.7.8 FIRE PROTECTION SYSTEM

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The fire protection system is defined as the systems, subsystems, and components that provide detection, warning, and suppression, as required, to extinguish fire(s) within the underground facilities.

Boundaries and Interfaces

For repository/ESF interface constraints, see ESFDR Appendix A.1. For repository/ESF interface drawings, see ESFDR Appendix A.2.

FUNCTIONAL REQUIREMENTS

1. Provide for the detection, warning, and suppression of fires in the ESF underground. [6.7FR1]

PERFORMANCE CRITERIA

1a. The underground portion of the ESF shall incorporate a fire protection system to control and limit the impact of credible fires in the ESF. [6.7PC1a,1e,1f,CD] {DAA 2.3.7.2}

1b. The fire suppression system shall be capable of operating automatically and/or manually. [6.7PC1a]

1c. Portable extinguishers shall be located in the subsurface areas. [6.7PC1a]

CONSTRAINTS

A. Fire 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 (i.e., they do not produce adverse geochemical effects), the in situ site characterization testing program, and performance objectives as stated in 10 CFR 60.112. [6.7PC1a,1e,1f,CB,CF,CG] (TBD) {DAA 1.6.7.1, 1.12.7.3}

   i. Water shall be used as the fire suppressing agent only after detailed analysis has been made of its effects on overall site characterization and individual testing activities.

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B. As a minimum, fire hose outlets shall be located at all shaft and/or ramp stations. [6.7PC1a,CF]

C. A fire protection system shall be provided for the subsurface data building and IDS facility. [6.7PC1a,CF]

ASSUMPTIONS

None.

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1.2.6.7.9 MUCK AND MATERIAL HANDLING SYSTEMS

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The muck and material handling systems are defined as those systems, subsystems, structures, equipment, and components that transport excavated rock (muck), materials (including supplies and fuel), and equipment between the ground surface and the underground to meet the needs of construction and underground site characterization testing. This includes any transferring at a shaft or ramp station. The material handling system includes material handling equipment, loading and unloading stations, transfer point structures, and buildings to accommodate all the necessary equipment and instrumentation, hydraulic power units, air compressor system, control room, electrical and motor control centers, and an area for repairs and laydown. The muck handling system includes the muck pockets, skip loaders, bottom cleanout systems, and the appropriate conveyances.

Boundaries and Interfaces

For repository/ESF interface constraints, see ESFDR Appendix A.1. For repository/ESF interface drawings, see ESFDR Appendix A.2.

FUNCTIONAL REQUIREMENTS

1. Provide for transport of excavated rock, materials, and equipment between the ground surface and the underground. [6.7FR1]

PERFORMANCE CRITERIA

1a. The muck handling system shall provide for collecting excavated rock at the shaft or ramp station, surge capacity, measuring, and loading the rock for conveyance. [6.7PC1a]

1b. Muck and material handling systems shall be sized and designed for ESF construction and underground site characterization needs and shall minimize the spillage of excavated rock during handling. These systems shall provide capabilities for gathering and removing spillage. [6.7PC1a,1e,1f]

1c. Sufficient flexibility and redundancy for sustaining production shall be built into the muck handling system to cope with problems/breakdowns (e.g., equipment failure, material handling problems, etc.) in the underground development and operations activities. [6.7PC1a,1b,1e,3a]

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CONSTRAINTS

A. The muck handling system design shall accommodate handling of oversize material at the transfer points. [6.7PC1a, 3a]

B. The conveyers and/or transport system shall incorporate fail-safe devices and be designed with adequate safety factors as per applicable requirements of 30 CFR 57, and State of Nevada and local regulations. [6.7PC3b]

C. The muck and material handling systems shall be designed with a separate power feeder from the power distribution system. [6.7PC3b]

D. The muck and material handling systems shall be designed, installed, tested, operated, and maintained in conformance with applicable regulations. [6.7PC1a,3a,3b]

E. If a repository is to be constructed, the muck and material handling systems shall be maintained to support initial repository construction until these can be replaced by repository facilities. [6.7PC3a]

F. The conveyers shall include smoke and heat detection systems. [6.7PC3b]

ASSUMPTIONS

None.

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1.2.6.7.10 SANITARY FACILITIES

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The sanitary facilities are defined as the system that provides for human waste collection within the underground facilities.

Boundaries and Interfaces

For repository/ESF interface constraints, see ESFDR Appendix A.1. For repository/ESF interface drawings, see ESFDR Appendix A.2.

FUNCTIONAL REQUIREMENTS

1. Provide sanitary facilities at convenient locations throughout the underground facilities for the underground work force. [6.7FR1]

PERFORMANCE CRITERIA

1a. Dry chemical, self-contained portable type toilets shall be provided underground to accommodate the collection of wastes from a maximum occupancy underground, per shift. [6.7PC1a]

1b. Toilet facilities shall be located at convenient, noninterfering locations relative to operations, site characterization testing, and monitoring. [6.7PC1a,1e,1f]

1c. Sanitary waste shall be disposed of through the sanitary waste disposal system provided in 1.2.6.2.3. [6.7PC1a]

CONSTRAINTS

None.

ASSUMPTIONS

None.

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1.2.6.7.11 MONITORING AND WARNING SYSTEMS

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The monitoring and warning systems are defined as those systems required to monitor underground environmental conditions (eg. water, noise, dust, toxic and flammable gases, smoke, radon/radon daughters) and to alert onsite personnel of possible dangerous situations so as to ensure a safe and healthful working environment.

Boundaries and Interfaces

For repository/ESF interface constraints, see ESFDR Appendix A.1. For repository/ESF interface drawings, see ESFDR Appendix A.2.

FUNCTIONAL REQUIREMENTS

1. Monitor the underground for environmental conditions dangerous to personnel and warn of such conditions. [6.7FR1]

PERFORMANCE CRITERIA

1a. An alarm system shall give warning of hazardous conditions by indicating when the monitored condition(s) exceed predetermined limits and shall notify the responsible personnel on surface and all underground personnel of such hazardous conditions. [6.7PC1a,1c]

1b. A life safety alarm system shall be provided between the underground and surface. [6.7PC1a,1c]

1c. The central surface control room for the monitoring of the underground systems shall provide a central location for facility instrument readouts, alarms, equipment status, and automatic and/or manual override equipment controls. Monitor/control of the following equipment shall be incorporated into the design of the control room: water supply pumps, primary fans and doors, Monitoring and Warning System, conveyers, and underground wastewater collection system. [6.7PC1a,1c]

1d. The air quality monitoring system shall have the capability to sample, measure, and analyze physical and chemical conditions consistent with the requirements of applicable Federal, State, and local regulations. [6.7PC1a]

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1e. The underground ventilation system shall be monitored, as a minimum, for noise, dust, radon daughters, ammonia, nitrogen dioxide, nitrous oxides, sulfur dioxide, hydrogen sulfide, methane, oxygen, carbon monoxide, carbon dioxide, temperature, humidity, and air velocity and volume flow, as required by applicable federal, state and local regulations. [6.7PC1a,1c]

i. Concentrations of radon daughters in underground work areas shall be monitored in accordance with 30 CFR 57.5037.

CONSTRAINTS

A. Redundant components for all systems which monitor potential life threatening conditions shall be installed in accordance with applicable federal, state, and local regulations. [6.7PC1]

B. The ventilation monitoring systems for site characterization shall be separate and independent from the monitoring systems required for industrial hygiene and life safety support systems wherever this is feasible. [6.7PC1a,1c]

C. Monitoring systems shall utilize the Integrated Data System (IDS) as much as possible. [6.7PC1a]

ASSUMPTIONS

None.

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1.2.6.8 TEST SUPPORT

Subparts are 1.2.6.8.1 Integrated Data System (IDS) Support
1.2.6.8.2 Underground Test Support

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

Test support is defined as those activities associated with test equipment including but not limited to installation and maintenance, test execution, test data recording, and test analysis for in situ site characterization to be performed within the Yucca Mountain ESF. The facility requirements for individual underground tests are described in ESFDR Appendix B.

Boundaries and Interfaces

For repository/ESF interface constraints, see ESFDR Appendix A.1. For repository/ESF interface drawings, see ESFDR Appendix A.2.

APPLICABLE REGULATIONS, CODES, STANDARDS, AND DOE ORDERS

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

FUNCTIONAL REQUIREMENTS

1. Provide the means for implementing characterization and performance confirmation testing plans. [6.0FR1, FR2]

PERFORMANCE CRITERIA

1a. An Uninterruptible Power Supply (UPS) System(s) (as required) shall be available to ensure continuous operation of equipment and instrumentation related to critical testing as determined by the YMP through analysis. [6.0PC1k]

1b. Support shall be provided for the IDS and for individual tests. See ESFDR Appendix B for a summary of requirements. [6.0PC1k]

1c. Testing instrumentation/hardware, cables, computer equipment, and data acquisition and monitoring systems, shall be suitable for the expected underground environment. [6.0PC1k]

1d. Experiments, tests, equipment, and monitoring and control systems shall be secure from unauthorized access. [6.0PC1k]

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INTERFACE CONTROL REQUIREMENTS

1. The ESF designers shall interface with surface-based testing and repository designers on ESF site location and layout and on permanent ESF structures, systems, and components.

CONSTRAINTS

A. Tests shall be 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. Refer to ESFDR Appendix B for further information. [6.0PC2d]

B. Tests shall be prioritized by DOE through a performance allocation process (see the SCPB). [6.0PC1d]

   i. The above test prioritization shall be the basis for instrumentation design; testing layout; and ventilation, personnel, and utility requirements.

C. Large scale testing in the main test area shall not be allowed until two routes of egress or safe means of evacuation are available. [6.0PC1h,CO]

   i. Tests or parts of tests which can be initiated prior to when the two routes of egress are available shall be determined on the basis of the information contained in ESFDR Appendix B.

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

   i. Multipurpose boreholes (MPBH) shall be located in unexcavated pillars, to the extent practicable. {DAA 1.2.8.1}

   ii. Boreholes drilled from the main test level shall not penetrate significantly below the base of the TSw2 host rock, unless the impacts on the waste isolation performance of the site have been evaluated and found to be acceptable. [TBD] {DAA 1.2.8.2}

E. The design of the underground facility shall provide for control of water or gas intrusion. [10 CFR 60.133(d)] [6.0PC2e]

   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. [TBD] {DAA 1.10.8.1, 2.2.8.1}

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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] {DAA 1.14.8.1, 1.14.8.4, 2.5.8.1}

iii. Water use in testing shall be consistent with repository design goals to limit the increase in average percent saturation of the repository horizon to [TBD] percent and to limit increase in the local percent saturation to [TBD] percent in areas of waste emplacement. [TBD] {DAA 1.14.8.2}

iv. MPBHs or other surface drilled exploratory boreholes associated with the ESF shall be drilled dry. {DAA 1.14.8.3}

v. Fluids recovered during testing operations shall be disposed of in such a way as to avoid potential for performance impacts.

vi. Excess water shall be removed. [TBD] {DAA 1.14.8.5, 2.5.8.2}

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. {DAA 1.14.8.6}

viii. Management of water entering the ESF shall include quantity, location, and water balance. {DAA 1.14.8.7, 2.5.8.3}

ix. Gaseous products used in characterization shall not produce geochemical effects that impact waste isolation capabilities of the site. [TBD] {DAA 1.14.8.8}

ASSUMPTIONS

1. Planned testing and monitoring may be conducted in the accesses, testing alcoves, the Upper Demonstration Breakout Room, the Main Test Level, and the Calico Hills unit, as identified in ESFDR Appendix B and as directed by DOE.

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1.2.6.8.1 INTEGRATED DATA SYSTEM (IDS) SUPPORT

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The Integrated Data System (IDS) is defined as those hardware components and associated computer software necessary to acquire, store and disseminate data collected in connection with testing operations and construction and operations monitoring in the ESF. Support for the IDS consists of providing facilities as described in ESFDR Appendix B.

Boundaries and Interfaces

For repository/ESF interface constraints, see ESFDR Appendix A.1. For repository/ESF interface drawings, see ESFDR Appendix A.2.

FUNCTIONAL REQUIREMENTS

1. Provide for the incorporation of an IDS into the ESF. [6.8FR1]

PERFORMANCE CRITERIA

1. Facilities shall be provided, as given in ESFDR Appendix B, to incorporate an IDS into the ESF. [6.8PC1b]

INTERFACE CONTROL REQUIREMENTS

1. The ESF designers shall interface with IDS and repository designers on ESF site location and layout and on permanent ESF structures, systems, and components.

   See Section 1.2.6.0, Interface Control Requirements.

2. Interface control will be established between the following:

   i. The Facility designers and the IDS designers for the electrical and mechanical cable and terminating requirements between the instruments and the IDS.

   ii. The IDS designers and the Facility designers for the support requirements for the IDS facility.

CONSTRAINTS

None

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ASSUMPTIONS

None

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1.2.6.8.2 UNDERGROUND TEST SUPPORT

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

Four types of tests will be performed: geologic, geomechanic, near-field and thermally perturbed, and hydrologic and transport phenomena. The geologic tests are defined as the detailed characterization of the geology in the area of the ESF for (1) determining the suitability of the locations of the underground tests, (2) for defining the distribution of the rock characteristics and properties at those locations, and (3) relating the results of ESF hydrological, geomechanical, and geochemical tests to variations in the geologic framework of the site. Facility requirements for these tests are described in ESFDR Appendix B.

Boundaries and Interfaces

For repository/ESF interface constraints, see ESFDR Appendix A.1. For repository/ESF interface drawings, see ESFDR Appendix A.2.

FUNCTIONAL REQUIREMENTS

1. Provide adequate facilities to allow effective execution of tests. [6.8FR1]

PERFORMANCE CRITERIA

1. Provide facilities, support, controls, access and test site configurations required for each test as described in ESFDR Appendix B. [6.8PC1b]

CONSTRAINTS

A. For each test, comply with the requirements in ESFDR Appendix B. [6.8PC1b]

ASSUMPTIONS

None.

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1.2.6.9 ESF DECOMMISSIONING AND CLOSURE

Subparts are 1.2.6.9.1 Surface Facilities
1.2.6.9.2 Accesses and Underground Facilities

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

Decommissioning and closure are defined as those activities enacted to place the ESF facilities (systems and subsystems) into a permanently non-operable and safe condition. Requirements in this section apply only if Yucca Mountain is determined to be unsuitable as a repository. For requirements if Yucca Mountain is determined to be suitable and a license obtained from the NRC, see 1.2.6.0 PC2d.

Boundaries and Interfaces

For repository/ESF interface constraints, see ESFDR Appendix A.1. For repository/ESF interface drawings, see ESFDR Appendix A.2.

APPLICABLE REGULATIONS, CODES, STANDARDS, AND DOE ORDERS

No specific regulation, codes, standards, or DOE Orders have been defined for decommissioning and closure, other than those contained in Section 1.2.6.0, Applicable Regulations, Codes, Standards, and DOE Orders.

FUNCTIONAL REQUIREMENTS

1. Provide for decommissioning and closure of the ESF. [6.0FR1, FR2]

PERFORMANCE CRITERIA

1a. The ESF shall be designed, constructed, and operated, to not preclude meeting restoration requirements of applicable Federal, BLM, State, and local codes. [6.0PC1g, CI]

1b. Decommissioning and closure shall be in accordance with the Site Characterization Plan. [6.0PC1k]

INTERFACE CONTROL REQUIREMENTS

None

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CONSTRAINTS

None

ASSUMPTIONS

1. Subsequent to the selection process, but prior to the actual decommissioning of the ESF facilities, alternative uses may be identified that can influence the range and extent of the actual decommissioning tasks and the designs and plans that are required. These alternative uses may be identified as near-term and/or long-term commitments. The ESF will only be fully decommissioned and closed if no alternative uses are identified.

2. Systems, subsystems, and facilities may be utilized in other repository programs or salvaged in accordance with the Nuclear Waste Policy Act (NWPA) funding requirements.

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1.2.6.9.1 SURFACE FACILITIES

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The surface facilities include all of the facilities, systems, and subsystems as defined in previous sections: ESF Site, Surface Utilities, Surface Facilities, Shaft Collar, Shaft Hoist System, Ramp Portal, and Material Handling System.

Boundaries and Interfaces

For repository/ESF interface constraints, see ESFDR Appendix A.1. For repository/ESF interface drawings, see ESFDR Appendix A.2.

FUNCTIONAL REQUIREMENTS

1. Provide for decommissioning and closure of the ESF surface facilities. [6.9FR1]

PERFORMANCE CRITERIA

1a. Near term decommissioning of the surface facilities shall place the facilities in a permanently non-operable and safe condition. [6.9PC1b]

1b. Permanent decommissioning of the surface facilities shall restore the ESF site and the immediate surrounding areas so it is compatible with its initial condition. [6.9PC1a,1b]

CONSTRAINTS

A. Facilities shall be removed by the most practical and cost-effective methods: [6.9PC1a,1b]

   i. Portable and prefabricated buildings shall be emptied of their contents, dismantled, and removed from the site.

   ii. Systems and subsystems such as the hoist equipment (including the headframes) electric generators, electrical and water distribution systems, ventilation equipment, meteorological towers, and communications equipment shall be dismantled and removed from the site.

   iii. Buried water, electrical, and sewage lines may be disconnected below the surface and left in the ground.

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B. Any significant adverse environmental impacts associated with the ESF decommissioning shall be minimized through the use of good engineering practices, Reclamation Guidelines, and the Reclamation Implementation Plan. The Reclamation Guidelines and the Reclamation Implementation Plan shall be implemented to the extent practicable. [6.9PC1a]

ASSUMPTIONS

None

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1.2.6.9.2 ACCESSES AND UNDERGROUND FACILITIES

DEFINITION OF SUBSYSTEM ELEMENTS

Definition

The accesses and underground facilities include all of the facilities, systems, and subsystems as described in previous sections: Accesses, Underground Excavations, Underground Utility Systems, and Underground Test Support (excluding Collar, Hoist, and Portal Systems).

Boundaries and Interfaces

For repository/ESF interface constraints, see ESFDR Appendix A.1. For repository/ESF interface drawings, see ESFDR Appendix A.2.

FUNCTIONAL REQUIREMENTS

1. Provide for decommissioning and closure of the ESF accesses and underground facilities. [6.9FR1]

PERFORMANCE CRITERIA

1. Near term decommissioning of the ESF accesses and underground excavations shall place the facilities, systems, and subsystems in a permanently non-operable and safe condition. [6.9PC1a,1b]

CONSTRAINTS

A. Facilities shall be removed by the most practical and cost-effective methods: [6.9PC1a,1b]

   i. Horizontal and vertical drillholes extending from the ESF accesses and rooms shall be sealed.

   ii. Subsurface accesses, drifts, and rooms shall be backfilled with the material that was removed during excavation and/or with other suitable engineered material.

   iii. Equipment and structures shall be removed from ESF accesses.

   iv. ESF access liners may be left in place.

ASSUMPTIONS

None