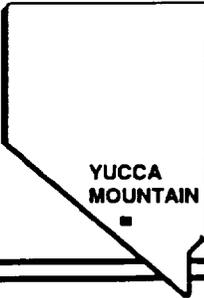


U.S. DEPARTMENT OF ENERGY

**WM**



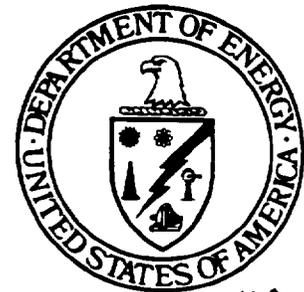
**YUCCA MOUNTAIN  
SITE CHARACTERIZATION  
PROJECT**

**PROJECT CCB CONTROLLED DOCUMENT**

*WM-11  
4/4/91*

**YUCCA MOUNTAIN  
MINED GEOLOGIC DISPOSAL  
SYSTEM REPOSITORY  
DESIGN REQUIREMENTS**

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



**UNITED STATES DEPARTMENT OF ENERGY  
YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT OFFICE**

*102-8*

106570001 110404  
PER WASTE  
WM 11

00011

*Delete all dist except CR, PDR, LDR, NUDOLS-abstract/  
NUDELS-full text - Please return original document  
Withdrawals to MD11.92th 414-3*

*102-8  
WM-11  
NHC-3*

U.S. DEPARTMENT OF ENERGY

**OC  
RM  
WM**



**YUCCA MOUNTAIN  
SITE  
CHARACTERIZATION  
PROJECT**

Document No. YMP/CC-0011  
Revision 0  
CI No. N/A  
Date 4/4/91  
WBS No. 1.2.1 - 1.2.7  
QA Level Yes

**PROJECT CCB CONTROLLED DOCUMENT**

**YUCCA MOUNTAIN  
MINED GEOLOGIC DISPOSAL  
SYSTEM REPOSITORY  
DESIGN REQUIREMENTS**

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

**UNITED STATES DEPARTMENT OF ENERGY  
YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT OFFICE**





6 Implementation Direction (continued)

will be identified on each page of the Publication Ready Document YMP/CC-0011.

4. The CCB Secretary shall ensure that YMP/CC-0011, Revision 0, 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-0011, Revision 0, 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 this Approved addition of Document YMP/CC-0011, Revision 0.
7. Any changes to Document YMP/CC-0011, Revision 0, will require submittal of a CR to the Project CCB.
8. Upon release of YMP/CC-0011, Revision 0, all Project Participants will be required to use YMP/CC-0011, Revision 0, in performing duties applicable to this document.

**YUCCA MOUNTAIN MINED GEOLOGIC DISPOSAL SYSTEM**  
**REPOSITORY DESIGN REQUIREMENTS**  
**(INTERFACE OF THE REPOSITORY AND EXPLORATORY SHAFT FACILITY)**

Prepared by Yucca Mountain Site Characterization Project participants as part of the Civilian Radioactive Waste Management Program. The Yucca Mountain Project is managed by the Project Office of the U.S. Department of Energy (DOE). Project work is sponsored by the DOE Office of Civilian Radioactive Waste Management.

**Compiled by:**

**Technical and Management Support Services Contractor**  
**101 Convention Center Drive, Suite 407**  
**Las Vegas, Nevada 89109**  
**Under the Direction of**  
**Sandia National Laboratories**

**Prepared for:**

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

~~RDR, REV. 0~~ <sup>mt</sup> 3/29/91

**SUBMITTALS AND APPROVALS**

This Repository Design Requirements document (RDR) for the Yucca Mountain Site Characterization Project has been prepared by the Technical and Management Support Services Contractor (T&MSS) and is submitted by the Sandia National Laboratories (SNL) with Project Office approval by:

Edgar H. Petrie Date : 3/22/91  
E. H. Petrie, Acting Director  
Engineering and Development Division  
Yucca Mountain Site Characterization Project Office

D. G. Horton Date : 3/22/91  
D. G. Horton, Director  
Quality Assurance Division  
Yucca Mountain Site Characterization Project Office

for Maxwell Blankoch Date : 3-22-91  
C. P. Gertz, Project Manager  
Yucca Mountain Site Characterization Project Office;  
Associate Director  
Office of Geologic Disposal

This document is approved for the resumption of ESF design studies. Verification of applicable requirements must be completed prior to the acceptance of design output.

YUCCA MOUNTAIN MINED GEOLOGIC DISPOSAL SYSTEM  
REPOSITORY DESIGN REQUIREMENTS  
(INTERFACE OF THE REPOSITORY AND EXPLORATORY SHAFT FACILITY)

TABLE OF CONTENTS

	<u>Pages</u>
Submittals and Approvals . . . . .	i
Table of Contents . . . . .	ii
List of Figures . . . . .	iii
List of Appendices . . . . .	iv
Introduction . . . . .	1
Interface of the Repository and Exploratory Shaft Facility. . .	7

YUCCA MOUNTAIN MINED GEOLOGIC DISPOSAL SYSTEM  
REPOSITORY DESIGN REQUIREMENTS

LIST OF FIGURES

	<u>Pages</u>
Figure 1. Yucca Mountain Project Document Hierarchy . . . . .	2
Figure 2. Waste Management Systems, Functions, and Requirements . . .	3

YUCCA MOUNTAIN MINED GEOLOGIC DISPOSAL SYSTEM  
REPOSITORY DESIGN REQUIREMENTS

LIST OF APPENDICES

	<u>Pages</u>
Appendix A. Responsibility Matrix . . . . .	A-1 - 2
Appendix B. References . . . . .	B-1

YUCCA MOUNTAIN MINED GEOLOGIC DISPOSAL SYSTEM  
REPOSITORY DESIGN REQUIREMENTS  
(INTERFACE OF THE REPOSITORY AND EXPLORATORY SHAFT FACILITY)

INTRODUCTION

The U.S. Department of Energy (DOE) has primary Federal responsibility for developing and implementing safe, environmentally acceptable, and cost-effective methods for the long-term disposal of radioactive waste. Within the DOE, the Office of Civilian Radioactive Waste Management (OCRWM) has chartered the Yucca Mountain Site Characterization Project (Project) to investigate the feasibility of using the Yucca Mountain site in southern Nevada for radioactive waste disposal.

This version of the Repository Design Requirements (RDR) document specifies the definition, function, performance criteria, and constraints for the Interface of the Repository and Exploratory Shaft Facility subelement of the repository section of the Yucca Mountain Mined Geologic Disposal System (YMMGDS).

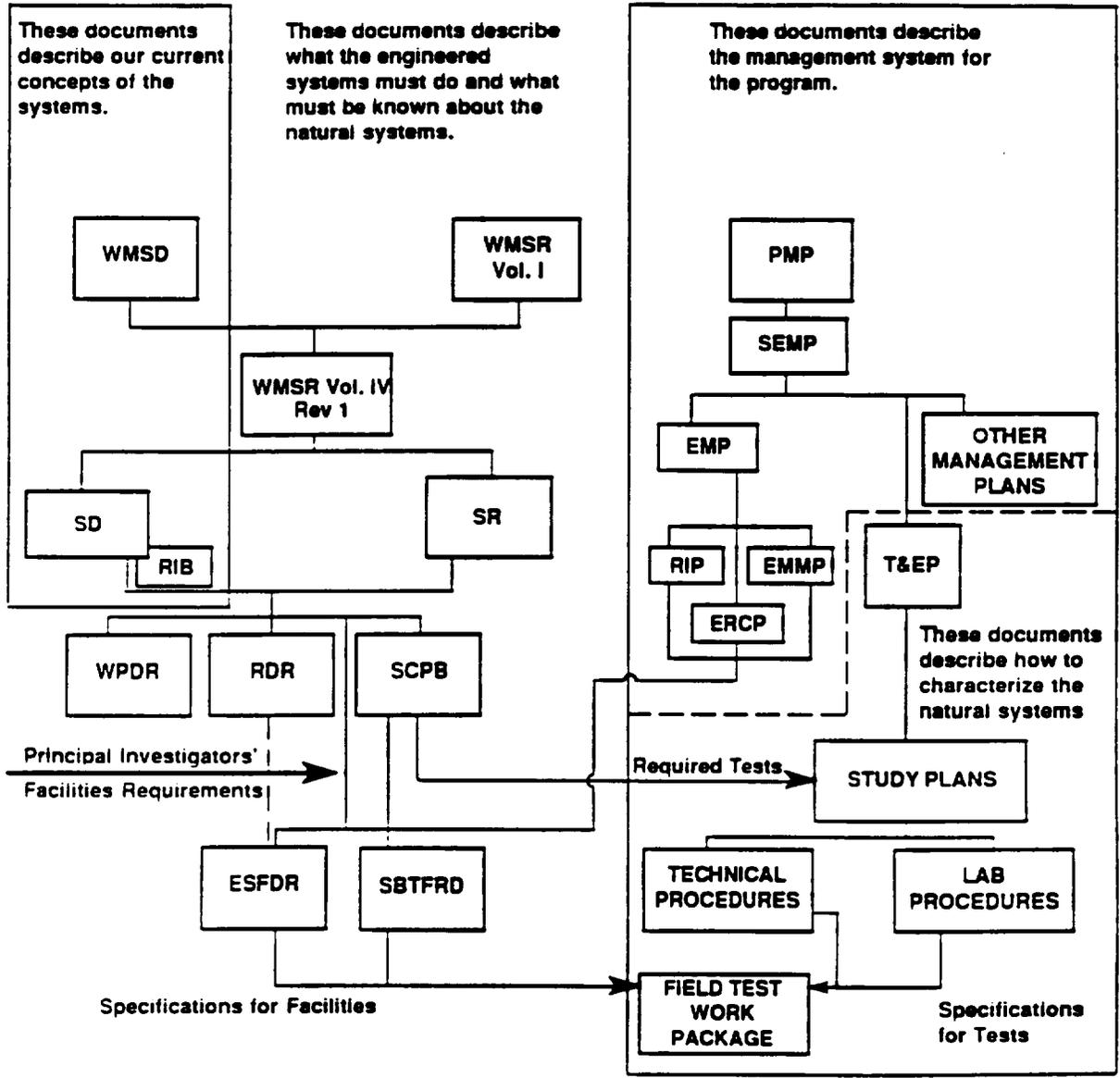
The YMMGDS, as defined in the SR document (see Figure 1), includes the following subsystems: Section 1.0 (Site) defines requirements for a suitable location of the repository. Section 2.0 (Repository) defines construction, operation, performance confirmation, closure, and decommissioning requirements. A subelement of 2.0 is The Interface of the Repository and Exploratory Shaft Facility which identifies the interface of the Repository Design Requirements and the ESF. Section 3.0 (System Performance Evaluation) defines requirements for evaluation of the MGDS repository and site. Subelements to 3.0 are the Surface Based Testing and Evaluations and the Exploratory Shaft Facility. These subsystems are developed from the Waste Management System Requirements (WMSR), Volume IV, Revision 1 (DOE 1991), Dispose of Waste (function 4.0), which includes the subfunctions To Process (4.1) and To Isolate (4.2) wastes. These functions require that a suitable location and a processing facility be provided. Other potential subelements, such as the Waste Package, are not needed for this analysis and are not included.

This requirements document is limited to activities and design relating to the Exploratory Shaft Facility. These are important to the proper evaluation of the ability of the site and repository to meet stated performance objectives (safe disposal and isolation of radioactive waste). The requirements provided in this document contribute to satisfying the upper tier requirements described in WMSR IV, and do not violate any upper tier requirements.

Figure 1 shows the Yucca Mountain Project Document Hierarchy for the total MGDS and the relationship of this document to the higher-tier documents. Figure 2, Waste Management Systems, Functions, and Requirements, shows the general flow-down of requirements from the waste management level. This figure summarizes the systems, functions and requirements.

**TECHNICAL DOCUMENT HIERARCHY**

**MANAGEMENT DOCUMENT HIERARCHY**



DOCHERP 126/3-18-91

NOTE: Refer to Systems Engineering Management Plan (SEMP) for definitions of acronyms.

FIGURE 1. The Yucca Mountain Project Document Hierarchy

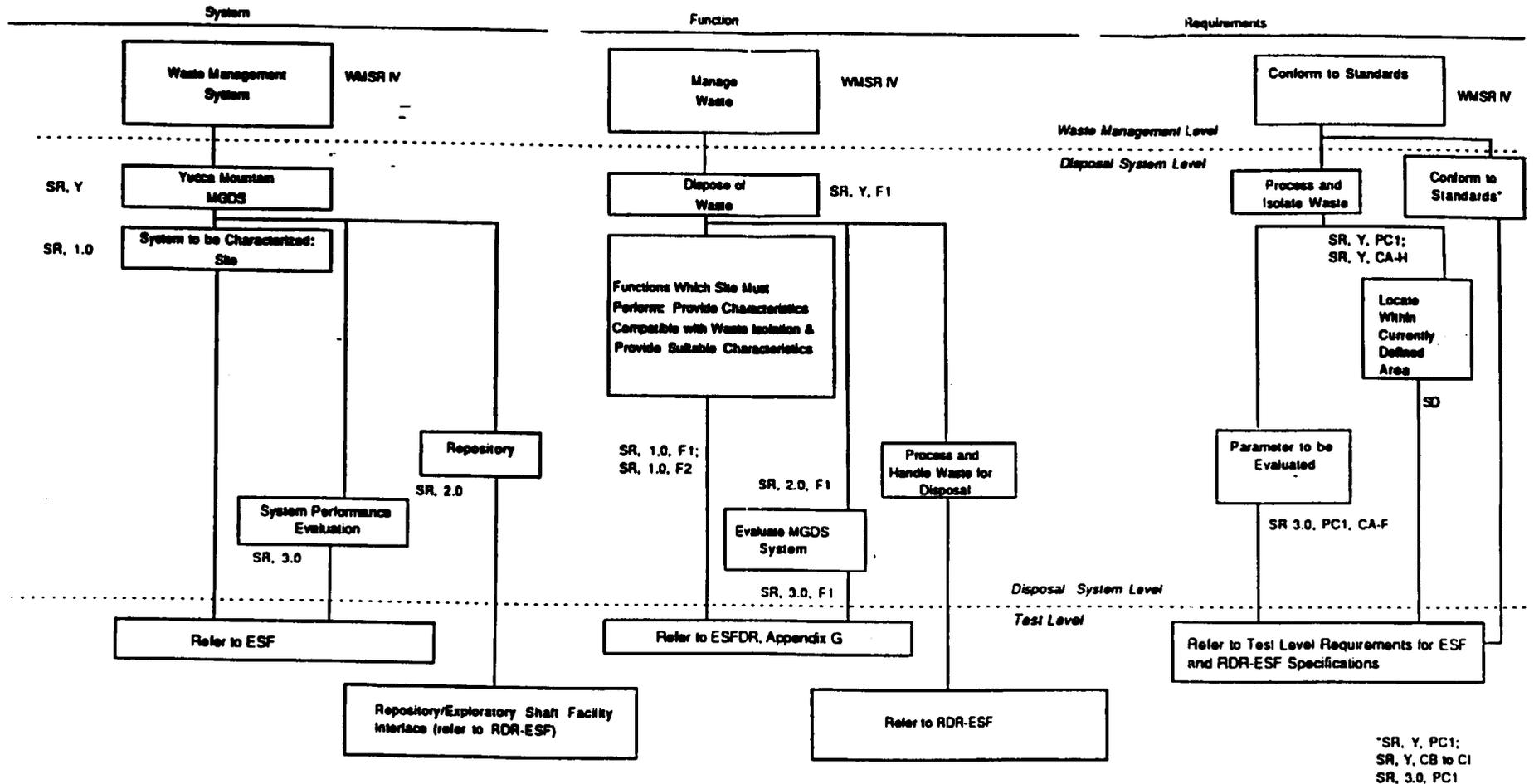


Figure 2 Waste Management Systems, Functions, and Requirements

Appendix A, as directed by YMP, is the responsibility matrix which lists the project organization responsible for accomplishing any requirement identified in this document. Appendix B lists the references for this document.

#### PURPOSE

The purpose of the RDR is to provide the interface requirements, known at the present time, which may affect the design of the ESF as it relates to functions and design of the repository. The primary assumption is that the ESF will provide systems, structures, and components to support the repository. Upon the future completion of a functional analysis for the repository (Section 2 of the SR), details will be added to this document to support functions identified by that functional analysis.

#### CHANGE PROCESS

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

#### WASTE MANAGEMENT SYSTEM REQUIREMENTS

The WMSR Volume I is the parent document which provides technical guidance and requirements for the technical requirements for the Yucca Mountain Site Characterization Project.

The WMSR Document Volume IV, Revision 1, is a major document in the technical element of the OCRWM Baseline. It contains the top-level requirements that guide Mined Geologic Disposal System (MGDS) development. Volume IV of WMSR incorporates by reference some requirements from Volume I of WMSR and thus is designed to be used in conjunction with Volume I of the WMSR, General System Requirements. Volume IV provides a set of requirements which must be satisfied. The changes to WMSR IV which affect the lower tier requirements documents will be included in the appropriate sections of this requirements document according to the change process.

#### ORGANIZATION

This document is organized by systems architecture. For the system element, the functions are described in the function category (F). The requirements of how well the function must be performed are included in the performance criteria (PC) and the constraints (C) sections.

The following format and definitions are used for all subsections of the Yucca Mountain Mined Geologic System Requirements.

## CONTENTS OF EACH SUBSECTION

Each of the following categories of information are included for each subelement. These categories will be expanded in the future with details identified by a functional analysis of the repository subelement.

## DEFINITION

This category states the general purpose of the subsystem or subsystem element.

## BOUNDARIES AND INTERFACES

This category defines the system boundary and identifies interfaces with other complimentary systems or subsystems which may affect the satisfaction of the requirements of interest.

## APPLICABLE REGULATIONS, CODES, AND SPECIFICATIONS

This category identifies those regulatory documents associated with the subject of the section.

## FUNCTION (F)

This category states definitions of what the system or subsystem element must accomplish. Functions are set forth as statements of purpose and are listed in numeric order.

## PERFORMANCE CRITERIA (PC)

This category contains criteria statements describing how well a specific subsystem must perform its function and, in some cases, provides direction for evaluating its performance. These criteria are listed in numeric-alphabetic order as a means of identifying the function with which they are associated. As an example, Performance Criteria 1a through 1f would be subordinate to Function 1.

## CONSTRAINTS (C)

This category contains statements on the limitations which are placed on the subsystem by the following:

1. design processes;
2. interrelated subsystems;
3. environmental conditions within which the subsystem or subsystem element must function;
4. applicable regulations, codes, standards, policies, guidance, and the like.

Constraints are listed in alphabetic order.

INTERFACES (I). This category identifies the complementary subelements which may affect the satisfaction of the requirements.

In addition to the above listed categories, the Yucca Mountain Project Systems Engineering Management Plan (SEMP) includes the categories: (1) PURPOSE, (2) DESIGN AND OPERATING REQUIREMENTS, (3) INTERFACE REQUIREMENTS, and (4) SYSTEM CONFIGURATION. Category (1) has been included in the category DEFINITION. Categories (2) and (3) are included in the categories PERFORMANCE CRITERIA and CONSTRAINTS. Category (4) is incorporated at the beginning of each system/subsystem entry. System Configuration includes the system "name" and the associated "subsystem." The overall system configuration is also shown on Figure 3.

#### TRACEABILITY

The basis for each statement in this section is given by a citation following the statement.

Specific examples of statement citations and their meanings are as follows:

[SR,2.0,PC1] This citation identifies that this statement is derived from Performance Criteria requirement one (1) from the System Requirements document (SR).

[10 CFR 60.133(d)] This citation example indicates that 10 CFR 60.133(d) has been quoted verbatim.

More than one statement citation can appear for a given requirement.

INTERFACE OF THE REPOSITORY AND EXPLORATORY SHAFT FACILITY

Subparts are:

TBD\*

Definition

The Interface of the Repository and Exploratory Shaft Facility is defined as Exploratory Shaft Facility accesses, underground openings, engineered items that are needed or intended for operating the potential repository, and equipment including piping, cable, or other components installed in the accesses or openings. After engineered items unnecessary to repository function have been removed, the remaining items may be modified or new structures, equipment, or other components may be constructed or installed to satisfy the functional requirements of the repository underground facility. Modifications to access and openings are bound by the repository underground excavations and the surface facilities.

Boundaries and Interfaces

Specific boundaries and interfaces between participating organizations' designs are identified in the Project Interface Control Document(s). Full compliance of the ESF design with the requirements and criteria of the ESFDR document necessitates an evaluation and understanding by the designer of the boundary and interface impacts of the requirements and criteria throughout this document.

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

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

\*The repository/ESF interface system details are not considered below this level. The interface will be developed more specifically during the Title I and II design phases.

## APPLICABLE REGULATIONS, CODES, AND SPECIFICATIONS

It is the responsibility of the Design Organization (DO) to identify which specific portions of regulations, codes, standards, and DOE orders apply. General references to some of these can be found in each section of this document. ESFDR Appendix E contains a listing of some additional commonly used regulations, codes, standards, and DOE orders. 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 Project 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 conflicting requirements, the mandatory standard providing the greater protection shall apply.

Written requests shall be made to the Project Manager of the Yucca Mountain Site Characterization Project Office, or his designee, to approve or obtain any required waivers.

### Function

1. Provide support for the repository underground facility ventilation system. [SR2.0,PC1]
2. Provide support for repository development or operations. [SR2.0,PC1]
3. Provide additional egress for repository underground facility emergency response. [SR2.0,PC1]

### Performance Criteria

1. The exploratory accesses and underground openings shall be considered in the repository ventilation design and shall support the airflow quantity that, when utilized in the airflow requirements in the repository design, is adequate for operations and closure. [SR2.0,PC1]
2. The exploratory accesses and underground openings shall be considered in the repository development and operations and shall include: personnel access and movement, material handling, muck handling, and utility services. [SR2.0,PC1]

3. The exploratory accesses shall be considered in the emergency response plan for the repository underground facility. [SR2.0,PC1]

### Constraints

- A. Siting, design, construction, operation, and modifications of the Exploratory Shaft Facility shall be in accordance with the requirements of Appendix E of the WMSR, Volume IV, such that the ESF modifications do not preclude the MGDS's ability to meet 10 CFR 60. [SR2.0,PC1]
  - i. ESF/repository interfaces must be included in the Exploratory Shaft Facility Design Requirements document (ESFDR), Appendix A. The ESFDR, Appendix A is not intended to be inclusive at this time and is subject to further definition during subsequent ESF and repository design phases. The following repository requirements must be considered during the preparation of ESF/repository interface documents and in the design of the ESF. These requirements are not intended to be inclusive at this time and are subject to further definition during subsequent ESF and repository design phases:
    - o Thermal loads from emplacement of wastes;
    - o Seal design criteria, locations, materials, and methods;
    - o Seismic loads, earthquakes and underground nuclear explosions;
    - o Adverse chemical identifications, usage and controls for construction, tests, etc.;
    - o Flooding from probable maximum flood;
    - o Geochemical properties for opening stability;
    - o Ventilation design for repository radionuclide release control, fire control and emergency egress considerations;
    - o Water usage and control;
    - o Flexibility of design;
    - o Control of water and gas intrusion;
    - o Rock excavation, creation of preferential pathways;
    - o Transportation and handling limitations (i.e., grades, drift sizes, etc.);
    - o Identification of adverse effects on the natural and engineered barrier systems; and
    - o Backfill (i.e., sizing, sorting, handling, storage, future repository needs).
  - ii. Repository regulatory requirements which pertain to the ESF (i.e., 10 CFR 60) must be identified in the ESFDR (see WMSR, Appendix E). Application of these regulatory requirements to design may necessitate the identification and definition of future ESF/repository interfaces.
- B. Use of the exploratory accesses and underground openings to support development and emplacement operations shall not interfere with site characterization and monitoring programs and experiments. [SR3.0,C]

Assumptions

None identified at this time.

## APPENDIX A

## EXPLANATION OF RESPONSIBILITY MATRIX

The responsibility matrix lists the organizations which are responsible for accomplishing two tasks associated with each requirement. The first task to be accomplished is to establish the requirement; the second is to implement it. The organizations responsible for the first task are listed under the heading, "Organization Responsible for Preparation of Requirement." Those listed are to determine that a requirement is correct and are responsible for defending the requirement. Although DOE is ultimately responsible for this, the responsibility can be delegated to other organizations, and such delegation is expected to occur. The organizations responsible for the second task are listed under the heading, "Organization Responsible for Compliance with Requirement." Those listed are responsible for demonstrating how the requirement has been met.

APPENDIX A  
RESPONSIBILITY MATRIX

Systems Description Section	Organization Responsible for Preparation or Allocation of Requirement	Organization Responsible for Compliance with Requirement
<u>RDR</u>		
PC #1	SNL prepares Project Office reviews/accepts	DOE/YMPO
PC #2	SNL prepares Project Office reviews/accepts	DOE/YMPO
PC #3	SNL prepares Project Office reviews/accepts	DOE/YMPO
C #A	SNL prepares Project Office reviews/accepts	DOE/YMPO
C #B	SNL prepares Project Office reviews/accepts	DOE/YMPO

APPENDIX B

REFERENCES

DOE (U.S. Department of Energy), "Waste Management Systems Requirements Document," Volume IV: Mined Geologic Disposal System, DOE/RW-0268P, Rev. 1, Washington, D.C., January 1991.

DOE (U.S. Department of Energy), "Yucca Mountain Mined Geologic Disposal System Requirements," YMP/91-8, Rev. 0., Las Vegas, NV, March 1991.