U.S. DEPARTMENT OF ENERGY

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YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT

Document No. YMP/CM-0023
Revision Rev. 0 ICN 1
CI No. N/A
Date 09/22/94
WBS No. 1.2.1.2
QA Level QA

PROJECT BASELINE DOCUMENT

REPOSITORY DESIGN REQUIREMENTS DOCUMENT

*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

YMP-035-RO
04/22/91

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

Page 1 of 1

1 Document Title:
Repository Design Requirements Document (RDRD)

2 Document Number:
YMP/CM-0023

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	94/387	Rev. 0, ICN-1	ICN 1 to the Repository Design Requirements Document Add a statement providing the status of the RDRD.	xvii		X		8/31/94

YMP-034-R2
11/13/91

YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT
CHANGE DIRECTIVE (CD)

¹ CR No. 94/387
Page 1 of 2

SECTION I. IDENTIFICATION

² Title of Change:

ICN 1 to the Repository Design Requirements Document

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 Repository Design Requirements Document ICN-1 is approved.
2. The CCB Secretary shall ensure that the Cover and Title pages for Document Number YMP/CM-0023, Revision 0, ICN-1 are prepared.
3. Within 10 working days of the signature of this CD, the Document Custodian shall provide a print ready copy of the Document YMP/CM-0023, Revision 0, ICN-1, with the Document Number and revision date identified on each page of the publication ready copy.

(See Change Documentation Continuation Page 2)

SECTION III. CONCURRENCE

All signatures below constitute procedural compliance. I have read, understood, and complied with Procedure YMP-03-09, Rev. 3, ICN # 4, in accomplishing my responsibilities in this procedure.

⁷ Quality Assurance Organization Concurrence

Name: R. E. Spence

(Print)

Org.: YMQAD

(Print)

Signature: J. Blaylock

Date: 9/13/94

⁸ Disposition Authority

Name: J. Russell Dyer

(Print)

Title: CCB Chprsn

(Print)

Signature: J. Russell Dyer

Date: 9/13/94

⁹ CD Effective Date

9/13/94

6 Implementation Direction (continued)

4. The CCB Secretary shall ensure that the Document YMP/CM-0023, Revision 0, ICN-1, 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-0023, Revision 0, ICN-1 to the Project Document Control Center (DCC) in accordance with AP-1.5Q.
5. Per AP-3.3Q, each Project Office Division Director (DD) and Technical Project Officer (TPO) shall complete an Affected Document Notice (ADN) as notification of completion of implementation for this CD. This review shall include all appropriate documents for which the DD or TPO are responsible, whether or not these documents are under CCB Control (e.g. Participant Procedures, Participant Analyses).

Each DD and TPO shall identify the personnel who perform the affected document review and ensure that these individuals are qualified to perform the review.

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-0023, Revision 0, ICN-1.
7. Any changes to Document YMP/CM-0023, Revision 0, ICN-1 will require submittal of a CR to the Project CCB.

YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT
CHANGE DIRECTIVE (CD)

SECTION I. IDENTIFICATION

2 Title of Change:

Repository Design Requirements Document

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 Repository Design Requirements Document is approved as a Project Baseline Document and is assigned Document Number YMP/CM-0023, Revision 0.
2. The CCB Secretary shall ensure that the Cover and Title pages for Document Number YMP/CM-0023, Revision 0 are prepared.
3. Within 10 working days of the signature of this CD, the Document Custodian shall provide a print ready copy of the Document YMP/CM-0023, Revision 0

(See Change Documentation Continuation Page 2)

SECTION III. CONCURRENCE

All signatures below constitute procedural compliance. I have read, understood, and complied with Procedure QMP-03-10 Rev. 3, ICN # 3, in accomplishing my responsibilities in this procedure.

7 Quality Assurance Organization Concurrence

Name: R. E. Spence

(Print)

Signature:

Org.: YMQAD

(Print)

Date: 7/29/93

8 Disposition Authority

Name: M. B. Blanchard

(Print)

Signature:

Title: CCB Chprsn

(Print)

Date: 7-29-93

9 CD Effective Date

7/29/93

6 Implementation Direction (continued)

with the Document Number and revision date identified on each page of the publication ready copy.

4. The CCB Secretary shall ensure that the Document YMP/CM-0023, Revision 0, 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-0023, 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 shall complete an Affected Document Notice (ADN) as notification of completion of implementation for this CD. This review shall include all appropriate documents for which the DD or TPO are responsible, whether or not these documents are under CCB Control (e.g. Participant Procedures, Participant Analyses).

Each DD and TPO shall identify the personnel who perform the affected document review and ensure that these individuals are qualified to perform the review.

The documents reviewed shall be identified, the required changes for each document shall be identified or indication made that no change is required (see attachment #1) and a recommended schedule for implementing the changes to come into compliance with YMP/CM-0023 shall be proposed. A Preliminary impact analysis was performed and is documented in the CR which is provided with this Directive as guidance.

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-0023, Revision 0.
7. Any changes to Document YMP/CM-0023, Revision 0 will require submittal of a CR to the Project CCB.
8. YMP/CM-0023, Revision 0, will be effective concurrent with YMP/CM-0024 (EBDRD) in accordance with the effectivity requirements of DCP-56.
9. YMP/CM-0023 is approved and supersedes YMP/CM-0018. Implementation must be held pending effectiveness of YMP/CM-0023 in accordance with the requirements of DCP-56.

Document Reviewed	Reviewer	Description Req'd Chgs	Planned Implementation

YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT
REPOSITORY DESIGN REQUIREMENTS DOCUMENT

REVISION 0

JULY 1993

Prepared for

U.S. Department of Energy
Office of Civilian Radioactive Waste Management

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

YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT
REPOSITORY DESIGN REQUIREMENTS DOCUMENT

REVISION HISTORY

<u>REV. NO.</u>	<u>ICN NO.</u>	<u>EFFECTIVE DATE</u>	<u>DESCRIPTION OF REVISION/ICN</u>
0			Initial issue

YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT
REPOSITORY DESIGN REQUIREMENTS DOCUMENT

Carl P. Gertz, Project Manager
Yucca Mountain Site Characterization Project

7-16-93
Date

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

7/15/93
Date

Richard E. Spence, Director
Yucca Mountain Quality Assurance Division
Yucca Mountain Site Characterization Project

7/16/93
Date

YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT

REPOSITORY DESIGN REQUIREMENTS DOCUMENT

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YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT
REPOSITORY DESIGN REQUIREMENTS DOCUMENT

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DOCUMENT NAME

TBD LOG

DOCUMENT/REVISION NUMBER _____

SECTION OR PARAGRAPH	RESPONSIBLE ORGANIZATION	SCHEDULE RESOLUTION DATE*	BRIEF DESCRIPTION
2.3	YMPO	TBD	Local ordinances
3.2.2.1.D.2	YMPO	TBD	Requirements, dose equivalent
3.2.3.1.2.B.3	YMPO	TBD	Nonstandard SNF
3.2.3.1.2.C.2	YMPO	TBD	Nonstandard HLW
3.2.3.1.3	YMPO	TBD	Retrieval
3.2.3.1.3.J	YMPO	TBD	Emergency assistance
Table 3-4	YMPO	TBD	Loaded from reactor (number of truck casks)
Table 3-4	YMPO	TBD	Unloaded from reactor (number of rail casks)
Table 3-4	YMPO	TBD	Loaded from reactor (number of rail casks)
Table 3-4	YMPO	TBD	Unloaded from reactor (number of truck casks)
3.2.3.2.2.A.7	YMPO	TBD	Proven technology
3.2.3.2.2.A.11.b	YMPO	TBD	Waste form temperature limit
3.2.3.2.2.B.3	YMPO	TBD	Engineered barrier system
3.2.3.2.2.B.3	YMPO	TBD	Shock and vibration
3.2.3.4.A	YMPO	TBD	Commercial power grid
3.2.3.4.A.1	YMPO	TBD	Independent feeds

SECTION OR PARAGRAPH	RESPONSIBLE ORGANIZATION	SCHEDULE RESOLUTION DATE*	BRIEF DESCRIPTION
3.2.3.4.A.2	YMPO	TBD	MVA
3.2.3.4.A.3	YMPO	TBD	Hertz
3.2.3.4.A.4	YMPO	TBD	Phase connections
3.2.3.4.B.	YMPO	TBD	Non-potable water
3.2.3.4.C.	YMPO	TBD	Potable water
3.2.3.4.D.	YMPO	TBD	Switched telephone system
3.2.3.4.D.1	YMPO	TBD	FTS lines
3.2.3.4.D.2	YMPO	TBD	Commercial long-distance lines
3.2.3.4.D.3	YMPO	TBD	Local NTS exchanges
3.2.3.4.D.4	YMPO	TBD	Private lines
3.2.3.4.E.1	YMPO	TBD	Channels
3.2.3.4.E.2	YMPO	TBD	Frequency
3.2.3.4.E.3	YMPO	TBD	Bandwidth
3.2.3.4.E.4	YMPO	TBD	Private lines
3.2.3.4.G	YMPO	TBD	Fuel supply
3.2.3.4.H	YMPO	TBD	Sewer system
3.2.5.2.5.B	YMPO	TBD	Detectable faults
3.2.5.2.5.C	YMPO	TBD	FD/FI
3.3.10	YMPO	TBD	Computer systems
3.5.3.3	YMPO	TBD	Cask maintenance

SECTION OR PARAGRAPH	RESPONSIBLE ORGANIZATION	SCHEDULE RESOLUTION DATE*	BRIEF DESCRIPTION
3.7.2.C.4	YMPO	TBD	Roads, emergency access
3.7.3.5.A.1	YMPO	TBD	Underground general lighting
3.7.3.5.A.2	YMPO	TBD	Service facility lighting
3.7.3.9.E	YMPO	TBD	Capacity to handle hazardous waste
3.7.4.1.A.2	YMPO	TBD	Storage capacity for waste receipts
3.7.4.1.A.3	YMPO	TBD	Storage facilities for waste receipts
3.7.5.A.5	YMPO	TBD	Size and weight of hoisting system
3.7.5.B.6	YMPO	TBD	Ventilation system
3.7.5.K.2	YMPO	TBD	Substances and tracers
3.7.5.N.5	YMPO	TBD	Shafts
3.7.5.P.3	YMPO	TBD	Emplacement area

DOCUMENT NAME

TBR LOG

DOCUMENT/REVISION NUMBER _____

SECTION OR PARAGRAPH	RESPONSIBLE ORGANIZATION	SCHEDULED RESOLUTION DATE*	BRIEF DESCRIPTION
3.1.5.B	YMPO	TBD	Cask maintenance facility
Table 3-3	YMPO	TBD	Waste delivery schedule
3.2.1.6.C	YMPO	TBD	Release of radionuclides
3.2.2.1	YMPO	TBD	Individual protection requirements
3.2.2.1.D.1	YMPO	TBD	Radiation
3.2.3.1.3.H	YMPO	TBD	NRC-certified casks
Table 3-5	YMPO	TBD	Cask fleet
3.2.5.4	YMPO	TBD	Service life
3.5.3.3	YMPO	TBD	Cask maintenance facility
3.7.1.C	YMPO	TBD	Groundwater
Glossary	YMPO	TBD	Vital area
Glossary	YMPO	TBD	Vital equipment
Table 6-1	YMPO	TBD	40 CFR 191.03(a)(1) 40 CFR 191.13(a) 40 CFR 191.15 40 CFR 191.16(a)(b)

DOCUMENT NAME

TBV LOG

DOCUMENT/REVISION NUMBER _____

SECTION OR PARAGRAPH	VERIFICATION/ VALIDATION ORGANIZATION	VERIFICATION/ VALIDATION DATE*	BRIEF DESCRIPTION
3.2.1.6.D	YMPO	TBD	Physical barriers
3.2.3.2.2.A.11.a	YMPO	TBD	Repository layout
3.2.3.2.2.A.9.a	YMPO	TBD	Cladding strain
3.2.3.2.2.A.9.b	YMPO	TBD	Cladding strain
3.2.3.4.F	YMPO	TBD	Trash pickup
3.2.5.2.5.D	YMPO	TBD	FD/FI commercial equipment
3.4.1.C	YMPO	TBD	TBV logs
3.7.5.A.5	YMPO	TBD	Size and weight of hoisting system
3.7.5.N.1	YMPO	TBD	Shaft airflow
3.7.5.N.2	YMPO	TBD	Tuff ramp airflow
3.7.5.O.2	YMPO	TBD	Men-and-materials shaft

Status of the Repository Design Requirements Document
(RDRD)

ICN-1 provides this statement on the status of the RDRD in partial response to CARs YM-94-002 and YM-94-003. In addition, CAR YM-94-002 requires that rationale be developed for the derived requirements in the RDRD and CAR YM-94-003 requires that any unqualified inputs be identified in the RDRD. The rationale for derived requirements and the identification of unqualified inputs will be included in the Requirements Backup Sheets and in Section 2, respectively, when the RDRD is revised (Rev. 1) in 1995. Potential users of the current RDRD (Rev. 0) need to be aware that: (1) developing the rationale for the derived requirements may require corrections to the derived requirements and (2) some inputs may be identified as unqualified inputs.

1. SCOPE

1.1 IDENTIFICATION

This Repository Design Requirements document, YMP/CM-0023 (RDRD) describes the functions to be performed by, and the requirements for, the Repository Segment of the Mined Geologic Disposal System (MGDS). The MGDS will be designed for the permanent disposal of spent nuclear fuel (SNF) and commercial and defense high level radioactive waste (HLW) in support of the Civilian Radioactive Waste Management System (CRWMS).

The Repository Segment is one of three segments of the MGDS. It is described conceptually in Section 1.3.

The development and control of the RDRD is quality-affecting work and is subject to the Department of Energy (DOE) Office of Civilian Radioactive Waste Management (OCRWM) Quality Assurance Requirements and Description, DOE/RW-033P (QARD). The RDRD and the other project-level requirements documents have been prepared and managed in accordance with the Technical Document Preparation Plan (TDPP) for the Preparation of MGDS Requirement Documents.

1.2 PURPOSE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT SYSTEM REQUIREMENTS DOCUMENTS

A description of the place of this requirements document within the CRWMS hierarchy and of the detailed purpose is provided in the following paragraphs.

1.2.1 CIVILIAN RADIOACTIVE WASTE MANAGEMENT SYSTEM REQUIREMENTS HIERARCHY

The OCRWM System Engineering Management Plan, YMP/CC-0007 (in preparation) establishes the technical document hierarchy (hierarchy of technical requirements and configuration baseline documents) for the CRWMS program. Figure 1-1 illustrates the program-level requirements documents in this hierarchy. This set of documents establishes the system requirements to be addressed by the design of the program elements, including the Repository Segment.

Many of the technical requirements for the CRWMS are documented in a variety of Federal regulations, DOE directives and orders, and other Government documents. The CRWMS Requirements document, DOE/RW-0406P (CRD) establishes the technical requirements for the entire program by summarizing the source documentation that must be addressed and by deriving requirements not covered in the regulations, but necessary to accomplish the CRWMS mission. The CRD also defines the CRWMS by identifying top-level functions for each element, defining the top-level system architecture of the CRWMS, and by allocating the functions and requirements to the architectural elements of the system, including the MGDS. In doing so, the CRD establishes the basis for the requirements to be addressed and expanded in the MGDS. The MGDS requirements document, DOE/RW-0404P (MGDS-RD) then allocates the requirements to the MGDS subsystems covered by the project level documents which provide additional definition for the requirements allocated to each segment.

SYSRQMTS.91/5-17-93

Figure 1-1 Program-level System Requirements Documents

1.2.2 PURPOSE OF REPOSITORY DESIGN REQUIREMENTS DOCUMENT

The purpose of the RDRD is to define the project-level requirements for the design of the Repository Segment consistent with the MGDS-RD. These requirements include design, operation, and decommissioning requirements to the extent they impact on the physical development of the repository. The document also presents an overall description of the Repository Segment and its functions (derived using the functional analysis documented by the MGDS-RD as a starting point). In addition, the project-level interfaces of the Repository Segment are identified. As such, the RDRD provides the technical baseline for the design of the repository.

Design of the Repository Segment must be consistent with the requirements of the RDRD. While the Repository Segment may evolve and change through the design process, changes must occur in a controlled manner that ensures the CRWMS remains integrated. In doing this, the CRD, MGDS-RD, and RDRD will be revised to capture the changes.

1.3 MINED GEOLOGIC DISPOSAL SYSTEM/REPOSITORY OVERVIEW

The CRWMS is composed of four system elements. These elements, as identified in the CRD, are Waste Acceptance (WA), Transportation, Monitored Retrievable Storage (MRS), and MGDS. Separate program-level requirements documents are written for each system element.

As illustrated in Figure 1-2, the project-level documents provide the requirements for the segments that comprise the MGDS system element. These documents are the RDRD for the Repository Segment, the Site Design and Test Requirements document (SD&TRD) for the Site Segment, and the Engineered Barrier Design Requirements document (EBDRD) for the Engineered Barrier Segment.

1.3.1 REPOSITORY MISSION

The mission of the repository is to provide a Nuclear Regulatory Commission (NRC)-licensed geologic repository in which to dispose of SNF and HLW in a timely manner that protects the health and safety of the public and workers, and maintains the quality of the environment.

1.3.2 REPOSITORY BACKGROUND

In the Nuclear Waste Policy Amendments Act of 1987, Public Law (P.L.) 100-203 (NWPAA), the Yucca Mountain site was designated by Congress as the single site for characterization as a geologic repository. The process and the schedule for this program were specified initially in the Nuclear Waste Policy Act of 1982, P.L. 97-425 (NWPAA). The act further states that Yucca Mountain will be selected only if suitable and the President recommends it, and, if the state of Nevada objects, Congress approves it.

This RDRD has been written to support the design of a repository in support of the potential license application should DOE determine that Yucca Mountain, Nevada is a suitable repository site. Technical efforts are inherently and unavoidably site-specific. It is fully recognized that Yucca Mountain may be found to be unsuitable for a repository,

Figure 1-2 Office of Civilian Radioactive Waste Management Requirements Document Hierarchy

MGDSOH-T.0908-11-92

or the CRWMS could be directed to another site. If that is the case, this document could become invalid and a new document written to support the revision of the design for whatever alternative site is specified for the repository by programmatic or policy decisions.

The NWPA defines SNF as the fuel that has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated by reprocessing. As used in this document, SNF is defined to include the nonfuel components and hardware as identified in Title 10 Code of Federal Regulations (CFR) 961. HLW is defined as: (1) the highly radioactive material resulting from the reprocessing of SNF, including liquid waste that contains fission products in sufficient concentrations, and (2) other highly radioactive material that has been determined by the NRC, consistent with the law, to require permanent isolation [42 United States Code (USC) 10102(23) and (12)]. Note that the CRWMS will accept both SNF and solidified HLW which are referred to herein as waste. By a 1985 Presidential Memorandum, the DOE was instructed to proceed with plans and actions to dispose of defense waste in the Repository.

1.3.3 SYSTEM CONCEPT

The CRWMS function, "Manage Waste Disposal," means to direct or control any physical activity, operation, or process conducted to accept, transport, store, or dispose of SNF or HLW. For planning, systems analysis, and conceptual design purposes, Manage Waste Disposal is divided into four subfunctions that the CRWMS must perform. These are Accept Waste, Transport Waste, Store Waste, and Dispose of Waste. The four corresponding physical system elements of the CRWMS that have been identified to implement these functions are WA, Transportation, MRS, and MGDS.

Figure 1-3 is a pictorial description of the CRWMS. This document addresses part of the fourth element, the MGDS.

The MGDS will emplace waste in an isolated geologic medium with no foreseeable intent of recovery, although the option to retrieve emplaced wastes will be preserved until the NRC amends the repository license for permanent closure.

The Repository Segment includes the geologic repository operations area (GROA), the portion of the geologic setting (i.e., geologic, hydrologic, and geochemical systems) that provides isolation of the radioactive wastes, and other facilities not directly subject to NRC licensing requirements.

Prior to license application for construction of the repository, the potential site at Yucca Mountain is being characterized to determine its suitability to host a repository and to obtain design and performance data. The data will be used to support repository and waste package design and to predict the performance of the geologic setting in isolating the waste from the accessible environment. The facilities supporting site characterization, the Exploratory Studies Facility (ESF) and Surface-based Testing Facilities (SBTF), are related to the MGDS and are defined as part of the MGDS Site Segment. If the site is found to be suitable, parts of the ESF may be incorporated into the Repository Segment design. The ESF will include roads, utilities, and other non-GROA features that could be retained in the non-GROA part of the MGDS. Additionally, the ramps, shafts, and some

Figure 1-3 Civilian Radioactive Waste Management System

drifts will likely be a part of the planned GROA. Site characterization activities, including the ESF and SBTf construction and operation, are required to not compromise the ability of the repository to isolate waste. A third MGDS segment is the Engineered Barrier Segment which consists of the waste package, backfill, if used in emplacement drifts, and other hardware.

The surface facilities will be clustered in two main sites, collocated with the portals to the ramps that provide access to the subsurface facilities. There will be auxiliary sites for special purposes such as storage of explosives. The facilities of one of the main sites is the location for receiving radioactive wastes in transportation casks by truck or rail. The waste will be removed from the transportation casks and placed into waste packages that will then be transported to the underground emplacement location. Surface facilities will also house support and performance confirmation functions as well as provide a place to store excavated rock. The underground facility will provide space for waste emplacement in vertical or horizontal boreholes or in the drifts; the emplacement method is now under study. The underground facility will also house support systems, including ventilation systems, equipment to monitor for radioactivity, and underground rescue equipment.

The support functions performed at the Repository Segment include administrative, safety, security, logistics, and performance confirmation functions.

1.3.4 REPOSITORY SEGMENT PERIOD OF PERFORMANCE

Once a site has been found suitable and a license issued, the Repository Segment will be constructed. The time period for Repository Segment performance begins with the initial delivery of waste to the MGDS and continues through at least 10,000 years following permanent closure of the MGDS facility.

1.3.5 REPOSITORY DESCRIPTION

The primary (but not only) source of requirements for the repository, 10 CFR 60, defines the repository as the GROA and the portion of the geologic setting that provides isolation of radioactive wastes. The MGDS-RD, however, requires and specifies additional facilities not covered by 10 CFR 60 and has allocated them to the Repository Segment

Conceptually, the Repository Segment is envisioned to include an underground facility, site civil improvements, waste handling facilities, surface support facilities on sites that contain entrances to the underground, piles of rock excavated from the underground, and various auxiliary sites for storage and other uses, and subsystems to supply, distribute, and control various utilities and services such as electrical power, water, and communications. Other facilities will be provided to house support functions such as administration, maintenance, personnel support, visitors center, security, safety, health physics, non waste-handling facilities, medical aid station, support for underground construction, and offices for NRC, Mine Safety and Health Act (MSHA), and other oversight organizations.

This RDRD addresses data- and design-related requirements that apply to the operational phases of the MGDS project from construction through post-closure.

1.4 DOCUMENT ORGANIZATION AND DESCRIPTION

1.4.1 DOCUMENT ORGANIZATION

This RDRD is organized as follows:

- A. Section 1: Scope. This section presents the system overview including the Repository mission and system concept.
- B. Section 2: Applicable Documents. This section identifies documents that provide a source or a reference for requirements for the RDRD.
- C. Section 3: Requirements. Except for the preparation for operation requirements in Section 5 this section contains all requirements of the repository. Performance characteristics and design and construction criteria are presented. Specialty engineering and logistics requirements are addressed along with requirements for documentation, personnel, and training. Qualification requirements, including requirements for quality assurance (QA), are also provided.
- D. Section 4: Conformance Verification. This section addresses conformance verification and includes a cross-reference matrix to define how each requirement of Sections 3 and 5 is to be verified.
- E. Section 5: Preparation for Operations. This section contains requirements for preparation for acceptance and operations.
- F. Section 6: Notes. This section contains material that is explanatory in nature, including a glossary and a table to cross reference requirements to their sources. There are no binding requirements in this section.
- G. Appendix A. This section contains the RDRD traceability matrix.

1.4.2 DESCRIPTION

The central purpose of the RDRD is to define the requirements for the design of the Repository Segment. As indicated in the outline of Section 1.4.1, Section 3 of this document is the primary source of the requirements, although some appear in Section 5. The requirements and source documents allocated to the RDRD by the MGDS-RD are addressed in expanded form. Requirements are included that have been derived to meet the system mission.

Section 3.1 establishes the description of the system in terms of functions and physical segments and the relationship between the two. Sections 3.2 to 3.6 address requirements important to the design of the Repository Segment in terms of interfaces, specialty engineering disciplines (e.g., system safety, integrated logistics support, human factors, reliability, availability, and maintainability (RAM), safeguards and security), and construction standards. Section 3.7 contains requirements associated with the Repository Segment functional areas.

The statement of a requirement is followed by a reference to the original source document reference to which the requirement is traced, in square brackets (e.g., [10 CFR 60.112] or [MGDS-RD]). When no source document is identified, "[Derived]" will follow the requirement and the approved RDRD is the authority for the requirement.

A fundamental objective of the RDRD is to reword the requirements from source documentation as necessary into statements of clear engineering direction that can be measured and verified by some engineering technique (analysis, examination, test, or demonstration). At times this may involve interpretation of requirements. It may also involve establishing measures for performance. Inasmuch as the Repository Segment design is evolving, some of this can only be done on an iterative basis. Sites have to be approved, studies and analyses have to be completed, decisions must be made, and issues have to be resolved [TBR] with the NRC. As a result, some requirements in early versions of requirements documents contain specifics that are still to be determined and are labeled to be determined [TBD]. In other instances, engineering judgment may permit a tentative statement as to values to be used for initial design work. In these instances, the requirement is labeled to be verified [TBV]. For the situations where the requirements are associated with issues that are at levels above this document, the use of [TBR] has been implemented. These requirements are being coordinated with the repository design organization to provide agreement with the conceptual design. Recognizing the risk associated with developing a design based on uncertainties associated with these requirements, the document includes requirements to develop a design that can be modified to address potential changes.

2. APPLICABLE DOCUMENTS

This section, specifically Sections 2.1 through 2.4, identifies documents which have been referenced as sources of requirements for the RDRD.

For each document, the issue in effect on the date of the approval of the RDRD, forms a part of the RDRD requirements to the degree specified herein. Each derivative specification is to use revisions and issues of source documents in effect on the date of approval of that specification.

Section 2.5 identifies reference materials that have not been used as sources of requirements, but are provided here for reference.

2.1 FEDERAL LAWS AND DOCUMENTS

In this category, the following are used as sources of requirements in the RDRD.

2.1.1 LAWS, STATUTES, U.S. CODES, AND TREATIES¹

<u>Identifier</u>	<u>Title or Description</u>
A. 7 USC 136 et seq.	Federal Insecticide, Fungicide, and Rodenticide Act of 1988
B. 15 USC 2601 et seq.	Toxic Substances Control Act
C. 29 USC 651 et seq.	Occupational Safety and Health Act (OSHA)
D. 33 USC 1251 et seq.	Clean Water Act of 1977 (CWA)
E. 42 USC 300f et seq.	Safe Drinking Water Act
F. 42 USC 4901 et seq.	Noise Control Act of 1972
G. 42 USC 7401 et seq.	Clean Air Act
H. 42 USC 10101 et seq.	Nuclear Waste Policy Act of 1982 (NWPAA, P.L. 97-425) and Nuclear Waste Policy Amendments Act of 1987 (NWPAA, P.L. 100-203)
I. 49 USC 1501 et seq.	Federal Aviation Act

¹Treaties will be included in this section, if and when applicable.

2.1.2 CODE OF FEDERAL REGULATIONS AND EXECUTIVE ORDERS

<u>Identifier</u>	<u>Title or Description</u>
A. 10 CFR 2	Rules of Practice For Domestic Licensing Proceedings and Issuance of Orders
B. 10 CFR 20	Standards for Protection Against Radiation
C. 10 CFR 60	Disposal of HLW in Geologic Repositories
D. 10 CFR 71	Packaging and Transportation of Radioactive Material
E. 10 CFR 75	Safeguards on Nuclear Material - Implementation of US/IAEA Agreement
F. 10 CFR 960	General Guidelines for Recommendation of Sites for Nuclear Waste Repositories
G. 10 CFR 961	Standard Contract for Disposal of SNF and/or HLW
H. 27 CFR 55	Commerce in Explosives
I. 29 CFR 1910	Occupational Safety and Health Standards
J. 29 CFR 1926	Safety and Health Regulations for Construction
K. 29 CFR 1960	Basic Programs Elements for Federal Employee Occupational Safety and Health Programs and Matters
L. 30 CFR 31	Diesel Mine Locomotives
M. 30 CFR 32	Mobile Diesel-Powered Equipment for Noncoal Mines
N. 30 CFR 36	Mobile Diesel-Powered Transportation Equipment for Gassy Noncoal Mines and Tunnels
O. 30 CFR 48	Training and Retraining of Miners
P. 30 CFR 49	Mine Rescue Teams
Q. 30 CFR 57	Safety and Health Standards - Underground Metal and Nonmetal Mines
R. 33 CFR 322	Permitting for Structures or Work in or Affecting Navigable Waters of the U.S.

S.	33 CFR 323	Permits for Discharges of Dredged or Fill Materials into Waters of the U.S.
T.	40 CFR 50	National Primary and Secondary Ambient Air Quality Standards
U.	40 CFR 60	Standards of Performance for New Stationary Sources
V.	40 CFR 61	National Emission Standards for Hazardous Air Pollutants
W.	40 CFR 122	U.S. Environmental Protection Agency (EPA) Administered Permit Programs: The National Pollutant Discharge Elimination System (NPDES)
X.	40 CFR 141	National Primary Drinking Water Regulations
Y.	40 CFR 143	National Secondary Drinking Water Regulations
Z.	40 CFR 144	Underground Injection Control Program
AA.	40 CFR 165	Regulations for the Acceptance of Certain Pesticides and Recommended Procedures for the Disposal and Storage of Pesticides and Pesticide Containers
AB.	40 CFR 191	Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes (under review)
AC.	40 CFR 204	Noise Emission Standards for Construction Equipment
AD.	40 CFR 205	Transportation Equipment Noise Emission Control
AE.	40 CFR 261	Identification and Listing of Hazardous Waste
AF.	40 CFR 262	Standards Applicable to Generators of Hazardous Waste
AG.	40 CFR 270	EPA Administrative Permit Programs, the Hazardous Waste Permit Program
AH.	41 CFR 101	Federal Property Management and Regulations
AI.	49 CFR 172	Hazardous Materials Tables and Hazardous Materials Communications Regulations

AJ. 49 CFR 173	Shippers -- General Requirements for Shipments and Packaging
AK. 49 CFR 177	Carriage by Public Highway
AL. 50 CFR 17	Endangered and Threatened Wildlife and Plants
AM. E.O. 11988	Executive Order: Floodplain Management
AN. Presidential Memorandum	Disposal of Defense Waste in a Commercial Repository (April 30, 1985)

2.1.3 OTHER DOCUMENTS, ORDERS, AND DIRECTIVES

<u>Identifier</u>	<u>Title or Description</u>
A. DOE 1324.2A	Records Disposition
B. DOE 3790.1A ²	Federal Employees' Occupational Safety and Health Program
C. DOE Order 4330.4A	Real Property Maintenance Management
D. DOE Order 4700.1	Project Management System
E. DOE 5000.3A	Occurrence Reporting and Processing of Operations Information
F. DOE NV 5400.1	General Environmental Protection Program
G. DOE 5480.1B	Environmental Safety, and Health Protection Program for DOE Operations
H. DOE 5480.4 [*]	Environmental Protection, Safety, and Health Protection Standards
I. DOE 5480.7 [*]	Fire Protection
J. DOE 5900.2A	Use of the Metric System of Measurement
K. DOE/NV 5480.3-27	Safety Requirements for the Packaging and Transportation of Hazardous Materials, Hazardous Substances and Hazardous Wastes
L. DOE 6430.1A	General Design Criteria
M. DOE/RW-0194	Records Management Policies and Procedures

^{2*}The asterisked DOE Orders apply only to the extent they do not conflict with NRC direction.

N.	DOE/RW-0333P	OCRWM Quality Assurance Requirements Document (QARD)
O.	DOE/RW-0239	DOE Position on Monitored Retrievable Storage (MRS)
P.	DOE/RW-0316P	Mission Plan Amendment (DRAFT), 1991
Q.	DOE/RW-0406P, CRD	CRWMS Requirements Document
R.	DOE/RW-0404P, MGDS-RD	Mined Geologic Disposal System Requirements Document
S.	NRC Reg Guides	1.52, Design, Testing, and Maintenance Criteria for Postaccident Engineered-Safety-Feature Atmosphere Cleanup System Air Filtration and Absorption Limits of Light-Water-Cooled Nuclear Power Plants, Revision 2, March 1978 8.5 Criticality and Other Interior Evacuation Signals, Revision 1, March 1981 8.8, Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations Will Be ALARA, Revision 3, June 1978 (Second Proposed Revision 4, Draft OP 618-4, 5/82) 8.10, Operating Philosophy for Maintaining Occupational Exposure ALARA, Revision 1-R, September 1975
T.	NUREG 0700	Guidelines for Control Room Design Reviews
U.	MIL-STD-1388-series	Logistics Support Analysis (LSA)
V.	MIL-STD-1472D	Human Engineering Design Criteria for Military Systems Equipments, and Facilities
W.	BLM Manual, Section 9113	Bureau of Land Management (BLM) Manual, Road Standards
X.	DOD-HDBK-743	Anthropometry of U.S. Military Personnel
Y.	MOA RW/NS	Nuclear Safety Requirements, dated April 16, 1992
Z.	MOU, DOE/DOL	Memo of Understanding Between the U.S. Department of Energy and the U.S. Department of Labor, December 23, 1986

2.2 STATE LAWS AND TRIBAL LAWS

In this category, the following are used as sources of requirements in the RDRD.

<u>Identifier</u>	<u>Title or Description</u>
A. NAC 445	Nevada Water Pollution Control Law
B. NRS Title 40 Chapter 445	Water Controls; Air Pollution
C. California Adminis- trative Code, Title 8	"Industrial Relations," Chapter 4, "Division of Industrial Safety," Subchapter 20, "Tunnel Safety Orders" (required by DOE Order 5480.4)

2.3 LOCAL ORDINANCES

In this category, the following are used as sources of requirements in the RDRD. [TBD]

2.4 NON-GOVERNMENT DOCUMENTS

In this category, the following are used as sources of requirements in the RDRD.

2.4.1 NATIONAL AND INTERNATIONAL STANDARDS

<u>Identifier</u>	<u>Title or Description</u>
A. AASHTO	A Policy on Geometric Design of Highways and Streets
B. ACGIH	Industrial Ventilation--A Manual of Recommended Practice, 19th Edition, 1986 Threshold Limit Values and Biological Exposure Indices for 1988-1989
C. ACI	ACI 318-83, "Building Code Requirements for Reinforced Concrete," in ACI--Manual of Concrete Practice--1985, Part 3, American Concrete Institute, Detroit, 1985. ACI 349-80, "Code Requirements for Nuclear Safety Related Concrete Structures" and "1984 Supplement to Code Requirements for Nuclear Safety Related Concrete Structures," in ACI--Manual of Concrete Practice--1985, Part 4, American Concrete Institute, Detroit, 1985.

NOTE: The previous two documents are also available as American National Standard Institute documents identified by their American National Standards Institute (ANSI) document number, e.g., ANSI/ACI 301-84, etc.

D.	ANSI/ASA 38-79	ANSI S3.18, Evaluation of Human Exposures to Whole Body Vibration
E.	ANSI	ANSI C2-1987, National Electrical Safety Code

ANSI N13.3-1969 (R1981), Dosimetry for Criticality Accidents

ANSI N42.18-1980 (R1985), Specification and Performance of Onsite Instrumentation for Continuously Monitoring Radioactivity in Effluents

ANSI N323-78 (R1983), Radiation Protection Instrumentation Test and Calibration |
| F. | ANS | ANSI/ANS 6.4-1985, Guidelines on the Nuclear Analysis and Design of Concrete Radiation Shielding for Nuclear Plants

ANSI/ANS 6.4.2-1985, Specification for Radiation Shielding Materials

ANSI/ANS 8.3-1979, Criticality Accident Alarm System |
G.	HFS	ANS/HFS 100-1988, American National Standard for Human Factors Engineering of Visual Display Terminal Workstations
H.	AREA	Manual of Railway Engineering
I.	ASCE 7-88	Minimum Design Loads for Buildings and Other Structures
J.	ASME	ANSI/ASME NOG-1-1985, Rules for Construction of Overhead and Gantry Cranes (Top Running Bridge, Multiple Girder)
K.	ASTM D4256	Test Method for Determination of the Decontaminability of Coatings used in Light-Water Nuclear Power Plants

L.	IES	ANSI/IES RP7-1983, Practice for Industrial Lighting

ANSI/IES RP8-1983, Practice for Loading Lighting |
| M. | NFPA | National Fire Protection Association (NFPA), 1992
National Fire Code |
| N. | SMACNA | "High Velocity Duct Construction Standards," 2nd
edition, Sheetmetal and Air Conditioning Contractors
National Association, Inc., 1969

"Low Velocity and Duct Construction Standards," 4th
edition, Sheetmetal and Air Conditioning Contractors
National Association Inc., 1969 |
| O. | ORNL NSIC-65, | Design, Construction and Testing of High-Efficiency
Air Filtration Systems for Nuclear Applications
(NRC Guide) |
| P. | CMAA 70 | Crane Manufacturer's Association of America
(CMAA) Specification for Electric Overhead
Traveling Cranes |
| Q. | AWS D1.1 | Structural Welding Code-Steel |
| R. | AWS D1.2 | Structural Welding Code-Aluminum |

2.4.2 OTHER PUBLICATIONS

<u>Identifier</u>	<u>Title or Description</u>
A. UCRL 15673	Human Factors Design Guidelines for Maintainability of DOE Nuclear Facilities
B. UCRL 15910	Design and Evaluation Guidelines for DOE Facilities Subjected to Natural Phenomena Hazards
C. UCRL 53526	Natural Phenomena Hazards Modeling Project: Seismic Hazard Models for DOE
D. MTR 10090	Guidelines for Designing User Interface Software (EST-TR-86-278)
E.	TDPP for the Preparation of MGDS-RD, Rev. 0, September 17, 1992

2.5 OTHER REFERENCES

This section identifies documents that have not been used as sources of requirements, but are provided here for reference.

<u>Identifier</u>	<u>Title or Description</u>
A. CRWMS	Interface Specification (Draft)
B. DOE/RW-0199	Site Characterization Plan: Yucca Mountain Site, Nevada Research and Development Area, Nevada (SCP)
C. DOE/RW-0334P	Physical Systems Requirements - Overall System, Rev. 0, January 1992
D. DOE/RW-DRAFT	Physical Systems Requirements - Dispose of Waste (Draft, June 21, 1991)
E. DOE/RW-DRAFT	Physical System Requirements - Exploratory Studies Facility (Draft, July 1991)
F. DOE/RW-0264	Waste Management System Requirements (WMSR) Document, Volume I, General System Requirements, Rev. 2, February 1992
G. DOE/RW-0268P	Waste Management System Requirements (WMSR) Document, Volume IV, MGDS, Rev. 2, February 1992
H. DOE/RW-0270P	Waste Management System Description Document (WMSD) Rev. 1, February 1992

3. REQUIREMENTS

Section 3, in Sections 3.2 to 3.9, specifies the requirements which are mandatory for the design, construction, and closure of the Repository Segment. Section 3.1 defines the system, while the balance of the sections specify requirements that are mandatory for Repository Segment design and construction. The design basis documents, to be published separately, will specify design-related requirements for each element as well as the interfaces particular to that element.

3.1 SYSTEM DEFINITION

This section defines the Repository Segment by identifying and defining the functions the Repository Segment will perform, providing information on the interrelationships of the functions, describing the Repository Segment, and allocating the identified functions to the functional areas. It also describes the major considerations and assumptions used in specifying the requirements contained in subsequent sections.

3.1.1 MINED GEOLOGIC DISPOSAL SYSTEM FUNCTIONAL ALLOCATION - DISPOSE OF WASTE - FUNCTION 1.4

The top-level function of the MGDS, Dispose of Waste, is shown in context with the other CRWMS functions in Figure 3-1. The Dispose of Waste function includes, as subfunctions, Characterize Site, Operate MGDS, Isolate Waste, Evaluate System Performance, and Close MGDS. These functions are depicted in the Functional Flow Block Diagram in Figure 3-2. There is no significance to the sequence of numbers assigned to the functions.

Shown in Figure 3-2 are the MGDS-RD allocated functions for the repository with the exception of the function Characterize Site. This function is the subject of another requirements document (see SD&TRD). Also, between the functions Characterize Site and Operate MGDS, a number of programmatic (or administrative) functions assigned to the DOE, NRC, the President, Congress, and possibly the courts are necessary. These are represented by the "ghost" function, Construct MGDS, and include, but are not limited to:

1. DOE recommendation and Presidential approval of site selection
2. Repository design
3. License application and approval
4. Repository construction (including the surface facilities and the initial portion of the underground emplacement areas)
5. Key Decision 4 - Approval to commence operations

Procedure-related requirements for these programmatic functions are not within the scope of this document. (The RDRD addresses the functions to be performed by the repository as a means to determine the facilities that are the end-products of design and construction. Design and construction requirements important to these facilities are included in Section 3.3 of this RDRD).

1-0FLOW.091/9-10-92

Figure 3-1 Manage Disposal of Waste (1.0)

3-3

WASTEFL0.091/4-30-93

Note: Characterize Site is a function driven by the Nuclear Waste Policy Act as amended

Figure 3-2 Dispose of Waste (1.4)

Dispose of Waste includes functions and activities required to emplace spent fuel and HLW in a geologic medium (while preserving an option for retrievability) and to isolate such wastes from the accessible environment.

The Characterize Site function (1.4.1) precedes the operation of the repository and includes performing a coordinated series of in situ and surface-based tests, investigations and analyses. The tests establish the geologic conditions and the ranges of the parameters of the site relevant to evaluation of site suitability and the design of the repository. The requirements allocated to the Characterize Site function are in the SD&TRD.

A site at Yucca Mountain in the State of Nevada was designated as the potential location for the repository. In order to determine whether the potential site is suitable for recommendation as a repository, the Secretary of Energy is directed by the NWPAA to "carry out ... appropriate site characterization activities at the Yucca Mountain site." Such investigations, also required by 10 CFR 60, consist primarily of surface-based field studies, the construction of an ESF, and the tests conducted in that facility. The requirements allocated to the surface based field studies and the ESF by the MGDS-RD are part of the SD&TRD.

The term "disposal" is defined in the law as the emplacement in a repository of HLW, SNF, or other highly radioactive material with no foreseeable intent of recovery, whether or not such emplacement permits the recovery of such waste. [42 USC 10102 (9)]³

This "disposal" isolates the radioactive wastes from the accessible environment. [10 CFR 60.2] This isolation is accomplished by a "Disposal System" - any combination of engineered and natural barriers that isolate SNF or radioactive waste after disposal. Those elements allocated to the natural barriers are the requirements contained in this document. Those requirements allocated to engineered barriers are contained in the EBD RD. [40 CFR 191.12(a)]

Table 3-1 provides a list of Dispose of Waste subfunctions that the MGDS-RD has allocated to the RDRD. The following sections define the major subfunctions of Dispose of Waste allocated to the Repository Segment.

3.1.1.1 OPERATE MINED GEOLOGIC DISPOSAL SYSTEM - FUNCTION 1.4.2

This function includes operating surface and underground facilities to handle radioactive wastes (including receiving, preparing, transferring, emplacing and retrieving (if required) radioactive wastes), and supporting repository operations (including, but not limited to, development of underground openings, and supplying utilities, services, QA, and administration). This function begins at the time the waste is received at the repository and ends at permanent closure.

³Entries in square brackets refer to the source documents from which the noted text was derived.

Table 3-1 Repository Segment Functions

Function Title	Number
Dispose of Waste	1.4
Operate MGDS	1.4.2
Handle Waste	1.4.2.1
Receive Waste	1.4.2.1.1
Prepare Waste	1.4.2.1.2
Transfer Containerized Waste To Underground	1.4.2.1.3
Emplace Waste	1.4.2.1.4
Retrieve Waste	1.4.2.1.5
Support MGDS Operations	1.4.2.2
Provide Utilities and Services	1.4.2.2.1
Provide Protective Services	1.4.2.2.2
Administer General Support Services	1.4.2.2.3
Process Site Generated Waste	1.4.2.2.4
Maintain Operating Facilities	1.4.2.2.5
Administer Quality Assurance	1.4.2.2.6
Develop Underground Openings	1.4.2.2.7
Isolate Waste	1.4.3
Limit Release of Radionuclides	1.4.3.2
Evaluate System Performance	1.4.4
Confirm In Situ Performance	1.4.4.1
Assess Performance	1.4.4.2
Assess Environmental Compliance	1.4.4.3
Monitor Performance	1.4.4.4
Close MGDS	1.4.5
Close Underground Openings	1.4.5.1
Decommission Surface Facilities	1.4.5.2
Establish Institutional Barriers	1.4.5.3
Reclaim Site	1.4.5.4

3.1.1.1.1 HANDLE WASTE - FUNCTION 1.4.2.1

This function includes receiving, preparing, transferring (within the MGDS), emplacing, and, if required, retrieving radioactive wastes. The capability for performing this function is necessary from the start of waste receipt at the MGDS. Each shipment requires this capability from the time of transfer of the shipment to the repository until completion of emplacement to satisfy the possibility of retrieval. The capability must remain available through the start of permanent closure. This function depends upon function 1.4.2.2 for utilities and other support, and assumes underground emplacement locations are prepared.

3.1.1.1.2 SUPPORT MINED GEOLOGIC DISPOSAL SYSTEM OPERATIONS - FUNCTION 1.4.2.2

This function includes operational and administrative support for operating and maintaining the MGDS, including continuing development of the underground waste emplacement areas.

3.1.1.2 ISOLATE WASTE - FUNCTION 1.4.3

This function includes inhibiting the transport of radionuclides so that amounts and concentrations entering the accessible environment are kept within prescribed limits. It includes initial containment of waste within a waste package, and then, by means of the other engineered and natural barriers, retardation of the movement of any uncontained radionuclides within the geologic setting. The functions allocated to the engineered barrier are included in a separate requirements document.

3.1.1.2.1 CONTAIN WASTE - FUNCTION 1.4.3.1

This function includes the containment of the waste within a waste package and has been allocated to the Engineered Barrier Segment.

3.1.1.2.2 LIMIT RELEASE OF RADIONUCLIDES - FUNCTION 1.4.3.2

This function includes the shared responsibility of the Repository Segment and Engineered Barrier Segment to retard the movement of any uncontained radionuclides within the geologic setting.

3.1.1.3 EVALUATE SYSTEM PERFORMANCE - FUNCTION 1.4.4

This function includes: estimating the ability of the repository system to comply with regulations governing its pre-closure and post-closure performance objectives and its effects on the environment; using the estimates in updates to compliance documents and in support of the continuing development of the system; conducting the performance confirmation and environmental monitoring programs needed to supply data for the estimates; and planning for post-closure monitoring of the system. This function will have started during the site characterization mode and will continue until permanent closure. [10 CFR 60.140(b)] Provision may be added for post-closure monitoring.

3.1.1.3.1 CONFIRM IN SITU PERFORMANCE - FUNCTION 1.4.4.1

This function includes the conducting performance confirmation program required by regulations; monitoring in situ conditions; collecting data through laboratory and field investigations; conducting in situ tests; and planning for appropriate actions. It consists of a program of tests, experiments, and analyses which is conducted to evaluate the accuracy and adequacy of the information used to determine with reasonable assurance that the performance objectives for the period after permanent closure will be met.

3.1.1.3.2 ASSESS PERFORMANCE - FUNCTION 1.4.4.2

This function includes estimating the ability of the MGDS to meet the performance objectives specified in regulations; using updated performance assessment models and data generated by the performance confirmation program; using the estimates in updates to compliance documents needed for licensing and in support of the continuing development of the system. Performance assessment is an analysis that: 1) identifies the processes and events that might impact the disposal system; 2) examines the effects of these processes and events on the performance of the disposal system; and 3) estimates the cumulative releases of radionuclides considering the associated uncertainties, caused by all significant processes and events. These estimates will be incorporated into an overall probability distribution of cumulative release to the extent practicable.

3.1.1.3.3 ASSESS ENVIRONMENTAL COMPLIANCE - FUNCTION 1.4.4.3

This function includes gathering the necessary data; performing the necessary analyses for determining compliance with regulations that govern the effects of the MGDS on the environment; and any necessary planning to mitigate environmental effects on the environment.

3.1.1.3.4 MONITOR PERFORMANCE - FUNCTION 1.4.4.4

This function includes planning for long-term monitoring of the performance of the geologic repository after it has been permanently closed.

3.1.1.4 CLOSE MINED GEOLOGIC DISPOSAL SYSTEM - FUNCTION 1.4.5

This function includes permanent closure of the repository to human access. This may include final backfilling of all or part of the underground facility (if deemed necessary by analysis and authorized by the license), closing and sealing openings (ramps, shafts, and boreholes), decommissioning surface facilities, reclaiming the site, and establishing institutional barriers. This does not preclude partial backfilling before permanent closure. This function begins upon approval of the license amendment for permanent closure and continues until the last institutional barrier is established and the license is terminated. Provisions may be added for post-permanent closure monitoring.

3.1.1.4.1 CLOSE UNDERGROUND OPENINGS - FUNCTION 1.4.5.1

This function includes final backfilling of the remaining open operational areas of the underground facility and boreholes after the termination of waste emplacement. It

includes removing underground equipment, backfilling underground openings, and the sealing of shafts and ramps.

3.1.1.4.2 DECOMMISSION SURFACE FACILITIES - FUNCTION 1.4.5.2

This function includes the permanent removal from service of surface facilities and components (necessary for preclosure operations only) after repository closure, in accordance with regulatory requirements and environmental policies. It includes decontaminating, dismantling, and removing facilities and reclaiming the site.

3.1.1.4.3 ESTABLISH INSTITUTIONAL BARRIERS - FUNCTION 1.4.5.3

This function includes establishing active and passive institutional controls for restricting access and avoiding disturbance to the MGDS controlled area and minimize or prevent intentional and unintentional activities in and around the MGDS that could breach the barrier systems for at least 1,000 years.

3.1.1.4.4 RECLAIM SITE - FUNCTION 1.4.5.4

This function includes actions taken to restore the MGDS site to as close as practicable to its original undisturbed condition.

3.1.2 MINED GEOLOGIC DISPOSAL SYSTEM FUNCTIONAL RELATIONSHIPS

Figure 3-1 shows the functional relationships between CRWMS functions. The relationships shown between the functions in Figure 3-1 illustrate the major functional flow of CRWMS - i.e., the flow of SNF and HLW waste from purchaser/producer to repository. The path through Store Waste is for a portion of the SNF only.

[DOE/RW-0239]

Figure 3-2 shows the relationships between Dispose of Waste functions.

Figure 3-3 shows the MGDS in context with the other CRWMS elements.

The functions that are addressed in this document are those that are to be performed by the facilities, geologic setting, hardware, and software that make up the Repository Segment. There are numerous other interfaces between the functions, e.g., movement of unloaded casks, reports, etc., which are secondary to the major functional flow and create additional feedback loops.

3.1.3 MINED GEOLOGIC DISPOSAL SYSTEM ARCHITECTURE DESCRIPTION

The MGDS consists of the physical segments that will be developed to accomplish the five top-level MGDS functions just discussed. These functions will be implemented by the Site Segment, the Repository Segment, and the Engineered Barrier Segment, as shown in the MGDS conceptual architecture in Figure 3-4. The ESF, the SBTF, and the site characterization test program are components of the Site Segment.

CRWMARCH.091/6-17-93

Figure 3-3 Civilian Radioactive Waste Management System Architecture

MGDSARCH.091/5-18-93

Figure 3-4 Mined Geologic Disposal System Architecture

These Site, Repository, and Engineered Barrier Segments will provide the primary facilities, hardware, software, and processes that comprise the physical means, together with the natural systems of the site, to accomplish all MGDS functions. The structure and components of the Engineered Barrier Segment and of the ESF and SBTF are specified in the EBDRD and SD&TRD, respectively. The primary linkages that involve significant material, equipment, data or information flows between MGDS segments will be defined and specified as interfaces in Section 3.2.3 of this RDRD.

3.1.4 FUNCTION TO ARCHITECTURE CROSS-REFERENCE

The allocation of functions to the MGDS segments is shown in Table 3-2.

This document addresses those functions allocated to the Repository Segment.

3.1.5 MAJOR CONSIDERATIONS AND ASSUMPTIONS

- A. For activities and facilities for which the NRC has regulatory authority, the NRC requirements are the controlling "nuclear safety" requirements. This means that portions of DOE CFR requirements and DOE Orders that address topics covered by CFR requirements issued by the NRC are not applicable to the CRWMS. Specifically, there are no nuclear safety design-related requirements in DOE Order 5480.11 applicable to the RDRD.
- B. A Cask Maintenance Facility (CMF), to be collocated with the MGDS [TBR], will be designed, constructed and integrated by the MGDS to meet the requirements of the Transportation element.

[CRD]

- C. The Repository Segment design will be based on the technical requirements contained in the current issue of 40 CFR 191 until it is revised and accepted. A new standard is to be developed by the EPA pursuant to the Energy Policy Act of 1992.
- D. The assumption used in developing this RDRD is the extent of blending (i.e., the mixing in waste packages of SNF and/or HLW of different thermal outputs) required is limited to that which can be accommodated by the WA process.

Thermal loading studies will determine the extent of blending that must occur. Limited blending can be accomplished at the MRS through the WA process. If significant blending is required, this could have a major impact on the MRS and/or repository design and operations, and will be the subject of system studies. If these studies show that changes in system design requirements are necessary, the requirements documents will be revised.

Table 3-2 Mined Geologic Disposal System Functions Allocated to Segments

FUNCTION TITLE	MGDS FUNCTION NUMBER	SITE SEGMENT	REPOSITORY SEGMENT	EBS SEGMENT
Dispose of Waste	1.4	X	X	X
Characterize Site	1.4.1	X		
Conduct Surface Investigations	1.4.1.1	X		
Conduct Subsurface Investigations	1.4.1.2	X		
Assess Data	1.4.1.3	X		
Close ESF	1.4.1.4	X		
Operate MGDS	1.4.2		X	
Handle Waste	1.4.2.1		X	
Support MGDS Operations	1.4.2.2		X	
Isolate Waste	1.4.3		X	X
Contain Waste	1.4.3.1			X
Limit Release of Radionuclides	1.4.3.2		X	X
Evaluate System Performance	1.4.4	X	X	X
Close MGDS	1.4.5		X	
Close Underground Openings	1.4.5.1		X	
Decommission Surface Facilities	1.4.5.2		X	
Establish Institutional Barriers	1.4.5.3		X	
Reclaim Site	1.4.5.4		X	

- E. The Repository Segment requirements are driven by 10 CFR 60. 10 CFR 60 is directed at "the licensing of DOE to receive and possess source, special nuclear, and by-product material at a geologic repository operations area." As such, it does not provide all (i.e., the non-license related) requirements needed for the repository. As the GROA and other areas become better defined, Repository Segment requirements will be modified.
- F. The term "controlled area" is used in this document as defined in YMP/89-15 Yucca Mountain Site Characterization Project Glossary.
- G. It is the position of DOE that the Federal Mine Safety and Health Act (MSHA) of 1977 (30 USC 801 et seq.) does not apply to the MGDS project because neither the geologic repository nor the ESF will be mines as defined in the Act. DOE's policy, however, is further stated in Memorandum of Understanding (MOU) with the Department of Labor, December 23, 1986. The MOU states DOE's "policy of compliance with MSHA [Mine Safety and Health Administration] standards as though repositories were commercial mines by taking necessary actions with the DOE contractors to assure prompt and effective correction of any deficiencies and to otherwise ensure general compliance with MSHA's mining health and safety requirements." Specifically, the MOU declares 30 CFR Parts 31, 32, 36, 48, 49, and 57 are relevant to OCRWM underground operations.

These parts are consistent with 10 CFR 60.131(b)(9). Further, DOE Order 5480.4, with change 3, imposes (by policy) Tunnel Safety Orders, Administrative Code, Title 8, Chapter 4, Subchapter 20, State of California. The California Mine Safety Orders are not considered applicable because there is no mine involved. This RDRD is based on these policies.

- H. The need to build a second repository to dispose of remaining inventories of waste will be submitted to and reviewed by Congress on or after January 1, 2007, but not later than January 1, 2010. This RDRD addresses only the first repository.
- I. The engineered barrier system (EBS), described in 10 CFR 60, overlaps with the GROA in that the underground facility is included in both. For the purposes of defining the MGDS, the underground facility including emplacement drifts is part of the Repository Segment. The waste packages and any backfill placed in emplacement drifts are part of the Engineered Barrier Segment.

3.2 CHARACTERISTICS

While all known requirements imposed by Government regulations for the GROA design are included in this document, these requirements are not exhaustive. Omissions in this document do not provide relief from any obligation to provide such safety features in a specific facility needed to achieve the performance objectives of 10 CFR 60.111, 60.112, and 60.113. Detailed GROA design shall include additional safety features developed in design analysis.

[MGDS-RD 3.7.2][10 CFR 60.130]

3.2.1 PERFORMANCE CHARACTERISTICS

Performance characteristics are the system's capabilities specified in terms of states, phases, or modes of operation in which the system can exist.

- A. **Mission Requirement.** The design of the Repository Segment shall provide for the disposal of SNF and civilian and defense HLW such that the public health and safety and the environment are protected.

[42 USC 10131(a)(4)][Presidential Memo, 1985]

- B. **Modes.** The Repository Segment will operate in seven of the eight modes depicted in the MGDS-RD. The only mode not applicable to the repository is Site Characterization which is the topic of the SD&TRD.

The Repository Segment can operate in more than one mode at a time. For example, the construction mode will begin after NRC issuance of the repository construction license. According to the current concept, only a portion of the emplacement locations will have been finished when the repository begins emplacement operations (again, after NRC approval). The Repository Segment will continue to expand the underground facility in parallel with waste emplacement operations. This is a unique program aspect in that construction becomes part of the operation of the system.

The requirements cited in the following Sections (3.2.1.1 through 3.2.1.7) are descriptive of the modes but may not be unique to the modes with which they are identified. For example, a performance confirmation program is required in all of the modes.

3.2.1.1 CONSTRUCTION MODE REQUIREMENTS

As stated above, the construction mode will begin after NRC issuance of the repository construction license. According to the current concept, only a portion of the emplacement locations will have been finished when the repository begins emplacement operations (again, after NRC approval). The Repository Segment will continue to expand the underground facility in parallel with waste emplacement operations.

- A. During the early or developmental stages of construction, a program for in situ testing of such features as borehole and shaft seals, backfill, and the thermal interaction effects of the waste packages, backfill, rock, and groundwater shall be conducted.

[MGDS-RD 3.2.1.2.A][10 CFR 60.142(a)]

- B. A program of in situ testing shall begin as early as practicable after construction authorization to meet the requirements of 10 CFR 60.142 (Section 3.7.6 of the RDRD).

[MGDS-RD 3.2.1.2.B][10 CFR 60.142(b)]

- C. Subsurface construction, excavation, alteration, and repair activities shall be governed by California Tunnel Safety Orders.

[MGDS-RD 3.2.1.2.C][DOE Order 5480.4, Att. 2, 2.e.(8)(a)]

- D. Because subsurface construction will continue after emplacement operations begin, radiological protection is required. The GROA shall be designed so that until permanent closure has been completed, radiation exposures, radiation levels, and releases of radioactive materials to unrestricted areas will at all times be maintained within the limits specified in 10 CFR 20 and applicable environmental standards for radioactivity established by the EPA, as listed in Section 3.2.2.

[MGDS-RD 3.2.1.2.D][10 CFR 60.111(a)]

3.2.1.2 EMPLACEMENT MODE REQUIREMENTS

The emplacement mode is defined to include all activities related to waste handling from receipt at the MGDS to permanent emplacement.

- A. Assuming the MRS facility is located more than 50 miles from the repository, no quantity of SNF and solidified HLW resulting from the reprocessing of such a quantity of spent fuel containing in excess of 70,000 metric tons of heavy metal shall be emplaced in the repository until such time as a second repository is in operation. (See Section 3.2.3.1.1.A)

[MGDS-RD 3.2.1.3.A][42 USC 10131 (d)]

- B. The repository shall be capable of receiving waste according to the schedule shown in Table 3-3 of this document.

[MGDS-RD 3.2.1.3.J][CRD 3.7.4.2.G]

- C. The GROA shall be designed so that until permanent closure has been completed, radiation exposures, radiation levels, and releases of radioactive materials to unrestricted areas will at all times be maintained within the limits specified in 10 CFR 20 and applicable environmental standards for radioactivity established by the EPA, as listed in Section 3.2.2.

[MGDS-RD 3.2.1.3.K][10 CFR 60.111(a)]

3.2.1.3 CARETAKER MODE REQUIREMENTS

When the repository has reached its legislated or physical capacity for waste disposal, it will be in the caretaker mode. The option to retrieve any and all emplaced waste will be preserved from the time of emplacement for up to 50 years. Performance confirmation will continue during this mode.

The GROA shall be designed so that until permanent closure has been completed, radiation exposures, radiation levels, and releases of radioactive materials to unrestricted areas will at all times be maintained within the limits specified in 10 CFR 20 and applicable environmental standards for radioactivity established by the EPA as listed in Section 3.2.2.

[MGDS-RD 3.2.1.4][10 CFR 60.111(a)]

3.2.1.4 RETRIEVAL MODE REQUIREMENTS

The retrieval mode includes functions related to removing waste packages from the underground facility.

- A. The repository shall be designed and constructed to permit the retrieval of any SNF and HLW emplaced in the repository, during an appropriate period of operation of the facility, as specified by the Secretary of Energy.

[MGDS-RD 3.2.1.5.A][42 USC 10142]

This schedule applies to the first repository only. The CRWMS WA system element will begin accepting title to waste in 1998 and the disposal function will continue until all waste is disposed of (conceptually, in a second repository).

[CRD]

Table 3-3 Waste Delivery Schedule
(In Metric Tons of Initial Uranium or Equivalent) [TBR]

Year	Spent Nuclear Fuel		High-Level Waste		Cumulative SNF and HLW
	From MRS*	Cumulative	Annual	Cumulative	
2010	300	300	0	0	300
2011	600	900	0	0	900
2012	1,200	2,100	0	0	2,100
2013	2,000	4,100	0	0	4,100
2014	3,000	7,100	0	0	7,100
2015	3,000	10,100	400	400	10,500
2016	3,000	13,100	400	800	13,900
2017	3,000	16,100	400	1,200	17,300
2018	3,000	19,100	400	1,600	20,700
2019	3,000	22,100	400	2,000	24,100
2020	3,000	25,100	400	2,400	27,500
2021	3,000	28,100	400	2,800	30,900
2022	3,000	31,100	400	3,200	34,300
2023	3,000	34,100	400	3,600	37,700
2024	3,000	37,100	400	4,000	41,100
2025	3,000	40,100	400	4,400	44,500
2026	3,000	43,100	400	4,800	47,900
2027	3,000	46,100	400	5,200	51,300
2028	3,000	49,100	400	5,600	55,700
2029	3,000	52,100	400	6,000	58,100
2030	3,000	55,100	400	6,400	61,500
2031	3,000	58,100	400	6,800	64,900
2032	3,000	61,100	200	7,000	68,100
2033	1,900	63,000	0	7,000	70,000
2034	0	63,000	0	7,000	70,000

*Notes: In years when SNF is shipped directly from the purchasers to the MGDS, the sum of the waste shipped directly and waste shipped from the MRS will be as stated in this column.

- B. The GROA 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 NRC review of the information obtained from such a program. To satisfy this objective, the geologic repository 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 NRC. 10 CFR 60.111(b)(3) gives guidance for developing the schedule.

[MGDS-RD 3.2.1.5.B][10 CFR 60.111(b)(1)]

- C. The GROA shall be designed so that until permanent closure has been completed, radiation exposures, radiation levels, and releases of radioactive materials to unrestricted areas will at all times be maintained within the limits specified in 10 CFR 20 and applicable environmental standards for radioactivity established by the EPA, as listed in Section 3.2.2.

[MGDS-RD 3.2.1.5.C][10 CFR 60.111(a)]

3.2.1.5

CLOSURE AND DECOMMISSIONING MODE REQUIREMENTS

When the NRC amends the repository license to authorize permanent closure, the underground facility will be backfilled (if required and authorized) and sealed; the surface facilities will be decontaminated and dismantled or converted to other uses.

The final state of the GROA shall conform to plans approved as part of the license for permanent closure and decontamination and dismantlement of surface facilities.

[MGDS-RD 3.2.1.6][10 CFR 60.52(c)(2)]

3.2.1.6

POST-CLOSURE MODE REQUIREMENTS

This mode begins at permanent closure and includes the isolate waste function and any residual functions such as maintaining the institutional barriers and performance confirmation.

- A. The repository shall include facilities with the capability of implementing a post-permanent closure monitoring program in accordance with the application to amend the license for permanent closure.

[MGDS-RD 3.2.1.7.A][10 CFR 60.51(a)(1)]

- B. The repository shall identify the controlled area and the GROA by monuments that are designed, fabricated, and emplaced to be as permanent as practicable.

[MGDS-RD 3.2.1.7.B][10 CFR 60.51(a)(2)(i)]

- C. The disposal system shall be designed to provide a reasonable expectation, based upon performance assessments, that the cumulative releases of radionuclides to the accessible environment for 10,000 years after disposal from all significant processes and events that may affect the disposal system shall have a likelihood of less than one chance in

10 of exceeding the quantities calculated according to Table A-1 of Appendix A of 40 CFR 191; and have a likelihood of less than one chance in 1,000 of exceeding ten times the quantities calculated according to Table A-1 of Appendix A of 40 CFR 191. [TBR]

[MGDS-RD 3.2.1.7.C][40 CFR 191.13(a)[TBR]]

- D. Facilities shall be provided to support active institutional controls at the repository site, including physical barriers to human intrusion and maintenance facilities. [TBV]

[Derived][MGDS-RD 3.2.1.7.A]

3.2.1.7 OFF-NORMAL MODE REQUIREMENTS

The off-normal mode involves accident, natural disaster, and other unexpected scenarios and can occur during any of the other modes.

- A. The GROA design shall 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 systems, structures, and components (SSCs) important to safety.

[MGDS-RD 3.2.1.8.A][10 CFR 60.131(b)(3)(iii)]

- B. The SSCs important to safety shall be designed to maintain control of radioactive waste and radioactive effluents, and permit prompt termination of operations and evacuation of personnel during an emergency.

[MGDS-RD 3.2.1.8.B][10 CFR 60.131(b)(4)(i)]

- C. The SSCs important to safety shall be designed to perform their safety functions during and after credible fires or explosions in the GROA repository.

[MGDS-RD 3.2.1.8.C][10 CFR 60.131(b)(3)(i)]

3.2.2 RADIOLOGICAL PROTECTION

3.2.2.1 GENERAL REQUIREMENTS

- A. The GROA shall, to the extent practicable, be designed and constructed to use procedures and engineering controls based upon sound radiation protection principles to achieve occupational doses and doses to members of the public that are as low as is reasonably achievable (ALARA). ALARA principles shall be based on the applicable sections of NRC Regulatory Guides 8.8 and 8.10.

[MGDS-RD 3.2.2.1.B][10 CFR 20.1101(b)]

- B. The GROA design and operations shall include provisions for controlling doses such that, when approved operational procedures are followed, the exposure dose limits specified in 10 CFR 20.1201 for occupational doses, and 10 CFR 20.1301 for individual members of the public, are not exceeded.

[MGDS-RD 3.2.2.1.C][10 CFR 20]

- C. The GROA shall be designed so that, until permanent closure has been completed, radiation exposures and radiation levels and releases of radioactive materials to unrestricted areas, will at all times be maintained within the limits specified in 10 CFR 20 and environmental standards for radioactivity as established by the EPA and specified in this document.

[MGDS-RD 3.2.2.1.D][10 CFR 60.111(a)]

- D. The GROA shall provide means to limit the levels of radioactive materials in effluents, during normal operations, anticipated occurrences, and under accident conditions.

[MGDS-RD 3.2.2.1.F][10 CFR 60.131(b)(4)(i)]

Releases shall be limited as follows:

1. Under normal operations and anticipated occurrences, the annual dose equivalent to any real individual who is located beyond the controlled area must not exceed 25 mrem to the whole body, 75 mrem to the thyroid, and 25 mrem to any other organ as a result of exposure to: planned discharges of radioactive materials, radon and its decay products excepted, to the general environment; direct radiation from Repository operations; and any other radiation from uranium fuel cycle operations within the region. [TBR]

[MGDS-RD 3.2.2.1.F.1][40 CFR 191.03(a)(1)[TBR]]

2. Under accident conditions, the annual dose equivalent shall not exceed [TBD].

[Derived][MGDS-RD 3.2.2.1]

- E. The disposal system shall be designed to meet the individual protection requirements specified by 40 CFR 191.15 [TBR].

[MGDS-RD 3.2.2.1.G][40 CFR 191.15 [TBR]]

3.2.2.2

PUBLIC PROTECTION

- A. Repository facilities shall be designed to operate so that the total effective dose equivalent (EDE) to individual members of the public from the licensed operation does not exceed 0.1 rem (1 mSv) in a year, exclusive of the dose contribution from the facility's disposal of radioactive material into sanitary sewerage in accordance with

10 CFR 20.2003. However, the facility may apply for prior NRC authorization to operate up to an annual dose limit for an individual member of the public of 0.5 rem (5 Msv) in accordance with 10 CFR 20.1301(c).

[MGDS-RD 3.2.2.3.A][10 CFR 20.1301(a),(c)]

- B. If members of the public have access to controlled areas, the limits for members of the public shall continue to be applicable to those individuals.

[MGDS-RD 3.2.2.3.B][10 CFR 20.1301(b)]

- C. Repository facilities shall be designed to operate so that the dose in any unrestricted area from external sources does not exceed 0.002 rem (0.02 mSv) in any one hour.

[MGDS-RD 3.2.2.3.C][10 CFR 20.1301(a)(2)]

3.2.2.3

AIRBORNE RADIOACTIVE MATERIAL CONTROL

- A. Concentrations of radioactive material in air shall to the extent practicable be controlled through the use of process or other engineering controls (e.g. containment or ventilation).

[MGDS-RD 3.2.2.4.A][10 CFR 20.1701]

- B. When it is not practicable to apply process or other engineering controls in restricted areas to control the concentrations of radioactive material in air to values below those that define an airborne radioactivity area, the repository shall, consistent with maintaining the total EDE ALARA, have the capability to increase monitoring and limit intakes by one or more of the following: control of access, limitation of exposure times, use of respiratory protection equipment, or other controls.

[MGDS-RD 3.2.2.4.B][10 CFR 20.1702]

- C. The GROA shall be capable of implementing and maintaining air sampling sufficient to identify potential hazards, to permit proper protective equipment selection, and to estimate exposures.

[MGDS-RD 3.2.2.4.C][10 CFR 20.1703(a)(3)(i)]

3.2.2.4

RADIATION MONITORING

Waste handling facilities shall be equipped to monitor occupational exposures to radiation at levels sufficient to demonstrate compliance with the occupational dose limits of 10 CFR 20, including:

A. Individual monitoring devices required for use by:

1. Adults likely to receive, in 1 year from sources external to the body, a dose in excess of 10% of the limits in 10 CFR 20.1201(a).

[MGDS-RD 3.2.2.5.A.1][10 CFR 20.1502(a)(1)]

2. Minors and declared pregnant women likely to receive, in 1 year from sources external to the body, a dose in excess of 10% of any of the applicable limits in 10 CFR 20.1207 or 10 CFR 20.1208.

[MGDS-RD 3.2.2.5.A.2][10 CFR 20.1502(a)(2)]

3. Individuals entering a high or very high radiation area.

[MGDS-RD 3.2.2.5.A.3][10 CFR 20.1502(a)(3)]

B. Equipment to monitor, as specified in 10 CFR 20.1204, the occupational intake of radioactive material by and assess the committed EDE to:

1. Adults likely to receive, in 1 year, an intake in excess of 10% of the applicable annual limit on intake in Table 1, Columns 1 and 2, of appendix B to 10 CFR 20.1001 - 10 CFR 20.2401.

[MGDS-RD 3.2.2.5.B.1][10 CFR 20.1502(b)(1)]

2. Minors and declared pregnant women likely to receive, in 1 year, a committed EDE in excess of 0.05 rem (0.5 mSv).

[MGDS-RD 3.2.2.5.B.2][10 CFR 20.1502(b)(2)]

C. Visual and audible alarm systems shall be provided to alert workers if radiation levels exceed established design levels. Visibility and audibility of alarms shall be in accordance with NRC Regulatory Guide 8.5.

[MGDS-RD 3.7.2.8.A.6][10 CFR 60.131(a)(6)]

D. Radiation monitors for monitoring radiation levels at various locations surrounding the site shall be provided. Appropriate monitors for ambient radiation, water, and airborne gaseous and particulate radioactivity will be used. Wells for monitoring radioactive contamination of groundwater shall be provided as required.

[MGDS-RD 3.7.2.8.G][10 CFR 60.132(c)(2)]

3.2.2.5

CRITICALITY PROTECTION

- A. All systems for processing, transporting, handling, storing, retrieving, emplacing, and isolating radioactive waste shall be designed to ensure that a nuclear criticality accident is not possible unless at least two unlikely, independent, and concurrent or sequential changes have occurred in the conditions essential to nuclear criticality safety. Each

system shall be designed for criticality safety under normal and accident conditions. The calculated effective multiplication factor must be sufficiently below unity to show at least a 5% margin, after allowance for the bias in the method of calculation and the uncertainty in the experiments used to validate the method of calculation.

[MGDS-RD 3.2.2.6.A][10 CFR 60.131(b)(7)]

- B. To mitigate any potential for nuclear criticality, the GROA shall be designed and constructed to comply with the nuclear criticality requirements specified by DOE Order 6430.1A, 1300-4.

[MGDS-RD 3.2.2.6.B][DOE Order 6430.1A, 1300-4]

- C. Facilities used to process radioactive wastes shall be designed and constructed to comply with the nuclear criticality criteria specified in DOE Order 6430.1A, 1324-3.

[MGDS-RD 3.2.2.6.C][DOE Order 6430.1A, 1324-3]

3.2.2.6 LOW-LEVEL WASTE DISPOSAL

- A. If the design of the Repository Segment provides for the disposal of licensed low-level waste material into sanitary sewerage, the requirements of 10 CFR 20.2003 shall be met.

[MGDS-RD 3.2.2.7.A][10 CFR 20.2003]

- B. If the design of the Repository Segment provides for the treatment or disposal of licensed low-level waste material by incineration, only the amounts and forms specified in 10 CFR 20.2005, or specifically approved by the NRC pursuant to 10 CFR 20.2002, shall be allowed.

[MGDS-RD 3.2.2.7.B][10 CFR 20.2004]

3.2.2.7 TRANSPORTATION PROTECTION

The Repository Segment shall be provided with the capability to comply with the requirements for packaging and transporting radioactive materials contained in 10 CFR 71 and 49 CFR 173 when shipping licensed radioactive material from the MGDS.

[MGDS-RD 3.2.2.8][CRD 3.2.2.7]

3.2.3 INTERFACE REQUIREMENTS

The Repository Segment interfaces with each of the other CRWMS elements and with local utilities and government services. The Engineered Barrier Segment depends upon the Repository Segment for these interfaces. The Repository Segment also interfaces with the geologic setting.

3.2.3.1 INTERFACES WITH OTHER CIVILIAN RADIOACTIVE WASTE MANAGEMENT SYSTEM ELEMENTS

3.2.3.1.1 REPOSITORY SEGMENT - MONITORED RETRIEVABLE STORAGE SEGMENT INTERFACES

The Repository Segment and the MRS interface through the combined waste capacity limits in effect when the two facilities are less than 50 miles apart, and during operation when SNF is unloaded from transportation casks from MRS and its identity is verified. In addition, this interface involves reports and schedules which are passed and coordinated between the MGDS and the MRS, including the coordination of shipments.

- A. In the event that the MRS is located, or planned to be located, within 50 miles of the MGDS, the combined quantity of waste in both the MRS and the first repository shall not exceed 70,000 metric tons of heavy metal until a second repository is in operation.

[MGDS-RD 3.2.3.2.1.A][42 USC 10134(d)]

- B. The Repository Segment shall have the capability to inspect and verify the description of SNF received from the MRS. If the SNF is improperly described, the Repository Segment will notify the MRS for resolution of the waste description.

[MGDS-RD 3.2.3.1.2.B]

3.2.3.1.2 REPOSITORY SEGMENT - WASTE ACCEPTANCE INTERFACES

This interface primarily involves reports and schedules communicated between the two entities. WA provides schedules of acceptance and shipping and descriptions of the contents of each waste shipment to the MGDS.

- A. The Repository Segment shall be capable of receiving and handling standard, failed, and nonstandard SNF described in Paragraphs 1, 2, and 3 below, respectively.
 1. Standard SNF meeting the criteria specified in 10 CFR 961.11 Appendix E, Sections B.1 through B.5.⁴
 2. Failed SNF meeting the criteria specified in 10 CFR 961.11 Appendix E, Section B.6.
 3. Nonstandard SNF [TBD], which is any SNF that does not fall within the standard or failed SNF description in Paragraphs 1 or 2 above.

[MGDS-RD 3.2.3.2.2.A][10 CFR 961.11 Article VI.A.1]

⁴SNF will be quantified in a subsequent revision of the WA-SRD.

- B. The Repository Segment shall be capable of receiving and handling standard and nonstandard HLW described in Paragraphs 1 and 2 below, respectively.
1. Standard canistered HLW, which is borosilicate glass sealed inside an austenitic stainless steel canister with a concentric neck and lifting flange which meets the following criteria:
 - a) Total length will be 3.000 meters (+0.005, -0.020 m).
 - b) Diameter will be 61.0 centimeters (+1.5, -1.0 cm).
 - c) Weight will not exceed 2500 kilograms.
 - d) Fill height will be equivalent to at least 80% of the volume of the empty canister.
 - e) Total heat generation rate will not exceed 1500 watts per canister at the year of shipment.
 - f) Waste temperature will not have exceeded 400°C during transit to ensure that the glass transition temperature was not exceeded.
 2. Nonstandard canistered HLW [TBD], which is any HLW that does not fall within the standard canistered HLW description in Paragraph 1.

[MGDS-RD 3.2.3.2.2.B][10 CFR 961.11 Article VI.A.1]

- C. The Repository Segment shall be capable of handling standard canistered HLW using a grapple provided by the waste producer with the following capabilities.
1. The grapple, when attached to the hoist and engaged with the flange, shall be capable of moving the canistered waste form in the vertical direction.
 2. The grapple shall be capable of being remotely engaged with and remotely disengaged from the HLW canister flange.
 3. The grapple shall be capable of being engaged or disengaged while remaining within the projected diameter of the waste form canister.
 4. The grapple shall include features that prevent inadvertent release of a suspended canistered waste form.

[MGDS-RD 3.2.3.2.2.C]

- D. The Repository Segment shall be capable of handling standard, failed, and nonstandard SNF, and nonstandard canistered HLW using grapples of its own design.

[MGDS-RD 3.2.3.2.2.D]

- E. The Repository Segment shall have the capability to inspect and verify the description of waste received. If the SNF or HLW is improperly described, the Repository Segment will notify WA for resolution of the waste description.

[MGDS-RD 3.2.3.2.2.E]

3.2.3.1.3

REPOSITORY SEGMENT - TRANSPORTATION INTERFACE

The Repository Segment and Transportation interface when SNF and HLW loaded in transportation casks are received for disposal at the Repository Segment and when unloaded casks are returned to the system. It includes all that is involved in interfacing and transferring the load cask systems from Transportation to the MGDS. It includes all the ancillary equipment and consumables needed for the task and then transferring the unloaded cask system from the MGDS to Transportation. The repository segment and the transportation element interface requirements shall be applicable for retrieval [TBD].

- A. Transportation provides the Repository Segment with all information needed to mate on-site equipment with the Cask/Transporter, off-load the cask from the transporter with the correct crane apparatus, prepare the cask for opening and ultimately open and mate the cask with the transfer cell so the waste constrained within can be unloaded. Transportation also relays information about the next waste shipment to be made so that the unloaded cask can be refitted at the CMF with the correct basket and ancillary equipment after being closed, cleaned, decontaminated, maintained, and repaired.
- B. The Repository Segment is responsible for inspecting and decontamination the cask using Transportation procedures. The Repository Segment also performs minor cask repairs using materials and instructions provided by Transportation.
- C. The Repository Segment shall be equipped with communications equipment to allow units operating in the vicinity of the Repository Segment to provide advance notice of their arrival.

[MGDS-RD 3.2.3.2.3.A]

- D. Access points for vehicles carrying transportation casks shall have an area for detaching and removing the Transportation prime mover from the site and attaching an on-site vehicle to the transporter.

[MGDS-RD 3.2.3.2.3.B]

- E. Provision shall be made for inspection of loaded transportation cask systems upon receipt. This inspection includes measurement of radiation levels external to the cask, levels of contamination on the cask surface, and the surface temperatures of the cask.

[MGDS-RD 3.2.3.2.3.C]

- F. Area shall be provided for queuing transportation casks/transporters awaiting access to the Repository Segment cask handling facility as designated in Table 3-4.

[MGDS-RD 3.2.3.2.3.D]

- G. The Repository Segment shall provide queuing space sufficient to allow 20 feet separation between loaded transportation casks awaiting access to the cask handling facility.

[MGDS-RD 3.2.3.2.3.E][49 CFR 177.842(f)]

- H. The Repository Segment shall be capable of handling NRC-certified transportation cask systems provided by Transportation. The types of cask systems are shown in Table 3-5.

[MGDS-RD 3.2.3.2.3.F][10 CFR 961.11 Article IV.B.2][TBR]

- I. The Repository Segment shall have facilities to clean the interiors of unloaded casks to satisfy the requirements of Transportation and any existing agreements for cleanliness with the waste purchasers/producers or the MRS.

[MGDS-RD 3.2.3.2.3.G]

- J. The Repository Segment shall be capable of providing emergency assistance (e.g., vehicle recovery, security, fire-fighting, ambulance) to Transportation operations within [TBD] miles of the MGDS.

[MGDS-RD 3.2.3.2.3.H]

- K. The Repository Segment shall provide a queuing area sufficient to accommodate loaded cask storage or waiting times of 24 hours.

[MGDS-RD 3.2.3.2.3.I]

3.2.3.2 LOCAL MINED GEOLOGIC DISPOSAL SYSTEM INTERFACES

The Repository Segment interfaces with the Engineered Barrier Segment and the Site Segment. It also interfaces with the geologic setting.

Table 3-4 Repository Segment Queuing Space for Transportation Casks/Transporters [TBV]

Transportation Cask/Transporter Type	Number of Truck Casks	Number of Rail Casks
Loaded From-Reactor	[TBD]	[TBD]
Unloaded From-Reactor	[TBD]	[TBD]
Loaded From-MRS	N/A	8
Unloaded From-MRS	N/A	10

Table 3-5 Transportation Cask Fleet [TBR]

Category	NRC Docket No.	Type	Capacity		Loaded Weight (lbs)	Overall Dimensions	
			PWR	BWR*		Length (in.)	Width (in.)
From-Reactor							
Existing Casks							
NLI 1/2	71-9010	LWT	1	2	49,500	195.2	47.125
NAC-LWT	71-9225	LWT	1	2	49,000	214	50
TN-8	71-9015	OWT	3	-	79,400	218	68
TN-9	71-9016	OWT	-	7	79,400	227	68
IF-300	71-9001	Rail	7	17	140,000	210	64
Proven Technology							
[TBD]	[TBD]	LWT	2	5	[TBD]	[TBD]	[TBD]
[TBD]	[TBD]	LAR LWT	4	12	[TBD]	[TBD]	[TBD]
[TBD]	[TBD]	Rail	10	21	[TBD]	[TBD]	[TBD]
[TBD]	[TBD]	Rail	12	24	[TBD]	[TBD]	[TBD]
Innovative Technology							
GA-4	[TBD]	LWT	4	-	52,600	187.5	48
GA-9	[TBD]	LWT	-	5	52,900	198.0	47.73
BR-100	71-9230	Rail	21	40	200,000	202	102
Extra Long	[TBD]	[TBD]	[TBD]	[TBD]	[TBD]	[TBD]	[TBD]
From-MRS							
[TBD]	[TBD]	Rail	37	[TBD]	332,000	205	104
Transportable Storage Casks							
[TBD]	[TBD]	Rail	26	52	200,000	202	102
HLW Cask							
[TBD]	[TBD]	[TBD]	[TBD]	[TBD]	[TBD]	[TBD]	[TBD]

* capacity of BWR fuel assembly with channels

** the requirement to handle existing casks at the MGDS is TBR

3.2.3.2.1 REPOSITORY SEGMENT - SITE SEGMENT INTERFACES

Portions of the Site Segment will be incorporated into the Repository Segment or will have been closed by the time the Repository Segment is constructed. The exploratory shafts and boreholes that are no longer needed may have been filled and sealed prior to initiation of Repository Segment construction, but remnants may still penetrate the underground facility. Prior to construction of the Repository Segment, however, the following requirement applies to the Site Segment.

Site characterization facilities and systems are to be designed and constructed in accordance with 10 CFR 60.15(c)(1) such that they do not preclude the ability of Repository Segment to meet the requirements in this document.

[MGDS-RD 3.2.1.1.B][10 CFR 60.15(c)(1)]

3.2.3.2.2 REPOSITORY SEGMENT - ENGINEERED BARRIER SEGMENT INTERFACE

The Repository Segment provides all mechanical, utility, logistics, safety, administrative, and mechanical support for the Engineered Barrier Segment. It also includes excavation and backfill machinery. The Engineered Barrier Segment has no inherent capability for these functions.

- A. The Repository Segment provides systems and facilities in support of the functions and services shown in Table 3-6.

Table 3-6 Repository Segment Functions Supporting the Engineered Barrier Segment

Emplacement area development and access
Waste receipt, preparation, transfer, emplacement, and retrieval, including shielding before and during emplacement and during retrieval.
Lag storage for waste and waste packages
Backfilling and sealing (if required)
Closing and decommissioning
Utilities (ventilation, fire protection, electric power (if needed), removal of site generated waste, communication, monitoring,
Performance assessment/confirmation
Security, health physics, safety, training, QA
Administration, logistics, material control
Radiologic protection
Personnel support and habitability

Physical outputs from the Repository Segment to the Engineered Barrier Segment include: waste packages for emplacement, backfill and other barrier materials, and fresh air. Requirements associated with this interface include the following:

1. The repository shall provide a reasonable assurance that the public and the environment will be adequately protected from the hazards posed by radioactive wastes emplaced.

[MGDS-RD 3.7.2.8.C][42 USC 10131(b)(1)]

2. The design and operation of the repository shall not compromise the Isolate Waste function of the Engineered Barrier Segment by affecting the performance of the waste packages and the underground facility or the geologic setting.

[Derived]

3. Performance confirmation testing interfaces will incorporate the following requirements:

- a) **Thermomechanical Response.** Waste emplacement methods and configurations shall permit in situ monitoring of the thermomechanical response of the emplacement areas until permanent closure to ensure that the performance of the natural and engineering features are within design limits.

[MGDS-RD 3.7.2.7.D][10 CFR 60.141(e)]

- b) **Laboratory Experiments.** To support the waste package monitoring program required by 10 CFR 60.143(a) and (b), Waste emplacement methods and configurations shall be designed to facilitate laboratory experiments that focus on the internal condition of the waste packages.

[MGDS-RD 3.7.2.7.E][10 CFR 60.143(c)]

4. Provisions shall be made for monitoring underground conditions and evaluating them against design assumptions.

[MGDS-RD 3.7.2.7.A.6][10 CFR 60.141(b)]

5. All fluids used in the construction and operation of the underground facility shall be strictly controlled to avoid introduction of products that could accelerate waste package corrosion or transport radionuclides.

[MGDS-RD 3.7.2.6.K]

6. The repository shall provide adequate shielding for a canisterized waste package with a maximum surface gamma dose rate of [TBD] rem/hr and a maximum surface neutron dose rate of [TBD] rem/hr.

[Derived]

7. The Repository Segment shall accommodate the emplacement concept [TBD] selected during advanced conceptual design.

[Derived]

8. Repository Segment test facilities and equipment shall be compatible with the periodic testing and evaluation requirements of the waste package as required by 10 CFR 60.143.

[Derived]

9. If the waste form is exposed for any purpose, the Repository Segment is responsible for the following:

- a) During the repository operations, the temperature of the spent fuel waste form and the access of air to the waste form shall be controlled before emplacement such that oxidation of spent fuel through existing cladding defects is less than the amount that would result in five percent [TBV] cladding strain.
- b) Repository operations at the surface handling facility shall be designed so that cladding failure from mechanical abrasion or deformation considering thermally-induced effects will result in less than five percent [TBV] cladding strain.
- c) Repository handling equipment and operations shall be physically and chemically compatible with the canisterized and uncanisterized waste forms.

[Derived][CRD 3.2.3.2.A, 3.2.3.2.B]

10. The repository layout shall be designed to preclude the potential for nuclear criticality accident of the stored waste at any time after being received at the MGDS.

[Derived][MGDS-RD 3.2.2.6]

11. The underground facility shall be designed based on the requirement that, assuming anticipated processes and events, containment of radioactive material within the waste packages will be substantially complete for a period TBD by the NRC, but not less than 300⁵ years nor more than 1,000 years after permanent closure of the geologic repository⁶.

⁵NRC Staff Position 60-001 indicates that this is a minimum performance requirement, and credit can be taken in performance assessments for containment in excess of 1000 years.

⁶10 CFR 60.113(b) says the NRC may later revise this requirement on a case-by-case basis.

- a) The repository layout shall be designed so that a combination of characteristics will assist in keeping liquid water from contacting the waste packages for the first 300 to 1000 [TBV] years after closure.

[Derived]

- b) The layout shall also ensure that the design limit temperatures [TBD] for waste forms are not exceeded.

[Derived][MGDS-RD 3.7.3.2.C][10 CFR 60.113 (a)(1)(ii)(A)]

B. The Engineered Barrier Segment outputs to the Repository Segment include heat, exhaust air, mechanical load, retrieved waste packages, and performance confirmation data.

- 1. The Engineered Barrier Segment will permit tests appropriate or necessary (as determined by the NRC) for the administration of the regulations of 10 CFR 60. The test may be performed in situ or in Repository Segment Facilities. The tests may include tests of:

- a) Radioactive waste.

[Derived][10 CFR 60.74(a)(1)]

- b) Other equipment and devices used in connection with the receipt, handling, or storage of radioactive waste.

[Derived][10 CFR 60.74(a)(4)]

- 2. The Waste Package, coupled with the repository, shall include provisions for controlling doses such that when approved and operational procedures are followed, the exposure doses specified in 10 CFR 20.1201 for occupational doses, and 10 CFR 20.1301 for individual members of the public, are not exceeded.

[Derived][10 CFR 20.1201][10 CFR 20.1301]

- 3. The Engineered Barrier Segment shall be able to withstand shock [TBD] and vibration [TBD] levels characteristic of handling, emplacement, retrieval and seismic environments, without adverse impacts on waste containment and isolation capability.

[Derived][MGDS-RD 3.7.3.3.E]

3.2.3.2.3 REPOSITORY SEGMENT - GEOLOGIC SETTING INTERFACES

The Repository Segment interfaces with the geologic setting at the surface of the rock that is exposed to excavated openings. The geologic setting outputs to the Repository Segment may include water and gas intrusion and preferential pathways for radionuclide travel. The Repository Segment outputs to the geologic setting include heat,

radionuclides, and radiation. Requirements associated with this interface are addressed in Section 3.7.2.2 of this RDRD. In addition,

- A. The underground facility shall assist the geologic setting in meeting the performance objectives for the period following permanent closure.

[MGDS-RD 3.7.3.2.A][10 CFR 60.133(h)]

- B. The ...⁷ underground facility shall be designed to assure that releases of radioactive materials to the accessible environment following permanent closure conform to applicable environmental standards for radioactivity established by the EPA with respect to both anticipated processes and events and unanticipated processes and events.

[MGDS-RD 3.7.3.2.B][10 CFR 60.112]

- C. The underground facility shall be designed, assuming anticipated processes and events, so that the release rate of any radionuclide from the underground following the containment period shall not exceed one part in 100,000 per year of the inventory of that radionuclide calculated to be present at 1,000 years following permanent closure, or such other fraction of the inventory as may be approved or specified by the NRC; provided, that this requirement does not apply to any radionuclide that is released at a rate less than 0.1% of the calculated total release rate limit. The calculated total release rate limit shall be taken to be one part in 100,000 per year of the inventory of radioactive waste, originally emplaced in the underground facility, that remains after 1,000 years of radioactive delay.

[MGDS-RD 3.7.3.2.D][10 CFR 60.113(a)(1)(ii)(B)]

3.2.3.3 REPOSITORY SEGMENT - GOVERNMENT SERVICES INTERFACES

The Repository Segment provides the MGDS interface with Nye County emergency services (fire, rescue, ambulance, and sheriff) via commercial telephone, road, and air (by helicopter).

3.2.3.4 REPOSITORY SEGMENT - UTILITIES INTERFACES

- A. **Electrical Power.** The Repository Segment interfaces with the commercial power grid at [TBD]. The MGDS requires:
1. [TBD] independent feeds.
 2. [TBD] MVA.

⁷The requirements for the geologic setting and the accesses, boreholes, and their seals are addressed in 3.7.1 and 3.7.5. Requirements for waste packages are in the EBD RD.

3. 60 hertz +/- [TBD] %.
 4. [TBD] phase connections.
- B. **Non-potable water.** The Repository Segment interfaces with the [TBD] water supply system. The MGDS requires [TBD] gallons per day at [TBD] psi.
 - C. **Potable water.** TBD
 - D. **Telephone communications.** The Repository Segment interfaces with the NTS switched telephone system at [TBD]. The MGDS requires:
 1. [TBD] FTS lines with [TBD] quality.
 2. [TBD] commercial long distance lines with [TBD] quality.
 3. [TBD] lines to the local NTS exchange with [TBD] quality.
 4. [TBD] private lines.
 - E. **Radio communications.** The Repository Segment will interface with the NTS emergency radio net. This net uses:
 1. [TBD] channels.
 2. [TBD] Frequency.
 3. [TBD] Bandwidth.
 4. [TBD] Private lines.
 - F. **Commercial trash pickup** [TBV].
 - G. **Fuel supply of** [TBD].
 - H. **Sewer Systems** [TBD].

3.2.4 PHYSICAL CHARACTERISTICS

Selection of standards to meet the requirements specified in this section shall be by engineering analysis and shall be documented in accordance with appropriate implementing documents.

[MGDS-RD 3.2.4][CRD 3.2.4]

3.2.4.1 PROTECTIVE COATINGS AND MATERIALS

Facilities and equipment that require coating to enhance decontamination of surfaces or because of environmental requirements shall be coated in accordance with ASTM D4256, or other DOE-approved guideline, e.g., DOE Order 6430.1A, 0900-99.0.

[MGDS-RD 3.2.4.1][CRD 3.2.4.1]

3.2.4.2 HABITABILITY

Some of the following statements refer to two or more documents which are acceptable references, the choice of which is left to the design organization.

3.2.4.2.1 ENVIRONMENTAL CONDITIONS

Environmental controls shall be capable of maintaining an environment that provides comfortable and appropriate workspace temperature, humidity, and personal storage, lavatory, and toilet facilities as required by 20 CFR 1910.141. NUREG 0700 Section 6.1.5 may be used for reference.

[MGDS-RD 3.2.4.2.1][29 CFR 1910.141]

3.2.4.2.2 HEATING, VENTILATION, AND AIR CONDITIONING

Heating, ventilation, and air conditioning (HVAC) equipment in facilities shall be sized to conform with the guidelines in NUREG 0700 Section 6.1.5. MIL-STD-1472D Section 5.8.1 and the applicable ASHRAE standard may be used for reference.

[MGDS-RD 3.2.4.2.2][CRD 3.2.4.2.2]

3.2.4.2.3 ILLUMINATION

Lighting in working areas and other enclosures shall conform to the applicable Recommended Practice of the Illumination Engineering Society. NUREG 0700 Section 6.1.5 may be used for reference.

[MGDS-RD 3.2.4.2.3][CRD 3.2.4.2.3]

3.2.4.2.4 ACOUSTICAL NOISE

Work spaces shall be provided an acoustic environment that conforms to the requirements of 29 CFR 1910.95. NUREG 0700 Section 6.1.5 and MIL-STD-1472D Section 5.8.3 may be used for reference.

[MGDS-RD 3.2.4.2.4][29 CFR 1910.95]

3.2.4.2.5 VIBRATION

Facilities, buildings, personnel enclosures, and vehicles shall be designed, located, or modified for vibration control (to be determined at the design level). ANSI/ASA 38-79 or MIL-STD-1472D Section 5.8.4. may be used for reference.

[MGDS-RD 3.2.4.2.5][CRD 3.2.4.2.5]

3.2.4.2.6 UNDERGROUND PERSONNEL ENCLOSURES

Unless otherwise specified, underground personnel enclosures, including but not limited to those provided for offices, laboratories, break rooms and the like, shall, to the extent practicable as determined by design analysis, conform to the environmental and habitability requirements specified above for surface personnel enclosures. This requirement does not apply to areas where active construction is underway and areas where deemed unnecessary by design analysis.

[MGDS-RD 3.2.4.2.6][CRD 3.2.4.2.6]

3.2.4.3 SECURITY**3.2.4.3.1 PHYSICAL SECURITY⁸****3.2.4.3.1.1 PHYSICAL PROTECTION**

The physical security system and access controls shall satisfy the applicable security requirements of DOE Order 6430.1A, 1300-10, tailored to the application and focused on the threat of sabotage to special nuclear material facilities and theft of high-value equipment and supplies.

[MGDS-RD 3.2.4.3.1.1][CRD]

3.2.4.3.1.2 PHYSICAL BARRIERS

- A. Vital equipment shall be located within a vital area, which, in turn, shall be located within a protected area such that access to vital equipment requires passage through at least two physical barriers. More than one vital area may be within a single protected area. See Section 6.1 for definition of vital area, vital equipment, protected area, and physical barrier.

[MGDS-RD 3.2.4.3.1.2.A]

- B. Material access areas shall be located within protected areas such that access to the material access area requires passage through at least two physical barriers. More than one material access area may be within a single protected area.

[MGDS-RD 3.2.4.3.1.2.B]

⁸The applicability of 10 CFR 73 to the MGDS is [TBD].

- C. The physical barrier at the perimeter of the protected area shall be separated from any other barrier designated as a physical barrier within the protected area, and the intervening space monitored or periodically checked to detect the presence of persons or vehicles so that the facility security organization can respond to suspicious activity or to the breaching of any physical barrier.

[MGDS-RD 3.2.4.3.1.2.C]

- D. An isolation zone shall be established around the physical barrier at the perimeter of the protected area and any part of a building used as part of that physical barrier.

[MGDS-RD 3.2.4.3.1.2.D]

- E. There shall be monitors in the isolation zone to detect the presence of individuals or vehicles within the zone so as to allow response by armed members of the repository security organization to be initiated at the time of penetration of the protected area.

[MGDS-RD 3.2.4.3.1.2.E]

- F. Parking facilities, both for employees and visitors, shall be located outside the isolation zone.

[MGDS-RD 3.2.4.3.1.2.F]

- G. Where health physics functions are required at access control points, the security functions shall be integrated with the health physics functions.

[Derived]

3.2.4.3.1.3 ACCESS CONTROL

- A. The Repository Segment shall provide control for all points of personnel and vehicle access into a protected area, including shipping or receiving areas, and into each vital area.

[MGDS-RD 3.2.4.3.1.3.A]

- B. Provisions shall be made to allow identification and validation of access authorization for personnel and vehicles at such points.

[MGDS-RD 3.2.4.3.1.3.B]

- C. At the point of personnel and vehicle access into a protected area, the Repository Segment shall provide equipment and space necessary for a search of individuals and hand-carried packages for devices such as firearms, explosives, and incendiary

devices, or other items which could be used for radiological sabotage. The search may be conducted either by a physical search or by the use of equipment capable of detecting such devices.

[MGDS-RD 3.2.4.3.1.3.C]

- D. The Repository Segment shall be designed to provide for identification and authorization checks, and for a random search of all packages being delivered into the protected area.

[MGDS-RD 3.2.4.3.1.3.D]

- E. The Repository Segment shall have a system to control keys, locks, combinations, and related equipment to minimize the possibility of compromise of the security of nuclear material.

[MGDS-RD 3.2.4.3.1.3.E]

3.2.4.3.1.4 SECURITY OF LICENSED MATERIAL

The Repository Segment shall provide the capability to control and maintain constant surveillance over licensed material that is in a controlled or unrestricted area and that is not in storage.

[MGDS-RD 3.2.4.3.1.4][10 CFR 20.1802]

3.2.4.3.2 HIGH RADIATION AREA ACCESS CONTROL

- A. Access to high and very high radiation areas shall be controlled in accordance with the requirements specified by 10 CFR 20.1601 and 20.1602.

[MGDS-RD 3.2.4.3.2.A][10 CFR 20.1601][10 CFR 20.1602]

- B. The repository design shall provide at each entrance or access point to a high radiation area:

1. One or more of the following features:

- a) A control device that, upon entry into the area, causes the level of radiation to be reduced below that level at which an individual might receive a deep-dose equivalent of 0.1 rem (1 mSv) in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates.

[MGDS-RD 3.2.4.3.2.B.1.a][10 CFR 20.1601(a)(1)]

- b) A control device that energizes a conspicuous visible or audible alarm signal so that the individual entering the high radiation area and the supervisor of the activity are made aware of the entry.

[MGDS-RD 3.2.4.3.2.B.1.b][10 CFR 20.1601(a)(2)]

- c) Entryways that are locked, except during periods when access to the areas is required, with positive control over each individual entry.

[MGDS-RD 3.2.4.3.2.B.1.c][10 CFR 20.1601(a)(3)]

- 2. Or, in place of the controls required by 3.2.4.3.2.B.1 above, continuous direct or electronic surveillance that is capable of preventing unauthorized entry.

[MGDS-RD 3.2.4.3.2.B.2][10 CFR 20.1601(b)]

- 3. Or an alternative method for controlling access to high radiation areas approved in advance by the NRC.

[MGDS-RD 3.2.4.3.2.B.3][10 CFR 20.1601(c)]

- 4. The controls required by subparagraphs 1 and 3 above shall not prevent individuals from leaving a high radiation area.

[MGDS-RD 3.2.4.3.2.B.4][10 CFR 20.1601(d)]

- 5. Control shall not be required for each entrance or access point to a room or other area that is a high radiation area solely because of the presence of radioactive materials prepared for transport and packaged and labeled in accordance with the regulations of the Department of Transportation provided that the packages do not remain in the area longer than 3 days and the dose rate at 1 meter from the external surface of any package does not exceed 0.01 rem (0.1 mSv) per hour.

[MGDS-RD 3.2.4.3.2.B.5][10 CFR 20.1601(e)]

3.2.4.3.3 UNDERGROUND ACCESS CONTROLS

A system shall be provided to control access to the underground as required by 30 CFR 57.11058 and 29 CFR 1926.800(c).

[MGDS-RD 3.2.4.3.3][30 CFR 57.11058][29 CFR 1926.800(c)]

3.2.4.4 RADIOACTIVE MATERIALS MONITORING

The Repository Segment shall be equipped to monitor the external surfaces of packages and casks known to contain radioactive material for radioactive contamination and radiation levels in compliance with 10 CFR 20.1906.

[MGDS-RD 3.2.4.4][10 CFR 20.1906]

3.2.4.5 SHIELDING

3.2.4.5.1 SHIELDING DESIGN

- A. **Normally Occupied Areas.** The shielding design basis shall limit the maximum exposure to an individual worker to one-fifth of the annual occupational external exposure limits. Within this design basis, personnel exposures must be maintained ALARA. Specifically, the shielding should be designed with the goal of limiting the total EDE to less than one rem per year to workers, based on their predicted exposure time in the normally occupied area. The EDE is the sum of all contributing external penetrating radiation (gamma and neutron). In addition, appropriate shielding must be installed, if necessary, to minimize non-penetrating external radiation exposures to the skin and lens of the eye of the worker. In most cases, the confinement barrier or process equipment provides this shielding.

[MGDS-RD 3.2.4.5.1.A][DOE Order 6430.1A, 1300-6.2]

- B. **Intermittently Occupied Areas.** Shielding and other radiation protection measures shall be provided for areas requiring intermittent access, such as for preventive maintenance, component changes, adjustment of systems and equipment, and so forth, with the goal of limiting dose rates based on occupancy, time, and frequency of exposure to one rem per year.

[MGDS-RD 3.2.4.5.1.B][DOE Order 6430.1A, 1300-6.2]

- C. **Concrete.** Concrete radiation shielding design shall comply with ANSI/ANS 6.4 and ACI 349 and shall consider the material specifications of ANSI/ANS 6.4.2 where it provides a critical confinement or structural function. For other shields, ACI 318 is appropriate and provides adequate strength for design earthquake (DE) loads.

[MGDS-RD 3.2.4.5.1.C][DOE Order 6430.1A, 1300-6.2]

- D. **Penetrations.** Design of shield walls shall avoid straight-line penetrations to prevent radiation streaming.

[MGDS-RD 3.2.4.5.1.D][DOE Order 6430.1A, 1300-6.2]

3.2.4.5.2 REMOTE SHIELDED OPERATION

Remote shielded operation (i.e., with remote handling equipment such as remote manipulators) shall be considered where it is anticipated that exposures to hands and forearms would otherwise approach the dose requirements in Section 3.2.2 or where contaminated puncture wounds could occur.

[MGDS-RD 3.2.4.5.2][DOE Order 6430.1A, 1300-6.3]

3.2.4.6 DESIGN BASIS EVENTS AND ACCIDENTS

- A. **Accidents.** SSCs that are required to function during accidents shall be designed to withstand accident conditions so that their required functions and performance criteria can be met during such events.

[Derived]

- B. **Design Objective.** Conservatively estimated consequences of normal operations and credible accidents shall be limited in accordance with requirements contained in DOE Order 6430.1A, Section 1300-1.4, Guidance on Limiting Exposure of the Public. The repository will develop events based on site function and licensing requirements.

[MGDS-RD 3.2.4.6.A][DOE Order 6430.1A, 1324-2.1]

- C. **Aircraft.** Unless the safety analysis can demonstrate that the risk from an aircraft crashing into the facility is acceptable, potential aircraft crashes shall be considered among the spectrum of man-made missiles that confinement structures must be designed to withstand or against which they must be protected.

[MGDS-RD 3.2.4.6.B][DOE Order 6430.1A, 0111-99.0]

- D. **External Blasts and Missiles.** The potential effects of a major explosion at a nearby facility or transportation route shall be considered among the spectrum of external blast effects and missiles that confinement structures must be designed to withstand or against which they must be protected.

[MGDS-RD 3.2.4.6.C][DOE Order 6430.1A, 0111-99.0]

- E. **Internal Blasts and Missiles.** The probable consequence of design basis accidents (DBAs) involving internally generated missiles or blast effects shall be considered. Such DBAs typically involve failure of high-speed rotating machinery, cranes, experimental facilities, high-energy fluid system components, or explosives. Structures required to function following such accidents must be designed to withstand these DBAs.

[MGDS-RD 3.2.4.6.D][DOE Order 6430.1A, 0111-99.0]

3.2.5 SYSTEM QUALITY FACTORS

The quality factors for the repository are described in this section. These factors include Reliability, Maintainability, Inspectability, Availability, and Service Life.

3.2.5.1 RELIABILITY

The Repository Segment shall provide a fault-tolerant (or fail-safe) system that allows for the continued management, handling, transfer, storage, emplacement, retrieval, and isolation of SNF and HLW in a safe manner that optimally protects health, safety, and the

environment under all operational conditions. Nothing in this section shall be construed to indicate that NRC-mandated redundancy of systems may be neglected.

[MGDS-RD 3.2.5.1][CRD 3.2.5.1.A]

3.2.5.1.1 RELIABILITY PROGRAM REQUIREMENTS

The Repository Segment design organizations shall establish and execute a Reliability, Availability, and Maintainability (RAM) program to support Integrated Logistics Support and the general engineering program for the CRWMS. Reliability shall be addressed as an element of design reviews.

[MGDS-RD 3.2.5.1.1][CRD 3.2.5.1.B]

3.2.5.1.2 RELIABILITY OF EQUIPMENT⁹

A failure modes and effects analysis shall be performed for all major equipment whose failure can result in personnel injury or illness. Based on this analysis, designs shall be developed to ensure reliability which minimizes safety hazards to the extent possible. Under such design conditions, failures shall not result in personal injury or occupational illness. If designs cannot be developed to these requirements, then the reliability of systems will be shown by analysis to be such as to minimize the probability of injury or illness to personnel. In demonstrating system reliability, MIL-STD-882B shall be considered in the design, where applicable. (These requirements differ from "items important to safety" and "items important to waste isolation", both of which have very specific meanings for meeting NRC requirements. Further, these criteria do not supplant radiological standards contained in NRC or EPA requirements; e.g., the radiological standards of 10 CFR 20).

[MGDS-RD 3.2.5.1.2][CRD 3.2.5.1.2]

3.2.5.1.3 STRUCTURE, SYSTEM AND COMPONENT RELIABILITY

SSCs that are important to safety shall be designed and located so that they continue to perform their safety functions effectively during and after credible fire and explosion conditions in the GROA.

[MGDS-RD 3.2.5.1.3][10 CFR 60.131(b)(3)]

3.2.5.1.4 UTILITIES RELIABILITY

- A. Each utility service system that is important to safety shall be designed so that essential safety functions can be performed under both normal and accident conditions.

[MGDS-RD 3.2.5.1.4.A][10 CFR 60.131(b)(5)(i)]

⁹This requirement is applicable only prior to permanent closure.

- B. The design of utility services and distribution systems that are important to safety shall include redundant systems to the extent necessary to maintain, with adequate capacity, the ability to perform safety functions.

[MGDS-RD 3.2.5.1.4.B][10 CFR 60.131(b)(5)(ii)]

3.2.5.1.5 SYSTEM THROUGHPUT

All equipment shall be shown by analysis to have adequate reliability to allow the repository to meet the throughput requirements identified in Table 3-3 and its mission.

[MGDS-RD 3.2.5.1.5][CRD 3.2.5.1.E]

3.2.5.2 MAINTAINABILITY/INSPECTABILITY

3.2.5.2.1 TESTING AND MAINTENANCE

SSCs that are important to safety shall be designed to permit periodic inspection, maintenance, and testing as necessary to ensure their continued functioning and readiness.

[MGDS-RD 3.2.5.2.1][10 CFR 60.131(b)(6)]

3.2.5.2.2 PHYSICAL CLEARANCE

- A. **Corridors.** The size and arrangement of interior corridors and drifts shall accommodate the movement of equipment including initial equipment installation, facility operations, and possible future removal or replacement of equipment. Movement of waste packages into and out of the emplacement drifts requires specific attention.

[MGDS-RD 3.2.5.2.2.A][DOE Order 6430.1A, 0110-99.0.4]

- B. **Maintenance Accessibility.** Facility design shall provide access for routine maintenance, repair, or replacement of equipment subject to failure. Accessibility includes proper lighting and utility hookups and acceptable levels of radiological exposure.

[MGDS-RD 3.2.5.2.2.B][DOE Order 6430.1A, 1300-3.5]

3.2.5.2.3 MEAN TIME TO REPAIR

The mean time to repair (MTTR) each piece of installed equipment shall be identified in design calculations. Sufficient storage must be provided for parts in inventory for items to be repaired in place and qualified repair personnel available to ensure the MTTR can be achieved.

[MGDS-RD 3.2.5.2.3]

3.2.5.2.4 REPLACEMENT EQUIPMENT

- A. Replacement equipment shall be provided as necessary for equipment which must be removed to be repaired to support the MTTR. Such equipment must be accessible and transportable.

[MGDS-RD 3.2.5.2.4.A]

- B. A lifting device having capability to remove and install equipment shall be provided for equipment that weighs more than the limits for human portability.

[MGDS-RD 3.2.5.2.4.B]

- C. Replaceability shall be addressed during design for all equipment.

[MGDS-RD 3.2.5.2.4.C]

3.2.5.2.5 FAULT ISOLATION

- A. When fault isolation is important in addressing MTTR, fault detection shall be built into the system in terms of electronic detection, measurement points, etc., to the extent practicable.

[MGDS-RD 3.2.5.2.5]

- B. The Repository Segment design shall detect [TBD] percent of all detectable faults. Of those faults detected [TBD] percent shall be isolated to one line replaceable unit (LRU), [TBD] percent to two LRUs and [TBD] percent to three or less LRUs.

[Derived]

- C. Newly developed equipment for the Repository Segment shall satisfy the following Repository Segment fault detection/fault isolation (FD/FI) requirements [TBD].

[Derived]

- D. For commercial equipment FD/FI shall not take more than 25% [TBV] of the component MTTR.

[Derived]

3.2.5.2.6 MAINTENANCE IN RADIOACTIVE ENVIRONMENTS

Equipment which normally operates in a radioactive environment or in the vicinity of radioactive components shall be designed to be moved to a non-radioactive environment for maintenance or repair, whenever possible. When that is not possible, the design shall allow for installation of temporary shielding, permit minimizing radiation exposure times, and provide sufficient space for ease of operation, maintenance, and repair.

[MGDS-RD 3.2.5.2.6][10 CFR 60.131(a)(2)]

3.2.5.2.7 IMPORTANT TO SAFETY EQUIPMENT

Equipment which could fail during an operation important to safety shall be designed to permit recovery of the operation without compromising the health and safety of the public or the repository employees.

[MGDS-RD 3.2.5.2.7]

3.2.5.2.8 DESIGN FOR MAINTAINABILITY

A. The Repository Segment shall be designed and constructed so that facilities are easily and economically maintained. Maintainability considerations include:

1. Use of easily maintained features and durable materials.
2. Ease of replacement of installed equipment (i.e., without structure modification).
3. Accessibility of installed equipment and building systems for performance of maintenance.
4. Life cycle costs in selection of features, systems, and finishes.
5. Provisions of maintenance instructions and as-built drawings, especially the location of underground and otherwise concealed utility lines, process chemical and coolant piping.

[MGDS-RD 3.2.5.2.8.A][DOE Order 4700.1, p. V-17, q]

B. Engineered hardware shall be designed to meet the maintainability requirements as specified in University of California Research Laboratory (UCRL) 15673, Human Factors Guidelines for Maintainability of Department of Energy Nuclear Facilities, Section 1. Should hardware require movement by personnel in order to provide accessibility for maintenance, requirements for portability (Section 3.2.9 of this document) shall be included in the design.

[MGDS-RD 3.2.5.2.8.B][UCRL 15673, Section 1]

C. Facility support equipment shall conform to the requirements for maintainability specified in UCRL 15673, Section 2.

[MGDS-RD 3.2.5.2.8.C][UCRL 15673, Section 2]

D. The design of equipment, facilities and systems shall conform to the maintainability requirements specified in UCRL 15673, Section 3.

[MGDS-RD 3.2.5.2.8.D][UCRL 15673, Section 3]

- E. The time required to perform work in the vicinity of radioactive components shall be kept to an absolute minimum; for example, by providing sufficient space for ease of operation and designing equipment for ease of repair and replacement.

[MGDS-RD 3.2.5.2.8.E][10 CFR 60.131(a)(2)]

- F. Maintenance and storage facilities in the underground facility shall include space and provisions for routine maintenance and minor repairs of repository equipment, including the mining and associated support equipment.

[Derived]

3.2.5.2.9 MEAN DOWNTIME

Facilities, subsystems, and equipment of the Repository Segment shall be designed with a mean downtime that is consistent with the availability requirements specified in Section 3.2.5.3 of this document. The mean downtime shall include MTTR, disruptive preventive maintenance time, logistics delay time, administrative delay time, and safety delay time.

[MGDS-RD 3.2.5.2.9]

3.2.5.3 AVAILABILITY

- A. The repository design shall address availability as a factor in determining the operational capacity of its subsystems.

[MGDS-RD 3.2.5.3.A][CRD 3.2.5.3.A]

- B. Availability shall be addressed at design reviews, to include the design and logistics factors listed in Section 3.2.5.2.9.

[MGDS-RD 3.2.5.3.B][CRD 3.2.5.3.B]

3.2.5.4 SERVICE LIFE

- A. The Repository Segment shall be designed for a maintainable service life of at least 100 years [TBR] or the period of time authorized by the license granted by the NRC in accordance with the provisions of 10 CFR 60.3.

[MGDS-RD 3.2.5.4.A]

- B. The service life requirements of SSCs shall be specified in the derivative specifications. Service life values will normally be determined by the logistic support analysis specified in Section 3.5.2, and other engineering and cost studies with appropriate consideration to the terms of the license or certificate.

[MGDS-RD 3.2.5.4.B][CRD 3.2.5.4]

missiles shall be considered separately in terms of penetration, perforation, or crushing effects. The horizontal and vertical velocities of the missiles shall be combined in the design.

[MGDS-RD 3.2.6.1.E.3.c][DOE Order 6430.1A, 0111-99.0.2]

4. **Load Combination.** Loads resulting from the design basis tornado shall be assumed capable of occurring at any time. However, for design purposes, design basis tornado loads need not be assumed to occur simultaneously with other severe site-related events such as earthquake, fire, or flood, except where the simultaneous occurrence is related (e.g., fire from lightning or other wind-related causes).

[MGDS-RD 3.2.6.1.E.4][DOE Order 6430.1A, 0111-99.0.2]

- F. **Floods.** The design loads on Repository Segment facilities from flooding shall comply with UCRL 15910. In calculating design loads from flooding, a conservative approach must be taken to ensure that the loads used in the design are greater than the maximum historic levels recorded for the site and no less than the probable maximum flood.

[MGDS-RD 3.2.6.1.F][DOE Order 6430.1A, 0111-99.0.3]

- G. **Flood Protection.** If, after compliance with the requirements of the Executive Order 11988, new construction of structures or facilities are to be located in a flood plain, then:

1. Accepted flood-proofing and other flood protection measures shall be applied by the repository design to new construction or rehabilitation.

[MGDS-RD 3.2.6.1.G.1][Executive Order 11988, Section 2(b)]

2. To achieve flood protection, the repository design shall, wherever practicable, elevate structures above the base flood level rather than filling in land.

[MGDS-RD 3.2.6.1.G.2][Executive Order 11988, Section 2(b)]

- H. **Earth and Groundwater.**

1. Every foundation wall or other wall serving as a retaining structure shall be designed to resist, in addition to the vertical loads acting on it, the incident lateral earth pressures and surcharges, plus hydrostatic pressures corresponding to the maximum probable groundwater level.

[MGDS-RD 3.2.6.1.H.1][DOE Order 6430.1A, 0111-2.8.2]

2. Retaining walls shall be designed for earth pressures and potential groundwater levels producing the highest stresses and overturning moments. When a water-pressure-relief system is incorporated into the design, only earth pressures need to be considered. In cohesive soils, the long-term consolidation effects on the

stability of the walls must be considered. Lateral earth pressures must be determined in accordance with accepted structural and geotechnical engineering practice.

[MGDS-RD 3.2.6.1.H.2][DOE Order 6430.1A, 0111-2.8.2]

- I. **Thermal Analysis.** The design of structures shall include the effects of stresses and movements resulting from variations in temperature, including the effect of emplaced waste packages. The rise and fall in the temperature must be determined for the localities in which the structures are to be built. Structures must be designed for movements resulting from the maximum seasonal temperature change. The design must provide for the lags between air temperatures and the interior temperatures of massive concrete members or structures. In cable-supported structures, changes in cable sag and tension must be considered.

[MGDS-RD 3.2.6.1.I][DOE Order 6430.1A, 0111-2.8.4]

- J. **Rain and Snow Loads.** Live loads on roofs shall be as stipulated in ASCE 7-88 which include the minimum roof live loads or the snow loads and snow drifts or possible rain loads stipulated therein, whichever produces the more severe effect.

[MGDS-RD 3.2.6.1.J][DOE Order 6430.1A, 0111-2.3.2]

3.2.6.2 INDUCED ENVIRONMENT

3.2.6.2.1 FIRE, EXPLOSION, AND OTHER DISASTER PROTECTION

- A. Repository Segment SSCs important to safety shall be designed to perform their safety functions during and after credible fire or explosion conditions at the Repository.

[MGDS-RD 3.2.6.2.1.A][10 CFR 60.131(b)(3)(i)]

- B. The Repository Segment shall be designed to include means to protect SSCs important to safety against the adverse effects of either the operation or failure of the fire suppression system.

[MGDS-RD 3.2.6.2.1.B][10 CFR 60.131(b)(3)(iv)]

- C. Repository Segment SSCs important to safety shall be designed to withstand dynamic effects, such as missile impacts, that could result from equipment failure, and similar events and conditions that could lead to loss of their safety functions.

[MGDS-RD 3.2.6.2.1.C][10 CFR 60.131(b)(2)]

3.2.6.2.2 FIRE RESISTANCE

- A. For Repository Segment facilities, development of the design basis fire shall include consideration of conditions that may exist during normal operations and special situations (e.g., during periods of decontamination, renovation, modification, repair, and maintenance).

[MGDS-RD 3.2.6.2.2.A][DOE Order 6430.1A, 0110-99.0.6]

- B. For Repository Segment facilities, the structural shell surrounding the critical areas and their supporting members shall remain standing and continue to act as a confinement structure during the design basis fire under conditions of failure of any fire suppression system not designed as a safety class item. Fire resistance of this shell must be attained by an integral part of the structure (concrete slabs, walls, beams, and columns) and not by a composite assembly (membrane fire-proofing). Penetrations in this shell must incorporate, as a minimum, protection against design basis fire exposures.

[MGDS-RD 3.2.6.2.2.B][DOE Order 6430.1A, 0110-99.0.6]

- C. For Repository Segment facilities, in no event shall the fire resistance rating be less than two hours under conditions of failure of any fire suppression system not designed as a safety class item.

[MGDS-RD 3.2.6.2.2.C][DOE Order 6430.1A, 0110-99.0.6]

- D. To the extent practicable, the Repository Segment facilities shall be designed to incorporate the use of noncombustible and heat resistant materials.

[MGDS-RD 3.2.6.2.2.D][10 CFR 60.131(b)(3)(ii)]

3.2.6.2.3 VIBRATION

Equipment supports shall be designed to avoid resonance resulting from the harmony between the natural frequency of the structure and the operating frequency of reciprocating or rotating equipment supported on the structure. The operating frequency of supported equipment must be determined from manufacturers' data prior to completion of structural design. Resonance must be prevented by designing equipment isolation supports to reduce the dynamic transmission of the applied load to as low a level as can be economically achieved in the design.

[MGDS-RD 3.2.6.2.3][DOE Order 6430.1A, 0111-2.8.1]

3.2.6.2.4 CREEP AND SHRINKAGE

Concrete and masonry structures used to house waste handling facilities shall be investigated for stresses and deformations induced by creep and shrinkage. For concrete and masonry structures, the minimum linear coefficient of shrinkage must be assumed to

be 0.0002 inch/inch, unless a detailed analysis is undertaken. The theoretical shrinkage displacement shall be computed as the product of the linear coefficient and the length of the member.

[MGDS-RD 3.2.6.2.4][DOE Order 6430.1A, 0111-2.8.5]

3.2.6.2.5 UNDERGROUND OPENINGS

Underground openings shall be designed and constructed to provide suitable ground control in compliance with 30 CFR 57 Subpart B.

[MGDS-RD 3.2.6.2.5][30 CFR 57 Subpart B]

3.2.7 TRANSPORTABILITY/MODULARITY

To the extent practical, any temporary facilities shall be of either transportable or modular design. Specific requirements for temporary/modular facilities shall be addressed in derivative specifications as appropriate.

[MGDS-RD 3.2.7][CRD 3.2.7]

3.2.8 FLEXIBILITY, EXPANSION, AND INTEGRATION

Repository Segment facilities shall be designed and constructed so as not to preclude the later addition, where appropriate, of facilities for offices and laboratories or expansion of its basic mission, e.g. increased storage area, waste consolidation, or increased disposal capacity.

[MGDS-RD 3.2.8][CRD 3.2.8]

3.2.9 PORTABILITY AND LOAD CARRYING

Equipment and components that are developed for the Repository Segment and that must be moved over short distances for maintenance or other purposes shall be designed to facilitate movement by taking into consideration such things as weight, hand grips, lifting aids, etc.

[MGDS-RD 3.2.9][CRD 3.2.9]

3.3 DESIGN AND CONSTRUCTION

3.3.1 GENERAL DESIGN CRITERIA

- A. All site survey, planning and design activities shall comply with NRC direction supplemented by the criteria of DOE Order 6430.1A to the extent there is no conflict.

[MGDS-RD 3.3.1.A][CRD 3.3.1.A]

- B. Unless specifically waived in writing by OCRWM, design and construction of all Repository Segment facilities and equipment shall be based on the criteria specified in the appropriate section of DOE Order 6430.1A, unless those requirements pertain to areas under NRC jurisdiction. The following components are addressed in DOE Order 6430.1A:

1. General Requirements.
2. Site and Civil Engineering.
3. Concrete.
4. Masonry.
5. Metals.
6. Woods and Plastics.
7. Thermal and Moisture Protection.
8. Doors and Windows.
9. Finishes.
10. Specialties.
11. Equipment.
12. Furnishings.
13. Special Facilities.
14. Conveying Systems.
15. Mechanical.
16. Electrical.

[MGDS-RD 3.3.1.B][CRD 3.3.1.B]

- C. State, county, municipal, and other local regulations, building and zoning codes, and ordinances shall be reviewed and incorporated, as appropriate, in the Repository Segment designs whenever those practices are not in conflict with the requirements of DOE Order 6430.1A.

[MGDS-RD 3.3.1.C]

- D. Should conflicts exist between DOE Order 6430.1A and state, county, municipal, or local codes or regulations, a deviation shall be requested in accordance with Section 0101-2, Criteria Deviations, of DOE Order 6430.1A. All deviations from DOE Order 6430.1A to meet NRC requirements or current engineering practices must be documented.

[MGDS-RD 3.3.1.D][DOE Order 6430.1A, 0101-2]

- E. All design bases shall be consistent with the results of site characterization.

[MGDS-RD 3.3.1.E][10 CFR 60.130]

- F. The Repository Segment facilities licensed by the NRC shall meet all requirements indicated by the rules governing the license and specified by the RDRD.

[MGDS-RD 3.3.1.F][CRD 3.3.1.B]

- G. Standards or other DOE-accepted documents, identified as sufficient or more appropriate for the support of design, shall be used at the discretion of the designers, provided there are no conflicts with the identified requirements of the Repository. Examples of this type of documentation are NUREGs, Regulatory Guides and other similar types of guidance provided by the NRC.

[MGDS-RD 3.3.1.G][CRD 3.3.1.C]

- H. An assessment shall be provided to document the predicted effectiveness of engineered and natural barriers, including barriers that may not be themselves a part of the GROA, against the release of radioactive material from the waste package to the environment. The analysis will 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.

[MGDS-RD 3.2.1.1.J][10 CFR 60.21(c)(1)(ii)(D)]

- I. The performance of the major design SSCs, both surface and subsurface, shall be analyzed to identify those that are important to safety. For the purposes of this analysis, it will be assumed that operations at the GROA will be carried out at the maximum capacity and rate of receipt of radioactive waste stated in the application.

[MGDS-RD 3.2.1.1.J][10 CFR 60.21(c)(1)(ii)(E)]

- J. A description and analysis of the design and performance requirements for SSCs of the geologic repository which are important to safety shall be provided. This analysis will consider:

[MGDS-RD 3.2.1.1.J][10 CFR 60.21(c)(3)]

1. the margins of safety under normal conditions and under conditions that may result from anticipated operational occurrences, including those of natural origin, and

[MGDS-RD 3.2.1.1.J][10 CFR 60.21(c)(3)(i)]

2. the adequacy of SSCs provided for the prevention of accidents and mitigation of the consequences of accidents, including those caused by natural phenomena.

[MGDS-RD 3.2.1.1.J][10 CFR 60.21(c)(3)(ii)]

3.3.2 ELECTROMAGNETIC RADIATION

- A. Critical communications and data circuits shall be protected or shielded from electromagnetic interference from sources within the Repository Segment and from external sources to the extent specified by manufacturers of sensitive data processing and communications equipment used in the system.

[MGDS-RD 3.3.2.A][DOE Order 6430.1A, 0200-99.8.1]

- B. Lighting fixture types and locations shall be coordinated with the equipment and functions of telecommunication, alarm, and automatic data processing centers to provide the required illumination without creating electrical or electromagnetic interference detrimental to proper operation of equipment.

[MGDS-RD 3.3.2.B][DOE Order 6430.1A 1655-99.8]

- C. Shielding shall be provided to protect magnetic recording equipment, magnetic tapes, and disk packs where electromagnetic field of 10 microvolts or 50 Oersteds or greater can be expected.

[MGDS-RD 3.3.2.C][DOE Order 6430.1A 0110-99.8.3]

- D. Provisions shall be made to minimize the possibility of electromagnetic transmitters inadvertently detonating blasting caps.

[MGDS-RD 3.3.2.D]

3.3.3 NAMEPLATES AND MARKINGS

- A. Equipment and any parts of that equipment to be used by personnel shall be identified with appropriate labels. Equipment and equipment parts include, but are not limited to, system and subsystem component groupings, individual components, control positions or modes, display markings, instructions, procedure manuals, storage spaces, access panels, and tools.

[MGDS-RD 3.3.3.A][DOE Order 6430.1A, 1300-12.4.11]

- B. The label shall indicate clearly and concisely the function and purpose of the item being labeled. Unnecessary information (e.g., information used only for manufacturing purposes) must not be included. Hierarchial labeling should be used to facilitate component location on control panels.

[MGDS-RD 3.3.3.B][DOE Order 6430.1A, 1300-12.4.11]

- C. The label information shall be easy to understand. Words, symbols, and other markings in a label or instruction shall be unambiguous and accurate. The terminology used shall have commonly accepted meaning for all users.

[MGDS-RD 3.3.3.C][DOE Order 6430.1A, 1300-12.4.11]

- D. Label design shall be consistent with use of abbreviations and acronyms minimized. Various equipment labels placed on the same or similar pieces of equipment and serving similar functions must use the same material, color, font type, relative location to component, general format, and other configuration features to promote simplicity and avoid clutter. The terminology used for equipment, procedures, and training materials must be the same for each case.

[MGDS-RD 3.3.3.D][DOE Order 6430.1A, 1300-12.4.11]

- E. Permanent labels shall be attached to the specific component or equipment in such a manner that environmental conditions or usage by personnel will not remove or destroy the label.

[MGDS-RD 3.3.3.E][DOE Order 6430.1A, 1300-12.4.11]

- F. The identification markings and identification plates, tags, or labels, when used on equipment, systems, subsystems, assemblies, subassemblies, components and piece parts if necessary, shall be permanent for the life of the item including withstanding environmental conditions and cleaning requirements. These markings shall be accomplished using methods that shall not impact the life and use of the item.

[MGDS-RD 3.3.3.F][CRD 3.3.3.F]

(See Sections 3.3.6.6 and 3.3.7.8 for other Labeling and Marking requirements).

3.3.4 WORKMANSHIP

- A. Special processes applicable to SSC important to safety, including welding, heat treating, and nondestructive testing, shall be controlled and accomplished by qualified personnel using qualified procedures in accordance with applicable codes, standards, specifications, criteria, and other special requirements.

[MGDS-RD 3.3.4.A][QARD]

- B. The workmanship criteria shall reflect the currently applicable codes, standards, regulations, architectural, engineering principles and practices specified in DOE Order 6430.1A (General Design Criteria) - 0109 Reference Standards and Guides, including:

AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
ANS	American Nuclear Society
ANSI	American National Standards Institute
AREA	American Railway Engineering Association
ARI	Air Conditioning and Refrigeration Institute
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers

ASME	American Society of Mechanical Engineers
AWS	American Welding Society
ASTM	American Society for Testing and Materials
IEEE	Institute of Electrical and Electronics Engineers
MBMA	Metal Building Manufacturers Association
NAAMM	National Association of Architectural Metal Manufacturers
NAPHCC	National Association of Plumbing-Heating-Cooling Contractors
NCMA	National Concrete Masonry Association
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NIST	National Institute of Standards and Technology (formerly National Bureau of Standards)
PCA	Portland Cement Association
PCI	Prestressed Concrete Institute

[MGDS-RD 3.3.4.B][DOE Order 6430.1A - 0109]

3.3.5 INTERCHANGEABILITY

To the extent practicable, components such as pumps, motors, fans, transformers, etc. used for similar functions in various parts of the system shall be of identical manufacture and model. The objective is to simplify logistical support such as repair parts supply, training, and documentation.

[MGDS-RD 3.3.5][CRD 3.3.5]

3.3.6 SAFETY

This section addresses the occupational safety requirements for the Repository Segment. The safety of workers and members of the public is paramount at the repository and is addressed throughout this document.

3.3.6.1 GENERAL REQUIREMENTS

- A. All Repository Segment work places shall be designed to be free from recognized hazards that are causing or likely to cause death or serious physical harm to employees.

[MGDS-RD 3.3.6.1.A][29 USC 651 (a), (b), (654 (a), (b))]

- B. All Repository Segment work places shall be designed to comply with occupational safety and health standards promulgated under 29 CFR 1910, 29 CFR 1926, and 30 CFR 57.

[MGDS-RD 3.3.6.1.B]

3.3.6.2 SYSTEM SAFETY PRECEDENCE

The order of precedence for satisfying system safety requirements and resolving identified hazards shall be as follows:¹⁰

- A. The first priority of design shall be to eliminate hazards. If an identified hazard cannot be eliminated, the associated risk shall be reduced to an acceptable level through design selection.

[MGDS-RD 3.3.6.2.A][CRD 3.3.6.2.A]

- B. If identified hazards cannot be eliminated or their associated risk adequately reduced through design selection, that risk shall be reduced through the use of fixed, automatic, or other protective safety design features or devices. Provisions shall be made for periodic functional checks of safety devices when applicable.

[MGDS-RD 3.3.6.2.B][CRD 3.3.6.2.B]

- C. When neither design nor safety devices can effectively eliminate identified hazards or adequately reduce associated risk, devices shall be used to detect the condition and to produce an adequate warning signal to alert personnel of the hazard. Warning signals and their application shall be designed to minimize the probability of incorrect personnel reaction to the signal and shall be standardized within like types of systems. (See Section 3.3.7.3.)

[MGDS-RD 3.3.6.2.C][CRD 3.3.6.2.C]

- D. Only where it is impractical to eliminate residual hazards through design selection or adequately reduce the associated risk with safety and warning devices, may procedures and training be used as the only protection.

[MGDS-RD 3.3.6.2.D][CRD 3.3.6.2.D]

- E. This Section (3.3.6) imposes requirements from 29 CFR 1910, 29 CFR 1926 and 30 CFR 57.

- 1. 30 CFR 57 shall apply only to underground facilities and equipment and to those mining-related surface facilities and equipment specifically addressed in 30 CFR 57.

[MGDS-RD 3.3.6.2.E.1][CRD 3.3.6.2.E.1]

¹⁰Useful guidelines for use by design organizations in analyzing safety hazards are available in MIL-STD-882B.

2. 29 CFR 1910 and 29 CFR 1926 shall apply to all other surface facilities and equipment. 29 CFR 1910 and 29 CFR 1926 shall also be applied to underground facilities and equipment not addressed by 30 CFR 57 and where safety hazard analysis following the precedence in Section 3.3.6.2.A-D deems it necessary.

[MGDS-RD 3.3.6.2.E.2][CRD 3.3.6.2.E.2]

3.3.6.3 FACILITIES, EQUIPMENT, AND MATERIALS PROTECTIVE MEASURES

- A. Surface facilities shall be constructed to meet the applicable requirements specified in 29 CFR 1910, subparts -

1. D - Walking Surfaces.
2. E - Means of Egress.
3. G - Occupational Health and Environmental Control.
4. J - General Environmental Controls.

[MGDS-RD 3.3.6.3.A][29 CFR 1910, Subparts D, E, G, J]

- B. Fire protection systems shall be designed in accordance with DOE Order 6430.1A, Divisions 1, 10, 11, and 16.

[MGDS-RD 3.3.6.3.B][DOE 6430.1A]

- C. Ventilation shall be provided to meet the standards of 29 CFR 1910.94 as applicable in surface areas where hazardous atmospheres are generated by construction, testing, or maintenance operations.

[MGDS-RD 3.3.6.3.C][29 CFR 1910.94]

- D. Facilities for storing and handling hazardous gases and combustible and flammable liquids shall be designed and installed to meet the requirements of 29 CFR 1910, Subpart H.

[MGDS-RD 3.3.6.3.D][29 CFR 1910, H]

- E. Protection against mechanical, fluid, and toxic hazards shall be in accordance with the requirements of 29 CFR 1910, Subparts H, J, Z and O. MIL-STD-1472D Section 5.13.7 may be used for reference.

[MGDS-RD 3.3.6.3.E][29 CFR 1910: H, O]

- F. Instrumentation and control systems shall include provisions to monitor and control the behavior of utility systems important to safety over anticipated ranges for normal operation and for off-normal conditions.

[MGDS-RD 3.3.6.3.F][10 CFR 60.131(b)(8)]

- G. Ventilation meeting the standards of 30 CFR 57, Subpart D shall be provided as applicable in underground facilities.

[MGDS-RD 3.3.6.3.G][30 CFR 57, Subpart D]

3.3.6.4 PERSONNEL PROTECTIVE EQUIPMENT

- A. Protective equipment such as helmets, face shields, safety shoes, and respiratory protectors shall be selected in accordance with the applicable requirements of 29 CFR 1910 Subpart I, 29 CFR 1926 Subpart E, NUREG-0700 Section 6.1.4, 30 CFR 57 Subpart N, and DOE Order 6430.1A Section 1300-12.4.5.

[MGDS-RD 3.3.6.4.A][29 CFR 1910, I; 29 CFR 1926, E][NUREG-0700 Section 6.1.4][30 CFR 57, N][DOE Order 6430.1A, 1300-12.4.5]

- B. Hearing protection devices shall be provided as required by 29 CFR 1910.95.

[MGDS-RD 3.3.6.4.B][29 CFR 1910.95]

- C. In addition to the engineering controls which are the primary method for providing healthful air, and which are specified elsewhere in this RDRD, respiratory equipment approved by the Mine Safety and Health Administration (MSHA) shall be provided to persons exposed for short periods to inhalation hazards from gas, dusts, fumes, or mist.

[MGDS-RD 3.3.6.4.C][30 CFR 57.5005(a)]

- D. Respiratory protection equipment shall be provided and shall be in compliance with the requirements specified by 10 CFR 20.1703(a).

[MGDS-RD 3.3.6.4.D][10 CFR 20.1703(a)]

- E. Appropriate facilities that provide convenient storage and emergency issue shall be provided for personal protective equipment.

[MGDS-RD 3.3.6.4.E][29 CFR 1910.132]

3.3.6.5 UNDERGROUND PROTECTIVE MEASURES

Safety and health protection systems shall be provided in underground spaces as required by 30 CFR 57, 29 CFR 1910, and 29 CFR 1926, as applicable, to afford the greatest protection (see Section 3.3.6.2.E).

[MGDS-RD 3.3.6.5][CRD 3.3.6.5]

3.3.6.6 SAFETY LABELS AND PLACARDS

- A. Safety labels and placards shall be designed and displayed as required in 29 CFR 1910 Subpart J. MIL-STD-1472D Section 5.13.1 may be used for reference.

[MGDS-RD 3.3.6.6.A][29 CFR 1910, J]

- B. Pipe, hose, and tube-line identification for liquids, gas, and steam shall be clearly and unambiguously labeled or coded as to contents, pressure, heat, cold, direction of flow, or other specific hazard information.

[MGDS-RD 3.3.6.6.B][CRD 3.3.6.6.B]

- C. Alerting devices, emergency doors and exits, and equipment provided for use in hazard areas and the environment around surface workspaces shall be designed in accordance with the requirements of 29 CFR 1910 Subpart E. MIL-STD-1472D Section 5.13.4. may be used for reference.

[MGDS-RD 3.3.6.6.C][29 CFR 1910, E]

3.3.6.7 EMERGENCY LIGHTING

- A. Failure of the normal lighting systems shall not inhibit or degrade the operation of emergency lighting.

[MGDS-RD 3.3.6.7.A][CRD 3.3.6.7.A]

- B. The emergency lighting system shall be designed to automatically actuate and shall be powered by batteries that are continuously charged.

[MGDS-RD 3.3.6.7.B][CRD 3.3.6.7.B]

- C. Lighting levels shall comply with the requirements of NUREG-0700 Section 6.1.5.4.c and the recommended practices of the Illumination Engineering Society.

[MGDS-RD 3.3.6.7.C]

3.3.6.8 EQUIPMENT RELATED HAZARDS

- A. Interlocks, alarms, access, hazard access, and edge rounding shall be provided and designed in accordance with the applicable requirements of 29 CFR 1910 for surface equipment or 30 CFR 57 for underground equipment. MIL-STD-1472D Section 5.13.5 may be used for reference.

[MGDS-RD 3.3.6.8.A][29 CFR 1910, 30 CFR 57]

- B. To protect servicing and maintenance personnel, tag-out and lock out fixtures shall be provided as required by 29 CFR 1910.147 for surface machines and equipment or 30 CFR 57.12016 for underground machines and equipment.

[MGDS-RD 3.3.6.8.B][29 CFR 1910.147, 30 CFR 57.12016]

- C. Fixed machinery tools shall be selected, installed, and guarded as required by 29 CFR 1910, Subpart O for surface machinery or 30 CFR 57, Subpart M for underground machinery.

[MGDS-RD 3.3.6.8.C][29 CFR 1910 Subpart O, 30 CFR 57 Subpart M]

- D. Hand and portable power tools shall meet the applicable requirements specified by 29 CFR 1910, Subpart P.

[MGDS-RD 3.3.6.8.D][29 CFR 1910, P]

- E. Welding equipment and areas where welding operations will be performed shall meet the requirements specified by 29 CFR 1910, Subpart Q.

[MGDS-RD 3.3.6.8.E][29 CFR 1910, Q]

- F. Where the possibility exists for the eyes or body of any person to be exposed to injurious corrosive materials, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the immediate work area for emergency use.

[MGDS-RD 3.3.6.8.F][29 CFR 1910.151(c)]

3.3.6.9 POSTING REQUIREMENTS

- A. **Posting of Radiation Areas.** Each radiation area shall be posted with a conspicuous sign or signs bearing the radiation symbol and the words "CAUTION, RADIATION AREA."

[MGDS-RD 3.3.6.9.A][10 CFR 20.1902(a)]

- B. **Posting of High Radiation Areas.** Each high radiation area shall be posted with a conspicuous sign or signs bearing the radiation symbol and the words "CAUTION, HIGH RADIATION AREA" or "DANGER, HIGH RADIATION AREA."

[MGDS-RD 3.3.6.9.B][10 CFR 20.1902(b)]

- C. **Posting of Very High Radiation Areas.** Each very high radiation area shall be posted with a conspicuous sign or signs bearing the radiation symbol and words "GRAVE DANGER, VERY HIGH RADIATION AREA."

[MGDS-RD 3.3.6.9.C][10 CFR 20.1902(c)]

3.2.5.5 OVERALL UTILIZATION

Overall utilization is the product of scheduled utilization, availability, and worker productivity, where scheduled utilization is the ratio of scheduled operating hours per year to total hours per year. Availability is the system element availability as required in Section 3.2.5.3. Worker productivity is the average fraction of a work period that workers perform required work; time waiting for resources, break time, dress out time, and other non-productive time is not included.

[MGDS-RD 3.2.5.5][CRD 3.2.5.5]

- A. Overall utilization shall be a subject addressed at design reviews.

[MGDS-RD 3.2.5.5.A][CRD 3.2.5.5.A]

- B. Design of the repository shall consider the appropriate overall utilization in the design of the system to meet the applicable portions of the WA schedule of Table 3-3.

[MGDS-RD 3.2.5.5.B][CRD 3.2.5.5.B.2]

3.2.6 ENVIRONMENTAL REQUIREMENTS

3.2.6.1 NATURAL ENVIRONMENT

GROA SSCs important to safety shall be designed so that the effects of anticipated natural phenomena and environmental conditions will not interfere with necessary safety functions.

[MGDS-RD 3.2.6.1][10 CFR 60.131(b)(1)]

- A. **Natural Conditions.** Natural phenomena and environmental conditions at the GROA considered in the design shall include events and conditions such as earthquakes, tornados, wind, lightning, floods, precipitation, humidity, temperature, sand and dust, and fungus, bacteria, and algae.

[MGDS-RD 3.2.6.1.A][CRD]

- B. **Combinations.** The design bases shall reflect appropriate consideration of the most severe conditions reported for the site and surrounding area and appropriate combinations of the normal and accidental conditions and the effects of natural phenomena, with appropriate margins to take into account the limitations of the data and the period of time in which the data have accumulated.

[MGDS-RD 3.2.6.1.B][CRD 3.2.6.1.B]

- C. **Adverse Interaction.** All SSCs shall be designed so that their failure does not lead to loss of safety function of structures, systems and components that are important to safety.

[MGDS-RD 3.2.6.1.C]

- D. **Design Earthquake.** DE parameters for surface facilities that house waste handling functions shall be calculated in accordance with UCRL 15910.

[MGDS-RD 3.2.6.1.D]

- E. **Tornado and Extreme Wind.**

1. **Regulatory Guidance.** The guidance in NRC Regulatory Guide 1.76, Design Basis Tornado for Nuclear Power Plants, applies to the geologic repository design.

[MGDS-RD 3.2.6.1.E.1]

2. **Determination of Design Basis Tornado.** DOE site-specific hazard model studies summarized in UCRL 53526 shall be used to select the design basis tornado and extreme wind characteristics for the design of structures important to safety. If site-specific hazard model studies are not available, a hazard model shall be developed consistent with the approach used in UCRL 15910. In applying UCRL 53526, specific information on relating frequency of occurrence to facility hazard levels may be obtained from UCRL 15910.

[MGDS-RD 3.2.6.1.E.2][DOE Order 6430.1A, 0111-99.0.2]

3. **Tornado Analysis.** In designing for tornado or extreme wind resistance:

- a) The tornado rotational speed shall be appropriately combined with the translational speed.

[MGDS-RD 3.2.6.1.E.3.a][DOE Order 6430.1A, 0111-99.0.2]

- b) Resulting loads from the rate of pressure drop, taking into consideration any pressure equalization due to permissible venting, shall be combined with velocity-induced pressure loads as stipulated in UCRL 15910.

[MGDS-RD 3.2.6.1.E.3.b][DOE Order 6430.1A, 0111-99.0.2]

- c) UCRL 53526 provides the characteristics of typical potential tornado-generated missiles. Additional missiles may be identified from review of on-site sources and possible missiles that could be borne to the site by tornado. Both small high-velocity missiles and massive low-velocity

- D. **Posting of Airborne Radioactivity Areas.** Each area with a potential airborne radioactivity hazard shall be posted with a conspicuous sign or signs bearing the radiation symbol and the words "CAUTION, AIRBORNE RADIOACTIVITY AREA" or "DANGER, AIRBORNE RADIOACTIVITY AREA."

[MGDS-RD 3.3.6.9.D][10 CFR 20.1902(d)]

- E. **Posting of Areas or Rooms in Which Licensed Material is Used or Stored.** Each area or room in which there is used or stored an amount of licensed material exceeding 10 times the quantity of such material specified in Appendix C to 10 CFR 20.1001-10 CFR 20.2401 shall be posted with a conspicuous sign or signs bearing the radiation symbol and the words "CAUTION, RADIOACTIVE MATERIAL(S)" or "DANGER, RADIOACTIVE MATERIAL(S)."

[MGDS-RD 3.3.6.9.E][10 CFR 20.1902(e)]

3.3.6.10 WORK PLATFORMS

- A. Any powered platforms, manlifts, and vehicle-mounted work platforms shall be designed and constructed to comply with 29 CFR 1910, Subpart F.

[MGDS-RD 3.3.6.10.A][29 CFR 1910, F]

- B. Scaffolds, ladders, work platforms, stands, and bridges shall be provided with safety devices in accordance with the requirements of 29 CFR 1910 Subparts D and F. MIL-STD-1472D Section 5.13.6 may be used for reference.

[MGDS-RD 3.3.6.10.B][29 CFR 1910, D and F]

3.3.6.11 ELECTRICAL SAFETY

- A. Electrical systems and components shall be selected, designed, and installed as required by 29 CFR 1910, Subpart S.

[MGDS-RD 3.3.6.11.A][29 CFR 1910, S]

- B. Provisions shall be made to make reliable and timely emergency power immediately available to instruments, utility service systems, central security systems and operating systems, including alarm systems important to safety, in the event of a loss of the primary electric power source or circuit. (Backup power requirements for items not identified as important to safety are treated by analysis during design development process).

[MGDS-RD 3.3.6.11.B][10 CFR 60.131(b)(5)(iii)]

- C. Protection against electrical hazards shall also conform to the National Electrical Code (NFPA-70), the National Electrical Safety Code (ANSI Standard C2), and, for underground applications, 30 CFR 57 Subpart K.

[MGDS-RD 3.3.6.11.C][NFPA-70][ANSI C2][30 CFR 57, K]

3.3.7 HUMAN FACTORS ENGINEERING

3.3.7.1 WORKSTATIONS AND CONTROL ROOMS

Control rooms include rooms, areas, and personnel enclosures for personnel who operate equipment or monitor the operations of the repository. Workstations contain workspace and associated equipment for performing those functions. Design and layout of control rooms and workstations shall be performed using NUREG 0700, Section 6.1 as a reference.

[MGDS-RD 3.3.7.1][CRD 3.3.7.1]

3.3.7.2 VOICE COMMUNICATIONS EQUIPMENT

Requirements for human factors engineering and man-machine interfaces with voice communications equipment influence the design and selection of telephones, intercoms, radios, and other voice communication equipment. Design and selection of voice communications equipment shall use NUREG-0700 Section 6.2.1 for general requirements, conventional-powered telephone systems, sound powered telephone systems, hand-portable radio transceivers, fixed-base radio transceivers, announcing systems, point-to-point communication systems, and emergency communications, and MIL-STD-1472D Section 5.3.10 for operating controls for voice communications equipment as references.

[MGDS-RD 3.3.7.2][CRD 3.3.7.2]

3.3.7.3 ALARMS AND WARNING SYSTEMS

Auditory and visual alarm systems alert personnel to out of tolerance conditions that, if overlooked, may lead to personnel injury, equipment damage, or loss of system capability. Alarms and warning systems shall use NUREG-0700 Section 6.2 for alarms and operator response systems and Section 6.3 for audio displays and alerts as references.

[MGDS-RD 3.3.7.3][CRD 3.3.7.3]

3.3.7.4 CONTROLS

Controls include operator activated switches, valves, and similar mechanisms or devices used to regulate or guide operations of a machine, apparatus, or system. Human factors engineering design of controls shall use NUREG-0700 Section 6.4 for selection of and design principles for controls as a reference.

[MGDS-RD 3.3.7.4][CRD 3.3.7.4]

3.3.7.5 VISUAL DISPLAYS

Visual displays include meters, colored lights, graphic devices, and numerical readouts. Design or acquisition of visual displays shall use NUREG-0700 Section 6.5 as a reference.

[MGDS-RD 3.3.7.5][CRD 3.3.7.5]

3.3.7.6 CONTROL PANEL LAYOUT

The consideration of human engineering aspects of control contributes to operator proficiency, lessens operator fatigue, decreases training requirements, and contributes to safety. Design and layout of control panels shall use NUREG-0700 Section 6.8 as a reference.

[MGDS-RD 3.3.7.6][CRD 3.3.7.6]

3.3.7.7 CONTROL DISPLAY INTEGRATION

Design and integration of controls with associated displays shall use NUREG-0700 Section 6.9 as a reference.

[MGDS-RD 3.3.7.7][CRD 3.3.7.7]

3.3.7.8 LABELING, MARKINGS, AND SIGNS

Labeling and marking equipment and providing signs and location aids shall use NUREG-0700 Section 6.6.1 as a reference.

[MGDS-RD 3.3.7.8][CRD 3.3.7.8]

3.3.7.9 VISUAL DISPLAY TERMINAL WORKSTATION

Human factors engineering of computer terminals, visual displays, and Video Display Terminal (VDT) workstations contributes to operator proficiency and lessens operator fatigue. Design, selection, and integration of VDT workstations shall use ANSI/HFS Std. No. 100-1988 Section 5 as a reference.

[MGDS-RD 3.3.7.9][CRD 3.3.7.9]

3.3.7.10 ANTHROPOMETRY

Sizing and layout dimensions for equipment, facilities, and the selection of personnel equipment and clothing to provide compatibility with using personnel shall use MIL-STD-1472D Section 5.6.3.2 as a reference. See DOD-HDBK-743A for special populations.

[MGDS-RD 3.3.7.10][CRD 3.3.7.10]

3.3.7.11 REMOTE HANDLING AND OPERATION

The design, selection, and integration of equipment, controls, and indicators for remotely operated systems, if used, shall use MIL-STD-1472D Section 5.10 or applicable industry standards as references.¹¹

[MGDS-RD 3.3.7.11][CRD 3.3.7.11]

¹¹For example, the Mining Equipment Manufacturer's Group of the American Mining Congress.

3.3.7.12 VEHICLES AND MATERIAL HANDLING

The human factors engineering, design, selection, and acquisition of operational and transportation vehicles and material handling equipment shall use MIL-STD-1472D Section 5.12 as a reference.

[MGDS-RD 3.3.7.12][CRD 3.3.7.12]

3.3.7.13 ACCESSIBILITY AND USEABILITY BY THE PHYSICALLY HANDICAPPED

- A. All buildings at the Repository Segment shall be designed and constructed to accommodate the physically handicapped as required by General Services Administration (GSA) Uniform Federal Accessibility Standards.

[MGDS-RD 3.3.7.13.A][41 CFR 101-19.603]

- B. The design, selection, and construction of all Repository Segment facilities shall consider accessibility and useability of surface facilities and equipment by physically handicapped personnel, both visitors and employees. As a minimum, the criteria and requirements specified in DOE Order 6430.1A Section 1300-13 shall be considered for all facility and equipment designs.

[MGDS-RD 3.3.7.13.B][CRD 3.3.7.13]

3.3.7.14 USER-COMPUTER SOFTWARE INTERFACE

Design of computer software and firmware that provides an interface between users and computers shall use Guidelines for Designing User Interface Software (MTR 10090) as a reference for data entry and user inputs, data display, sequence control, user guidance and prompts, data transmission, and data protection.

[MGDS-RD 3.3.7.14][CRD 3.3.7.14]

3.3.8 METHODS AND CONTROLS**3.3.8.1 MATERIAL MANAGEMENT**

- A. The Repository Segment shall include systems (preferably automated) to provide identification and control of materials, parts, and components, including the use of heat numbers, part numbers, serial numbers, or other means, either on the item or on records traceable to the item as required, throughout fabrication, installation, and use of the item. The identification and control shall be designated to prevent the use of incorrect or defective materials, parts, and components. The material management system shall enable location and removal of such items.

[MGDS-RD 3.3.8.1.A]

- B. Materials, parts, or components that do not conform to requirements shall not be used or installed. Controls shall include procedures for identification, documentation, segregation, disposition, and notification to affected organizations.

Nonconforming items shall be reviewed and accepted, rejected, repaired, or reworked in accordance with documented procedures.

[MGDS-RD 3.3.8.1.B][CRD 3.3.8.1.B]

- C. Measures shall be established to ensure that purchased material, equipment, and services conform to procurement documents.

[MGDS-RD 3.3.8.1.C][CRD 3.3.8.1.C]

- D. Current and projected requirements and capabilities in support of the proposed system/equipment design shall make maximum use of standardization in order to ensure reliability and supportability.

[MGDS-RD 3.3.8.1.D][CRD 3.3.8.1.D]

- E. Materials used for stabilization, compaction, dust control, site preparation, surface paving, construction, and utility systems shall be evaluated to ensure that they do not adversely impact waste isolation.

[Derived]

3.3.8.2 INVENTORY CONTROL

- A. The repository shall use compatible hardware and software systems for maintaining a physical inventory of all SNF and HLW in storage at the Repository Segment and emplaced underground. These systems shall meet the applicable requirements of this RDRD as appropriate.

[MGDS-RD 3.3.8.2.A][CRD 3.3.8.2.A]

- B. An inventory management system shall be implemented for the Repository Segment for control of supplies and spare parts.

[MGDS-RD 3.3.8.2.B][CRD 3.3.8.2.B]

- C. Inventory accounting and control systems for nuclear material shall comply with the safeguard requirements of 10 CFR 75, in compliance with the US/IAEA agreement.

[MGDS-RD 3.3.8.2.C][10 CFR 75.1]

3.3.9 GOVERNMENT FURNISHED PROPERTY

- A. The site for the repository will be provided by the U. S. Government, in accordance with the criteria specified in Appendix B to the MGDS Requirements document.

[MGDS-RD 3.3.9.A][CRD 3.3.9.A]

- B. Derivative specifications shall identify, as appropriate, any property to be furnished by the U.S. Government.

[MGDS-RD 3.3.9.B][CRD 3.3.9.B]

- C. Requirements pertaining to the receipt, maintenance, operation and disposition of Government furnished property shall be specified in derivative specifications as appropriate.

[MGDS-RD 3.3.9.C][CRD 3.3.9.C]

3.3.10 COMPUTER RESOURCES

The design of Repository Segment computer systems [TBD] shall provide for the intercompatibility of resources, including hardware and software. The design goal is to allow for the common use of databases and information with other CRWMS elements.

[MGDS-RD 3.3.10][CRD 3.3.10]

3.3.11 ENVIRONMENTAL PROTECTION REQUIREMENTS

This section identifies and imposes requirements on the Repository Segment to comply with Federal and state laws and regulations to protect the environment.

- A. Derivative specifications shall include these requirements as a minimum and shall add any applicable state and local environmental requirements on the design and construction of the repository.

[MGDS-RD 3.3.11.A][CRD 3.3.11.A]

- B. Significant adverse environmental impacts shall be mitigated, to the extent practicable, during repository construction, operation, closure, and decommissioning.

[MGDS-RD 3.3.11.B][10 CFR 960.3-4]

- C. Environmental monitoring shall adhere to the requirements of DOE Order 5400.1.

[Derived]

3.3.11.1 AIR POLLUTION CONTROL

- A. **Point Sources.** Stationary sources of air emissions shall comply with the provisions of the Clean Air Act as amended (42 USC 7401 et seq.). Federal regulations pertaining to compliance with the Clean Air Act include 40 CFR 50, 40 CFR 60, and 40 CFR 61.

[MGDS-RD 3.3.11.2.A][40 CFR 50, 40 CFR 60, and 40 CFR 61]

- B. **Non-point Sources.** Fugitive air emissions shall be controlled in accordance with the provisions of the Clean Air Act as amended.

[MGDS-RD 3.3.11.2.B][42 USC 7401 et seq.]

- C. **Gas and Dust Control.** Specific criteria for gas and dust control shall be based on the threshold limit values (TLV) adopted by the American Conference of Governmental Industrial Hygienists (ACGIH).

[Derived]

3.3.11.2 WATER POLLUTION CONTROL

- A. **Point Sources.** Point source discharges of treated waste waters into surface water systems shall comply with the provisions of the CWA as amended (33 USC 1251 et seq.), as implemented through the NPDES permit process (Section 402 of the CWA).

[MGDS-RD 3.3.11.3.A][33 USC 1251 et seq.][40 CFR 122.41]

1. If a reservoir is used to regulate the flow in a stream, water releases from the reservoir shall not be used as a substitute for adequate treatment of a waste source which is being discharged into the stream.

[MGDS-RD 3.3.11.3.A.1][33 USC 1252(b)(1)]

2. The ultimate disposal of sludge from wastewater treatment facilities shall be performed in accordance with the requirements of Section 405 of the CWA in addition to any permit requirements.

[MGDS-RD 3.3.11.3.A.2][33 USC 1345]

3. A wastewater treatment system shall be provided to comply with 33 USC 1251 et seq.

[MGDS-RD 3.3.11.3.A.3][33 USC 1311 (a)]

4. The wastewater treatment system shall have means to monitor effluents in compliance with the requirements specified in 33 USC 1318.

[MGDS-RD 3.3.11.3.A.4][33 USC 1318 (a)(1)(A)]

5. Provision shall be made to limit the discharge of effluents in accordance with 33 USC 1311.

[MGDS-RD 3.3.11.3.A.5][33 USC 1311]

- B. **Fill or Dredged Materials.** Placement of fill or dredged material into waters of the United States shall be performed in accordance with the requirements of Section 404 of the CWA (33 USC 1251 et seq.). Federal regulations regarding this permit are contained in 33 CFR 323.

[MGDS-RD 3.3.11.3.B][33 CFR 323]

3.3.11.3 DRINKING WATER PROTECTION

- A. **General.** Any Repository Segment activity which may impact a drinking water source shall meet the requirements of the Safe Drinking Water Act as amended (42 USC 300f et seq.).

[MGDS-RD 3.3.11.4.A][42 USC 300f et seq.]

- B. **Underground Injections.** Any activity involving underground injections (i.e. of non-radioactive material) shall comply with the provisions of the Safe Drinking Water Act as amended (42 USC 300f et seq.) which could require an Underground Injection Control permit under 40 CFR 144.31.

[MGDS-RD 3.3.11.4.B][42 USC 300j]

3.3.11.4 TOXIC SUBSTANCES CONTROL

The handling, use, and disposal of any toxic substances shall comply with the requirements of the Toxic Substances Control Act, as amended (15 USC 2601 et seq.) and 29 CFR 1910 Subpart Z.

[MGDS-RD 3.3.11.5][15 USC 2601 et seq., 29 CFR 1910 Subpart Z]

3.3.11.5 PESTICIDE CONTROL

The use of pesticides shall comply with the requirements of the Federal Insecticide, Fungicide, and Rodenticide Act as amended (7 USC 136 et seq.) and its implementing regulations which include 40 CFR 165.

[MGDS-RD 3.3.11.6][7 USC 136 et seq., 40 CFR 165]

3.3.11.6 SOLID WASTE CONTROL

The management and disposal of any solid and hazardous wastes shall be conducted in accordance with the requirements of the Resource Conservation and Recovery Act, as amended (42 USC 6901 et seq.) which include permitting for the hazardous wastes. The federal regulations that impact the design of the Repository are included in 40 CFR 261, 40 CFR 262, and 40 CFR 270.

[MGDS-RD 3.3.11.7][40 CFR 261, 40 CFR 262, 40 CFR 270]

3.3.11.7 NOISE CONTROL

Provisions shall be made to control and monitor noise levels in accordance with the requirements of the Noise Control Act of 1972 (42 USC 4901 et seq.) as amended, and shall adhere to applicable Federal regulations for the selection of portable air compressors and medium and heavy trucks.

[MGDS-RD 3.3.11.8][42 USC 4901 et seq.][40 CFR 204, 40 CFR 205]

3.3.11.8 ENDANGERED SPECIES

All site development shall be designed and constructed with due regard for protection of endangered species of natural life and their habitats.

[MGDS-RD 3.3.11.9][50 CFR 17]

3.3.11.9 EROSION CONTROL

Runoff and erosion at the repository site shall be controlled in accordance with applicable State of Nevada and local regulations.

[Derived]

3.4 DOCUMENTATION

3.4.1 SPECIFICATIONS

- A. All specifications for Repository Segment facility construction and for equipment development and procurement shall be prepared in accordance with the standards of the Construction Specification Institute format, tailored for the application.

[MGDS-RD 3.4.1.B][CRD 3.4.1.A]

- B. Implementing documents shall be established to ensure that applicable requirements as specified herein are correctly translated into specifications. These implementing documents must ensure that appropriate quality standards are specified and included in design documents and that deviations from these standards are properly controlled.

[MGDS-RD 3.4.1.C][QARD]

- C. Repository design organizations shall provide TBD/TBR/TBV logs for all information included as part of the design package. The log shall take the form of summary tables that show the location of the TBD, TBR, or TBV, and their titles. The log shall be located directly after the table of contents and directly before any change pages.

[Derived]

3.4.2 DRAWINGS

Implementing documents shall be established to ensure that applicable regulatory requirements, design basis requirements, and other requirements as specified herein are correctly translated into drawings. These implementing documents shall ensure that appropriate quality standards are specified and included in design documents and that deviations from these standards are properly controlled.

[MGDS-RD 3.4.2][QARD]

3.4.3 MAINTENANCE, OPERATORS, AND TECHNICAL MANUALS

Implementing documents shall be established to ensure that applicable requirements as specified herein are correctly translated into training, operator's, maintenance, and other technical manuals.

[MGDS-RD 3.4.3][QARD]

3.4.4 TEST PLANS AND PROCEDURES

The repository project shall establish a test and evaluation program to demonstrate the conformance of the design to the system requirements as required in the verification cross reference table of Section 4.3.

[MGDS-RD 3.4.4][CRD]

3.4.5 QUALITY ASSURANCE DOCUMENTATION

QA records shall be prepared, maintained, and stored in accordance with the requirements specified in the OCRWM QARD, or an equivalent OCRWM-approved QA program.

[MGDS-RD 3.4.5][QARD]

3.4.6 CONSTRUCTION RECORDS

- A. Construction records requirements for the Repository Segment, including as-built documentation, shall be specified in the derivative specifications.

[MGDS-RD 3.4.6.A][CRD 3.4.6.A]

- B. Construction records for the GROA shall be prepared and maintained in accordance with 10 CFR 60.72(b) and Section 3.4.5 to ensure useability for future generations. The required records include as a minimum, the following:

1. Surveys of the underground facility excavations, shafts, ramps, and boreholes referenced to readily identifiable features or monuments.
2. A description of the materials encountered.
3. Geologic maps and geologic cross-sections.

4. Locations and amount of seepage.
5. Details of equipment, methods, progress, and sequence of work.
6. Construction problems.
7. Anomalous conditions encountered.
8. Instrument locations, readings, and analysis.
9. Location and description of structural support systems.
10. Location and description of dewatering systems.
11. Details, methods of emplacement, and location of seals used.

[MGDS-RD 3.4.6][10 CFR 60.72(a) and (b)]

3.4.7 COMPUTER DOCUMENTATION

Analytical models, computational models, and software user documentation developed for the Repository Segment that are considered to be quality affecting shall be prepared in accordance with the OCRWM QARD.

[MGDS-RD 3.4.7][QARD]

3.4.8 RECORDS MANAGEMENT

Derivative specifications shall address records management requirements in accordance with 10 CFR 60.71(b).

[MGDS-RD 3.4.8][10 CFR 60.71(b)]

3.5 LOGISTICS

Logistics requirements are established in this section to provide a disciplined, unified, and iterative approach to development of the support requirements for Repository Segment sites, facilities, systems, and equipment. The systems, procedures, and measures developed to achieve these requirements will, in turn, ensure the design, readiness, and operational objectives of the Repository Segment.

3.5.1 MAINTENANCE

The basic premise of the program maintenance concept is to minimize the likelihood of, and mitigate the effects of, SSC failures using preventive maintenance and inspections. When failures do occur, the goal is to provide a capability to restore full operational capability as quickly as possible through a proactive corrective maintenance program.

Therefore, SSCs important to safety shall be designed to permit periodic inspection, testing, and maintenance, as necessary, to ensure their continued functioning and readiness.

[MGDS-RD 3.5.1][10 CFR 60.131(b)(6)]

3.5.1.1 EQUIPMENT MAINTENANCE

3.5.1.1.1 ON-LINE MAINTENANCE

- A. The performance of on-line maintenance shall be limited to those actions necessary for safety, to prevent system degradation, and to restore security monitoring. It consists of remove and replace actions, minor servicing, minor repairs, or repair to items which cannot easily be removed from service for maintenance.

[MGDS-RD 3.5.1.1.1.A]

- B. The maintenance system shall be equipment intensive, rather than personnel intensive, and shall rely on technology to reduce maintenance requirements.

[MGDS-RD 3.5.1.1.1.B][CRD 3.5.1.1.A]

- C. Built-in-test equipment (BITE) and automatic-test-equipment (ATE) shall be used where it is already incorporated into the design of a system or equipment, but existing equipment should not be redesigned to accommodate BITE or ATE without specific authorization. Newly designed equipment or systems shall incorporate BITE and/or ATE only where it can be demonstrated to significantly reduce the on-site maintenance workload.

[MGDS-RD 3.5.1.1.1.C][CRD 3.5.1.1.B]

- D. Maintenance facilities, equipment, and tools shall be provided based on the criteria specified by DOE Order 4330.4A, I, 3.5.

[MGDS-RD 3.5.1.1.1.D][DOE Order 4330.4A, I, 3.5]

- E. Provisions shall be made for maintenance of underground equipment as required by 30 CFR 57 Subpart M.

[MGDS-RD 3.5.1.1.1.E][30 CFR 57 Subpart M]

- F. Preventive maintenance programs shall be established that take advantage of shutdowns and off-duty cycles to perform the maintenance necessary to lower downtime of equipment and facilities.

[Derived]

3.5.1.1.2 INTERMEDIATE MAINTENANCE

- A. Intermediate maintenance shall provide failure detection, isolation, and replacement of units which are shop-repairable or vendor-repairable.

[MGDS-RD 3.5.1.1.2.A]

- B. Facilities, tools, and parts for shop repairable items shall be provided at the repository.

[MGDS-RD 3.5.1.1.2.B]

3.5.1.1.3 SALVAGING, OFF-SITE REPAIR, AND VENDOR REPAIR

Items which cannot be repaired at the repository shall be salvaged or returned to an off-site shop or the vendor for repair. Because of the long life of the repository, vendor supportability must be addressed in procurement and maintenance agreements.

[MGDS-RD 3.5.1.1.3]

3.5.1.2 CALIBRATION MAINTENANCE

- A. Radiation and other alarm systems, as appropriate, shall be designed with provisions for calibration and for testing their operability.

[MGDS-RD 3.5.1.2.A][10 CFR 60.131(a)(6)]

- B. The Repository Segment shall have provisions to ensure that instruments and equipment used for quantitative radiation measurements (e.g., dose rate and effluent monitoring) are calibrated periodically for the radiation measured.

[MGDS-RD 3.5.1.2.B][10 CFR 20.1501(b)]

3.5.1.3 CASK MAINTENANCE.

The repository waste handling facilities shall be capable, as a minimum, of supporting the following maintenance tasks for all transportation casks.

- A. Testing the surfaces of incoming casks for contamination and radiation.
- B. Decontaminating cask surfaces if required prior to admission into the processing and transfer facilities.
- C. Cleaning the interior of the casks following unloading.
- D. If necessary, decontaminating to satisfy the cleanliness requirements for transportation and any agreements which may exist with the waste producers as identified in the Waste Acceptance System Requirements Document.

- E. Providing technical information, special tools, equipment, lifting trunnions, spare parts and consumables needed to perform incidental maintenance on the cask.

[MGDS-RD 3.5.1.3][10 CFR 961.11, IV, B, (2)(c)]

3.5.1.4 STANDARDIZATION

- A. The design of the repository shall allow maintenance to be performed, to the extent practical, using standard tools, lubricants, cleaners, test equipment, etc.

[MGDS-RD 3.5.1.4.A]

- B. The use of special tools and the number of standard tools required shall be minimized by selection of common fasteners, clamps, adapters, and connectors.

[MGDS-RD 3.5.1.4.B]

3.5.1.5 SECURITY EQUIPMENT MAINTENANCE

The repository shall be designed to include means to test and maintain intrusion alarms, emergency alarms, communications equipment, physical barriers, and other security related devices or equipment.¹²

[MGDS-RD 3.5.1.5]

3.5.2 SUPPLY

As the maintenance concept influences the design it also affects the type and quantity of supply support that will be required to support the system. Based on projected logistics support requirements for design considerations, an analysis shall be conducted to assess the capability of support available to the system. This Logistic Support Analysis shall be conducted iteratively through all phases of the system or equipment life cycle to satisfy supportability objectives. The level of detail of the analyses and the timing of the task performance shall be tailored to each system and equipment item and shall be responsive to program schedules and milestones. An LSA program in accordance with the MIL-STD-1388-series or the equivalent shall be established for the repository.

[MGDS-RD 3.5.2][CRD 3.5.2]

3.5.3 FACILITIES

3.5.3.1 WAREHOUSE REQUIREMENTS

Warehouse space shall be provided for the storage of all spare parts, consumable equipment and replaceable equipment in an environment conducive to their safe-keeping and protection.

[MGDS-RD 3.5.3.1][CRD 3.5.3.C]

¹²The applicability of 10 CFR 73 to the MGDS is [TBD].

3.5.3.2 RECEIVING AND SHIPPING FACILITIES

A. A facility shall be provided for receipt of maintenance and repair materials and tools, and shipment and return receipt of items shipped off-site for repair.
[MGDS-RD 3.5.3.2.A]

B. The facility shall be designed with door openings, halls, and aisles adequate for movement of items to be shipped into and out of the facility.
[MGDS-RD 3.5.3.2.B]

3.5.3.3 CASK MAINTENANCE FACILITY

A CMF shall be collocated with the Repository [TBR] to meet the following requirements [TBD]:

[MGDS-RD 3.5.3.3]

3.5.3.4 LICENSING SUPPORT SYSTEM FACILITY

The repository design shall include facilities and equipment to support the Licensing Support System as described in 10 CFR 2.1011(b)(1).

[MGDS-RD 3.5.3.4][10 CFR 2.1011(b)(1)]

3.5.3.5 OTHER FACILITIES

Facilities and equipment shall be provided to implement support functions, such as administration (security, visitor center, etc.) and logistics (maintenance, utilities, etc.) not specified above.

[MGDS-RD 3.5.3.5][CRD 3.5.3.E]

3.5.4 SUPPORT AND TEST EQUIPMENT

Requirements for support and test equipment (S&TE) shall be determined through the logistic support analysis process. Multiple requirements for the same or similar S&TE shall be consolidated to the extent that performance of maintenance actions is not adversely impacted. S&TE requirements are determined for each level of maintenance.

[MGDS-RD 3.5.4][CRD 3.5.4]

3.6 PERSONNEL AND TRAINING

3.6.1 PERSONNEL

System effectiveness (readiness) is bounded by the availability and capabilities of personnel who must operate and maintain the repository in an operational mode. Operational requirements shall be derived through human factors analysis, particularly through generation of operational sequencing diagrams and detailed operator task analysis.

Maintenance requirements evolve from the maintainability analysis, the LSA, and detailed maintenance task analysis. These requirements are included for their impacts on the physical requirements of the repository.

- A. Operations of systems and components that have been identified as important to safety in the Safety Analysis Report (SAR) and in the license shall be performed only by trained and certified personnel or by personnel under the direct visual supervision of an individual with training and certification in such operation.

[MGDS-RD 3.6.1.A][10 CFR 60.160]

- B. The physical condition and general health of personnel certified in the operation of equipment and controls that are important to safety must not be such as might cause operational errors that could endanger other in-plant personnel or the public health and safety. Any condition that might cause impaired judgement or motor coordination shall be considered in the selection of personnel for activities that are important to safety. These conditions need not categorically disqualify a person, so long as appropriate provisions are made to accommodate such conditions.

[MGDS-RD 3.6.1.B][10 CFR 60.162]

3.6.2 TRAINING

Training may be accomplished through a combination of formal structured programs and on-the-job training. Training requirements include both the training of personnel initially assigned to the Repository Segment and the training of replacement personnel throughout the system life cycle as required due to attrition. Training shall cover both operator and maintenance tasks. These requirements are included for the impacts on the physical system (facilities and equipment) of the Repository Segment.

[MGDS-RD 3.6.2][CRD 3.6.2]

3.6.2.1 GENERAL REQUIREMENTS

- A. Repository Segment equipment maintenance training shall be provided based on the criteria specified by DOE Order 4330.4A, I, 3.1.4.

[MGDS-RD 3.6.2.1.A][DOE Order 4330.4A, I, 3.1.4]

- B. A training requirements document shall be provided to identify requirements for operator and maintenance training for facilities, hardware and software procured or constructed for the Repository Segment. The document shall address the following subjects:

1. The contractor and government responsibility for training shall be defined. This will include the concept of how training will be accomplished (e.g., school, contractor training).
2. Equipment required for training purposes shall be identified.

3. Training devices to be developed, characteristics of the training devices, and training and skills to be developed through the use of training devices shall be identified.
4. Training time and locations available for training shall be identified.
5. Source material and training aids to support the specified training shall be identified.

[MGDS-RD 3.2.6.1.B][CRD 3.6.2.1.D]

- C. A program for training, proficiency testing, and certification of personnel shall be established for personnel involved in activities important to safety at the Repository Segment.

[MGDS-RD 3.6.2.1.C][10 CFR 60.161]

3.6.2.2 HEALTH PHYSICS TRAINING

The Repository Segment project shall have facilities, equipment, manuals, and training aids to support a program for training, proficiency testing, and certification of personnel in radiation protection (health physics), and ALARA.

[MGDS-RD 3.6.2.2][CRD 3.6.2.2]

3.7 REPOSITORY SEGMENT CHARACTERISTICS AND REQUIREMENTS

This section addresses requirements allocated to Repository Segment functional areas, including requirements for:

- A. Geologic Setting.
- B. Site Development.
- C. Utilities and Services.
- D. Surface Facilities.
- E. Underground Facilities.
- F. Performance Confirmation.
- G. Radiologic Protection.

3.7.1 GEOLOGIC SETTING REQUIREMENTS

- A. **Geologic setting.** The geologic setting shall be selected ...¹³ to assure that releases of radioactive materials to the accessible environment following permanent closure conform to applicable environmental standards for radioactivity established by the EPA with respect to both anticipated processes and events and unanticipated processes and events.

[MGDS-RD 3.7.2.2.A][10 CFR 60.112]

- B. **Groundwater Travel Time.** The geologic repository shall be located so that the pre-waste-emplacement groundwater travel time along the fastest path of likely radionuclide travel from the disturbed zone to the accessible environment shall be at least 1,000 years, or such other travel time as may be approved or specified by the NRC.

[MGDS-RD 3.7.2.2.B][10 CFR 60.113 (a)(2)]

- C. **Groundwater.** If any of the average annual radionuclide concentrations existing in a special source of groundwater, if one exists, before construction of the disposal system already exceed the limits in 40 CFR 191.16 (a), the disposal system shall be designed to provide a reasonable expectation that, for 1,000 years after disposal, undisturbed performance of the disposal system shall not increase the existing average annual radionuclide concentrations in water withdrawn from the special source of groundwater by more than the limits established in 40 CFR 191.16(a). [TBR]

[MGDS-RD 3.7.2.2.C][40 CFR 191.16 (b) [TBR]]

- D. **Adverse Effects.** Assuming the site has been found suitable and to meet the requirements specified in 10 CFR 60.122(a), the Repository Segment design organization shall account for the effects of any of the potentially adverse conditions listed in 10 CFR 60.122(c) if they are found to be characteristic of the planned controlled area. 10 CFR 60.122(a) specifies that the effects of the potentially adverse conditions can be addressed by analysis, by compensation by favorable conditions (10 CFR 60.122(b)), or remedied [by engineering design].

[MGDS-RD 3.7.2.2.D][10 CFR 60.122]

- E. **Land Ownership.** The GROA and the controlled area shall be sited on land for which the DOE exercises the controls specified by 10 CFR 60.121.

[MGDS-RD 3.7.2.2.E][10 CFR 60.121]

¹³The requirements for the EBS and accesses, boreholes and their seals are addressed in 3.7.5 and the EBD RD.

1. Water rights as may be needed to accomplish the purpose of the GROA shall have been secured.

[10 CFR 60.121(c)(1)]

2. These lands shall be held free and clear of all encumbrances.

[10 CFR 60.121(a)(2)]

3.7.2 REPOSITORY SITE DEVELOPMENT REQUIREMENTS

- A. **Site Surveys.** Construction, control, property and topographic surveys shall be conducted in accordance with the standards specified in DOE Order 6430.1A, Section 0202, "Surveying". The appropriate class shall be selected from the Survey Suggested Standards and Specifications for Local Surveys (Table 0202-3.1) for each application. The appropriate order for level closure shall be selected from the Accuracy Standards for Level Closures (Table 0202-3.3) for each application.

[MGDS-RD 3.7.2.3.A][DOE Order 6430.1A, 0202]

- B. **Site Grading.**

1. In compliance with DOE Order 6430.1A, Section 0150-1, disturbance of the natural terrain shall be minimized during site grading. Where feasible, natural flora on or adjacent to the construction site shall be preserved and protected from vehicular and pedestrian traffic. Topsoil within the area of disturbance shall be stockpiled for later use in landscaping and reclamation efforts.

[MGDS-RD 3.7.2.3.B.1][DOE Order 6430.1A, Section 0150-1]

2. Site grading shall be designed and constructed in accordance with DOE Order 6430.1A, Section 0220, "Earthwork."

[MGDS-RD 3.7.2.3.B.2][DOE Order 6430.1A, Section 0220]

3. Parking areas shall be designed and constructed in accordance with DOE Order 6430.1A, Section 0250-4, "Parking Areas."

[MGDS-RD 3.7.2.3.B.3][DOE Order 6430.1A, 0250-4]

4. Areas for the surface facilities and entry points of underground accesses shall be graded as necessary to accommodate the facilities and to permit performance of the required functions, including drainage.

[Derived]

5. Landscaping shall not restrict visibility for roadways, transportation, or security activities.

[Derived]

C. Roads and Accesses.

1. Off-site roads traversing BLM property shall be designed and constructed in compliance with BLM Manual, Section 9113.

[MGDS-RD 3.7.2.3.C.1][BLM Manual, Section 9113]

2. Site roads shall be designed and constructed in accordance with DOE Order 6430.1A, Section 0250-3, "Roads," and Section 0250-5, "Pavements."

[MGDS-RD 3.7.2.3.C.2][DOE Order 6430.1A, 0250-3, -5]

3. Emergency access and evacuation routes for vehicles and personnel shall be provided. Roads, gates, and fence lines shall permit full access for fire-fighting and other emergency equipment and shall accommodate the largest turning radii and operating space required by emergency vehicles.[TBD]

[Derived]

D. Fencing.

1. Construction area and temporary security fences shall be designed and constructed in accordance with the requirements of DOE Order 6430.1A, Section 0150-5 "Temporary Security Fencing".

[MGDS-RD 3.7.2.3.D.1][DOE Order 6430.1A, 0150-5]

2. Permanent security fences shall be designed and constructed in accordance with the requirements of DOE Order 6430.1A, Section 0280-1 "Fencing".

[MGDS-RD 3.7.2.3.D.2][DOE Order 6430.1A, 0280-1]

- E. **Environment.** Significant adverse environmental impacts shall be mitigated, to the extent practicable, during repository construction, operation, closure, and decommissioning.

[MGDS-RD 3.7.2.3.E][42 USC 132(b)(1)(D)(iii)][42 USC 1033(a)][10 CFR 960.3-4]

- F. **Storm Water.** The storm water control and site drainage systems shall be designed and constructed in accordance with DOE Order 6430.1A Section 0270-2, Storm Water Management Systems.

[MGDS-RD 3.7.2.3.F][DOE Order 6430.1A, 0270-2]

- G. **Permits.** Repository Segment construction and operations shall comply with State of Nevada and local requirements for permitting.

[Derived]

3.7.3 REPOSITORY UTILITIES AND SERVICES REQUIREMENTS

Each utility service system that is important to safety shall be designed so that essential safety functions can be performed under both normal and accident conditions.

[MGDS-RD 3.7.2.4][10 CFR 60.131(b)(5)(i)]

3.7.3.1 LIGHTNING PROTECTION

Lightning protection, including lightning arrestors, static wires, and grounding systems, shall be provided. Lightning protection shall be provided for all major buildings and surface facilities. A ground grid shall be provided around each surface facility and shall be tied to an single point ground system.

[Derived]

3.7.3.2 ELECTRIC POWER

- A. **Emergency Power.** Provisions shall be made to make reliable and timely emergency power immediately available to instruments, utility service systems, central security systems, and operating systems, including alarm systems important to safety, in the event of loss of the primary electric power source or circuit. (Backup power requirements for items not identified as important to safety are treated by analysis during design development process.)

[MGDS-RD 3.7.2.4.1.A][10 CFR 60.131(b)(5)(iii)]

- B. **Electric Power.** The electric power system shall be designed in accordance with DOE Order 6430.1A, Division 16, "Electrical," ANSI C2, National Electrical Safety Code and applicable state laws.

[MGDS-RD 3.7.2.4.1.B][DOE Order 6430.1A]

- C. **Uninterruptible Power.** An uninterruptible power supply system shall be provided and shall be designed in accordance with DOE Order 6430.1A, Division 16 Electrical.

[MGDS-RD 3.7.2.4.1.C][DOE Order 6430.1A]

- D. **Standby Electrical Power.** The emergency electrical power supply system shall be provided and shall be designed in accordance with DOE Order 6430.1A, Division 16 Electrical and applicable state law.

[MGDS-RD 3.7.2.4.1.D][DOE Order 6430.1A]

3.7.3.3 SUPPLY AND CONTROL WATER

- A. **Plumbing.** Plumbing providing water for human consumption shall be lead-free in compliance with 42 USC 300g-6.

[MGDS-RD 3.7.2.4.2.A][42 USC 300g-6]

- B. **Potable Water.** The potable water system shall be designed and installed to comply with all Federal, State, and local requirements, administrative authorities, and process and sanctions regarding the provisions of safe drinking water.

[MGDS-RD 3.7.2.4.2.B][42 USC 300g-3][40 CFR 141 and 40 CFR 143]

- C. **Water Supply.** The water system shall be designed in accordance with DOE Order 6430.1A, Division 2 Site and Civil Engineering, and Division 15 Mechanical and applicable state laws.

[MGDS-RD 3.7.2.4.2.C][DOE Order 6430.1A]

3.7.3.4 COMMUNICATIONS

- A. **Communication Systems.** Communication systems shall be designed in accordance with the applicable sections of DOE Order 6430.1A, Division 1, Division 2, Division 10, Division 13, Division 15 and Division 16.

[MGDS-RD 3.7.2.4.3.A][DOE Order 6430.1A]

1. The communications network shall provide a telephone system, a two-way radio communications system, and an alarm system. The telephone system shall provide direct communication between the repository, the existing NTS network, and the offsite commercial system.

[Derived]

2. Offsite communications shall also provide for dial-access data transmission lines to offsite locations via long-distance toll and FTS services.

[Derived]

3. All electrical wiring and fixtures shall be kept physically separate from data and communication wiring for safety and to prevent induced interference.

[Derived]

4. Reliable and maintainable communications capability shall be established in and between the underground facility and the surface facilities.

[Derived]

- B. **Communications Facilities.** Communications facilities shall be designed in accordance with the applicable sections of DOE Order 6430.1A Section 1630-99.8 (Telecommunications, Alarms, and Automated Data Processing (ADP) Centers and Radio Repeater Stations).

[MGDS-RD 3.7.2.4.3.B][DOE Order 6430.1A, 1630-99.8]

- C. **Guard Communication.** Each guard or watchman on duty shall be provided continuous communication with a central alarm station within the protected area. This station shall be capable of communication with other guards and watchmen and local law enforcement authorities.

[MGDS-RD 3.7.2.4.3.C]

- D. **Telephone Communication.** The required security alarm stations shall have conventional telephone service for communication with law enforcement authorities.

[MGDS-RD 3.7.2.4.3.D]

- E. **Radio Communication.** To provide the capability of continuous communication, two-way radio voice communication shall be established in addition to conventional telephone service between local law enforcement authorities and the facility and shall terminate at the facility in a central alarm station within the protected area.

[MGDS-RD 3.7.2.4.3.F]

- F. **Communications Power Supply.** All communications equipment required for security, including off-site equipment, shall remain operable from independent power sources in the event of loss of primary power.

[MGDS-RD 3.7.2.4.3.G]

- G. **Central Management and Operations Control Center (CMOCC) Communications.** Communication with program operations and management at the CMOCC will be by the commercial telephone system.

[MGDS-RD 3.7.2.4.3.H]

3.7.3.5 ILLUMINATION SYSTEM

- A. **Lighting.** Lighting shall be designed in accordance with DOE Order 6430.1A, Division 16, Electrical.

[MGDS-RD 3.7.2.4.4.A][DOE Order 6430.1A]

1. General lighting for underground shall be at least [TBD] ft-candles in the mains.

[Derived]

2. In the service facilities not related to waste handling or security, lighting shall be at least [TBD] ft-candles.

[Derived]

- B. **Security Lighting.** Security lighting shall be designed to comply with the DOE Order 5632 series and NFPA-70, National Electrical Code.

[MGDS-RD 3.7.2.4.4.B][DOE Order 6430.1A, 0278]

3.7.3.6 TRANSPORTATION

- A. Vehicle and pedestrian transportation facilities and systems at the repository shall be designed and constructed to comply with DOE Order 6430.1A Section 0281, Vehicular and Pedestrian Circulation.

[MGDS-RD 3.7.2.4.5][DOE Order 6430.1A, 0281]

- B. Highways and railroads shall provide adequate space, load support, signs, and signals for transportation vehicles.

[Derived]

- C. Access roads shall be provided for the transport of radioactive waste, personnel, and materials from the appropriate major highway to the repository site.

[Derived]

- D. The highway shall be designed in accordance with the applicable requirements of the American Association of State Highway and Transportation Officials (AASHTO). The route and geometric design shall be in accordance with "A Policy on Geometric Design of Highways and Streets."

[Derived]

- E. The railroad spur shall be designed to accommodate the amount of waste and any other materials to be shipped by rail.

[Derived]

- F. Rail access shall be provided for the transport of radioactive waste and other materials from an existing mainline railroad to the repository onsite rail parking area, waste handling building, and any facilities that handle rail-shipped materials.

[Derived]

- G. The railroad track design shall conform to the applicable requirements of the Manual for Railway Engineering, American Railway Engineering Association (AREA, 1987/1988).

[Derived]

- H. Wherever deemed necessary, bridges shall be built over topographical depressions so that access roads and railroads can be constructed with smooth vertical curves without blocking drainage channels or necessitating the use of excessive earthwork.

[Derived]

- I. Transportation facilities shall be designed with drainage features to mitigate flooding effects.

[Derived]

3.7.3.7 MONITORING

- A. Instrumentation and control systems shall include provisions to monitor and control the behavior of systems important to safety over anticipated ranges for normal operation and for accident conditions.

[MGDS-RD 3.7.2.4.6.B][10 CFR 60.131(b)(8)]

- B. Control systems and instrumentation shall be designed in accordance with the applicable sections of DOE Order 6430.1A, Division 15 "Mechanical," and Division 16, "Electrical."

[MGDS-RD 3.7.2.4.6.C][DOE Order 6430.1A]

- C. Flammable gases shall be monitored in accordance with DOE Order 5400.1 and any other applicable local, State, and Federal regulations.

[Derived]

- D. Explosive gases shall be monitored in accordance with 30 CFR 57, Subpart T and any other applicable local, State, and Federal regulations.

[Derived]

- E. Noxious gases shall be monitored in accordance with 30 CFR 31.9(a)(4), 32.9(a)(4), and any other applicable local, State, and Federal regulations.

[Derived][30 CFR 31.9(a)(4)][30 CFR 32.9(a)(4)]

- F. A ground motion monitoring system shall be provided to detect seismic events or underground nuclear event (UNE)s and record associated ground motion.

[Derived]

- G. Seismic monitoring shall be provided for SSCs important to safety so that the structural response of these facilities to ground motion can be determined.

[Derived]

- H. Instrumentation shall be provided to monitor ground motion resulting from earthquakes and UNEs at the surface and at depth.

[Derived]

- I. Radiation monitoring systems shall be selected, installed, tested, and calibrated following the recommendations of ANSI Standard N42.18 - 1980, "Guide to Sampling Airborne Radioactive Materials in a Nuclear Facility."

[Derived][ANSI N42.18]

- J. Portable instrumentation shall be available as needed and shall comply with ANSI Standard N323-1979 (R1983), "Radiation Protection Instrumentation Test and Calibration."

[Derived][ANSI N323]

- K. The water quality monitoring system shall have the capability to sample, measure, and analyze physical, chemical, and biological conditions consistent with the requirements of the CWA (33 USC 1251) and the Safe Drinking Water Act (42 USC 300f) in accordance with DOE Order 5400.1. Such capability must also be compatible with the type and range of concentrations/occurrences of conditions specified in the governing regulations (e.g., 40 CFR 122, 141, 143 and State and local regulations).

[Derived][DOE Order 5400.1]

- L. Dosimetry for nuclear accidents shall meet ANSI N13.3, "Dosimetry For Criticality Accidents."

[Derived][ANSI N13.3]

3.7.3.8 SANITARY SEWERAGE

- A. The design, construction and operation of sanitary sewage handling and disposal systems shall be as permitted in accordance with the CWA, 33 USC 1251 et seq. Section 1345, and applicable state laws.

[MGDS-RD 3.7.2.4.7.A][33 USC 1345a]

- B. The sewerage system shall be designed in accordance with DOE Order 6430.1A, Division 2, Site and Civil Engineering and applicable state laws.

[MGDS-RD 3.7.2.4.7.B][DOE Order 6430.1A]

- C. The surface and underground sewage system shall be designed in accordance with DOE Order 5480.1, chg 1, 12-18-80, Chapter XII.

[Derived][DOE Order 5480.1, XII]

3.7.3.9 SITE-GENERATED WASTE TREATMENT

- A. Radioactive waste treatment facilities shall be designed to process any radioactive waste generated at the GROA into a form suitable to permit safe disposal at the GROA or to permit safe transportation and conversion to a form suitable for disposal at an alternative site in accordance with any regulations that are applicable.

[MGDS-RD 3.7.2.4.8.A][10 CFR 60.132(d)]

- B. Facilities shall be provided to manage and dispose of site-generated solid and hazardous wastes (excluding radioactive wastes) in accordance with requirements of the CWA, unless arrangements are made for off-site disposal.

[MGDS-RD 3.7.2.4.8.B][33 USC 1251 et seq.]

- C. The Repository Segment facilities shall be designed to minimize the production of site-generated hazardous wastes.

[Derived]

- D. The surface and underground wastewater system shall be designed in accordance with the following:

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

[Derived][NAC 445]

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

[Derived][DOE Order 5480.1, XII]

- E. Nonradioactive hazardous waste disposal facilities shall have sufficient capacity to process the quantities of hazardous waste anticipated throughout the operation of the repository [TBD]. Nonradioactive hazardous waste disposal facilities shall comply with DOE Orders 5480.3, and 5480.4.

[Derived][DOE Order 5480.3; 5480.4]

3.7.4 REPOSITORY SURFACE FACILITY REQUIREMENTS

Structures exceeding 200 ft in height shall meet Federal Aviation Administration safety provisions implemented under 49 USC 1501.

[Derived][49 USC 1501]

3.7.4.1 WASTE HANDLING REQUIREMENTS

A. Waste Handling.

1. Surface facilities in the GROA shall be designed to allow safe handling and lag storage (if needed) of wastes at the GROA, whether these wastes are temporarily on the surface before emplacement or as a result of retrieval from the underground facility.

[MGDS-RD 3.7.2.5.1.A.1][10 CFR 60.132(a)]

2. Waste-handling facilities shall provide a temporary storage capacity equivalent to [TBD] waste receipts.

[Derived]

3. Storage facilities shall have the capability to store the waste as received from offsite as well as the prepared waste packages onsite. [TBD].

[Derived]

4. The facilities and equipment used for waste-handling operations shall be designed so that waste-handling operations can be performed in reverse order to permit retrieval of emplaced waste packages.

[Derived]

5. Cranes and similar handling equipment shall be capable of meeting the requirements specified by DOE Order 6430.1A, Section 1460 and the CMAA 70 Standard.

[MGDS-RD 3.7.2.5.1.A.2][DOE Order 6430.1A, 1460]

6. All remotely operated cranes, manipulators, and other equipment used for handling highly radioactive solid wastes, shall be capable of being viewed and remotely monitored for contamination and radiation levels.

[Derived]

7. The ventilation system shall be designed in accordance with the requirements of Energy Research and Development Administration, ORNL-NSIC-65, and DOE/EV/1830-T5, and other applicable NRC and industry standards, including NUREG 0700 Section 6.15.

[Derived]

8. Waste-handling facilities shall provide a contamination free waste package exterior surface prior to release to the underground.

[Derived]

- B. **Delivery Modes.** The repository shall be capable of receiving shipments of spent fuel and commercial and HLW delivered by truck or rail.

[MGDS-RD 3.7.2.5.1.B][DOE/RW-0316, p 101]

- C. **Surface Facility Ventilation.** Surface facility ventilation systems supporting waste transfer, inspection, decontamination, processing, or packaging shall be designed to provide protection against radiation exposures and off-site releases as provided in 10 CFR 60.111(a).

[MGDS-RD 3.7.2.5.1.C][10 CFR 60.132(b)]

3.7.4.2 ALARM SYSTEMS

- A. The GROA shall include fire and explosion detection and alarm systems in SSCs important to safety.

[MGDS-RD 3.7.2.5.2.A][10 CFR 60.131 (b)(3)(iii)]

- B. All required security alarms shall annunciate in a central security alarm station located within the protected area and in at least one other security station, not necessarily within the protected area, such that a single act cannot remove the capability of calling for assistance or otherwise responding to an alarm.
1. All alarms shall be self-checking and tamper indicating.
 2. The annunciation of an alarm at the on-site central security alarm station shall indicate the type of alarm (e.g. intrusion alarm, emergency exit alarm, etc.) and location.
 3. All intrusion alarms, emergency exit alarms, alarm systems, and line supervision systems shall, at minimum, meet the performance and reliability levels indicated by GSA Interim Federal Specification W-A-00450 B (GSA-FSS).

[MGDS-RD 3.7.2.5.2.B]

- C. All emergency exits in each protected area and each vital area shall be alarmed.

[MGDS-RD 3.7.2.5.2.C]

- D. The repository design shall include air monitoring and alarm systems designed and installed in compliance with DOE Order 6430.1A, 1300-6.5.

[MGDS-RD 3.7.2.5.2.D][DOE Order 6430.1A, 1300-6.5]

- E. At least two security alarm stations, including at least one inside the protected area, shall be provided with the following capabilities:

1. Support continuous manning,

2. Monitor all security alarms initiated on the repository site,
3. Communicate with emergency response agencies and facilities on and off the repository site.

[MGDS-RD 3.7.2.5.2.E]

- F. Unoccupied vital areas and special material access areas shall be protected by an active intrusion alarm system.

[MGDS-RD 3.7.2.5.2.F]

- G. Nuclear accident alarms shall meet ANSI/ANS 8.3, "Criticality Accident Alarm System."

[Derived][ANSI/ANS 8.3]

3.7.4.3 FIRE PROTECTION REQUIREMENTS

Fire protection standards for the Repository Segment are imposed by various authoritative sources. In the event of conflict, the requirements affording greater protection (as determined by design analysis) prevail.

- A. The GROA shall be designed to include appropriate suppression systems with sufficient capacity and capability to reduce the adverse effects of fires and explosions on SSCs important to safety.

[MGDS-RD 3.7.2.5.4.A][10 CFR 60.131(b)(3)(iii)]

- B. The fire protection shall be designed in accordance with DOE Order 6430.1A, 0110-6.

[MGDS-RD 3.7.2.5.4.B][DOE Order 6430.1A, 0110-6]

- C. Detection equipment for fires and explosions shall meet the requirements of DOE Order 5480.7; DOE Order 6430.1A, Division 15 and Division 16; and any applicable local, State and Federal regulations.

[MGDS-RD 3.7.2.5.4.C][DOE Order 5480.7; 6430.1A]

- D. The Repository Segment is to be designed and constructed to achieve the improved risk objectives prescribed by DOE Order 5480.7, paragraph 4. To this end the design shall include the compliance features and essential elements specified by DOE Order 5480.7, Paragraphs 9 and 10.

[MGDS-RD 3.7.2.5.4.D][DOE Order 5480.7]

- E. Fuel storage areas shall comply with Federal, State of Nevada, and local requirements.

[Derived]

- F. Fuel storage tanks shall be designed and located in accordance with applicable regulations and shall be accessible by tank truck and rail. Fuel shall be transferred to the underground facility by the safest method. If a pipeline is used, it shall be capable of being emptied after fuel transfer is completed.

[Derived]

- G. The system for delivering fuel to the dispensing unit in the waste emplacement area shall maintain fuel separation between development and waste emplacement areas.

[Derived]

- H. Fire-extinguishing systems that do not use water shall be considered to protect areas where the use of water could result in undesirable consequences or inside remote handling areas where fire fighting by hand is impossible or hazardous.

[Derived]

- I. A fire alarm system shall be installed in each major facility, including the underground facility, to warn occupants of a fire, to activate the automatic fire protection systems, and to alert the fire station on the surface.

[Derived]

3.7.4.4 OTHER SURFACE FACILITIES

- A. **Change Rooms.** Change facilities shall be provided to comply with DOE Order 6430.1A, 1300-6.8.

[MGDS-RD 3.7.2.5.6.A][DOE Order 6430.1A, 1300-6.8]

- B. **Industrial Health and Safety.** The Repository Segment shall have the capability of sampling work environments where there is reason to suspect that work processes may create health hazards.

[MGDS-RD 3.7.2.5.6.B][DOE Order 3790.1A, I.3.a.(5)]

- C. **Training Facility Requirements.** The Repository Segment design shall provide facilities, equipment, manuals, and training aids to support training programs required by 10 CFR 60.161; 29 CFR 1910; 29 CFR 1926; 29 CFR 1960, Subpart H; 30 CFR 48; 30 CFR 57; 49 CFR 172, Subpart H; the QARD; and DOE Orders 3790.1A, 4330.4A and 5000.3A.

[MGDS-RD 3.7.2.5.6.C]

- D. **Medical Facility Requirements.** The Repository Segment shall include facilities to support the medical services required by DOE Order 3790.1A, Chapter VIII.

[MGDS-RD 3.7.2.5.6.D][DOE Order 3790.1A, Chapter VIII]

- E. **Office Requirements.**

1. Office spaces shall be based on a minimum of 100 square feet per office and a maximum per the Federal Property Management Regulations.

[MGDS-RD 3.7.2.5.6.E.1][41 CFR 101-17.3]

2. The Repository Segment shall include, within the GROA, unfurnished office space dedicated for the use of NRC inspection personnel. The office space shall be equipped with heating, ventilation and air-conditioning, lighting, electrical outlets, visual and acoustic privacy provisions, full access to the repository, and a minimum of 250 square feet of floor area. The office space that is provided will be subject to the approval of the Director, Office of Nuclear Material Safety and Safeguards.

[MGDS-RD 3.7.2.5.6.E.3][10 CFR 60.75(c)]

3. Office space including a clearly marked mining office shall be provided as necessary to support the management and operation of the repository, and to support MSHA, OSHA, and other oversight agencies.

[MGDS-RD 3.7.2.5.6.E.4]

4. Interior spaces shall comply with operating and functional requirements. Where practical, operations that are similar to each other shall be combined to permit joint use of facilities. Multipurpose buildings shall be designed to provide reasonable separation of operations without disrupting efficient circulation of personnel. Modular design elements shall be used where possible.

[Derived]

- F. **Records Management Requirements.**

1. Facilities and equipment shall be provided to preserve and maintain accident records in accordance with 29 USC 651.

[MGDS-RD 3.7.2.5.6.F.1][29 USC 657]

2. Facilities and equipment shall be provided to preserve and maintain the records as required by DOE Order 1324.2A, Records Disposition.

[MGDS-RD 3.7.2.5.6.F.2][DOE Order 3790.1A, page VII-8, (5)(b)(2)(g)(3)]

3. If a local records center is required and authorized, it shall be designed and outfitted to meet the requirements specified by DOE/RW-0194.

[MGDS-RD 3.7.2.5.6.F.3][DOE/RW-0194]

4. Facilities and equipment shall be provided to collect, store, and maintain QA records in accordance with the requirements of the QARD.

[MGDS-RD 3.7.2.5.6.F.4][QARD]

5. Additional record storage facilities shall be provided as necessary to support the operation and management of the Repository.

[MGDS-RD 3.7.2.5.6.F.5]

- G. **Maintenance Facility Requirements.** Maintenance facilities, equipment, and tools shall be provided to support the maintenance concept of the Repository Segment to be developed based on the policy, and criteria specified by DOE Order 4330.4A.

[MGDS-RD 3.7.2.5.6.G][DOE Order 4330.4A]

- H. **Test and Maintenance Facility Requirements.** The Repository Segment shall include facilities to test and maintain intrusion alarms, emergency alarms, communications equipment, physical barriers, and other security-related devices or equipment utilized pursuant to 10 CFR 60.

[MGDS-RD 3.7.2.5.6.H]

- I. **Emergency Response Requirements.**

1. The Repository Segment shall include a medical emergency response capability including: (1) the ability to treat the initial consequences of potential medical emergencies that might occur on the site and, if necessary, the ability to process injured or sick personnel for transfer to off-site medical emergency facilities; and (2) the capacity to treat the number of patients and types of illnesses or injuries that are likely to occur on the site.

[MGDS-RD 3.7.2.5.6.I.1][DOE Order 3790.1A, VIII.5(l)(m)]

2. The GROA shall be designed to include on-site facilities and services that ensure a safe and timely response to emergency conditions and that facilitate the use of available off-site services (such as fire, police, medical and ambulance service) that may aid in recovery from emergencies.

[MGDS-RD 3.7.2.5.6.I.2][10 CFR 60.131(b)(4)(ii)]

3. Space for storage of emergency equipment shall be provided.

[MGDS-RD 3.7.2.5.6.I.3][DOE Order 6430.1A, 0110-1.3]

J. Explosives Storage.

1. Storage magazines for explosives and caps shall meet the most stringent of the requirements of 29 CFR 1910.109; 27 CFR 55.201-211; California Administrative Code (CAC) Title 8, Chapter 4, Subchapter 20; applicable State or local regulations; and DOE Orders 5480.4 and 6430.1A.

[MGDS-RD 3.7.2.5.6.J.1][29 CFR 1910.109; 27 CFR 55.201-211; DOE Order 5480.4; 6430.1A]

2. Facilities for the storage of explosive materials shall be located in compliance with the regulations in 27 CFR 55.206.

- a) Outdoor magazines in which high explosives are stored shall be located no closer to inhabited buildings, passenger railways, public highways, or other magazines in which high explosives are stored, than the minimum distances specified in the table of distances for storage of explosive materials in 27 CFR 55.218.

[MGDS-RD 3.7.2.5.6.J.2.a][27 CFR 55.206]

- b) Ammonium nitrate and magazines in which blasting agents are stored shall be located no closer to magazines in which high explosives or other blasting agents are stored than the minimum distances specified in the table of distances for the separation of ammonium nitrate and blasting agents in 27 CFR 55.220. However, the minimum distances for magazines in which explosives and blasting agents are stored from inhabited buildings, etc., may not be less than the distances specified in the table of distances for storage of explosives materials in 27 CFR 55.218.

[MGDS-RD 3.7.2.5.6.J.2.c][27 CFR 55.206]

- K. **Personnel Support.** Facilities shall be provided to support the working staff at the Repository Segment to include vehicle access, parking, food service, restrooms, sleeping accommodations as required, and others as determined by analysis of the concept of operations.

[MGDS-RD 3.7.2.5.6.K]

L. Decontamination and Dismantlement.

1. Surface facilities shall be designed to facilitate decontamination or dismantlement to the same extent as would be required, under other parts of NRC regulations, with respect to equivalent activities licensed thereunder.

[MGDS-RD 3.7.2.5.6.L.1][10 CFR 60.132(c)]

2. The SSCs shall include features that will facilitate decontamination for future decommissioning, increase the potential for other uses, or both.

[MGDS-RD 3.7.2.5.6.L.2][DOE Order 6430.1A, 1300-11.2]

3. Capability shall be provided for decontamination of equipment, containers, casks, or carriers that may become contaminated.

[Derived]

- M. **Storage Facilities.** Provisions shall be made for the storage of private and DOE equipment (including test equipment and construction/drilling equipment).

[Derived]

- N. **Health Physics Facility.** Health physics facilities shall be provided to incorporate the features necessary to ensure compliance with 10 CFR 20.

[Derived]

- O. **Visitors' Center.** A visitors' center that includes adequate space for displays and presentations shall be provided to serve as an information center for visitors to the repository. An overlook area shall be provided at the visitors' center or elsewhere on the site to provide a visitor view of the repository surface area.

[Derived]

3.7.5 REPOSITORY UNDERGROUND REQUIREMENTS

- A. **Shaft conveyances.** Shaft conveyances, if used for handling radioactive waste, shall meet the following requirements:

1. Hoists important to safety shall be designed to preclude cage free-fall.

[MGDS-RD 3.7.2.6.A.1][10 CFR 60.131(b)(10)(i)]

2. Hoists important to safety shall be designed with a reliable cage location system.

[MGDS-RD 3.7.2.6.A.2][10 CFR 60.131(b)(10)(ii)]

3. Loading and unloading systems for hoists important to safety shall be designed with a reliable system of interlocks that will fail safely upon malfunction.

[MGDS-RD 3.7.2.6.A.3][10 CFR 60.131(b)(10)(iii)]

4. Hoists important to safety shall be designed to include two independent indicators to indicate when waste packages are in place and ready for transfer.

[MGDS-RD 3.7.2.6.A.4][10 CFR 60.131(b)(10)(iv)]

5. The size and weight limits of the hoisting system in the men-and-materials [TBV] shaft for materials handling shall be [TBD].

[Derived]

6. The hoist shall satisfy all local, state and federal regulations pertaining to safety, including those applicable to Title 8, Chapter 4, Subchapter 20 of the CAC.

[DOE Order 5480.4]

B. Underground Facility Ventilation. The underground facility ventilation system shall be designed to:

1. control the transport of radioactive particulates and gases within and releases from the underground facility in accordance with the performance objectives of 10 CFR 60.111(a) (Section 3.2.2 of this document);

[MGDS-RD 3.7.2.6.B.1][10 CFR 60.133(g)(1)]

2. assure continued function during normal operations and under accident conditions;

[MGDS-RD 3.7.2.6.B.2][10 CFR 60.133(g)(2)]

3. separate the ventilation of excavation and waste emplacement areas;

[MGDS-RD 3.7.2.6.B.3][10 CFR 60.133(g)(3)]

4. ensure that ventilation leakage between the emplacement system and the development system will always be from the development system to the emplacement system;

[Derived]

5. take into account geologic conditions encountered during in situ monitoring, testing, or development of subsurface facilities, which affect air contaminant levels, temperatures, or other conditions;

[Derived]

6. supply air to and exhaust adequate quantities of air [TBD] to and from underground working areas such that operator safety, health and productivity requirements are maintained;

[Derived]

7. contain safety features in accordance with 30 CFR 57 Subpart G, 30 CFR 57 Subpart T, and/or applicable requirements of CAC Title 8, Article 12.

[Derived][30 CFR 57]

C. **Diesel Exhaust Ventilation.**¹⁴ The underground facility shall be ventilated to comply with the following requirements:

1. 30 CFR 31.9(a) for diesel locomotives, if used.

[MGDS-RD 3.7.2.6.C.1][10 CFR 60.131(b)(9) as correlated with revised 30 CFR Chapter I][MOU DOE/DOL]

2. 30 CFR 32.9(a) for other diesel-powered equipment, if used, in a non-gassy environment.

[MGDS-RD 3.7.2.6.C.2][10 CFR 60.131(b)(9) as correlated with revised 30 CFR Chapter I][MOU DOE/DOL]

3. 30 CFR 36.45 for other diesel-powered equipment, if used, in a gassy environment.

[MGDS-RD 3.7.2.6.C.3][10 CFR 60.131(b)(9) as correlated with revised 30 CFR Chapter I][MOU DOE/DOL]

D. **Retrieval of Waste.** The underground facility shall be designed to permit retrieval of waste in accordance with the performance objectives of 10 CFR 60.111. (Section 3.2.1.4.B of this document)

[MGDS-RD 3.7.2.6.D][10 CFR 60.133(c)]

E. **Underground Openings.**

1. Openings in the underground facility shall be designed so that operations can be carried out safely and the retrievability option maintained.

[MGDS-RD 3.7.2.6.E.1][10 CFR 60.133(e)(1)]

2. Openings in the underground facility shall be designed to reduce the potential for deleterious rock movement or fracturing of overlying or surrounding rock.

[MGDS-RD 3.7.2.6.E.2][10 CFR 60.133(e)(2)]

¹⁴The components of diesel exhaust may accelerate corrosion of waste packages in addition to the health hazard. (This is an explanatory note.)

3. 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.

[MGDS-RD 3.7.3.4.A][10 CFR 60.133(a)(1)]

4. The location of underground openings shall be placed such that the effects of a maximum possible flood will not intrude on the operations of the subsurface facilities.

[Derived]

5. The openings shall be maintainable until closure.

[Derived]

6. 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.

[Derived]

7. 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, and groundwater system.

[MGDS-RD 3.7.3.4.C][10 CFR 60.133(i)]

F. Underground Facilities and Systems.

1. Underground facilities and systems shall be in accordance with the applicable health and safety requirements of 30 CFR 57.

[MGDS-RD 3.7.2.6.F.1]

2. The underground facility shall be designed so that the effects of credible disruptive events during the period of operations, such as flooding, fires, and explosions, will not spread through the facility.

[MGDS-RD 3.7.2.6.F.2][10 CFR 60.133 (a)(2)]

3. Underground explosives and cap storage facilities shall meet the requirements of 30 CFR 57 Subpart E and CAC, Title 8, Article 21. Physical security requirements also govern storage design and placement.

[MGDS-RD 3.7.2.6.F.3][30 CFR 57, Subpart E]

4. The GROA 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 SSCs important to safety.

[MGDS-RD 3.7.2.6.F.4][10 CFR 60.131(b)(3)(iii)]

5. The design of the GROA shall include such provisions for worker protection as may be necessary to provide reasonable assurance that all SSCs important to safety can perform their intended functions. Any deviation from relevant design requirements in 30 CFR 57 will give rise to a rebuttable presumption that this requirement has not been met and shall be justified in writing.

[MGDS-RD 3.7.2.6.F.5][10 CFR 60.131(b)(9), correlated with the revised 30 CFR Chapter I]

6. The Repository Segment design shall include air monitoring and alarm systems designed and installed in compliance with DOE Order 6430.1A, 1300-6.5.

[MGDS-RD 3.7.2.6.F.6][DOE Order 6430.1A, 1300-6.5]

7. Space for storage of emergency equipment shall be provided.

[MGDS-RD 3.7.2.6.F.7][DOE Order 6430.1A, 0110-1.3]

G. Rock Excavation.

1. Provisions shall be made to control dust due to drilling in rock, by the use of dust collectors, or by water or water with a wetting agent (water is the least preferred means), or by ventilation, or by any other approved method or device that is at least as effective in controlling dust.

[MGDS-RD 3.7.2.6.G.1][30 CFR 57.5003]

2. The design of the underground facility shall incorporate excavation methods that will limit the potential for creating a preferential pathway for groundwater to contact the waste packages or radionuclide migration to the accessible environment.

[MGDS-RD 3.7.2.6.G.2][10 CFR 60.133(f)]

- H. **Flexibility.** The underground facility shall be designed to allow adjustments to accommodate specific site conditions identified through in-situ monitoring, testing, or excavations.

[MGDS-RD 3.7.2.6.H][10 CFR 60.133(b)]

- I. **Water and Gas.** The underground facility shall be designed to control water and gas intrusion.

[MGDS-RD 3.7.2.6.I][10 CFR 60.133 (d)]

J. Seals.

1. Seals for accesses 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.

[MGDS-RD 3.7.2.6.J.1][10 CFR 60.134(a)]

2. Materials and placement methods for seals shall be selected to reduce, to the extent practicable, (a) the potential for creating a preferential pathway for groundwater to contact the waste packages; or (b) for radionuclide migration through existing pathways.

[MGDS-RD 3.7.2.6.J.2][10 CFR 60.134(b)(1) and (2)]

3. The ...¹⁵ seals for accesses and boreholes shall be designed to assure that releases of radioactive materials to the accessible environment following permanent closure conform to applicable environmental standards for radioactivity established by the EPA with respect to both anticipated processes and events and unanticipated processes and events.

[MGDS-RD 3.7.2.6.J.3][10 CFR 60.112]

K. Control of Fluids in Construction.

1. All fluids used in the construction and operation of the Repository Segment shall be strictly controlled to avoid introduction of products that could accelerate waste package corrosion or transport of radionuclides.

[MGDS-RD 3.7.2.6.K]

2. All substances and tracers intended to be added to water or other fluids to be piped underground for such purposes as drilling and dust control shall first be reviewed for potential to adversely affect waste isolation. They may be added only with review and approval by [TBD].

[Derived]

- L. **Fire Protection.** Fire protection standards for the underground facility are imposed by various authoritative sources. In the event of conflict, the requirements affording greater protection (as determined by design analysis) prevail.

¹⁵The requirements for the geologic setting and the EBS accesses and boreholes are addressed in 3.7.1A and 3.7.5 and the EBD RD.

1. The GROA shall be designed to include appropriate suppression systems with sufficient capacity and capability to reduce the adverse effects of fires and explosions on SSCs important to safety.

[MGDS-RD 3.7.2.6.L.1][10 CFR 60.131(b)(3)(iii)]

2. The fire protection shall be designed in accordance with DOE Order 6430.1A, 0110-6 and CAC, Title 8, Article 20.

[MGDS-RD 3.7.2.6.L.2][DOE Order 5480.1; 6430.1A, 0110-6]

3. Detection equipment for fires and explosions shall meet the requirements of DOE Order 5480.7; DOE Order 6430.1A, Division 15 and Division 16; and any applicable local, State and Federal regulations.

[MGDS-RD 3.7.2.6.L.3][DOE Order 5480.7; 6430.1A]

4. The underground facility is to be designed and constructed to achieve the improved risk objectives prescribed by DOE Order 5480.7, paragraph 4. To this end the design shall include the compliance features and essential elements specified by DOE Order 5480.7, Paragraphs 9 and 10.

[MGDS-RD 3.7.2.6.L.4][DOE Order 5480.7]

- M. **Industrial Health and Safety.** The Repository Segment shall have the capability of sampling work environments where there is reason to suspect that work processes may create health hazards.

[MGDS-RD 3.7.2.6.M][DOE Order 3790.1A, I.3.a.(5)]

N. **Ramps and Shafts.**

1. The waste ramp shall permit flow of intake ventilation air for the emplacement area, which, when combined with the airflow in the shafts, is adequate for emplacement operations [TBV].

[Derived]

2. The tuff ramp shall permit flow of ventilation airflow capacity adequate to meet the return air requirements of the development area during the construction and operation periods [TBV].

[Derived]

3. The portals shall be founded in rock and shall not be located in area subject to flooding.

[Derived]

4. The ramps shall be designed to prevent water from flowing into the ramp.

[Derived]

5. If shafts are used, the shaft size shall be determined by the size of the conveyances needed to move materials, personnel, and equipment underground; the volume of ventilation flow needed; and the space required for utility lines.
[TBD]

[Derived]

6. The shafts shall be designed to prevent objects or missiles from accidentally falling or being dropped down the shaft.

[Derived]

7. The structures in the shafts and ramps shall be designed to withstand the expected static (e.g., earth pressures within the shaft fill, water column pressures, and in situ stresses) and dynamic loading conditions so that performance is not impaired.

[Derived]

O. Drifts.

1. Drift sizes shall take into account requirements for hauling equipment and shall allow for clearances, ground support, and ventilation.

[MDS-RD 3.2.5.2.2.A]

2. The service main shall be adequate to handle the transport of development personnel, supplies, utility lines, and machinery to the men-and-materials shaft [TBV], to the service facilities for the development area, and to the development area.

[Derived]

3. The service main shall permit flow of adequate ventilation airflow to supply the volumes of air needed in the development area.

[Derived]

P. Emplacement Area.

1. Emplacement drift spacing shall consider the heat load as indicated by thermal analysis related to the thermal characteristics of the waste over the life of the repository.

[Derived]

2. The design of the access and emplacement drifts must take into account requirements for the transporter, haulage equipment, and other support equipment and shall include allowances for clearances, ground support, and ventilation.

[MGDS-RD 3.2.5.2.2.A]

3. In a drift emplacement concept the design of the emplacement area shall ensure that the emplacement drifts can accommodate the potential disposal of partial or fully shielded waste packages and the accommodations required for performance confirmation instrumentation. [TBD]

[Derived]

3.7.6 PERFORMANCE CONFIRMATION REQUIREMENTS

A. General Requirements.

1. The GROA shall be designed to include the capability to support tests appropriate or necessary (as determined by the NRC) for the administration of the regulations of 10 CFR 60. These tests may include tests of
 - a) radioactive waste,
 - b) the geologic repository including its SSCs,
 - c) radiation detection and monitoring instruments, and
 - d) other equipment and devices used in connection with the receipt, handling, or storage of radioactive waste.

[MGDS-RD 3.7.2.7.A.1][10 CFR 60.74(a)]

2. Environmental monitoring equipment shall be provided to acquire baseline data for performance confirmation.

[Derived]

3. The tests required in Section 3.7.6.A.1 shall include a performance confirmation program carried out in accordance with Subpart F of 10 CFR 60.

[MGDS-RD 3.7.2.7.A.2][10 CFR 60.74(b), 60.137]

4. The performance confirmation program shall provide data that indicates, where practical, whether:
 - a) Actual underground conditions encountered and changes in those conditions during construction and waste emplacement operations are within limits assumed in the licensing review; and

- b) Natural and engineered systems and components required for repository operation, or that are designed or assumed to operate as barriers after permanent closure, are functioning as intended and anticipated.

[MGDS-RD 3.7.2.7.A.3][10 CFR 60.140(a)]

- 5. The program shall include in situ monitoring, laboratory and field testing, and in situ experiments, as appropriate, to accomplish the objectives stated in Subpart F of 10 CFR 60 (3.7.6.A.2) above.

[MGDS-RD 3.7.2.7.A.4][10 CFR 60.140(c)]

- 6. The program shall:

- a) Not adversely affect the ability of the natural and engineered elements of the geologic repository to meet the performance objectives.
- b) Provide baseline information and analysis of that information on those parameters and natural processes pertaining to the geologic setting that may be changed by site characterization, construction, and operational activities.
- c) Monitor and analyze changes from the baseline condition of performance of the geologic repository.
- d) Provide an established plan for feedback and analysis of data, and implementation of appropriate action.

[MGDS-RD 3.7.2.7.A.5][10 CFR 60.140(d)]

- 7. The Repository Segment shall be capable of monitoring underground conditions and evaluating them against design assumptions.

[MGDS-RD 3.7.2.7.A.6][10 CFR 60.141(b)]

- B. **Testing.** During the early developmental stages of construction, a program of in situ testing of such features as borehole and access seals, backfill, and the thermal interaction effects of the waste packages, backfill, rock, and groundwater shall be conducted.

[MGDS-RD 3.7.2.7.B][10 CFR 60.142(a)]

- C. **Rock Measurements.** The Repository Segment shall be capable of measuring, as a minimum, rock deformations and displacement, changes in rock stress and strain, rate and location of water inflow into underground areas, changes in groundwater

conditions, rock pore water pressures, including those along fractures and joints, and the thermal and thermomechanical response of the rock mass as a result of development and operations of the geologic repository.

[MGDS-RD 3.7.2.7.C][10 CFR 60.141(c)]

- D. **Thermomechanical Response.** The Repository Segment shall be capable of in situ monitoring of the thermomechanical response of the underground facility until permanent closure to ensure that the performance of the natural and engineering features are within design limits.

[MGDS-RD 3.7.2.7.D][10 CFR 60.141(e)]

- E. **Laboratory Experiments.** To support the waste package monitoring program required by 10 CFR 60.143(a) and (b), the GROA shall be designed to include facilities (to the extent appropriate for on-site work) capable of supporting laboratory experiments that focus on the internal condition of the waste packages. To the extent practical, the environment experienced by the emplaced waste packages within the underground facility during the waste package monitoring program shall be duplicated in the laboratory experiments.

[MGDS-RD 3.7.2.7.E][10 CFR 60.143(c)]

- F. **Backfill Test.** A backfill test section shall be constructed to test the effectiveness of backfill placement and compaction procedures against design requirements before permanent backfill placement is begun.

[MGDS-RD 3.7.2.7.F][10 CFR 60.142(c)]

- G. **Borehole and Access Seal Tests.** Test sections shall be established to test the effectiveness of borehole and access seals before full-scale operation proceeds to seal boreholes and accesses.

[MGDS-RD 3.7.2.7.G][10 CFR 60.142(d)]

3.7.7 RADIOLOGICAL PROTECTION

- A. The GROA shall be designed to maintain radiation doses, levels, and concentrations of radioactive material in air in restricted areas within the limits specified in 10 CFR 20. Design shall include:

1. Means to limit concentrations of radioactive material in air.

[MGDS-RD 3.7.2.8.A.1][10 CFR 60.131(a)(1)]

2. Means to limit the time required to perform work in the vicinity of radioactive materials, including, as appropriate, designing equipment for ease of repair and replacement and providing adequate space for ease of operation.

[MGDS-RD 3.7.2.8.A.2][10 CFR 60.131(a)(2)]

3. Suitable shielding.

[MGDS-RD 3.7.2.8.A.3][10 CFR 60.131(a)(3)]

4. Means to monitor and control the dispersal of radioactive contamination.

[MGDS-RD 3.7.2.8.A.4][10 CFR 60.131(a)(4)]

5. Means to control access to high radiation areas or airborne radioactivity areas.

[MGDS-RD 3.7.2.8.A.5][10 CFR 60.131(a)(5)]

6. A radiation alarm system to warn of significant increases in radiation levels, concentrations of radioactive material in air, and of increased radioactivity released in effluent. The alarm system shall be designed with provisions for calibration and for testing its operability.

[MGDS-RD 3.7.2.8.A.6][10 CFR 60.131(a)(6)]

- B. Occupational health facilities shall be designed in accordance with DOE Order 6430.1A, Division 1.

[MGDS-RD 3.7.2.8.B][DOE Order 6430.1A]

- C. The repository shall provide a reasonable assurance that the public and the environment will be adequately protected from the hazards posed by radioactive wastes emplaced therein.

[MGDS-RD 3.7.2.8.C][42 USC 10131(b)(1)]

- D. Personnel decontamination facilities shall be provided close to areas that are potential sources of contamination in accordance with DOE Order 6430.1A, 1300-6.6.

[MGDS-RD 3.7.2.8.D][DOE Order 6430.1A, 1300-6.6]

- E. The Repository Segment shall be equipped with instrumentation capable of suitable and timely measurement and indication of, at least the following: (a) Concentrations of radioactive materials in air in the work areas, (b) Quantities of radionuclides in the body, and (c) Quantities of radionuclides excreted from the body.

[MGDS-RD 3.7.2.8.E][10 CFR 20.1204]

- F. Surface facilities shall be designed to control the release of radioactive materials in effluents during normal operations so as to meet the performance objectives of 10 CFR 60.111(a).

[MGDS-RD 3.7.2.8.F][10 CFR 60.132(c)(1)]

- G. The effluent monitoring systems shall be designed to measure the amount and concentration of radionuclides in any effluent with sufficient precision to determine whether releases conform to the design requirement for effluent control. The monitoring systems shall be designed to include alarms that can be periodically tested.

[MGDS-RD 3.7.2.8.G][10 CFR 60.132(c)(2)]

- H. Hot cells shall be provided for the performance of any functions that involve handling SNF and solidified HLW outside shielded casks.

[Derived]

3.8 PRECEDENCE

- A. The general order of precedence for repository requirements is:

1. Federal Law.
 - a) Statutes and Treaties.
 - b) Regulations and Executive Orders.
 - c) Other (e.g., DOE Orders).
2. State Law and Tribal Law.
3. Local Ordinances.
4. National and International Standards.

[MGDS-RD 3.8.A][CRD 3.8.A]

- B. In resolving questions of precedence involving DOE Orders or parts of the CFR issued by DOE that address nuclear safety requirements covered by the CFR parts issued by the NRC, the NRC requirements shall take precedence.¹⁶ (See also 3.1.5.C)

[MGDS-RD 3.8.B][MOA, RW/NS, 04/16/92]

- C. Precedence between 29 CFR 1910 (OSHA) and 30 CFR 57 (MSHA) shall be as described in 3.3.6.2.E.

[MGDS-RD 3.8.C][CRD 3.8.C]

¹⁶However, DOE Orders of CFRs, or other standards may be used as a reference in meeting NRC requirements.

3.9 QUALIFICATION/QUALITY ASSURANCE

The repository shall have a QA program approved by the NRC to satisfy the provisions of Subpart G of 10 CFR 60.

[MGDS-RD 3.9][10 CFR 60 Subpart G, QARD]

The applicable QA controls established by the OCRWM QARD shall be applied to quality affecting items and their associated activities based on the classification of the SSC.

[MGDS-RD 3.9][DOE/RW-0333P]

4. CONFORMANCE VERIFICATION

4.1 RESPONSIBILITIES

This section relates the requirements of this document to the compliance methods of Section 4.2 that will be used to verify compliance with the requirements.

The test and evaluation program and the conformance verification activities are not intended to replace activities associated with NRC license application or the satisfaction of that license.

4.2 METHODS

The methods of compliance to be used are:

- A. **Analysis.** Analysis is the process needed to verify a requirement by rational thinking, tradeoff studies, modeling, and processing test data and accumulated results to reach a conclusion. Analysis involves the processing of accumulated results and conclusions, intended to provide proof that verification of a requirement has been accomplished. The analytical results may be comprised of a compilation or interpretation of existing information or derived from lower level examinations, tests, demonstrations, or analyses.

Example: Verifying compliance with the Groundwater Travel Time requirement will require integration of the results of multiple studies involving models, test data, and other information.

- B. **Examination.** Examination is the process of investigating a product to verify that required features are incorporated. Examination consists of investigation, without the use of special laboratory appliances, procedures, supplies, or services, to determine conformance to those specified requirements that can be determined by such investigations. Examination is generally nondestructive and includes, but is not limited to, visual, auditory, olfactory, tactile, and other investigations; simple physical manipulation; gauging; and measurement.

Example: Visual inspection of a road to verify that drainage ditches and culverts are present.

- C. **Test.** Test is the quantitative process whereby data is collected over a specified time period, under controlled conditions, in order to document the as-built performance of a product. A test denotes the determination of the properties or elements of items (or components thereof) by technical means, including functional operation, the application of established principles and procedures and the collection of quantitative data. The analysis of data derived from testing is an integral part of the method.

Example: Measurements to verify radiologic shielding effects.

- D. **Demonstration.** Demonstration is the qualitative process of exercising a product to verify its operability, where data may or may not be collected. Demonstration differs from test by directness of approach in the verification of a requirement and is accomplished without the use of instrumentation or special equipment. Thus, operation of a representative item in or near its use environment would be defined as a Demonstration rather than a Test. Demonstration attempts to verify, qualitatively, the performance of a function, where as Test involves verifying performance within a specific range of measurement.

Example: Deliberate cut-off of an electric power source to verify automatic operation of emergency lighting.

4.3 CROSS-REFERENCE

Table 4-1 correlates the requirements of Sections 3 and 5 with the method to be used to verify compliance with the requirements. Documentation of conformance will be accomplished through the use of detailed procedures developed and performed on all procured, constructed, and developed equipment, structures, and software.

4.4 VERIFICATION

Documentation of compliance will be accomplished through the use of detailed verification procedures developed in accordance with direction provided in test and evaluation plans and Section 5. These procedures will be developed and performed on all procured, constructed, and developed equipment, structures, and software. The plans will address: test program documentation; definition of developmental, acceptance, and operational testing; identification of test sites and resources; test philosophy; division of test responsibilities; and general test management. The plans will be implemented through individual test plans, test planning analysis, and test procedures.

In the following table, items marked "N/A" (not applicable) have no verification required. These items are titles or contain explanatory materials. The other columns "Analysis", "Exam", "Test", and "Demo" refer to the verification methods identified in Section 4.2.

Table 4-1 Conformance Verification Matrix

Requirement		Verification Method Code				
Number	Title	N/A	Analysis	Exam	Demo	Test
3.2	Characteristics		X			
3.2.1	Performance Characteristics	X				
3.2.1.A	Mission Requirement		X			
3.2.1.B	Modes	X				
3.2.1.1	Construction Mode Requirements	X				
3.2.1.1.A	Construction Mode Requirements		X			
3.2.1.1.B	Construction Mode Requirements		X			
3.2.1.1.C	Construction Mode Requirements		X			
3.2.1.1.D	Construction Mode Requirements		X			
3.2.1.2	Emplacement Mode Requirements	X				
3.2.1.2.A	Emplacement Mode Requirements			X		
3.2.1.2.B	Emplacement Mode Requirements		X		X	
3.2.1.2.C	Emplacement Mode Requirements		X			
3.2.1.3	Caretaker Mode Requirements		X			
3.2.1.4	Retrieval Mode Requirements	X				
3.2.1.4.A	Retrieval Mode Requirements			X		
3.2.1.4.B	Retrieval Mode Requirements		X	X		
3.2.1.4.C	Retrieval Mode Requirements		X			
3.2.1.5	Closure and Decommissioning Mode Requirements	X				
3.2.1.6	Post-closure Mode Requirements	X				
3.2.1.6.A	Post-closure Mode Requirements		X			
3.2.1.6.B	Post-closure Mode Requirements			X		
3.2.1.6.C	Post-closure Mode Requirements		X			
3.2.1.6.D	Post-closure Mode Requirements		X			
3.2.1.7	Off-normal Mode Requirements	X				
3.2.1.7.A	Off-normal Mode Requirements		X			
3.2.1.7.B	Off-normal Mode Requirements		X			
3.2.1.7.C	Off-normal Mode Requirements		X			
3.2.2	Radiological Protection	X				
3.2.2.1	General Requirements	X				
3.2.2.1.A	General Requirements		X	X		
3.2.2.1.B	General Requirements		X	X		
3.2.2.1.C	General Requirements		X			

Table 4-1 Conformance Verification Matrix (Continued)

Requirement		Verification Method Code				
Number	Title	N/A	Analysis	Exam	Demo	Test
3.2.2.1.D	General Requirements		X			
3.2.2.1.D.1	General Requirements		X			
3.2.2.1.D.2	General Requirements		X			
3.2.2.1.E	Individual Protection		X			
3.2.2.2	Public Protection	X				
3.2.2.2.A	Public Protection		X	X		
3.2.2.2.B	Public Protection		X	X		
3.2.2.2.C	Public Protection		X	X		
3.2.2.3	Airborne Radioactive Material Control	X				
3.2.2.3.A	Airborne Radioactive Material Control			X		
3.2.2.3.B	Airborne Radioactive Material Control			X		
3.2.2.3.C	Airborne Radioactive Material Control			X		
3.2.2.4	Radiation Monitoring	X				
3.2.2.4.A	Radiation Monitoring	X				
3.2.2.4.A.1	Radiation Monitoring			X		
3.2.2.4.A.2	Radiation Monitoring			X		
3.2.2.4.A.3	Radiation Monitoring			X		
3.2.2.4.B	Radiation Monitoring	X				
3.2.2.4.B.1	Radiation Monitoring			X		
3.2.2.4.B.2	Radiation Monitoring			X		
3.2.2.4.C	Radiation Monitoring		X			X
3.2.2.4.D	Radiation Monitoring		X			X
3.2.2.5	Criticality Protection	X				
3.2.2.5.A	Criticality Protection		X			
3.2.2.5.B	Criticality Protection		X			
3.2.2.5.C	Criticality Protection		X			
3.2.2.6	Low Level Waste Disposal	X				
3.2.2.6.A	Low Level Waste Disposal			X		
3.2.2.6.B	Low Level Waste Disposal			X		
3.2.2.7	Transportation Protection		X	X		
3.2.3	Interface Requirements	X				
3.2.3.1	Interfaces with Other CRWMS Elements	X				
3.2.3.1.1	Repository Segment - MRS Interfaces	X				

Table 4-1 Conformance Verification Matrix (Continued)

Requirement		Verification Method Code				
Number	Title	N/A	Analysis	Exam	Demo	Test
3.2.3.1.1.A	Repository Segment - MRS Interfaces	X				
3.2.3.1.1.B	Repository Segment - MRS Interfaces	X				
3.2.3.1.2	Repository Segment - Waste Acceptance Interfaces	X				
3.2.3.1.2.A	Repository Segment - Waste Acceptance Interface Requirements		X		X	
3.2.3.1.2.B	Repository Segment - Waste Acceptance Interface Requirements	X				
3.2.3.1.2.B.1	Repository Segment - Waste Acceptance Interface Requirements		X	X	X	
3.2.3.1.2.B.2	Repository Segment - Waste Acceptance Interface Requirements		X		X	
3.2.3.1.2.C	Repository Segment - Waste Acceptance Interface Requirements		X		X	
3.2.3.1.2.C.1	Repository Segment - Waste Acceptance Interface Requirements				X	
3.2.3.1.2.C.2	Repository Segment - Waste Acceptance Interface Requirements				X	
3.2.3.1.2.C.3	Repository Segment - Waste Acceptance Interface Requirements				X	
3.2.3.1.2.C.4	Repository Segment - Waste Acceptance Interface Requirements		X		X	
3.2.3.1.2.D	Repository Segment - Waste Acceptance Interface Requirements		X		X	
3.2.3.1.2.E	Repository Segment - Waste Acceptance Interface Requirements		X		X	
3.2.3.1.3	Repository - Transportation Interface Requirements	X				
3.2.3.1.3.A	MGDS-Transportation Interface Requirements	X				
3.2.3.1.3.B	MGDS-Transportation Interface Requirements	X				
3.2.3.1.3.C	MGDS-Transportation Interface Requirements		X	X		
3.2.3.1.3.D	MGDS-Transportation Interface Requirements				X	
3.2.3.1.3.E	MGDS-Transportation Interface Requirements		X	X	X	

Table 4-1 Conformance Verification Matrix (Continued)

Requirement		Verification Method Code				
Number	Title	N/A	Analysis	Exam	Demo	Test
3.2.3.1.3.F	MGDS-Transportation Interface Requirements		X	X		
3.2.3.1.3.G	MGDS-Transportation Interface Requirements			X	X	
3.2.3.1.3.H	MGDS-Transportation Interface Requirements		X		X	
3.2.3.1.3.I	MGDS-Transportation Interface Requirements		X	X	X	
3.2.3.1.3.J	MGDS-Transportation Interface Requirements		X		X	
3.2.3.1.3.K	MGDS-Transportation Interface Requirements		X	X		
3.2.3.2	Local MGDS Interfaces	X				
3.2.3.2.1	Repository Segment - Site Segment Interfaces ; Description	X				
3.2.3.2.2	Repository Segment - Engineered Barrier Segment Interfaces; Functions	X				
3.2.3.2.2.A	Repository Segment - Engineered Barrier Segment Interfaces	X				
3.2.3.2.2.A.1	Repository Segment - Engineered Barrier Segment Interfaces		X			
3.2.3.2.2.A.2	Repository Segment - Engineered Barrier Segment Interfaces		X			
3.2.3.2.2.A.3	Repository Segment - Engineered Barrier Segment Interfaces	X				
3.2.3.2.2.A.3.a	Repository Segment - Engineered Barrier Segment Interfaces		X	X	X	
3.2.3.2.2.A.3.b	Repository Segment - Engineered Barrier Segment Interfaces		X		X	
3.2.3.2.2.A.4	Repository Segment - Engineered Barrier Segment Interfaces		X	X	X	
3.2.3.2.2.A.5	Repository Segment - Engineered Barrier Segment Interfaces		X			
3.2.3.2.2.A.6	Repository Segment - Engineered Barrier Segment Interfaces	X				
3.2.3.2.2.A.7	Repository Segment - Engineered Barrier Segment Interfaces		X			X
3.2.3.2.2.A.8	Repository Segment - Engineered Barrier Segment Interfaces		X			

Table 4-1 Conformance Verification Matrix (Continued)

Requirement		Verification Method Code				
Number	Title	N/A	Analysis	Exam	Demo	Test
3.2.3.2.2.A.9	Repository Segment - Engineered Barrier Segment Interfaces		X			
3.2.3.2.2.A.9.a	Repository Segment - Engineered Barrier Segment Interfaces		X			
3.2.3.2.2.A.9.b	Repository Segment - Engineered Barrier Segment Interfaces		X		X	
3.2.3.2.2.A.9.c	Repository Segment - Engineered Barrier Segment Interfaces		X			
3.2.3.2.2.A.9.d	Repository Segment - Engineered Barrier Segment Interfaces		X			X
3.2.3.2.2.A. 10	Repository Segment - Engineered Barrier Segment Interfaces		X		X	
3.2.3.2.2.A. 11	Repository Segment - Engineered Barrier Segment Interfaces	X				
3.2.3.2.2.A. 11.a	Repository Segment - Engineered Barrier Segment Interfaces		X			X
3.2.3.2.2.A. 11.b	Repository Segment - Engineered Barrier Segment Interfaces		X			X
3.2.3.2.2.A. 11.c	Repository Segment - Engineered Barrier Segment Interfaces		X		X	X
3.2.3.2.2.A. 12	Repository Segment - Engineered Barrier Segment Interfaces		X			
3.2.3.2.2.A. 13	Repository Segment - Engineered Barrier Segment Interfaces		X			
3.2.3.2.2.B	Repository Segment - Engineered Barrier Segment Interfaces	X				
3.2.3.2.2.B.1	Repository Segment - Engineered Barrier Segment Interfaces	X				
3.2.3.2.2.B.1.a	Repository Segment - Engineered Barrier Segment Interfaces	X				
3.2.3.2.2.B.1.b	Repository Segment - Engineered Barrier Segment Interfaces	X				
3.2.3.2.2.B.2	Repository Segment - Engineered Barrier Segment Interfaces	X				
3.2.3.2.2.B.3	Repository Segment - Engineered Barrier Segment Interfaces	X				
3.2.3.2.3	Repository Segment - Geologic Setting Interfaces; Description	X				

Table 4-1 Conformance Verification Matrix (Continued)

Requirement		Verification Method Code				
Number	Title	N/A	Analysis	Exam	Demo	Test
3.2.3.2.3.A	Repository Segment - Geologic Setting Interfaces		X			
3.2.3.2.2.B	Repository Segment - Geologic Setting Interfaces		X			
3.2.3.2.3.C	Repository Segment - Geologic Setting Interfaces		X			
3.2.3.3	Repository Segment - Government Services Interfaces			X	X	
3.2.3.4	Repository Segment - Utilities Interfaces	X				
3.2.3.4.A	Electric Power	X				
3.2.3.4.A.1	Electric Power			X		
3.2.3.4.A.2	Electric Power			X		
3.2.3.4.A.3	Electric Power		X			
3.2.3.4.A.4	Electric Power			X		
3.2.3.4.B	Non-Potable Water			X		
3.2.3.4.C	Potable Water	X				
3.2.3.4.D	Telephone Communications	X				
3.2.3.4.D.1	Telephone Communications			X		
3.2.3.4.D.2	Telephone Communications			X		
3.2.3.4.D.3	Telephone Communications			X		
3.2.3.4.D.4	Telephone Communications			X		
3.2.3.5.E	Radio Communications	X				
3.2.3.5.E.1	Radio Communications			X		
3.2.3.5.E.2	Radio Communications			X		
3.2.3.5.E.3	Radio Communications			X		
3.2.3.5.E.4	Radio Communications			X		
3.2.3.5.F	Commercial Trash Pickup	X				
3.2.3.5.G	Fuel Supply	X				
3.2.4	Physical Characteristics			X		
3.2.4.1	Protective Coatings and Materials		X			
3.2.4.2	Habitability	X				
3.2.4.2.1	Environmental Controls		X			
3.2.4.2.2	HVAC		X		X	
3.2.4.2.3	Illumination		X		X	

Table 4-1 Conformance Verification Matrix (Continued)

Requirement		Verification Method Code				
Number	Title	N/A	Analysis	Exam	Demo	Test
3.2.4.2.4	Acoustical Noise		X		X	
3.2.4.2.5	Vibration		X		X	
3.2.4.2.6	Underground Personnel Enclosures			X		
3.2.4.3	Security	X				
3.2.4.3.1	Physical Security	X				
3.2.4.3.1.1	Physical Protection		X			
3.2.4.3.1.2	Physical Barriers	X				
3.2.4.3.1.2.A	Physical Barriers		X			
3.2.4.3.1.2.B	Physical Barriers		X			
3.2.4.3.1.2.C	Physical Barriers		X			
3.2.4.3.1.2.D	Physical Barriers		X			
3.2.4.3.1.2.E	Physical Barriers		X			
3.2.4.3.1.2.F	Physical Barriers		X			
3.2.4.3.1.3	Access Control	X				
3.2.4.3.1.3.A	Access Control		X			
3.2.4.3.1.3.B	Access Control		X			
3.2.4.3.1.3.C	Access Control		X			
3.2.4.3.1.3.D	Access Control		X			
3.2.4.3.1.3.E	Access Control		X			
3.2.4.3.1.4	Security of Licensed Material		X			
3.2.4.3.2	High Radiation Area Access Control	X				
3.2.4.3.2.A	High Radiation Area Access Control		X			
3.2.4.3.2.B	High Radiation Area Access Control		X			
3.2.4.3.2.B.1	High Radiation Area Access Control			X		
3.2.4.3.2.B.2	High Radiation Area Access Control			X		
3.2.4.3.2.B.3	High Radiation Area Access Control			X		
3.2.4.3.2.B.4	High Radiation Area Access Control		X			
3.2.4.3.2.B.5	High Radiation Area Access Control		X			
3.2.4.3.3	Underground Access Controls		X			
3.2.4.4	Radioactive Materials Monitoring		X	X		
3.2.4.5	Shielding and Protective Clothing	X				
3.2.4.5.1	Shielding Design	X				
3.2.4.5.1.A	Normally Occupied Areas		X	X		
3.2.4.5.1.B	Intermittently Occupied Areas		X	X		

Table 4-1 Conformance Verification Matrix (Continued)

Requirement		Verification Method Code				
Number	Title	N/A	Analysis	Exam	Demo	Test
3.2.4.5.1.C	Concrete		X	X		
3.2.4.5.1.D	Penetrations		X			
3.2.4.5.2	Remote Shielded Operation			X		
3.2.4.6	Design Basis Events and Accidents	X				
3.2.4.6.A	Accidents		X			
3.2.4.6.B	Design Objective		X			
3.2.4.6.C	Aircraft		X	X		
3.2.4.6.D	External Blasts and Missiles		X	X		
3.2.4.6.E	Internal Blasts and Missiles		X	X		
3.2.5	System Quality Factors	X				
3.2.5.1	Reliability		X			
3.2.5.1.1	RAM Program Requirements			X		
3.2.5.1.2	Reliability of Equipment		X			
3.2.5.1.3	SSC Reliability		X			
3.2.5.1.4	Utilities Reliability	X				
3.2.5.1.4.A	Utilities Reliability		X			
3.2.5.1.4.B	Utilities Reliability		X			
3.2.5.1.5	System Throughput			X		
3.2.5.2	Maintainability/Inspectability	X				
3.2.5.2.1	Testing and Maintenance		X			
3.2.5.2.2	Physical Clearance	X				
3.2.5.2.2.A	Physical Clearance		X			
3.2.5.2.2.B	Physical Clearance		X			
3.2.5.2.3	Mean Time to Repair			X		
3.2.5.2.4	Replacement Equipment	X				
3.2.5.2.4.A	Replacement Equipment		X			
3.2.5.2.4.B	Replacement Equipment		X			
3.2.5.2.4.C	Replacement Equipment		X			
3.2.5.2.5	Fault Isolation	X				
3.2.5.2.5.A	Fault Isolation		X	X		
3.2.5.2.5.B	Fault Isolation		X			
3.2.5.2.5.C	Fault Isolation		X			
3.2.5.2.5.D	Fault Isolation		X			
3.2.5.2.6	Maintenance in Radioactive Areas		X			

Table 4-1 Conformance Verification Matrix (Continued)

Requirement		Verification Method Code				
Number	Title	N/A	Analysis	Exam	Demo	Test
3.2.5.2.7	Important to Safety Equipment		X			
3.2.5.2.8	Design for Maintenance	X				
3.2.5.2.8.A	Design for Maintenance		X	X		
3.2.5.2.8.B	Design for Maintenance		X			
3.2.5.2.8.C	Design for Maintenance		X			
3.2.5.2.8.D	Design for Maintenance		X			
3.2.5.2.8.E	Design for Maintenance		X			
3.2.5.2.8.F			X	X		
3.2.5.2.9	Mean Downtime		X	X		
3.2.5.3	Availability	X				
3.2.5.3.A	Availability			X		
3.2.5.3.B	Availability			X		
3.2.5.4	Service Life	X				
3.2.5.4.A	Service Life		X			
3.2.5.4.B	Service Life			X		
3.2.5.5	Overall Utilization	X				
3.2.5.5.A	Overall Utilization			X		
3.2.5.5.B	Overall Utilization			X		
3.2.6	Environment Requirements	X				
3.2.6.1	Natural Environment			X		
3.2.6.1.A	Natural Conditions			X		
3.2.6.1.B	Combinations		X	X		
3.2.6.1.C	Adverse Interaction		X	X		
3.2.6.1.D	Design Earthquake		X			
3.2.6.1.E	Tornado and Extreme Wind	X				
3.2.6.1.E.1	Regulatory Guidance	X				
3.2.6.1.E.2	Determination of Design Basis Tornado		X	X		
3.2.6.1.E.3	Tornado Analysis	X				
3.2.6.1.E.3.a	Tornado Analysis			X		
3.2.6.1.E.3.b	Tornado Analysis			X		
3.2.6.1.E.3.c	Tornado Analysis			X		
3.2.6.1.E.4	Load Combination			X		
3.2.6.1.F	Floods		X			

Table 4-1 Conformance Verification Matrix (Continued)

Requirement		Verification Method Code				
Number	Title	N/A	Analysis	Exam	Demo	Test
3.2.6.1.G	Flood Protection	X				
3.2.6.1.G.1	Flood Protection		X			
3.2.6.1.G.2	Flood Protection		X			
3.2.6.1.H	Earth and Groundwater	X				
3.2.6.1.H.1	Earth and Groundwater			X		
3.2.6.1.H.2	Earth and Groundwater			X		
3.2.6.1.I	Thermal Analysis			X		
3.2.6.1.J	Rain and Snow Loads			X		
3.2.6.2	Induced Environment	X				
3.2.6.2.1	Fire, Explosion and Other Disaster Protection	X				
3.2.6.2.1.A	Fire, Explosion and Other Disaster Protection		X	X		
3.2.6.2.1.B	Fire, Explosion and Other Disaster Protection		X	X		
3.2.6.2.1.C	Fire, Explosion and Other Disaster Protection		X	X		
3.2.6.2.2	Fire Resistance	X				
3.2.6.2.2.A	Fire Resistance			X		
3.2.6.2.2.B	Fire Resistance			X		
3.2.6.2.2.C	Fire Resistance			X		
3.2.6.2.2.D	Fire Resistance		X			
3.2.6.2.3	Vibration			X		
3.2.6.2.4	Creep and Shrinkage			X		
3.2.6.2.5	Underground Openings		X			
3.2.7	Transportability/Modularity			X		
3.2.8	Flexibility		X			
3.2.9	Portability and Load Carrying		X			
3.3	Design and Construction	X				
3.3.1	General Design Criteria	X				
3.3.1.A	General Design Criteria		X			
3.3.1.B	General Design Criteria		X			
3.3.1.C	General Design Criteria		X			
3.3.1.D	General Design Criteria		X			
3.3.1.E	General Design Criteria		X			

Table 4-1 Conformance Verification Matrix (Continued)

Requirement		Verification Method Code				
Number	Title	N/A	Analysis	Exam	Demo	Test
3.3.1.F	General Design Criteria		X			
3.3.1.G	General Design Criteria		X			
3.3.1.I	Alternative Design Requirements		X	X		
3.3.1.H	Alternative Design Requirements		X	X		
3.3.1.J	Alternative Design Requirements		X	X		
3.3.1.J.1	Alternative Design Requirements		X	X		
3.3.1.J.2	Alternative Design Requirements		X	X		
3.3.2	Electromagnetic Radiation	X				
3.3.2.A	Electromagnetic Radiation		X			
3.3.2.B	Electromagnetic Radiation		X			
3.3.2.C	Electromagnetic Radiation		X			
3.3.2.D	Electromagnetic Radiation		X			
3.3.3	Nameplates and Markings	X				
3.3.3.A	Nameplates and Markings			X		
3.3.3.B	Nameplates and Markings			X		
3.3.3.C	Nameplates and Markings			X		
3.3.3.D	Nameplates and Markings			X		
3.3.3.E	Nameplates and Markings			X		
3.3.3.F	Nameplates and Markings			X		
3.3.4	Workmanship	X				
3.3.4.A	Workmanship		X			
3.3.4.B	Workmanship		X			
3.3.5	Interchangeability		X			
3.3.6	Safety	X				
3.3.6.1	General Requirements	X				
3.3.6.1.A	General Requirements		X			
3.3.6.1.B	General Requirements		X			
3.3.6.2	System Safety Precedence		X			
3.3.6.2.A	System Safety Precedence		X			
3.3.6.2.B	System Safety Precedence		X			
3.3.6.2.C	System Safety Precedence		X			
3.3.6.2.D	System Safety Precedence		X			
3.3.6.2.E	System Safety Precedence	X				
3.3.6.2.E.1	System Safety Precedence		X			

Table 4-1 Conformance Verification Matrix (Continued)

Requirement		Verification Method Code				
Number	Title	N/A	Analysis	Exam	Demo	Test
3.3.6.2.E.2	System Safety Precedence		X			
3.3.6.3	Facilities, Equipment, and Materials Protective Measures	X				
3.3.6.3.A	Facilities, Equipment, and Materials Protective Measures	X				
3.3.6.3.A.1	Facilities, Equipment, and Materials Protective Measures		X			
3.3.6.3.A.2	Facilities, Equipment, and Materials Protective Measures		X			
3.3.6.3.A.3	Facilities, Equipment, and Materials Protective Measures		X			
3.3.6.3.A.4	Facilities, Equipment, and Materials Protective Measures		X			
3.3.6.3.B	Facilities, Equipment, and Materials Protective Measures		X			
3.3.6.3.C	Facilities, Equipment, and Materials Protective Measures		X			
3.3.6.3.D	Facilities, Equipment, and Materials Protective Measures		X			
3.3.6.3.E	Facilities, Equipment, and Materials Protective Measures		X			
3.3.6.3.F	Facilities, Equipment, and Materials Protective Measures		X			
3.3.6.3.G	Facilities, Equipment, and Materials Protective Measures		X			
3.3.6.4	Personal Protective Equipment	X				
3.3.6.4.A	Personal Protective Equipment		X			
3.3.6.4.B	Personal Protective Equipment		X			
3.3.6.4.C	Personal Protective Equipment		X			
3.3.6.4.D	Personal Protective Equipment		X			
3.3.6.4.E	Personal Protective Equipment		X	X		
3.3.6.5	Underground Protective Measures		X			
3.3.6.6	Safety Labels and Placards	X				
3.3.6.6.A	Safety Labels and Placards			X		
3.3.6.6.B	Safety Labels and Placards			X		
3.3.6.6.C	Safety Labels and Placards		X	X		
3.3.6.7	Emergency Lighting	X				

Table 4-1 Conformance Verification Matrix (Continued)

Requirement		Verification Method Code				
Number	Title	N/A	Analysis	Exam	Demo	Test
3.3.6.7.A	Emergency Lighting		X	X		
3.3.6.7.B	Emergency Lighting		X	X		
3.3.6.7.C	Emergency Lighting		X			
3.3.6.8	Equipment Related Hazards	X				
3.3.6.8.A	Equipment Related Hazards			X		
3.3.6.8.B	Equipment Related Hazards			X		
3.3.6.8.C	Equipment Related Hazards			X		
3.3.6.8.D	Equipment Related Hazards			X		
3.3.6.8.E	Equipment Related Hazards			X		
3.3.6.8.F	Equipment Related Hazards			X	X	
3.3.6.9	Posting Requirements	X				
3.3.6.9.A	Posting Requirements			X		
3.3.6.9.B	Posting Requirements			X		
3.3.6.9.C	Posting Requirements			X		
3.3.6.9.D	Posting Requirements			X		
3.3.6.9.E	Posting Requirements			X		
3.3.6.10	Work Platforms	X				
3.3.6.10.A	Work Platforms		X			
3.3.6.10.B	Work Platforms		X			
3.3.6.11	Electrical Safety	X				
3.3.6.11.A	Electrical Safety		X			
3.3.6.11.B	Electrical Safety		X			
3.3.6.11.C	Electrical Safety		X			
3.3.7	Human Factors Engineering	X				
3.3.7.1	Workstations and Control Rooms		X			
3.3.7.2	Voice Communications Equipment		X			
3.3.7.3	Alarms and Warning Systems		X		X	
3.3.7.4	Controls		X			
3.3.7.5	Visual Displays		X	X		
3.3.7.6	Control Panel Layout		X	X		
3.3.7.7	Control-Display Integration		X	X		
3.3.7.8	Labeling, Markings and Signs		X			
3.3.7.9	VDT Workstation		X	X		
3.3.7.10	Anthropometry		X			

Table 4-1 Conformance Verification Matrix (Continued)

Requirement		Verification Method Code				
Number	Title	N/A	Analysis	Exam	Demo	Test
3.3.7.11	Remote Handling and Operation		X			
3.3.7.12	Vehicles and Material Handling		X			
3.3.7.13	Accessibility and Usability by the Physically Handicapped	X				
3.3.7.13.A	Accessibility and Usability by the Physically Handicapped			X		
3.3.7.13.B	Accessibility and Usability by the Physically Handicapped			X		
3.3.7.14	User-Computer Software Interface		X			
3.3.8	Methods and Controls	X				
3.3.8.1	Material Management	X				
3.3.8.1.A	Material Management		X			
3.3.8.1.B	Material Management		X			
3.3.8.1.C	Material Management		X			
3.3.8.1.D	Material Management		X			
3.3.8.1.E	Material Management			X		
3.3.8.2	Inventory Control	X				
3.3.8.2.A	Inventory Control		X			
3.3.8.2.B	Inventory Control		X			
3.3.8.2.C	Inventory Control		X			
3.3.9	Government Furnished Property	X				
3.3.9.A	Government Furnished Property	X				
3.3.9.B	Government Furnished Property		X			
3.3.9.C	Government Furnished Property		X			
3.3.10	Computer Resources			X		
3.3.11	Environmental Protection Requirements	X				
3.3.11.A	Environmental Protection Requirements		X			
3.3.11.B	Environmental Protection Requirements		X			
3.3.11.C	Environmental Protection Requirements		X			
3.3.11.1	Air Pollution Control	X				
3.3.11.1.A	Air Pollution Control		X			
3.3.11.1.B	Air Pollution Control		X			

Table 4-1 Conformance Verification Matrix (Continued)

Requirement		Verification Method Code				
Number	Title	N/A	Analysis	Exam	Demo	Test
3.3.11.1.C	Air Pollution Control		X			
3.3.11.2	Water Pollution Control	X				
3.3.11.2.A	Water Pollution Control		X			
3.3.11.2.A.1	Water Pollution Control		X			
3.3.11.2.A.2	Water Pollution Control		X			
3.3.11.2.A.3	Water Pollution Control		X			
3.3.11.2.A.4	Water Pollution Control		X			
3.3.11.2.A.5	Water Pollution Control		X			
3.3.11.2.B	Water Pollution Control		X			
3.3.11.3	Drinking Water Protection	X				
3.3.11.3.A	Drinking Water Protection		X			
3.3.11.3.B	Drinking Water Protection		X			
3.3.11.4	Toxic Substance Control		X			
3.3.11.5	Pesticide Control		X			
3.3.11.6	Solid Waste Control		X			
3.3.11.7	Noise Control		X			
3.3.11.8	Endangered Species		X			
3.3.11.9	Erosion Control		X			
3.4	Documentation	X				
3.4.1	Specifications	X				
3.4.1.A	Specifications			X		
3.4.1.B	Specifications		X	X		
3.4.1.C	Specifications		X	X		
3.4.2	Drawings		X	X		
3.4.3	Maintenance, Operators, and Tech Manuals		X			
3.4.4	Test Plans and Procedures		X	X		
3.4.5	Quality Assurance Documentation			X		
3.4.6	Construction Records	X				
3.4.6.A	Construction Records			X		
3.4.6.B	Construction Records		X			
3.4.7	Computer Documentation		X			
3.4.8	Records Management		X			
3.5	Logistics	X				

Table 4-1 Conformance Verification Matrix (Continued)

Requirement		Verification Method Code				
Number	Title	N/A	Analysis	Exam	Demo	Test
3.5.1	Maintenance		X			
3.5.1.1	Equipment Maintenance	X				
3.5.1.1.1	On-line Maintenance	X				
3.5.1.1.1.A	On-line Maintenance		X			
3.5.1.1.1.B	On-line Maintenance		X			
3.5.1.1.1.C	On-line Maintenance		X			
3.5.1.1.1.D	On-line Maintenance		X			
3.5.1.1.1.E	On-line Maintenance		X			
3.5.1.1.1.F	On-line Maintenance			X		
3.5.1.1.2	Intermediate Maintenance	X				
3.5.1.1.2.A	Intermediate Maintenance		X			
3.5.1.1.2.B	Intermediate Maintenance		X			
3.5.1.1.3	Salvaging, Off-site Repair, and Vendor Repair		X			
3.5.1.2	Calibration Maintenance	X				
3.5.1.2.A	Calibration Maintenance		X			
3.5.1.2.B	Calibration Maintenance		X			
3.5.1.3	Cask Maintenance	X				
3.5.1.3.A	Cask Maintenance		X			
3.5.1.3.B	Cask Maintenance		X			
3.5.1.3.C	Cask Maintenance		X			
3.5.1.3.D	Cask Maintenance		X			
3.5.1.3.E	Cask Maintenance		X			
3.5.1.4	Standardization	X				
3.5.1.4.A	Standardization		X			
3.5.1.4.B	Standardization		X			
3.5.1.5	Security Equipment Maintenance		X		X	
3.5.2	Supply		X	X		
3.5.3	Facilities	X				
3.5.3.1	Warehouse		X	X		
3.5.3.2	Receiving and Shipping Facilities	X				
3.5.3.2.A	Receiving and Shipping Facilities		X	X		
3.5.3.2.B	Receiving and Shipping Facilities		X	X		
3.5.3.3	Cask Maintenance Facility (TBD)	X				

Table 4-1 Conformance Verification Matrix (Continued)

Requirement		Verification Method Code				
Number	Title	N/A	Analysis	Exam	Demo	Test
3.5.3.4	LSS Support Facility		X			
3.5.3.5	Other Facilities		X			
3.5.4	Support and Test Equipment		X			
3.6	Personnel and Training	X				
3.6.1	Personnel		X			
3.6.1.A	Personnel		X			
3.6.1.B	Personnel		X			
3.6.2	Training		X			
3.6.2.1	General Requirements	X				
3.6.2.1.A	General Requirements		X			
3.6.2.1.B	General Requirements		X			
3.6.2.1.B.1	General Requirements			X		
3.6.2.1.B.2	General Requirements			X		
3.6.2.1.B.3	General Requirements			X		
3.6.2.1.B.4	General Requirements			X		
3.6.2.1.B.5	General Requirements			X		
3.6.2.1.C	General Requirements		X			
3.6.2.2	Health Physics Training	X				
3.7	Repository Segment Characteristics and Requirements	X				
3.7.1	Geologic Setting Requirements	X				
3.7.1.A	Geologic Setting		X			
3.7.1.B	Groundwater Travel Time		X			
3.7.1.C	Groundwater		X	X		
3.7.1.D	Adverse Effects		X	X		
3.7.1.E	Land Ownership			X		
3.7.1.E.1	Land Ownership			X		
3.7.1.E.2	Land Ownership			X		
3.7.2	Repository Site Development Requirements	X				
3.7.2.A	Site Surveys		X			
3.7.2.B	Site Grading	X				
3.7.2.B.1	Site Grading		X			
3.7.2.B.2	Site Grading		X			
3.7.2.B.3	Site Grading		X			

Table 4-1 Conformance Verification Matrix (Continued)

Requirement		Verification Method Code				
Number	Title	N/A	Analysis	Exam	Demo	Test
3.7.2.B.4	Site Grading			X		
3.7.2.B.5	Site Grading			X		
3.7.2.C	Roads	X				
3.7.2.C.1	Roads		X			
3.7.2.C.2	Roads		X			
3.7.2.C.3	Roads		X			
3.7.2.C.4	Roads			X	X	
3.7.2.D	Fencing	X				
3.7.2.D.1	Fencing		X			
3.7.2.D.2	Fencing		X			
3.7.2.E	Environment		X	X		
3.7.2.F	Storm Water		X			
3.7.2.G	Permits		X	X		
3.7.3	Repository Utility and Services Requirements		X	X		
3.7.3.1	Lightning Protection		X	X		
3.7.3.2	Electric Power	X				
3.7.3.2.A	Emergency Power		X			
3.7.3.2.B	Electric Power		X			
3.7.3.2.C	Uninterruptible Power		X			
3.7.3.2.D	Standby Electrical Power		X			
3.7.3.3	Supply and Control Water	X				
3.7.3.3.A	Plumbing		X			
3.7.3.3.B	Potable Water		X			
3.7.3.3.C	Water Supply		X			
3.7.3.4	Communications	X				
3.7.3.4.A	Communication Systems		X			
3.7.3.4.A.1	Communication Systems			X	X	
3.7.3.4.A.2	Communication Systems			X	X	
3.7.3.4.A.3	Communication Systems			X	X	
3.7.3.4.A.4	Communication Systems			X	X	
3.7.3.4.B	Communication Facilities		X			
3.7.3.4.C	Guard Communications		X			
3.7.3.4.D	Telephone Communication			X		

Table 4-1 Conformance Verification Matrix (Continued)

Requirement		Verification Method Code				
Number	Title	N/A	Analysis	Exam	Demo	Test
3.7.3.4.E	Radio Communication		X			
3.7.3.4.F	Communications Power Supply		X			
3.7.3.4.G	CMOCC Communications			X		
3.7.3.5	Illumination System	X				
3.7.3.5.A	Lighting		X	X		
3.7.3.5.A.1	Lighting					X
3.7.3.5.A.2	Lighting					X
3.7.3.5.B	Security Lighting		X	X		
3.7.3.6	Transportation	X				
3.7.3.6.A	Transportation		X			
3.7.3.6.B	Transportation		X			
3.7.3.6.C	Transportation			X		
3.7.3.6.D	Transportation		X			
3.7.3.6.E	Transportation		X			
3.7.3.6.F	Transportation		X			
3.7.3.6.G	Transportation		X			
3.7.3.6.H	Transportation		X			
3.7.3.6.I	Transportation			X		
3.7.3.7	Monitoring	X				
3.7.3.7.A	Monitoring		X			
3.7.3.7.B	Monitoring		X			
3.7.3.7.C	Monitoring		X			
3.7.3.7.D	Monitoring		X			
3.7.3.7.E	Monitoring		X			
3.7.3.7.F	Monitoring		X			
3.7.3.7.G	Monitoring		X			
3.7.3.7.H	Monitoring		X			
3.7.3.7.I	Monitoring		X			
3.7.3.7.J	Monitoring		X			
3.7.3.7.K	Monitoring		X			X
3.7.3.7.L	Monitoring		X			
3.7.3.8	Sanitary Sewerage	X				
3.7.3.8.A	Sanitary Sewerage		X			
3.7.3.8.B	Sanitary Sewerage		X			

Table 4-1 Conformance Verification Matrix (Continued)

Requirement		Verification Method Code				
Number	Title	N/A	Analysis	Exam	Demo	Test
3.7.3.8.C	Sanitary Sewerage		X			
3.7.3.9	Site-Generated Waste Treatment	X				
3.7.3.9.A	Site-Generated Waste Treatment		X			
3.7.3.9.B	Site-Generated Waste Treatment			X		
3.7.3.9.C	Site-Generated Waste Treatment		X			
3.7.3.9.D	Site-Generated Waste Treatment		X			
3.7.3.9.D.1	Site-Generated Waste Treatment		X			
3.7.3.9.D.2	Site-Generated Waste Treatment		X			
3.7.3.9.E	Site-Generated Waste Treatment		X			
3.7.4	Repository Surface Facility Requirements		X			
3.7.4.1	Waste Handling Requirements	X				
3.7.4.1.A	Waste Handling	X				
3.7.4.1.A.1	Waste Handling		X			
3.7.4.1.A.2	Waste Handling		X	X		
3.7.4.1.A.3	Waste Handling		X			
3.7.4.1.A.4	Waste Handling		X			
3.7.4.1.A.5	Waste Handling		X			
3.7.4.1.A.6	Waste Handling		X	X	X	
3.7.4.1.A.7	Waste Handling		X			
3.7.4.1.B	Delivery Modes		X	X		
3.7.4.1.C	Surface Facility Ventilation		X	X		
3.7.4.2	Alarm Systems	X				
3.7.4.2.A	Alarm Systems		X	X		
3.7.4.2.B	Alarm Systems		X		X	
3.7.4.2.B.1	Alarm Systems			X	X	
3.7.4.2.B.2	Alarm Systems				X	
3.7.4.2.B.3	Alarm Systems		X			
3.7.4.2.C	Alarm Systems			X		
3.7.4.2.D	Alarm Systems		X			
3.7.4.2.E	Alarm Systems		X			
3.7.4.2.E.1	Alarm Systems		X			
3.7.4.2.E.2	Alarm Systems		X			
3.7.4.2.E.3	Alarm Systems		X		X	

Table 4-1 Conformance Verification Matrix (Continued)

Requirement		Verification Method Code				
Number	Title	N/A	Analysis	Exam	Demo	Test
3.7.4.2.F	Alarm Systems		X			
3.7.4.2.G	Alarm Systems		X			
3.7.4.3	Fire Protection Requirements	X				
3.7.4.3.A	Fire Protection Requirements		X	X		
3.7.4.3.B	Fire Protection Requirements		X			
3.7.4.3.C	Fire Protection Requirements		X			
3.7.4.3.D	Fire Protection Requirements		X			
3.7.4.3.E	Fire Protection Requirements		X			
3.7.4.3.F	Fire Protection Requirements		X	X		
3.7.4.3.G	Fire Protection Requirements		X	X		
3.7.4.3.H	Fire Protection Requirements			X		
3.7.4.3.I	Fire Protection Requirements		X	X	X	
3.7.4.4	Other Surface Facilities	X				
3.7.4.4.A	Change Rooms		X			
3.7.4.4.B	Industrial Health and Safety		X			
3.7.4.4.C	Training Facility Requirements		X			
3.7.4.4.D	Medical Facility Requirements		X			
3.7.4.4.E	Office Requirements	X				
3.7.4.4.E.1	Office Requirements		X	X		
3.7.4.4.E.2	Office Requirements		X			
3.7.4.4.E.3	Office Requirements		X			
3.7.4.4.E.4	Office Requirements		X			
3.7.4.4.F	Records Management Requirements	X				
3.7.4.4.F.1	Records Management Requirements		X			
3.7.4.4.F.2	Records Management Requirements		X			
3.7.4.4.F.3	Records Management Requirements		X			
3.7.4.4.F.4	Records Management Requirements		X			
3.7.4.4.F.5	Records Management Requirements		X			
3.7.4.4.G	Maintenance Facility Requirements		X			
3.7.4.4.H	Test and Maintenance Facility Requirements		X			
3.7.4.4.I	Emergency Response Requirements	X				
3.7.4.4.I.1	Emergency Response Requirements		X			
3.7.4.4.I.2	Emergency Response Requirements		X			

Table 4-1 Conformance Verification Matrix (Continued)

Requirement		Verification Method Code				
Number	Title	N/A	Analysis	Exam	Demo	Test
3.7.4.4.I.3	Emergency Response Requirements		X			
3.7.4.4.J	Explosives Storage	X				
3.7.4.4.J.1	Explosives Storage			X		
3.7.4.4.J.2	Explosives Storage		X	X		
3.7.4.4.J.2.a	Explosives Storage		X	X		
3.7.4.4.J.2.b	Explosives Storage		X	X		
3.7.4.4.K	Personnel Support		X			
3.7.4.4.L	Decontamination and Dismantling	X				
3.7.4.4.L.1	Decontamination and Dismantling		X			
3.7.4.4.L.2	Decontamination and Dismantling		X			
3.7.4.4.L.3	Decontamination and Dismantling		X		X	
3.7.4.4.M	Storage Facility		X			
3.7.4.4.N	Meteorologic Tower		X			
3.7.4.4.O	Health Physics Facility		X			
3.7.4.4.P	Visitors' Center		X			
3.7.5	Repository Underground Requirements	X				
3.7.5.A	Shaft Conveyances			X		
3.7.5.A.1	Shaft Conveyances		X	X		
3.7.5.A.2	Shaft Conveyances		X			
3.7.5.A.3	Shaft Conveyances		X			
3.7.5.A.4	Shaft Conveyances		X			
3.7.5.A.5	Shaft Conveyances		X			
3.7.5.A.6	Shaft Conveyances		X			
3.7.5.B	Underground Facility Ventilation			X		
3.7.5.B.1	Underground Facility Ventilation		X	X		
3.7.5.B.2	Underground Facility Ventilation		X			
3.7.5.B.3	Underground Facility Ventilation		X	X		
3.7.5.B.4	Underground Facility Ventilation			X		
3.7.5.B.5	Underground Facility Ventilation		X			
3.7.5.B.6	Underground Facility Ventilation		X			
3.7.5.B.7	Underground Facility Ventilation		X			
3.7.5.B.8	Underground Facility Ventilation		X			
3.7.5.C	Diesel Exhaust Ventilation		X			
3.7.5.C.1	Diesel Exhaust Ventilation		X			

Table 4-1 Conformance Verification Matrix (Continued)

Requirement		Verification Method Code				
Number	Title	N/A	Analysis	Exam	Demo	Test
3.7.5.C.2	Diesel Exhaust Ventilation		X			
3.7.5.C.3	Diesel Exhaust Ventilation		X			
3.7.5.D	Retrieval of Wastes		X	X		
3.7.5.E	Underground Openings	X				
3.7.5.E.1	Underground Openings		X			
3.7.5.E.2	Underground Openings		X			
3.7.5.E.3	Underground Openings		X			
3.7.5.E.4	Underground Openings		X			
3.7.5.E.5	Underground Openings		X			
3.7.5.E.6	Underground Openings		X			
3.7.5.E.7	Underground Openings		X			
3.7.5.F	Subsurface Facilities and Systems		X			
3.7.5.F.1	Subsurface Facilities and Systems		X			
3.7.5.F.2	Subsurface Facilities and Systems		X			
3.7.5.F.3	Subsurface Facilities and Systems		X	X		
3.7.5.F.4	Subsurface Facilities and Systems		X	X	X	
3.7.5.F.5	Subsurface Facilities and Systems		X			
3.7.5.F.6	Subsurface Facilities and Systems		X		X	
3.7.5.F.7	Subsurface Facilities and Systems		X	X		
3.7.5.G	Rock Excavation	X				
3.7.5.G.1	Rock Excavation		X	X		
3.7.5.G.2	Rock Excavation		X	X		
3.7.5.H	Flexibility		X	X		
3.7.5.I	Water and Gas		X	X		
3.7.5.J	Seals	X				
3.7.5.J.1	Seals		X	X	X	X
3.7.5.J.2	Seals		X	X	X	X
3.7.5.J.3	Seals		X	X	X	X
3.7.5.K	Control of Fluids in Construction		X			
3.7.5.K.1	Control of Fluids in Construction			X		
3.7.5.K.2	Control of Fluids in Construction		X			
3.7.5.L	Fire Protection	X				
3.7.5.L.1	Fire Protection		X			
3.7.5.L.2	Fire Protection		X			

Table 4-1 Conformance Verification Matrix (Continued)

Requirement		Verification Method Code				
Number	Title	N/A	Analysis	Exam	Demo	Test
3.7.5.L.3	Fire Protection		X			
3.7.5.L.4	Fire Protection		X			
3.7.5.M	Industrial Health and Safety			X		
3.7.5.N	Ramps and Shafts	X				
3.7.5.N.1	Ramps and Shafts		X			
3.7.5.N.2	Ramps and Shafts		X			
3.7.5.N.3	Ramps and Shafts		X			
3.7.5.N.4	Ramps and Shafts		X			
3.7.5.N.5	Ramps and Shafts		X			
3.7.5.N.6	Ramps and Shafts		X			
3.7.5.N.7	Ramps and Shafts		X			
3.7.5.O	Drifts	X				
3.7.5.O.1	Drifts		X			
3.7.5.O.2	Drifts		X			
3.7.5.O.3	Drifts		X			
3.7.5.P	Emplacement Area	X				
3.7.5.P.1	Emplacement Area		X			
3.7.5.P.2	Emplacement Area		X		X	
3.7.5.P.3	Emplacement Area		X			
3.7.6	Performance Confirmation Requirements	X				
3.7.6.A	General Requirements	X				
3.7.6.A.1	General Requirements		X	X		
3.7.6.A.2	General Requirements		X	X		
3.7.6.A.3	General Requirements		X	X		
3.7.6.A.4	General Requirements		X	X		
3.7.6.A.5	General Requirements		X	X		
3.7.6.A.6	General Requirements		X	X		
3.7.6.A.6.a	General Requirements	X				
3.7.6.A.6.b	General Requirements		X	X		
3.7.6.A.6.c	General Requirements		X	X		
3.7.6.A.6.d	General Requirements		X	X		
3.7.6.A.7	General Requirements		X	X		
3.7.6.B	Testing				X	

Table 4-1 Conformance Verification Matrix (Continued)

Requirement		Verification Method Code				
Number	Title	N/A	Analysis	Exam	Demo	Test
3.7.6.C	Rock Measurement		X	X		
3.7.6.D	Thermomechanical Response		X	X		
3.7.6.E	Laboratory Experiments		X			
3.7.6.F	Backfill Test		X	X		
3.7.6.G	Borehole and Access Seal Tests		X	X		
3.7.7	Radiological Protection	X				
3.7.7.A	Radiological Protection	X				
3.7.7.A.1	Radiological Protection		X	X		
3.7.7.A.2	Radiological Protection		X	X		
3.7.7.A.3	Radiological Protection		X	X		
3.7.7.A.4	Radiological Protection		X			
3.7.7.A.5	Radiological Protection		X			
3.7.7.A.6	Radiological Protection		X			
3.7.7.B	Radiological Protection		X			
3.7.7.C	Radiological Protection		X	X		
3.7.7.D	Radiological Protection		X			
3.7.7.E	Radiological Protection		X			
3.7.7.F	Radiological Protection		X			
3.7.7.G	Radiological Protection		X	X		
3.7.7.H	Radiological Protection		X			
3.8	Precedence	X				
3.8.A	Precedence		X			
3.8.B	Precedence		X			
3.8.	Precedence		X			
3.9	Qualification/Quality Assurance		X			
5	Preparation for Operations	X				
5.1	Key Decisions		X			
5.2	Requirements		X			

5. PREPARATION FOR OPERATIONS

5.1 KEY DECISIONS

Preparation for operations is governed by a series of key decision points as defined in DOE Order 4700.1. The Energy System Acquisition Advisory Board (ESAAB) supports the DOE Acquisition Executive by providing advice and assistance at those points. The approval to commence operation is scheduled prior to transition from acquisition and construction to operation of the Repository. Preparation of applications for the licenses, certificates, and permits which must be issued prior to commencement of operations shall be undertaken in a timely manner to ensure their review, approval and issuance prior to approval being granted for operations to begin. Transition to the operations phase is not formally made until demonstrated capability to meet technical performance goals specified in derivative specifications are achieved, and required licenses, certificates, and permits have been issued. These conditions are confirmed by the ESAAB.

A presentation package in accordance with DOE Order 4700.1, shall be developed to support ESAAB determination of the readiness of the Repository to proceed with operations. As a minimum, the presentation packages to support the ESAAB in the review process shall contain: a description of the project; background data; major technical and performance requirements; licenses, certificates and permits; readiness to proceed with operations; and problems, issues, or items of concern.

5.2 REQUIREMENTS

In addition to satisfying the requirements of the specifications, the Repository shall establish programs to ensure, at the commencement of operations, the availability of sufficient trained personnel to operate the elements and validated documentation to support the operations.

The Repository shall additionally establish logistics support systems, to include ensuring the availability of sufficient spares to support the element maintenance concept and the design availability factors used in the design.

Specific plans and procedures for acceptance, operational, and integrated testing, as well as preparation of test documentation, will be governed by test and evaluation plans.

6. NOTES

The contents of this section are not contractually binding. Any information which should be made known as background information or instructions to the contracting officer may be included herein.

6.1 GLOSSARY

Accessible Environment means: (1) the atmosphere, (2) the land surface, (3) surface water, (4) oceans, and (5) the portion of the lithosphere that is outside the controlled area.

[10 CFR 60.2]

Administrative Delay Time is that portion of downtime during which maintenance is delayed for administrative reasons.

Anticipated processes and events mean those natural processes and events that are reasonably likely to occur during the period the intended performance objective must be achieved. To the extent reasonable in the light of the geologic record, it shall be assumed that those processes operating in the geologic setting during the Quaternary Period continue to operate but with the perturbations caused by the presence of emplaced radioactive waste superimposed thereon.

[10 CFR 60.2]

Architecture is the physical system to be built, found, or selected to perform a function subject to its stated requirements.

As low as is reasonably achievable (ALARA) means making every reasonable effort to maintain exposures to radiation as far below the dose limits in 10 CFR 20 as is practical consistent with the purpose for which the licensed activity is undertaken, taking into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and licensed materials in the public interest.

[10 CFR 20.1003]

Barrier is any material or structure that prevents or substantially delays movement of water or radionuclides.

[10 CFR 60.2]

Canister is the structure surrounding the waste form (e.g., high-level waste immobilized in borosilicate glass) that facilitates handling, storage, transportation, and/or disposal. A metal receptacle with the following purpose: (1) for solidified high-level waste, its purpose is a pour mold and (2) for spent fuel, it may provide structural support for loose rods, non-fuel components or containment of radionuclides during preclosure operations.

Cask is a container for shipping or storing spent nuclear fuel and/or high-level waste that meets all applicable regulatory requirements.

Cask Maintenance Facility (CMF) is a facility to maintain the cask system. The specific mission of the cask maintenance facility is to provide for the servicing, testing, maintenance, repair, modification, storage and configuration control of all cask system elements.

Cask maintenance means those functions necessary to keep a transportation cask in working order (i.e., keep cask in accordance with certification).

Civilian Radioactive Waste Management System (CRWMS) is the composite of the sites, and all facilities, systems, equipment, materials, information, activities, and the personnel required to perform those activities necessary to manage radioactive waste disposal.

Cladding is the metal cyclinder that surrounds the uranium pellets.

Collocate means to place together.

Commission is the Nuclear Regulatory Commission or its duly authorized representatives.

[10 CFR 60.2][NWSA Section 2(7)]

Containment is the confinement of radioactive waste within a designated boundary.

[10 CFR 60.2]

Controlled area means:

- 1) a surface location, to be marked by suitable monuments, extending horizontally no more than 10 kilometers in any direction from the outer boundary of the underground facility, and the underlying subsurface, which area has been committed to use as a geologic repository and from which incompatible activities would be restricted following permanent closure;

[10 CFR 60.2]

- 2) (a) a surface location, to be identified by passive institutional controls, that encompasses no more than 100 square kilometers and extends horizontally no more than 5 kilometers in any direction from the outer boundary of the original location of the radioactive wastes in a disposal system; and (b) the subsurface underlying such a surface location;

[40 CFR 191.12(g)]

- 3) an area, outside of a restricted area but inside the site boundary, access to which can be limited by the licensee for any reason.

[10 CFR 20.1003]

Decommission means to remove (as a facility) safely from service and reduce residual radioactivity to a level that permits release of the property for unrestricted use and termination of license.

[10 CFR 72.3]

Defense High-Level Radioactive Waste (DHLW) is the high-level radioactive waste, as defined by Nuclear Waste Policy Act of 1982 Section 2(12), resulting from reprocessing spent nuclear fuel in a defense facility.

Disposal is the isolation of radioactive wastes from the accessible environment. [10 CFR 60.2] Disposal means the emplacement in a repository of high-level radioactive waste, spent nuclear fuel, or other highly radioactive material with no foreseeable intent of recovery, whether or not such emplacement permits the recovery of such waste.

[10 CFR 961.11][NWSA Section 2(9)]

Disposal package or waste package is the primary container that holds, and is in contact with, solidified high-level radioactive waste, spent nuclear fuel, or other radioactive materials, and any overpacks that are emplaced at a repository.

[NWSA Section 2(9)]

Disposal system is any combination of engineered and natural barriers that isolate spent nuclear fuel or radioactive waste after disposal.

[40 CFR 191.12(a)]

Disturbed zone means that portion of the controlled area the physical or chemical properties of which have changed as a result of underground facility construction or as a result of heat generated by the emplaced radioactive wastes such that the resultant change of properties may have a significant effect on the performance of the geologic repository.

[10 CFR 60.2]

Engineered barrier system is the waste packages and the underground facility.

[10 CFR 60.2]

Function is a primary statement of purpose; definition of what a system or subsystem must accomplish to meet the system mission.

Functional analysis is the first step in the Systems Engineering process that defines a baseline of functions and function performance requirements that must be met in order to adequately accomplish the operation, support, test, and production requirements of a system.

Functional interface is the interaction between functions, as in the flow of material or information between a sequence of activities.

Geologic repository is a system which is intended to be used for, or may be used for, the disposal of radioactive wastes in excavated geologic media. A geologic repository includes: (1) the geologic repository operations area, and (2) the portion of the geologic setting that provides isolation of the radioactive waste.

[10 CFR 60.2]

Geologic repository operations area (GROA) is a high-level radioactive waste facility that is part of a geologic repository, including both surface and subsurface areas, where waste handling activities are conducted.

[10 CFR 60.2]

Geologic setting is the geologic, hydrologic, and geochemical systems of the region in which a geologic repository operations area is or may be located.

[10 CFR 60.2]

Groundwater is all water which occurs below the land surface.

[10 CFR 60.2]

High-level Radioactive Waste (HLW) means (1) the highly radioactive material resulting from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid material derived from such liquid waste that contains fission products in sufficient concentrations; and (2) other highly radioactive material that the Nuclear Regulatory Commission, consistent with existing law, determines by rule requires permanent isolation.

[NWPA Section 2(12)][10 CFR 72.3][10 CFR 960.2][10 CFR 961.11]

High Radiation Access Area means an area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 0.1 rem (1 mSv) in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates.

[10 CFR 20.1003]

Important to safety with reference to systems, structures, and components means those engineered structures, systems, and components essential to the prevention or mitigation of an accident that could result in a radiation dose to the whole body, or any organ, of 0.5 rem or greater at or beyond the nearest boundary of the unrestricted area at any time until the completion of permanent closure.

[10 CFR 60.2]

(Items) **Important to Waste Isolation** means the natural and engineered barriers which are relied on for achieving the postclosure performance objectives in 10 CFR 60 Subpart E.

Input is anything that is acted upon by a function to produce desired outputs. Inputs can be classified as either internal or external. Inputs that originate from outside a particular system are considered to be external. Inputs that are outputs from functions within a particular system are considered to be internal.

Institutional Barrier System consists of the active and passive institutional controls.

Active institutional controls include: (1) Controlling access to the MGDS by any means other than passive institutional controls; (2) Performing maintenance operations or remedial actions at a site; (3) Controlling or cleaning up releases from a site; or (4) Monitoring parameters related to disposal system performance.

Passive institutional controls include: (1) Permanent markers placed at a disposal site; (2) Public records and archives; (3) Government ownership and regulations regarding land or resource use, and (4) other means of preserving knowledge about the location, design, and contents of a disposal system.

[40 CFR 191.02]

Intermediate Maintenance is maintenance normally beyond the capability of personnel performing on-line maintenance. Intermediate maintenance activities have more tools, test equipment, and specially trained personnel to work on equipment than does on-line maintenance. Maintenance at this level is normally more complicated and time consuming, thereby requiring more highly skilled technicians.

Isolation is inhibiting the transport of radioactive material so that amounts and concentrations of this material entering the accessible environment will be kept within prescribed limits.

[10 CFR 60.2]

Licensed Material is source material, special nuclear material, or byproduct material received, possessed, used, transferred or disposed of under a general or specific license issued by the Nuclear Regulatory Commission.

[10 CFR 20]

Licensee is a person who is authorized to conduct activities under a license or construction permit issued by the Commission.

[10 CFR 2.4]

Logistics Delay Time means maintenance downtime that is expanded as a result of waiting for a spare part, tool, facility, or whatever to become available in order to effect repair.

Material access area means any location which contains special nuclear material.

Mean Time To Repair (MTTR) is the mean or average elapsed time to perform scheduled and unscheduled maintenance. (Excludes LDT and ADT).

Mined Geologic Disposal System (MGDS) - See Section 1.3.4.

N-Square Diagram is a type of function flow diagram. The N-Square diagram has been used extensively to develop data interfaces. The system functions are placed on the diagonal of an N-by-N matrix. The remainder of the squares of the matrix represent interface inputs and outputs. Inputs to a function appear in the column above and below the function, and outputs from a functions appear in the row to the left and right of a function. Where a blank square exists there is no interface between the respective functions. N-Square diagrams are used to develop and document system and system element interfaces. The N-Square diagrams may also be used to document hardware-to-hardware interfaces where hardware items are placed on the diagonal and their interfaces shown in the remaining squares of the matrix.

Nuclear waste negotiator means the Office of the Nuclear Waste Negotiator established by NWPAA Section 402.

Off-normal are abnormal or unplanned events or conditions that adversely affect, potentially affect, or are indicative of degradation in, the safety, security, environmental or health protection performance or operation of a facility.

On-line Maintenance is maintenance performed by the using organization on its own equipment. Personnel involved in maintenance at this level are usually the operators of the equipment and have limited time available for detailed maintenance tasks.

Output is anything that leaves the system or function after it has been acted upon by that function.

Owner is any person who has title to spent nuclear fuel or high-level radioactive waste.

[10 CFR 961.3]

Package means the packaging together with its radioactive contents as presented for transport.

[10 CFR 71.4]

Packaging means the assembly of components necessary to ensure compliance with the packaging requirements of 10 CFR 71. It may consist of one or more receptacles, absorbent materials, spacing structures, thermal insulation, radiation shielding, and devices for cooling or absorbing mechanical shocks. The vehicle, tie-down system, and auxiliary equipment may be designated as part of the packaging.

[10 CFR 71.4]

Performance confirmation is the program of tests, experiments, and analyses which is conducted to evaluate the accuracy and adequacy of the information used to determine with reasonable assurance that the performance objectives for the period after permanent closure will be met.

[10 CFR 60.2]

Permanent closure is final backfilling of the underground facility and the sealing of shafts and boreholes.

[10 CFR 60.2]

Physical barriers are: (1) fences constructed of No. 11 American wire gauge or heavier wire fabric, topped by three strands or more of barbed wire or similar material on brackets angled inward or outward between 30° and 45° from vertical, with an overall height including the barbed topping of not less than 8 feet; (2) building walls, ceilings, and floors constructed of stone, brick, cinder block, concrete, steel, or similar materials (openings in which are secured by grates, doors, or covers of construction and fastening of sufficient strength such that the integrity of the wall is not lessened by any opening), or walls of similar construction, not a part of a building, provided with barbed topping described above, of a height not less than 8 feet; (3) Any other physical obstruction constructed in a manner and of materials suitable for the purpose for which the obstruction is intended.

[10 CFR 73.2]

Physical interface is the boundary at which physical systems interact, as in a necessary fit between elements, segments, subsystems, etc.

Physical system means the Civilian Radioactive Waste Management System (CRWMS) consisting of the composite of the sites, and all facilities, systems, equipment, materials, information, activities, and the personnel required to perform those activities necessary to manage waste disposal.

Producer is any generator of high-level radioactive waste resulting from atomic energy activities.

Protected area is any area encompassed by physical barriers and to which access is controlled.

[10 CFR 73.2]

Radioactive waste or waste is HLW and other radioactive materials other than HLW that are received for emplacement in a geologic repository.

[10 CFR 60.2]

Repository is any system licensed by the Commission that is intended to be used for, or may be used for, the permanent deep geologic disposal of high-level radioactive waste and spent nuclear fuel, whether or not such system is designed to permit the recovery, for a limited period during initial operation, of any materials placed in such system. Such term includes both surface and subsurface areas at which high-level radioactive waste and spent nuclear fuel handling activities are conducted.

[NWPA]

Restricted area is any area access to which is controlled by the licensee for purposes of protection of individuals from exposure to radiation and radioactive materials. Restricted area shall not include any areas used as residential quarters, although a separate room or rooms in a residential building may be set apart as a restricted area.

[10 CFR 60.2]

Retrieval is the act of intentionally removing radioactive waste from the underground location at which the waste had been previously emplaced for disposal.

[10 CFR 60.2]

Safeguards (IAEA)¹⁷ means a system of technical measures within the framework of international non-proliferation policy intrusted to the International Atomic Energy Agency (IAEA) in its Statute and by the Non-Proliferation Treaty (NPT) . . . designed to ensure that special fissionable and other materials, services, equipment, facilities, and information . . . are not used in such a way as to further any military purpose.

[IAEA Glossary]

Safeguards (NRC) means (1) security measures for the physical protection of special nuclear material or (2) security measures for the physical protection and location of certain plant equipment vital to the safety of production or utilization facilities.

[10 CFR 73]

Safety Delay Time means maintenance downtime imposed due to safety reasons, i.e., radiological hazard, environmental hazard, and the like.

Saturated zone is that part of the earth's crust beneath the regional water table in which all voids, large and small, are ideally filled with water under pressure greater than atmospheric.

[10 CFR 60.2]

Segment is a distinct, top-level component of the overall architecture of each system element to which functions and requirements are allocated.

Site is the location of the controlled area.

[10 CFR 60.2]

Site Characterization means the program of exploration and research both in the laboratory and in the field, undertaken to establish the geologic conditions and the ranges of those parameters of a particular site relevant to the procedures under 10 CFR 60. Site characterization includes borings, surface excavations, excavation of exploratory shafts,

¹⁷The term safeguards or international (IAEA) safeguards should not be confused with similar terms used in the context of national legislations; these sometimes cover measures for physical protection.

limited subsurface lateral excavations and borings, and in situ testing at depth needed to determine the suitability of the site for a geologic repository, but does not include preliminary borings and geophysical testing needed to decide whether site characterization should be undertaken.

[10 CFR 60.2]

Special nuclear material means (1) Plutonium, Uranium 233, Uranium enriched in the isotope 233 or in the isotope 235, and any other material which the commission (NRC), pursuant to the provisions of Section 51 of the Atomic Energy Act of 1954 as amended, determines to be special nuclear material, but does not include source material; or (2) any material artificially enriched by any of the foregoing but does not include source material.

[10 CFR 70.4]

Special Source of Groundwater, as used in this document, means those Class I groundwaters identified in accordance with the EPA Groundwater Protection Strategy published in 1984 that: (1) are within the controlled area encompassing a disposal system or are less than five kilometers beyond the controlled area; (2) are supplying drinking water for thousands of persons as of the date that the DOE chooses a location within that area for detailed characterization as a potential site for a disposal system (e. g., in accordance with Section 112(b)(1)(B) of the NWPA); and (3) are irreplaceable in that no reasonable source of drinking water is available for that population.

[40 CFR 191.12(o)]

Specialty Engineering encompasses those disciplines that support the design process by applying knowledge from a specific area to ensure system operability in its operational environment. They include reliability, availability, maintainability, human factors engineering, transportability, safety, electromagnetic compatibility, parts/materials/processes and other specialist areas involved in development of a general class of system. These specialties are integrated into the development effort through the System Engineering Process. [Based on the Defense Systems Management College Systems Engineering Management Guide.]

Spent Nuclear Fuel (SNF) is fuel which has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not separated by reprocessing. {Specifically in this document, SNF includes (1) intact, non-defective fuel assemblies; (2) failed fuel assemblies in canisters; (3) fuel assemblies in canisters; (4) consolidated fuel rods in canisters; (5) non-fuel assembly hardware inserted in PWR fuel assemblies, including, but not limited to, control rod assemblies, burnable poison assemblies, thimble plug assemblies, neutron source assemblies, instrumentation assemblies; (6) fuel channels attached to boiling water reactor fuel assemblies; and (7) non-fuel assembly hardware and structural parts of assemblies resulting from consolidation in canisters.}

[NWPA Section 2(23)][10 CFR 961.11]

Subsurface, as used in this document, means the underground portions of the ESF and the Repository Segment, whether or not part of the GROA. It is used to avoid confusion

with the "underground facility," which is part of the GROA/Engineered Barrier System (EBS). "Subsurface" does not include trenches, ditches, cellars or other similar below grade excavations.

System Element is one of the elements of the CRWMS (e.g., WA, Trans, MRS, MGDS). This differs from the "project" that may be initiated by DOE to manage and control development of one or more system element (e.g., the Yucca Mountain Project or the MRS project).

Transportable Storage Cask (TSC) is any cask simultaneously certified by the NRC for the purposes of transporting SNF as described in 10 CFR 71, and storing SNF as described in 10 CFR 72, Subpart L.

Unanticipated processes and events mean those processes and events affecting the geologic setting that are judged not to be reasonably likely to occur during the period the intended performance objective must be achieved, but which are nevertheless sufficiently credible to warrant consideration. Unanticipated processes and events may be either natural processes or events or processes and events initiated by human activities other than those activities licensed under this part. Processes and events initiated by human activities may only be found to be sufficiently credible to warrant consideration if it is assumed that: (1) The monuments provided for by this part are sufficiently permanent to serve their intended purpose; (2) the value to future generations of potential resources within the site can be assessed adequately under the applicable provisions of this part; (3) an understanding of the nature of radioactivity, and an appreciation of its hazards, have been retained in some functioning institutions; (4) institutions are able to assess risk and to take remedial action at a level of social organization and technological competence equivalent to, or superior to, that which was applied in initiating the processes or events concerned; and (5) relevant records are preserved, and remain accessible, for several hundred years after permanent closure.

[10 CFR 60.2]

Underground facility is the underground structure, including openings and backfill materials, but excluding shafts, boreholes, and their seals.

[10 CFR 60.2]

Unsaturated zone is the zone between the land surface and the regional water table. Generally, fluid pressure in this zone is less than atmospheric pressure, and some of the voids may contain air or other gases at atmospheric pressure. Beneath flooded areas or in perched water bodies the fluid pressure locally may be greater than atmospheric.

[10 CFR 60.2]

Very High Radiation Access Area means an area, accessible to individuals, in which radiation levels could result in an individual receiving an absorbed dose in excess of 500 rads (5 grays) in 1 hour at 1 meter from the radiation source or from any surface that the radiation penetrates.

[Note: At very high doses received at high dose rates, units of absorbed dose (e.g., rads and grays) are appropriate, rather than units of dose equivalent (e.g., rems and sieverts)].

Vital area means any area which contains vital equipment.

[10 CFR 73.2[TBR]]

Vital equipment means any equipment, system, device, or material, the failure, destruction, or release of which could directly or indirectly endanger the public health and safety by exposure to radiation.

[10 CFR 73.2[TBR]]

Waste is spent nuclear fuel (SNF) and high-level waste (HLW).

Waste form is the radioactive waste materials and any encapsulating or stabilizing matrix.

[10 CFR 60.2]

Waste package means the waste form and any containers, shielding, packing and other absorbent materials immediately surrounding an individual waste container.

[10 CFR 60.2]

6.2

ACRONYMS AND ABBREVIATIONS

AASHTO	American Association of State Highway and Transportation Officials
ACGIH	American Conference of Governmental Industrial Hygienists
ACI	American Concrete Institute
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
ALARA	As low as is reasonably achievable
ALI	Annual limit on intake
ANS	American Nuclear Society
ANSI	American National Standards Institute
AREA	American Railway Engineering Association
ARI	Air Conditioning and Refrigeration Institute
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating Refrigeration and Air-Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATE	Automatic-Test-Equipment
AWS	American Welding Society
BITE	Built-in-Test Equipment
BLM	Bureau of Land Management
BWR	Boiling water reactor
CAC	California Administrative Code

CFR	Code of Federal Regulations
CMAA	Crane Manufacturers Association of America
CMF	Cask Maintenance Facility
CMOCC	Central Management and Operations Control Center
CRD	CRWMS Requirements document
CRWMS	Civilian Radioactive Waste Management System
CWA	Clean Water Act
DBA	Design basis accident
DE	Design earthquake
DOD	Department of Defense
DOE	Department of Energy
EBDRD	Engineered Barrier Design Requirements document
EBS	Engineered Barrier System
EDE	Effective dose equivalent
EPA	U.S. Environmental Protection Agency
ESAAB	Energy System Acquisition Advisory Board
ESF	Exploratory Studies Facility
et seq.	And following
FD/FI	fault detection/fault isolation
GROA	Geologic Repository Operations Area
GSA	General Services Administration
HDBK	Handbook
HFS	Human Factors Society
HLW	High-level radioactive waste
HVAC	Heating, Ventilation, and Air conditioning
IEEE	Institute of Electrical and Electronics Engineers
LAR	Low Aspect Ratio
LRU	Line replaceable unit
LSA	Logistics Support Analysis
LWT	Legal Weight Truck
MBMA	Metal Building Manufacturer's Association
MGDS	Mined Geologic Disposal System
MGDS-RD	Mined Geologic Disposal System Requirements document
MIL-STD	Military Standard
MOU	Memorandum of Understanding
mph	Miles per hour
mrem	millirem
MRS	Monitored Retrievable Storage
MSHA	Mine Safety and Health Administration
mSv	Millisievert
MTTR	Mean Time To Repair

NAAMM	National Association of Architectural Metal Manufacturers
NAPHCC	National Association of Plumbing-Heating-Cooling Contractors
NCMA	National Concrete Masonry Association
NEMA	National Electrical Manufacturers Association
NEPA	National Environmental Policy Act
NFPA	National Fire Protection Association
NIST	National Institute of Standards and Technology
NPDES	National Pollutant Discharge Elimination System
NQA	Nuclear Quality Assurance
NRC	Nuclear Regulatory Commission
NUREG	Nuclear Regulatory Guideline
NWPA	Nuclear Waste Policy Act of 1982
NWPAA	Nuclear Waste Policy Amendments Act of 1987
OCRWM	Office of Civilian Radioactive Waste Management
OSHA	Occupational Safety and Health Administration
OWT	Overweight Truck
PCA	Portland Cement Association
PCI	Prestressed Concrete Institute
P.L.	Public Law
PWR	Pressurized water reactor
QA	Quality Assurance
QARD	Quality Assurance Requirements and Description (OCRWM)
RAM	Reliability, Availability, and Maintainability
RDRD	Repository Design Requirements document
S&TE	Support and Test Equipment
SAR	Safety Analysis Report
SBTF	Surface-based testing facilities
SNF	Spent Nuclear Fuel
SSC	Systems, structures, and components
STD	Standard
TBD	To be determined
TBR	To be resolved
TBV	To be verified
TDPP	Technical Document Preparation Plan
UCRL	University of California Research Laboratory
USC	United States Code
VDT	Video Display Terminal
WA	Waste Acceptance

6.3 REQUIREMENTS CROSS-REFERENCE

Table 6-1 provides a cross-reference between the MGDS-RD requirements, the regulatory source documents, and the sections in the RDRD in which they are addressed. Entries listed within parentheses were referred to or used as guidance, but requirements were not directly taken from them.

Table 6-1 Requirements Cross-Reference Table

SOURCE	MGDS-RD PARAGRAPH	RDRD PARAGRAPH
10 CFR 60.111(b)(3)	3.2.1.5.B	3.2.1.4.B
10 CFR 60.72(b)	3.4.6.B	3.4.6.B
10 CFR 60	3.2.1.1.H	Allocated to Site Segment
10 CFR 71	3.2.2.8	3.2.2.7
10 CFR 960	3.2.1.1.H	Allocated to Site Segment
29 CFR 1910	3.3.6.2.E.2	3.3.6.2.E.2
29 CFR 1910	3.3.6.5	3.3.6.5
29 CFR 1910	3.3.6.1.B	3.3.6.1.B
29 CFR 1910	3.8.C	3.8.C
29 CFR 1926.21	3.7.2.5.6.C	3.7.4.4.C
29 CFR 1926	3.3.6.5	3.3.6.5
29 CFR 1926	3.3.6.2.E.2	3.3.6.2.E.2
29 CFR 1926	3.3.6.1.B	3.3.6.1.B
29 CFR 1960 Subpart H	3.7.2.5.6.C	3.7.4.4.C
30 CFR 48	3.7.2.5.6.C	3.7.4.4.C
30 CFR 57, G, T		3.7.5.B.8
30 CFR 57, T	3.3.6.5	3.7.3.7.D
30 CFR 57	3.3.6.1.B	3.3.6.1.B
30 CFR 57	3.3.6.2.E.2	3.3.6.2.E.2
30 CFR 57	3.3.6.5	3.3.6.5
30 CFR 57	3.3.6.2.E.1	3.3.6.2.E.1
30 CFR 57	3.7.2.5.6.C	3.7.4.4.C
30 CFR 57	3.8.C	3.8.C
33 USC 1251 et seq.	3.3.11.3.B	3.3.11.2.B
40 CFR 144.31	3.3.11.4.B	3.3.11.3.B
40 CFR 191	3.2.1.1.H	Allocated to Site Segment
42 USC 300f et seq.	3.3.11.4.B	3.3.11.3.B
42 USC 6901 et seq.	3.3.11.7	3.3.11.6
42 USC 7401	3.3.11.2.A	3.3.11.1.A

Table 6-1 Requirements Cross-Reference Table (continued)

SOURCE	MGDS-RD PARAGRAPH	RDRD PARAGRAPH
49 CFR 172 Subpart H	3.7.2.5.6.C	3.7.4.4.C
49 CFR 173	3.2.2.8	3.2.2.7
49 USC 1501 et seq.		3.7.4
AASHTO: Policy on Geometric Design of Highways and Streets	3.3.1.G	3.7.3.6.D
ACI 318	3.2.4.5.1.C	3.2.4.5.1.C
ANSI/ANS 6.4.2	3.2.4.5.1.C	3.2.4.5.1.C
ANSI/ANS 6.4	3.2.4.5.1.C	3.2.4.5.1.C
ANSI/ANS 8.3	3.3.1.G	3.7.4.2.G
ANSI/ASCE 7-88	3.2.6.1.J	3.2.6.1.J
ANSI/HFS Std. No. 100-1988	3.3.7.9	3.3.7.9
ANSI N 13.3	3.3.1.G	3.7.3.7.L
ANSI N 323	3.3.1.G	3.7.3.7.J
ANSI N 42.18	3.3.1.G	3.7.3.7.H
ANSI S-3.18	3.2.4.2.5	3.2.4.2.5
AREA: Manual for Railway Engineering	3.3.1.G	3.7.3.6.G
CMAA 70	3.7.2.5.1.A.2	3.7.4.1.A.5
DOE 4330.4A	3.7.2.5.6.C	3.7.4.4.C
DOE 4700.1	5.1	5.1
DOE 5000.3A	3.7.2.5.6.C	3.7.4.4.C
DOE 5400.1	3.3.1.G	3.7.3.7.K
DOE 5480.1, XII	3.3.1.G	3.7.3.9.D.2
DOE 5480.3	3.3.1.G	3.7.3.9.E
DOE 5480.4	3.3.1.G	3.7.3.9.E
DOE 5480.4	3.3.1.G	3.7.5.A.6
DOE 5840.4	3.3.1.G	3.7.5.B.8
DOE 6430.1A, 0900-99.0)	3.2.4.1	3.2.4.1
DOE 6430.1A, 1300-10)	3.2.4.3.1.1	3.2.4.3.1.1
DOE 6430.1A, 1300-13)	3.3.7.13.B	3.3.7.13.B
DOE 6430.1A	3.3.1.A	3.3.1.A

Table 6-1 Requirements Cross-Reference Table (continued)

SOURCE	MGDS-RD PARAGRAPH	RDRD PARAGRAPH
DOE 6430.1A	3.3.1.B	3.3.1.B
DOE/EV-1830-TS	3.3.1.G	3.7.4.1.A.7
ERDA 76-21	3.3.1.G	3.7.4.1.A.7
HDBK-743A	3.3.7.10	3.3.7.10
MIL-STD-1388 Series	3.5.2	3.5.2
MIL-STD-1472D	3.3.6.10.B	3.3.6.10.B
MIL-STD-1472D	3.3.7.10	3.3.7.10
MIL-STD-1472D	3.3.6.3.E	3.3.6.3.E
MIL-STD-1472D	3.3.7.11	3.3.7.11
MIL-STD-1472D	3.3.6.6.C	3.3.6.6.C
MIL-STD-1472D	3.3.6.6.A	3.3.6.6.A
MIL-STD-1472D	3.3.7.2	3.3.7.2
MIL-STD-1472D	3.3.6.8.A	3.3.6.8.A
MIL-STD-1472D	3.2.4.2.2	3.2.4.2.2
MIL-STD-1472D	3.2.4.2.4	3.2.4.2.4
MIL-STD-1472D	3.3.7.12	3.3.7.12
MIL-STD-1472D	3.2.4.2.5	3.2.4.2.5
MIL-STD-882B	3.2.5.1.2	3.2.5.1.2
MTR 10090	3.3.7.14	3.3.7.14
NAC 445	3.3.1.C	3.7.3.9.D.1
NAC 445	3.3.11.A	3.7.3.8.C
NRC Regulatory Guide 1.23	3.3.1.G	3.7.4.4.N
NRC Regulatory Guide 8.5	3.3.1.G	3.2.2.4.C
NRC Regulatory Guides 8.8 and 8.10	3.2.2.1.B	3.2.2.1.A
NUREG-0700 Section 6.1.5	3.2.4.2.2	3.2.4.2.2
NUREG-0700	3.3.7.5	3.3.7.5
NUREG-0700	3.3.7.6	3.3.7.6
NUREG-0700	3.3.7.1	3.3.7.1
NUREG-0700	3.3.7.4	3.3.7.4
NUREG-0700	3.2.4.2.1	3.2.4.2.1

Table 6-1 Requirements Cross-Reference Table (continued)

SOURCE	MGDS-RD PARAGRAPH	RDRD PARAGRAPH
NUREG-0700	3.3.7.8	3.3.7.8
NUREG-0700	3.3.7.7	3.3.7.7
NUREG-0700	3.3.7.3	3.3.7.3
NUREG-0700	3.3.7.2	3.3.7.2
NUREG-0700	3.2.4.2.4	3.2.4.2.4
NUREG-0700	3.2.4.2.3	3.2.4.2.3
ORNL-NSIC-65	3.3.1.G	3.7.4.1.A.7
QARD	3.7.2.5.6.C	3.7.4.4.C
Recommended Practice of the Illumination Engineering Society	3.2.4.2.3	3.2.4.2.3
UCRL 15910	3.2.6.1.E.3.b	3.2.6.1.E.3.b
UCRL 15910	3.2.6.1.E.2	3.2.6.1.E.2
UCRL 15910	3.2.6.1.F	3.2.6.1.F
UCRL 53526	3.2.6.1.E.2	3.2.6.1.E.2
UCRL 53526	3.2.6.1.E.3.c	3.2.6.1.E.3.c
10 CFR 2.1011(b)(1)	3.5.3.4	3.5.3.4
10 CFR 20	3.2.2.1.C	3.2.2.1.B
10 CFR 20	3.2.5.1.2	3.2.5.1.2
10 CFR 20	3.2.2.1.D	3.2.2.1.C
10 CFR 20	3.2.1.4	3.2.1.3
10 CFR 20	3.2.1.3.K	3.2.1.2.C
10 CFR 20	3.3.6.9.E	3.3.6.9.E
10 CFR 20	3.2.2.5.B.1	3.2.2.4.B.1
10 CFR 20	3.2.1.5.C	3.2.1.4.C
10 CFR 20	3.2.1.1.H	Allocated to Site Segment
10 CFR 20.1201(a)	3.2.2.5.A.1	3.2.2.4.A.1
10 CFR 20.1207	3.2.2.5.A.2	3.2.2.4.A.2
10 CFR 20.1208	3.2.2.5.A.2	3.2.2.4.A.2
10 CFR 20.1301(c)	3.2.2.3.A	3.2.2.2.A
10 CFR 20.2002	3.2.2.7.B	3.2.2.6.B

Table 6-1 Requirements Cross-Reference Table (continued)

SOURCE	MGDS-RD PARAGRAPH	RDRD PARAGRAPH
10 CFR 20.2005	3.2.2.7.B	3.2.2.6.B
10 CFR 20.1101(b)	3.2.2.1.B	3.2.2.1.A
10 CFR 20.1204	3.7.2.8.E	3.7.7.E
10 CFR 20.1301(a)	3.2.2.3.A	3.2.2.2.A
10 CFR 20.1301(a)(2)	3.2.2.3.C	3.2.2.2.C
10 CFR 20.1301(b)	3.2.2.3.B	3.2.2.2.B
10 CFR 20.1501(b)	3.5.1.2.B	3.5.1.2.B
10 CFR 20.1502(a)(1)	3.2.2.5.A.1	3.2.2.4.A.1
10 CFR 20.1502(a)(3)	3.2.2.5.A.3	3.2.2.4.A.3
10 CFR 20.1502(a)(2)	3.2.2.5.A.2	3.2.2.4.A.2
10 CFR 20.1502(b)(1)	3.2.2.5.B.1	3.2.2.4.B.1
10 CFR 20.1502(b)(2)	3.2.2.5.B.2	3.2.2.4.B.2
10 CFR 20.1601	3.2.4.3.2.A	3.2.4.3.2.A
10 CFR 20.1601(a)(2)	3.2.4.3.2.B.1.b	3.2.4.3.2.B.1.b
10 CFR 20.1601(a)(3)	3.2.4.3.2.B.1.c	3.2.4.3.2.B.1.c
10 CFR 20.1601(a)(1)	3.2.4.3.2.B.1.a	3.2.4.3.2.B.1.a
10 CFR 20.1601(b)	3.2.4.3.2.B.2	3.2.4.3.2.B.2
10 CFR 20.1601(c)	3.2.4.3.2.B.3	3.2.4.3.2.B.3
10 CFR 20.1601(d)	3.2.4.3.2.B.4	3.2.4.3.2.B.4
10 CFR 20.1601(e)	3.2.4.3.2.B.5	3.2.4.3.2.B.5
10 CFR 20.1602	3.2.4.3.2.A	3.2.4.3.2.A
10 CFR 20.1701	3.2.2.4.A	3.2.2.3.A
10 CFR 20.1702	3.2.2.4.B	3.2.2.3.B
10 CFR 20.1703(a)	3.3.6.4.D	3.3.6.4.D
10 CFR 20.1703(a)(3)(i)	3.2.2.4.C	3.2.2.3.C
10 CFR 20.1802	3.2.4.3.1.4	3.2.4.3.1.4
10 CFR 20.1902(a)	3.3.6.9.A	3.3.6.9.A
10 CFR 20.1902(b)	3.3.6.9.B	3.3.6.9.B
10 CFR 20.1902(c)	3.3.6.9.C	3.3.6.9.C
10 CFR 20.1902(d)	3.3.6.9.D	3.3.6.9.D

Table 6-1 Requirements Cross-Reference Table (continued)

SOURCE	MGDS-RD PARAGRAPH	RDRD PARAGRAPH
10 CFR 20.1902(e)	3.3.6.9.E	3.3.6.9.E
10 CFR 20.1906	3.2.4.4	3.2.4.4
10 CFR 20.2003	3.2.2.7.A	3.2.2.6.A
10 CFR 20.2004	3.2.2.7.B	3.2.2.6.B
10 CFR 60 Subpart G	3.9	3.9.A
10 CFR 60.111(a)	3.2.1.5.C	3.2.1.4.C
10 CFR 60.111(a)	3.2.2.1.D	3.2.2.1.C
10 CFR 60.111(a)	3.2.1.3.K	3.2.1.2.C
10 CFR 60.111(a)	3.2.1.4	3.2.1.3
10 CFR 60.111(a)	3.2.1.2.D	3.2.1.1.D
10 CFR 60.111(b)(1)	3.2.1.5.B	3.2.1.4.B
10 CFR 60.112	3.7.3.2.B	3.2.3.2.3.B
10 CFR 60.112	3.7.2.6.J.3	3.7.5.J.3
10 CFR 60.112	3.7.2.2.A	3.7.1.A
10 CFR 60.113(a)(1)(ii)(B)	3.7.3.2.D	3.2.3.2.3.C
10 CFR 60.113(a)(1)(ii)(A)	3.7.3.2.C	3.2.3.2.2.A.11
10 CFR 60.113(a)(2)	3.7.2.2.B	3.7.1.B
10 CFR 60.121	3.7.2.2.E	3.7.1.E
10 CFR 60.121(a)(2)	3.7.2.2.E	3.7.1.E.2
10 CFR 60.121(c)(1)	3.7.2.2.E	3.7.1.E.1
10 CFR 60.122	3.7.2.2.D	3.7.1.D
10 CFR 60.130	3.3.1.E	3.3.1.E
10 CFR 60.130	3.7.2	3.2
10 CFR 60.131(a)(1)	3.7.2.8.A.1	3.7.7.A.1
10 CFR 60.131(a)(2)	3.2.5.2.6	3.2.5.2.6
10 CFR 60.131(a)(2)	3.2.5.2.8.E	3.2.5.2.8.E
10 CFR 60.131(a)(2)	3.7.2.8.A.2	3.7.7.A.2
10 CFR 60.131(a)(3)	3.7.2.8.A.3	3.7.7.A.3
10 CFR 60.131(a)(4)	3.7.2.8.A.4	3.7.7.A.4
10 CFR 60.131(a)(5)	3.7.2.8.A.5	3.7.7.A.5

Table 6-1 Requirements Cross-Reference Table (continued)

SOURCE	MGDS-RD PARAGRAPH	RDRD PARAGRAPH
10 CFR 60.131(a)(6)	3.7.2.8.A.6	3.7.7.A.6
10 CFR 60.131(a)(6)	3.5.1.2.A	3.5.1.2.A
10 CFR 60.131(b)(1)	3.2.6.1	3.2.6.1
10 CFR 60.131(b)(10)(ii)	3.7.2.6.A.2	3.7.5.A.2
10 CFR 60.131(b)(10)(i)	3.7.2.6.A.1	3.7.5.A.1
10 CFR 60.131(b)(10)(iv)	3.7.2.6.A.4	3.7.5.A.4
10 CFR 60.131(b)(10)(iii)	3.7.2.6.A.3	3.7.5.A.3
10 CFR 60.131(b)(2)	3.2.6.2.1.C	3.2.6.2.1.C
10 CFR 60.131(b)(3)(iv)	3.2.6.2.1.B	3.2.6.2.1.B
10 CFR 60.131(b)(3)(iii)	3.2.1.8.A	3.2.1.7.A
10 CFR 60.131(b)(3)(i)	3.2.1.8.C	3.2.1.7.C
10 CFR 60.131(b)(3)	3.2.5.1.3	3.2.5.1.3
10 CFR 60.131(b)(3)(i)	3.2.6.2.1.A	3.2.6.2.1.A
10 CFR 60.131(b)(3)(ii)	3.2.6.2.2.D	3.2.6.2.2.D
10 CFR 60.131(b)(3)(iii)	3.7.2.6.F.4	3.7.5.F.4
10 CFR 60.131(b)(3)(iii)	3.7.2.5.4.A	3.7.4.3.A
10 CFR 60.131(b)(3)(iii)	3.7.2.6.L.1	3.7.5.L.1
10 CFR 60.131(b)(3)(iii)	3.7.2.5.2.A	3.7.4.2.A
10 CFR 60.131(b)(4)(i)	3.2.1.8.B	3.2.1.7.B
10 CFR 60.131(b)(4)(ii)	3.7.2.5.6.I.2	3.7.4.4.I.2
10 CFR 60.131(b)(5)(iii)	3.3.6.11.B	3.3.6.11.B
10 CFR 60.131(b)(5)(i)	3.2.5.1.4.A	3.2.5.1.4.A
10 CFR 60.131(b)(5)(ii)	3.2.5.1.4.B	3.2.5.1.4.B
10 CFR 60.131(b)(5)(i)	3.7.2.4	3.7.3
10 CFR 60.131(b)(5)(iii)	3.7.2.4.1.A	3.7.3.2.A
10 CFR 60.131(b)(6)	3.2.5.2.1	3.2.5.2.1
10 CFR 60.131(b)(6)	3.5.1	3.5.1
10 CFR 60.131(b)(7)	3.2.2.6.A	3.2.2.5.A
10 CFR 60.131(b)(8)	3.3.6.3.F	3.3.6.3.F
10 CFR 60.131(b)(8)	3.7.2.4.6.B	3.7.3.7.A

Table 6-1 Requirements Cross-Reference Table (continued)

SOURCE	MGDS-RD PARAGRAPH	RDRD PARAGRAPH
10 CFR 60.131(b)(9)	3.7.2.6.F.5	3.7.5.F.5
10 CFR 60.131(b)(9)	3.7.2.6.C.3	3.7.5.C.3
10 CFR 60.131(b)(9)	3.7.2.6.C.1	3.7.5.C.1
10 CFR 60.131(b)(9)	3.7.2.6.C.2	3.7.5.C.2
10 CFR 60.132(a)	3.7.2.5.1.A.1	3.7.4.1.A.1
10 CFR 60.132(b)	3.7.2.5.1.C	3.7.4.1.C
10 CFR 60.132(c)(1)	3.7.2.8.F	3.7.7.F
10 CFR 60.132(c)(2)	3.7.2.8.G	3.7.7.G
10 CFR 60.132(d)	3.7.2.4.8.A	3.7.3.9.A
10 CFR 60.132(e)	3.7.2.5.6.L.1	3.7.4.4.L.1
10 CFR 60.133(a)(1)	3.7.3.4.A	3.7.5.E.3
10 CFR 60.133(a)(2)	3.7.2.6.F.2	3.7.5.F.2
10 CFR 60.133(b)	3.7.2.6.H	3.7.5.H
10 CFR 60.133(c)	3.7.2.6.D	3.7.5.D
10 CFR 60.133(d)	3.7.2.6.I	3.7.5.I
10 CFR 60.133(e)(1)	3.7.2.6.E.1	3.7.5.E.1
10 CFR 60.133(e)(2)	3.7.2.6.E.2	3.7.5.E.2
10 CFR 60.133(f)	3.7.2.6.G.2	3.7.5.G.2
10 CFR 60.133(g)(1)	3.7.2.6.B.1	3.7.5.B.1
10 CFR 60.133(g)(2)	3.7.2.6.B.2	3.7.5.B.2
10 CFR 60.133(g)(3)	3.7.2.6.B.3	3.7.5.B.3
10 CFR 60.133(h)	3.7.3.2.A	3.2.3.2.3.A
10 CFR 60.133(i)	3.7.3.4.C	3.7.5.E.7
10 CFR 60.134(a)	3.7.2.6.J.1	3.7.5.J.1
10 CFR 60.134(b)(1)(2)	3.7.2.6.J.2	3.7.5.J.2
10 CFR 60.135(a)(1)	3.7.3.3.A	Allocated to Engineered Barrier Segment
10 CFR 60.135(a)(2)	3.7.3.3.B	Allocated to Engineered Barrier Segment
10 CFR 60.135(b)(1)	3.7.3.3.C	Allocated to Engineered Barrier Segment
10 CFR 60.135(b)(2)	3.7.3.3.D	Allocated to Engineered Barrier Segment
10 CFR 60.135(b)(3)	3.7.3.3.E	Allocated to Engineered Barrier Segment

Table 6-1 Requirements Cross-Reference Table (continued)

SOURCE	MGDS-RD PARAGRAPH	RDRD PARAGRAPH
10 CFR 60.135(b)(4)	3.7.3.3.F	Allocated to Engineered Barrier Segment
10 CFR 60.135(c)(1)	3.7.3.3.G.1	Allocated to Engineered Barrier Segment
10 CFR 60.135(c)(1)	3.7.3.3.G.2	Allocated to Engineered Barrier Segment
10 CFR 60.135(c)(2)	3.7.3.3.G.3	Allocated to Engineered Barrier Segment
10 CFR 60.135(c)(3)	3.7.3.3.G.4	Allocated to Engineered Barrier Segment
10 CFR 60.137	3.7.2.7.A.2	3.7.6.A.3
10 CFR 60.140(a)	3.7.2.7.A.3	3.7.6.A.4
10 CFR 60.140(c)	3.7.2.7.A.4	3.7.6.A.5
10 CFR 60.140(d)	3.7.2.7.A.5	3.7.6.A.6
10 CFR 60.141(b)	3.7.2.7.A.6	3.7.6.A.7
10 CFR 60.141(c)	3.7.2.7.C	3.7.6.C
10 CFR 60.141(e)	3.7.2.7.D	3.7.6.D
10 CFR 60.142(a)	3.2.1.2.A	3.2.1.1.A
10 CFR 60.142(a)	3.7.2.7.B	3.7.6.B
10 CFR 60.142(b)	3.2.1.2.B	3.2.1.1.B
10 CFR 60.142(c)	3.7.2.7.F	3.7.6.F
10 CFR 60.142(d)	3.7.2.7.G	3.7.6.G
10 CFR 60.143(c)	3.7.2.7.E	3.7.6.E
10 CFR 60.15(c)(1)	3.2.1.1.B	3.2.3.2.1
10 CFR 60.15(c)(2)	3.7.1.1.C	Allocated to Site Segment
10 CFR 60.15(c)(3)	3.2.1.1.D	Allocated to Site Segment
10 CFR 60.15(c)(4)	3.2.1.1.E	Allocated to Site Segment
10 CFR 60.160	3.6.1.A	3.6.1.A
10 CFR 60.161	3.6.2.1.C	3.6.2.1.C
10 CFR 60.162	3.6.1.C	3.6.1.B
10 CFR 60.17(a)(3)	3.2.1.1.F.2	Allocated to Site Segment
10 CFR 60.21(c)(1)(ii)(E)	3.2.1.1.J	3.3.1.I
10 CFR 60.21(c)(1)(ii)(D)	3.2.1.1.J	3.3.1.H
10 CFR 60.21(c)(3)(ii)	3.2.1.1.J	3.3.1.J.2
10 CFR 60.21(c)(3)(i)	3.2.1.1.J	3.3.1.J.1

Table 6-1 Requirements Cross-Reference Table (continued)

SOURCE	MGDS-RD PARAGRAPH	RDRD PARAGRAPH
10 CFR 60.51(a)(1)	3.2.1.7.A	3.2.1.6.A
10 CFR 60.51(a)(2)(i)	3.2.1.7.B	3.2.1.6.B
10 CFR 60.52(c)(2)	3.2.1.6	3.2.1.5
10 CFR 60.71(b)	3.4.8	3.4.8
10 CFR 60.72(a)(b)	3.4.6.B	3.4.6.B
10 CFR 60.74(a)	3.7.2.7.A.1	3.7.6.A.1
10 CFR 60.74(b)	3.7.2.7.A.2	3.7.6.A.3
10 CFR 60.75(c)	3.7.2.5.6.E.3	3.7.4.4.E.2
10 CFR 75.1	3.3.8.2.C	3.3.8.2.C
10 CFR 960.3-4	3.3.11.B	3.3.11.B
10 CFR 960.3-4	3.2.1.1.F.2	Allocated to Site Segment
10 CFR 960.3-4	3.2.1.1.F.1	Allocated to Site Segment
10 CFR 960.3-4	3.7.2.3.E	3.7.2.E
10 CFR 961.11 Article IV, B, (2)(c)	3.5.1.3	3.5.1.3
10 CFR 961.11 Article IV, B, 2	3.2.3.2.3.F	3.2.3.1.3.H
10 CFR 961.11 Article VI.A.1	3.2.3.2.2.B	3.2.3.1.2.B
10 CFR 961.11 Article VI.A.1	3.2.3.2.2.A	3.2.3.1.2.A
15 USC 2601 et seq.	3.3.11.5	3.3.11.4
27 CFR 55.201-211	3.7.2.5.6.J.1	3.7.4.4.J.1
27 CFR 55.206	3.7.2.5.6.J.2.b	3.7.4.4.J.2.b
27 CFR 55.206	3.7.2.5.6.J.2.a	3.7.4.4.J.2.a
29 CFR 1910	3.3.6.8.A	3.3.6.8.A
29 CFR 1910, D, E, G, J	3.3.6.3.A	3.3.6.3.A
29 CFR 1910, D, F	3.3.6.10.B	3.3.6.10.B
29 CFR 1910, E	3.3.6.6.C	3.3.6.6.C
29 CFR 1910, F	3.3.6.10.A	3.3.6.10.A
29 CFR 1910, H	3.3.6.3.D	3.3.6.3.D
29 CFR 1910, H, O	3.3.6.3.E	3.3.6.3.E
29 CFR 1910, I	3.3.6.4.A	3.3.6.4.A
29 CFR 1910, J	3.3.6.6.A	3.3.6.6.A

Table 6-1 Requirements Cross-Reference Table (continued)

SOURCE	MGDS-RD PARAGRAPH	RDRD PARAGRAPH
29 CFR 1910, O	3.3.6.8.C	3.3.6.8.C
29 CFR 1910, P	3.3.6.8.D	3.3.6.8.D
29 CFR 1910, Q	3.3.6.8.E	3.3.6.8.E
29 CFR 1910, S	3.3.6.11.A	3.3.6.11.A
29 CFR 1910, Z	3.3.11.5	3.3.11.4
29 CFR 1910.109	3.7.2.5.6.J.1	3.7.4.4.J.1
29 CFR 1910.132	3.3.6.4.E	3.3.6.4.E
29 CFR 1910.141	3.2.4.2.1	3.2.4.2.1
29 CFR 1910.147	3.3.6.8.B	3.3.6.8.B
29 CFR 1910.151(c)	3.3.6.8.F	3.3.6.8.F
29 CFR 1910.94	3.3.6.3.C	3.3.6.3.C
29 CFR 1910.95	3.3.6.4.B	3.3.6.4.B
29 CFR 1910.95	3.2.4.2.4	3.2.4.2.4
29 CFR 1926, E	3.3.6.4.A	3.3.6.4.A
29 CFR 1926.800(c)	3.2.4.3.3	3.2.4.3.3
29 USC 654 (a), (b)	3.3.6.1.A	3.3.6.1.A
29 USC 657	3.7.2.5.6.F.1	3.7.4.4.F.1
30 CFR Chapter I	3.7.2.6.F.5	3.7.5.F.5
30 CFR 31.9(a)(4)	3.7.2.6.F.5	3.7.3.7.E
30 CFR 32.9(a)(4)	3.7.2.6.F.5	3.7.3.7.E
30 CFR 57	3.3.6.8.A	3.3.6.8.A
30 CFR 57, B	3.2.6.2.5	3.2.6.2.5
30 CFR 57, D	3.3.6.3.G	3.3.6.3.G
30 CFR 57, E	3.7.2.6.F.3	3.7.5.F.3
30 CFR 57, K	3.3.6.11.C	3.3.6.11.C
30 CFR 57, M	3.3.6.8.C	3.3.6.8.C
30 CFR 57, M	3.5.1.1.1.E	3.5.1.1.1.E
30 CFR 57, N	3.3.6.4.A	3.3.6.4.A
30 CFR 57.11058	3.2.4.3.3	3.2.4.3.3
30 CFR 57.12016	3.3.6.8.B	3.3.6.8.B

Table 6-1 Requirements Cross-Reference Table (continued)

SOURCE	MGDS-RD PARAGRAPH	RDRD PARAGRAPH
30 CFR 57.5003	3.7.2.6.G.1	3.7.5.G.1
30 CFR 57.5005(a)	3.3.6.4.C	3.3.6.4.C
33 CFR 323	3.3.11.3.B	3.3.11.2.B
33 USC 1251 et seq.	3.3.11.3.A	3.3.11.2.A
33 USC 1251 et seq.	3.7.2.4.8.B	3.7.3.9.B
33 USC 1252(b)(1)	3.3.11.3.A.1	3.3.11.2.A.1
33 USC 1311	3.3.11.3.A.5	3.3.11.2.A.5
33 USC 1311(a)	3.3.11.3.A.3	3.3.11.2.A.3
33 USC 1318(a)(1)(A)	3.3.11.3.A.4	3.3.11.2.A.4
33 USC 1345	3.3.11.3.A.2	3.3.11.2.A.2
33 USC 1345(a)	3.7.2.4.7.A	3.7.3.8.A
40 CFR 122.41	3.3.11.3.A	3.3.11.2.A
40 CFR 141	3.7.2.4.2.B	3.7.3.3.B
40 CFR 143	3.7.2.4.2.B	3.7.3.3.B
40 CFR 165	3.3.11.6	3.3.11.5
40 CFR 191.03(a)(1)(TBR)	3.2.2.1.F.1	3.2.2.1.D.1
40 CFR 191.13(a) (TBR)	3.2.1.7.C	3.2.1.6.C
40 CFR 191.15(TBR)	3.2.2.1.G	3.2.2.1.E
40 CFR 191.16(a), (b) (TBR)	3.7.2.2.C	3.7.1.C
40 CFR 204	3.3.11.8	3.3.11.7
40 CFR 205	3.3.11.8	3.3.11.7
40 CFR 261	3.3.11.7	3.3.11.6
40 CFR 262	3.3.11.7	3.3.11.6
40 CFR 270	3.3.11.7	3.3.11.6
40 CFR 50	3.3.11.2.A	3.3.11.1.A
40 CFR 60	3.3.11.2.A	3.3.11.1.A
40 CFR 61	3.3.11.2.A	3.3.11.1.A
41 CFR 101-17.3	3.7.2.5.6.E.1	3.7.4.4.E.1
41 CFR 101-19.603, (GSA Uniform Accessibility Standards)	3.3.7.13.A	3.3.7.13.A

Table 6-1 Requirements Cross-Reference Table (continued)

SOURCE	MGDS-RD PARAGRAPH	RDRD PARAGRAPH
42 USC 10131(a)(1)	3.2.1.A	3.2.1.A
42 USC 10131(b)(1)	3.7.2.8.C	3.7.7.C
42 USC 10132(b)(1)(D)(iii)	3.2.1.1.F.1	Allocated to Site Segment
42 USC 10133(a)	3.2.1.1.F.1	Allocated to Site Segment
42 USC 10133(b)(1)(A)(iii)	3.2.1.1.F.2	Allocated to Site Segment
42 USC 10133(c)(1)	3.7.1.3.A	Allocated to Site Segment
42 USC 10133(c)(1)	3.2.1.1.A	Allocated to Site Segment
42 USC 10133(c)(2)	3.2.1.1.I	Allocated to Site Segment
42 USC 10134(d)	3.2.1.3.A	3.2.1.2.A
42 USC 10134(d)	3.2.3.2.1.A	3.2.3.1.1.A
42 USC 10142	3.2.1.5.A	3.2.1.4.A
42 USC 300f et seq.	3.3.11.4.A	3.3.11.3.A
42 USC 300g-3	3.7.2.4.2.B	3.7.3.3.B
42 USC 300g-6	3.7.2.4.2.A	3.7.3.3.A
42 USC 300j	3.3.11.4.B	3.3.11.3.B
42 USC 4901 et seq.	3.3.11.8	3.3.11.7
42 USC 7401	3.3.11.2.B	3.3.11.1.B
49 CFR 177.842(f)	3.2.3.2.3.E	3.2.3.1.3.G
50 CFR 17	3.3.11.9	3.3.11.8
7 USC 136	3.3.11.6	3.3.11.5
ANSI C2	3.3.6.11.C	3.3.6.11.C
BLM, 9113	3.7.2.3.C.1	3.7.2.C.1
CRD	3.3.7.10	3.3.7.10
CRD	3.3.7.1	3.3.7.1
CRD	3.3.6.2.D	3.3.6.2.D
CRD	3.3.6.2.E.1	3.3.6.2.E.1
CRD	3.3.6.2.E.2	3.3.6.2.E.2
CRD	3.3.7.14	3.3.7.14
CRD	3.2.1.3.J	3.2.1.2.B
CRD	3.3.6.7.B	3.3.6.7.B

Table 6-1 Requirements Cross-Reference Table (continued)

SOURCE	MGDS-RD PARAGRAPH	RDRD PARAGRAPH
CRD	3.3.11.A	3.3.11.A
CRD	3.3.6.5	3.3.6.5
CRD	3.3.6.6.B	3.3.6.6.B
CRD	3.3.6.7.A	3.3.6.7.A
CRD	3.3.7.12	3.3.7.12
CRD	3.5.1.1.1.B	3.5.1.1.1.B
CRD	3.3.5	3.3.5
CRD	3.3.6.1.B	3.3.6.1.B
CRD	3.3.3.F	3.3.3.F
CRD	3.3.7.11	3.3.7.11
CRD	3.3.6.2.C	3.3.6.2.C
CRD	3.3.6.2.B	3.3.6.2.B
CRD	3.3.6.2.A	3.3.6.2.A
CRD	3.3.7.13.B	3.3.7.13.B
CRD	3.2.2.1.F	3.2.2.1.D
CRD	3.5.1.1.1.C	3.5.1.1.1.C
CRD	3.2.4.2.6	3.2.4.2.6
CRD	3.2.5.1	3.2.5.1
CRD	3.3.8.2.A	3.3.8.2.A
CRD	3.3.7.8	3.3.7.8
CRD	3.3.9.A	3.3.9.A
CRD	3.3.8.1.D	3.3.8.1.D
CRD	3.2.5.1.1	3.2.5.1.1
CRD	3.3.7.9	3.3.7.9
CRD	3.3.9.C	3.3.9.C
CRD	3.3.9.B	3.3.9.B
CRD	3.3.7.5	3.3.7.5
CRD	3.3.7.7	3.3.7.7
CRD	3.3.8.2.B	3.3.8.2.B
CRD	3.3.7.6	3.3.7.6

Table 6-1 Requirements Cross-Reference Table (continued)

SOURCE	MGDS-RD PARAGRAPH	RDRD PARAGRAPH
CRD	3.4.1.B	3.4.1.A
CRD	3.2.5.3.B	3.2.5.3.B
CRD	3.2.5.3.A	3.2.5.3.A
CRD	3.2.5.4.B	3.2.5.4.B
CRD	3.2.5.5.A	3.2.5.5.A
CRD	3.3.8.1.C	3.3.8.1.C
CRD	3.2.5.1.5	3.2.5.1.5
CRD	3.3.8.1.B	3.3.8.1.B
CRD	3.2.3.1.B	3.2.3.2 and following
CRD	3.2.5.1.2	3.2.5.1.2
CRD	3.2.5.5.B	3.2.5.5.B
CRD	3.2.6.1.A	3.2.6.1.A
CRD	3.2.6.1.B	3.2.6.1.B
CRD	3.7.2.1.C	3.2.3.2.1 and 3.2.3.2.2
CRD	3.3.7.2	3.3.7.2
CRD	3.3.1.B	3.3.1.B
CRD	3.3.1.F	3.3.1.F
CRD	3.3.1.G	3.3.1.G
CRD	3.3.1.A	3.3.1.A
CRD	3.2.4.2.2	3.2.4.2.2
CRD	3.2.4.1	3.2.4.1
CRD	3.2.2.8	3.2.2.7
CRD	3.2.4.2.5	3.2.4.2.5
CRD	3.3.10.A	3.3.10
CRD	3.3.10.B	3.3.10
CRD	3.2.4.2.3	3.2.4.2.3
CRD	3.4.4	3.4.4
CRD	3.2.4.3.1.1	3.2.4.3.1.1
CRD	3.3.7.3	3.3.7.3
CRD	3.2.7	3.2.7

Table 6-1 Requirements Cross-Reference Table (continued)

SOURCE	MGDS-RD PARAGRAPH	RDRD PARAGRAPH
CRD	3.2.3.1.A	3.2.3.3, 3.2.3.4
CRD	3.3.7.4	3.3.7.4
CRD	3.4.6.A	3.4.6.A
CRD	3.2.9	3.2.9
CRD	3.2.4	3.2.4
CRD	3.2.8	3.2.8
CRD	3.5.3.1	3.5.3.1
CRD	5.2	5.2
CRD	3.7.1.3.C	Allocated to Site Segment
CRD	3.5.2	3.5.2
CRD	3.8.C	3.8.C
CRD	5.1	5.1
CRD	3.2.1.1.H	Allocated to Site Segment
CRD	3.7.1.2	Allocated to Site Segment
CRD	3.5.3.5	3.5.3.5
CRD	3.7.2.5.6.F.5	3.7.4.4.F.5
CRD	3.6.2	3.6.2
CRD	3.7.2.5.6.C	3.7.4.4.C
CRD	3.5.4	3.5.4
CRD	3.8.A	3.8.A
CRD	3.6.2.2.A	3.6.2.2
CRD	3.6.2.1.B	3.6.2.1.B
CRD	3.7.2.1.A	3.7 and following
CRD	3.6.1	3.6.1
CRD	3.7.3.1.C	Allocated to Engineered Barrier Segment
CRD	3.7.3.1.A	Allocated to Engineered Barrier Segment
Derived, (10 CFR 60.15)	3.7.1.1.A	Allocated to Site Segment
Derived, (10 CFR 60.3)	3.2.5.4.A	3.2.5.4.A
Derived, (10 CFR 60)	3.7.2.5.6.H	3.7.4.4.H
Derived, (30 CFR 57)	3.7.2.6.F.1	3.7.5.F.1

Table 6-1 Requirements Cross-Reference Table (continued)

SOURCE	MGDS-RD PARAGRAPH	RDRD PARAGRAPH
Derived, (DOE 6430.1A)	3.3.1.C	3.3.1.C
Derived, (GSA-IFS-W-A-00450B)	3.7.2.5.2.B	3.7.4.2.B
Derived, (NRC Regulatory Guide 1.76)	3.2.6.1.E.1	3.2.6.1.E.1
Derived, (NUREG-0700)	3.3.6.7.C	3.3.6.7.C
Derived, (UCRL 15910)	3.2.6.1.D	3.2.6.1.D
Derived in MGDS-RD	3.2.5.2.4.B	3.2.5.2.4.B
Derived in MGDS-RD	3.2.5.2.4.A	3.2.5.2.4.A
Derived in MGDS-RD	3.2.5.2.3	3.2.5.2.3
Derived in MGDS-RD	3.2.5.2.4.C	3.2.5.2.4.C
Derived in MGDS-RD	3.2.4.3.1.3.E	3.2.4.3.1.3.E
Derived in MGDS-RD	3.2.4.3.1.2.B	3.2.4.3.1.2.B
Derived in MGDS-RD	3.2.4.3.1.2.C	3.2.4.3.1.2.C
Derived in MGDS-RD	3.2.4.3.1.2.A	3.2.4.3.1.2.A
Derived in MGDS-RD	3.2.4.3.1.2.F	3.2.4.3.1.2.F
Derived in MGDS-RD	3.2.4.3.1.2.E	3.2.4.3.1.2.E
Derived in MGDS-RD	3.2.4.3.1.2.D	3.2.4.3.1.2.D
Derived in MGDS-RD	3.2.4.3.1.3.D	3.2.4.3.1.3.D
Derived in MGDS-RD	3.2.4.3.1.3.B	3.2.4.3.1.3.B
Derived in MGDS-RD	3.2.3.2.3.B	3.2.3.1.3.D
Derived in MGDS-RD	3.5.1.1.1.A	3.5.1.1.1.A
Derived in MGDS-RD	3.2.3.2.3.A	3.2.3.1.3.C
Derived in MGDS-RD	3.2.3.2.2.E	3.2.3.1.2.F
Derived in MGDS-RD	3.2.3.2.3.D	3.2.3.1.3.F
Derived in MGDS-RD	3.2.3.2.3.C	3.2.3.1.3.E
Derived in MGDS-RD	3.2.3.2.3.G	3.2.3.1.3.I
Derived in MGDS-RD	3.2.4.3.1.3.C	3.2.4.3.1.3.C
Derived in MGDS-RD	3.2.3.2.1.B	3.2.3.1.1.B
Derived in MGDS-RD	3.2.4.3.1.3.A	3.2.4.3.1.3.A
Derived in MGDS-RD	3.2.3.2.2.D	3.2.3.1.2.E
Derived in MGDS-RD	3.3.2.D	3.3.2.D

Table 6-1 Requirements Cross-Reference Table (continued)

SOURCE	MGDS-RD PARAGRAPH	RDRD PARAGRAPH
Derived in MGDS-RD	3.2.3.2.2.C	3.2.3.1.2.D
Derived in MGDS-RD	3.2.5.2.5	3.2.5.2.5.A
Derived in MGDS-RD	3.2.5.2.9	3.2.5.2.9
Derived in MGDS-RD	3.2.6.1.C	3.2.6.1.C
Derived in MGDS-RD	3.2.5.2.9	3.2.5.2.9
Derived in MGDS-RD	3.2.5.2.7	3.2.5.2.7
Derived in MGDS-RD	3.2.3.2.3.H	3.2.3.1.3.J
Derived in MGDS-RD	3.2.3.2.3.I	3.2.3.1.3.K
Derived in MGDS-RD	3.7.3.4.D	3.7.5.K.1
Derived in MGDS-RD	3.7.2.6.K	3.7.5.K.1
Derived in MGDS-RD	3.7.2.4.3.H	3.7.3.4.G
Derived in MGDS-RD	3.5.3.2.A	3.5.3.2.A
Derived in MGDS-RD	3.5.1.4.A	3.5.1.4.A
Derived in MGDS-RD	3.7.2.4.3.F	3.7.3.4.E
Derived in MGDS-RD	3.7.2.4.3.C	3.7.3.4.C
Derived in MGDS-RD	3.5.1.4.B	3.5.1.4.B
Derived in MGDS-RD	3.7.1.3.B	Allocated to Site Segment
Derived in MGDS-RD	3.5.1.5	3.5.1.5
Derived in MGDS-RD	3.7.2.4.3.D	3.7.3.4.D
Derived in MGDS-RD	3.7.2.4.3.G	3.7.3.4.F
Derived in MGDS-RD	3.7.2.5.6.E.4	3.7.4.4.E.3
Derived in MGDS-RD	3.7.2.5.2.C	3.7.4.2.C
Derived in MGDS-RD	3.7.1.3.B.3	Allocated to Site Segment
Derived in MGDS-RD	3.7.2.1.B	3.7 and following
Derived in MGDS-RD	3.5.3.3	3.5.3.3
Derived in MGDS-RD	3.7.2.5.6.K	3.7.4.4.K
Derived in MGDS-RD	3.7.2.5.2.F	3.7.4.2.F
Derived in MGDS-RD	3.7.2.5.2.E	3.7.4.2.E
Derived in MGDS-RD	3.5.1.1.2.B	3.5.1.1.2.B
Derived in MGDS-RD	3.5.1.1.3	3.5.1.1.3

Table 6-1 Requirements Cross-Reference Table (continued)

SOURCE	MGDS-RD PARAGRAPH	RDRD PARAGRAPH
Derived in MGDS-RD	3.5.3.2.B	3.5.3.2.B
Derived in MGDS-RD	3.5.1.1.2.A	3.5.1.1.2.A
Derived in RDRD	3.2.5.2.5	3.2.5.2.5.D
Derived in RDRD	3.2.5.2.5	3.2.5.2.5.C
Derived in RDRD	3.3.11.B	3.3.11.9
Derived in RDRD		3.3.11.C
Derived in RDRD	3.2.5.2.5	3.2.5.2.5.B
Derived in RDRD		3.3.11.1.C
Derived in RDRD		3.3.11.1.D
Derived in RDRD		3.2.4.3.1.2.G
Derived in RDRD		3.4.1.C
Derived in RDRD		3.2.2.4.D
Derived in RDRD	3.2.4.6.A	3.2.4.6.A
Derived in RDRD		3.3.11.D
Derived in RDRD		3.3.8.1.D
Derived in RDRD		3.2.5.2.8.F
Derived in RDRD		3.5.1.1.1.F
Derived in RDRD		3.7.7.H
Derived in RDRD		3.7.5.K.2
Derived in RDRD		3.7.3.1
Derived in RDRD		3.7.3.2.B
Derived in RDRD		3.7.3.4.A.1
Derived in RDRD		3.7.5.N.1
Derived in RDRD		3.7.5.N.7
Derived in RDRD		3.7.5.O.3
Derived in RDRD		3.7.3.4.A.4
Derived in RDRD		3.7.5.N.6
Derived in RDRD		3.7.5.O.3
Derived in RDRD		3.7.5.O.1
Derived in RDRD		3.7.5.O.2

Table 6-1 Requirements Cross-Reference Table (continued)

SOURCE	MGDS-RD PARAGRAPH	RDRD PARAGRAPH
Derived in RDRD		3.7.5.P.2
Derived in RDRD		3.7.5.N.3
Derived in RDRD		3.7.5.N.4
Derived in RDRD		3.7.5.N.2
Derived in RDRD		3.7.6.A.2
Derived in RDRD		3.7.5.N.5
Derived in RDRD		3.7.3.4.A.2
Derived in RDRD		3.7.3.4.A.3
Derived in RDRD		3.7.4.3.F
Derived in RDRD		3.7.4.4.M
Derived in RDRD		3.7.2.B.5
Derived in RDRD		3.7.4.4.N
Derived in RDRD		3.7.2.B.4
Derived in RDRD	3.7.1.1.B	Allocated to Site Segment
Derived in RDRD		3.7.2.C.3
Derived in RDRD		3.7.5.A.5
Derived in RDRD		3.7.4.4.O
Derived in RDRD		3.7.3.9.C
Derived in RDRD		3.7.2.C.4
Derived in RDRD		3.7.4.3.I
Derived in RDRD		3.7.4.3.H
Derived in RDRD		3.7.4.3.E
Derived in RDRD		3.7.4.3.G
Derived in RDRD		3.7.4.1.A.2
Derived in RDRD		3.7.4.1.A.3
Derived in RDRD		3.7.4.1.A.4
Derived in RDRD		3.7.4.4.E.4
Derived in RDRD		3.7.4.1.A.6
Derived in RDRD		3.7.3.5.A.1
Derived in RDRD		3.7.5.E.6

Table 6-1 Requirements Cross-Reference Table (continued)

SOURCE	MGDS-RD PARAGRAPH	RDRD PARAGRAPH
Derived in RDRD		3.7.5.E.5
Derived in RDRD		3.7.3.6.F
Derived in RDRD		3.7.5.E.4
Derived in RDRD		3.7.2.G
Derived in RDRD		3.7.3.5.A.2
Derived in RDRD		3.7.3.6.B
Derived in RDRD		3.7.3.6.E
Derived in RDRD		3.7.3.6.C
Derived in RDRD		3.7.5.B.4
Derived in RDRD		3.7.5.B.7
Derived in RDRD		3.7.5.B.6
Derived in RDRD		3.7.3.7.G
Derived in RDRD		3.7.5.B.5
Derived in RDRD		3.7.3.6.H
Derived in RDRD		3.7.3.7.F
Derived in RDRD		3.7.3.7.C
Derived in RDRD		3.7.3.6.I
DOE 3790.1A, Chapter VIII	3.7.2.5.6.D	3.7.4.4.D
DOE 3790.1A, I, (3)(a)(5)	3.7.2.6.M	3.7.5.M
DOE 3790.1A, I, (3)(a)(5)	3.7.2.5.6.B	3.7.4.4.B
DOE 3790.1A, page VII-8, (5)(b)(2)(g)(3)	3.7.2.5.6.F.2	3.7.4.4.F.2
DOE 3790.1A, page VII-8	3.7.2.5.6.F.2	3.7.4.4.F.2
DOE 3790.1A, VII.5(1)(m)	3.7.2.5.6.I.1	3.7.4.4.I.1
DOE 4330.4A	3.7.2.5.6.G	3.7.4.4.G
DOE 4330.4A, I, 3.1.4	3.6.2.1.A	3.6.2.1.A
DOE 4330.4A, I, 3.5	3.5.1.1.1.D	3.5.1.1.1.D
DOE 4700.1, p.V-17, q	3.2.5.2.8.A	3.2.5.2.8.A
DOE 5480.4	3.7.2.5.6.J.1	3.7.4.4.J.1
DOE 5480.4, Attach. 2, 2.e.(8)(a)	3.2.1.2.C	3.2.1.1.C
DOE 5480.7	3.7.2.6.L.4	3.7.5.L.4

Table 6-1 Requirements Cross-Reference Table (continued)

SOURCE	MGDS-RD PARAGRAPH	RDRD PARAGRAPH
DOE 5480.7	3.7.2.5.4.C	3.7.4.3.C
DOE 5480.7	3.7.2.5.4.D	3.7.4.3.D
DOE 5480.7	3.7.2.6.L.3	3.7.5.L.3
DOE 6430.1A	3.3.6.3.B	3.3.6.3.B
DOE 6430.1A	3.7.2.4.4.A	3.7.3.5.A
DOE 6430.1A	3.7.2.4.6.C	3.7.3.7.B
DOE 6430.1A	3.7.2.4.3.A	3.7.3.4.A
DOE 6430.1A	3.7.2.5.4.C	3.7.4.3.C
DOE 6430.1A	3.7.2.4.7.B	3.7.3.8.B
DOE 6430.1A	3.7.2.6.L.3	3.7.5.L.3
DOE 6430.1A	3.7.2.4.1.B	3.7.3.2.B
DOE 6430.1A	3.7.2.4.1.C	3.7.3.2.C
DOE 6430.1A	3.7.2.4.2.C	3.7.3.3.C
DOE 6430.1A	3.7.2.4.1.D	3.7.3.2.D
DOE 6430.1A	3.7.2.8.B	3.7.7.B
DOE 6430.1A	3.7.2.5.6.J.1	3.7.4.4.J.1
DOE 6430.1A, 0101-2	3.3.1.D	3.3.1.D
DOE 6430.1A, 0109	3.3.4.B	3.3.4.B
DOE 6430.1A, 0110-1.3	3.7.2.6.F.7	3.7.5.F.7
DOE 6430.1A, 0110-1.3	3.7.2.5.6.I.3	3.7.4.4.I.3
DOE 6430.1A, 0110-6	3.7.2.6.L.2	3.7.5.L.2
DOE 6430.1A, 0110-6	3.7.2.5.4.B	3.7.4.3.B
DOE 6430.1A, 0110-99.0.4	3.2.5.2.2.A	3.2.5.2.2.A
DOE 6430.1A, 0110-99.0.6	3.2.6.2.2.B	3.2.6.2.2.B
DOE 6430.1A, 0110-99.0.6	3.2.6.2.2.C	3.2.6.2.2.C
DOE 6430.1A, 0110-99.0.6	3.2.6.2.2.A	3.2.6.2.2.A
DOE 6430.1A, 0110-99.8.3	3.3.2.C	3.3.2.C
DOE 6430.1A, 0111-2.3.2	3.2.6.1.J	3.2.6.1.J
DOE 6430.1A, 0111-2.8.1	3.2.6.2.3	3.2.6.2.3
DOE 6430.1A, 0111-2.8.2	3.2.6.1.H.2	3.2.6.1.H.2

Table 6-1 Requirements Cross-Reference Table (continued)

SOURCE	MGDS-RD PARAGRAPH	RDRD PARAGRAPH
DOE 6430.1A, 0111-2.8.2	3.2.6.1.H.1	3.2.6.1.H.1
DOE 6430.1A, 0111-2.8.4	3.2.6.1.I	3.2.6.1.I
DOE 6430.1A, 0111-2.8.5	3.2.6.2.4	3.2.6.2.4
DOE 6430.1A, 0111-99.0	3.2.4.6.B	3.2.4.6.C
DOE 6430.1A, 0111-99.0	3.2.4.6.D	3.2.4.6.E
DOE 6430.1A, 0111-99.0	3.2.4.6.C	3.2.4.6.D
DOE 6430.1A, 0111-99.0.2	3.2.6.1.E.3.c	3.2.6.1.E.3.c
DOE 6430.1A, 0111-99.0.2	3.2.6.1.E.4	3.2.6.1.E.4
DOE 6430.1A, 0111-99.0.2	3.2.6.1.E.3.b	3.2.6.1.E.3.b
DOE 6430.1A, 0111-99.0.2	3.2.6.1.E.3.a	3.2.6.1.E.3.a
DOE 6430.1A, 0111-99.0.2	3.2.6.1.E.2	3.2.6.1.E.2
DOE 6430.1A, 0111-99.0.3	3.2.6.1.F	3.2.6.1.F
DOE 6430.1A, 0150-1	3.7.2.3.B.1	3.7.2.B.1
DOE 6430.1A, 0150-5	3.7.2.3.D.1	3.7.2.D.1
DOE 6430.1A, 0200-99.8.1	3.3.2.A	3.3.2.A
DOE 6430.1A, 0202	3.7.2.3.A	3.7.2.A
DOE 6430.1A, 0220	3.7.2.3.B.2	3.7.2.B.2
DOE 6430.1A, 0250-3	3.7.2.3.C.2	3.7.2.C.2
DOE 6430.1A, 0250-4	3.7.2.3.B.3	3.7.2.B.3
DOE 6430.1A, 0250-5	3.7.2.3.C.2	3.7.2.C.2
DOE 6430.1A, 0270-2	3.7.2.3.F	3.7.2.F
DOE 6430.1A, 0278	3.7.2.4.4.B	3.7.3.5.B
DOE 6430.1A, 0280-1	3.7.2.3.D.2	3.7.2.D.2
DOE 6430.1A, 0281	3.7.2.4.5	3.7.3.6.A
DOE 6430.1A, 1300-11.2	3.7.2.5.6.L.2	3.7.4.4.L.2
DOE 6430.1A, 1300-12.4.11	3.3.3.E	3.3.3.E
DOE 6430.1A, 1300-12.4.11	3.3.3.D	3.3.3.D
DOE 6430.1A, 1300-12.4.11	3.3.3.A	3.3.3.A
DOE 6430.1A, 1300-12.4.11	3.3.3.B	3.3.3.B
DOE 6430.1A, 1300-12.4.11	3.3.3.C	3.3.3.C

Table 6-1 Requirements Cross-Reference Table (continued)

SOURCE	MGDS-RD PARAGRAPH	RDRD PARAGRAPH
DOE 6430.1A, 1300-12.4.5	3.3.6.4.A	3.3.6.4.A
DOE 6430.1A, 1300-3.5	3.2.5.2.2.B	3.2.5.2.2.B
DOE 6430.1A, 1300-4	3.2.2.6.B	3.2.2.5.B
DOE 6430.1A, 1300-6.2	3.2.4.5.1.B	3.2.4.5.1.B
DOE 6430.1A, 1300-6.2	3.2.4.5.1.C	3.2.4.5.1.C
DOE 6430.1A, 1300-6.2	3.2.4.5.1.D	3.2.4.5.1.D
DOE 6430.1A, 1300-6.2	3.2.4.5.1.A	3.2.4.5.1.A
DOE 6430.1A, 1300-6.3	3.2.4.5.2	3.2.4.5.2
DOE 6430.1A, 1300-6.5	3.7.2.6.F.6	3.7.5.F.6
DOE 6430.1A, 1300-6.5	3.7.2.5.2.D	3.7.4.2.D
DOE 6430.1A, 1300-6.6	3.7.2.8.D	3.7.7.D
DOE 6430.1A, 1300-6.8	3.7.2.5.6.A	3.7.4.4.A
DOE 6430.1A, 1324-2.1	3.2.4.6.A	3.2.4.6.B
DOE 6430.1A, 1324-3	3.2.2.6.C	3.2.2.5.C
DOE 6430.1A, 1460	3.7.2.5.1.A.2	3.7.4.1.A.5
DOE 6430.1A, 1630-99.8	3.7.2.4.3.B	3.7.3.4.B
DOE 6430.1A, 1655-99.8	3.3.2.B	3.3.2.B
DOE letter 2/27/90	3.7.1.3.B.1	Allocated to Site Segment
DOE letter 2/27/90	3.7.1.3.B.2	Allocated to Site Segment
E.O. 11988, 2(b)	3.2.6.1.G.1	3.2.6.1.G.1
E.O. 11988, 2(b)	3.2.6.1.G.2	3.2.6.1.G.2
Derived in RDRD		3.7.5.P.1
MOA, RW/NS 4/16/92	3.8.B	3.8.B
MOU DOE/DOL	3.7.2.6.C.3	3.7.5.C.3
MOU DOE/DOL	3.7.2.6.C.2	3.7.5.C.2
MOU DOE/DOL	3.7.2.6.C.1	3.7.5.C.1
NFPA-70	3.3.6.11.C	3.3.6.11.C
NUREG-0700 Section 6.1.4	3.3.6.4.A	3.3.6.4.A
Presidential Memo, 1985	3.2.1.A	3.2.1.A
QARD	3.4.7	3.4.7

Table 6-1 Requirements Cross-Reference Table (continued)

SOURCE	MGDS-RD PARAGRAPH	RDRD PARAGRAPH
QARD	3.3.8.1.A	3.3.8.1.A
QARD	3.4.2	3.4.2
QARD	3.4.3	3.4.3
QARD	3.4.1.C	3.4.1.B
QARD	3.3.4.A	3.3.4.A
QARD	3.4.5	3.4.5
QARD	3.7.2.5.6.F.4	3.7.4.4.F.4
QARD	3.9	3.9.A
Reserved	3.2.2.1.F.2	3.2.2.1.D.2 (TBD)
RW-0194	3.7.2.5.6.F.3	3.7.4.4.F.3
RW-0316, pp 101	3.7.2.5.1.B	3.7.4.1.B
UCRL 15673, Section 1	3.2.5.2.8.B	3.2.5.2.8.B
UCRL 15673, Section 2	3.2.5.2.8.C	3.2.5.2.8.C
UCRL 15673, Section 3	3.2.5.2.8.D	3.2.5.2.8.D

APPENDIX A

MINED GEOLOGIC DISPOSAL SYSTEM REQUIREMENTS DOCUMENT
TRACEABILITY MATRIX

APPENDIX A

MINED GEOLOGIC DISPOSAL SYSTEM REQUIREMENTS DOCUMENT
TRACEABILITY MATRIX

Appendix A identifies the rationale for all requirements identified in the MGDS-RD that have not been incorporated into the RDRD.

Table A-1 provides a cross-reference between the MGDS-RD requirement statements and the sections in the RDRD in which they are addressed. If an entry in the MGDS-RD column is blank, there is no corresponding MGDS-RD requirement.

Table A-1 Mined Geologic Disposal System Requirements
Document Traceability Matrix

MGDS-RD PARAGRAPH	RDRD PARAGRAPH
3.2.1.A	3.2.1.A
3.2.1.1.A	Allocated to Site Segment
3.2.1.1.B	3.2.3.2.1
3.2.1.1.C	Allocated to Site Segment
3.2.1.1.D	Allocated to Site Segment
3.2.1.1.E	Allocated to Site Segment
3.2.1.1.F.1	Allocated to Site Segment
3.2.1.1.F.2	Allocated to Site Segment
3.2.1.1.G (Reserved)	No requirement
3.2.1.1.H	Allocated to Site Segment
3.2.1.1.I	Allocated to Site Segment
3.2.1.1.J	3.3.1.H
3.2.1.1.J	3.3.1.I
3.2.1.1.J	3.3.1.J.1
3.2.1.1.J	3.3.1.J.2
3.2.1.2.A	3.2.1.1.A
3.2.1.2.B	3.2.1.1.B
3.2.1.2.C	3.2.1.1.C
3.2.1.2.D	3.2.1.1.D
3.2.1.3.A	3.2.1.2.A
3.2.1.3.B (Reserved)	No requirement
3.2.1.3.C (Reserved)	No requirement
3.2.1.3.D (Reserved)	No requirement
3.2.1.3.E (Reserved)	No requirement
3.2.1.3.F (Reserved)	No requirement
3.2.1.3.G (Reserved)	No requirement
3.2.1.3.H (Reserved)	No requirement
3.2.1.3.I (Reserved)	No requirement

Table A-1 Mined Geologic Disposal System Requirements Document
Traceability Matrix (continued)

MGDS-RD PARAGRAPH	RDRD PARAGRAPH
3.2.1.3.J	3.2.1.2.B
3.2.1.3.K	3.2.1.2.C
3.2.1.4	3.2.1.3
3.2.1.5.A	3.2.1.4.A
3.2.1.5.B	3.2.1.4.B
3.2.1.5.C	3.2.1.4.C
3.2.1.6	3.2.1.5
3.2.1.7.A	3.2.1.6.A
3.2.1.7.B	3.2.1.6.B
3.2.1.7.C	3.2.1.6.C
3.2.1.8.A	3.2.1.7.A
3.2.1.8.B	3.2.1.7.B
3.2.1.8.C	3.2.1.7.C
3.2.2.1.A (Reserved)	No requirement
3.2.2.1.B	3.2.2.1.A
3.2.2.1.C	3.2.2.1.B
3.2.2.1.D	3.2.2.1.C
3.2.2.1.E (Reserved)	No requirement
3.2.2.1.F	3.2.2.1.D
3.2.2.1.F.1	3.2.2.1.D.1
3.2.2.1.F.2 (Reserved)	No requirement
3.2.2.1.G	3.2.2.1.E
3.2.2.2 (Reserved)	No requirement
3.2.2.3.A	3.2.2.2.A
3.2.2.3.B	3.2.2.2.B
3.2.2.3.C	3.2.2.2.C
3.2.2.4.A	3.2.2.3.A
3.2.2.4.B	3.2.2.3.B

Table A-1 Mined Geologic Disposal System Requirements Document
Traceability Matrix (continued)

MGDS-RD PARAGRAPH	RDRD PARAGRAPH
3.2.2.4.C	3.2.2.3.C
3.2.2.5	3.7.4.4.N
3.2.2.5.A.1	3.2.2.4.A.1
3.2.2.5.A.2	3.2.2.4.A.2
3.2.2.5.A.3	3.2.2.4.A.3
3.2.2.5.B.1	3.2.2.4.B.1
3.2.2.5.B.2	3.2.2.4.B.2
3.2.2.6.A	3.2.2.5.A
3.2.2.6.B	3.2.2.5.B
3.2.2.6.C	3.2.2.5.C
3.2.2.7.A	3.2.2.6.A
3.2.2.7.B	3.2.2.6.B
3.2.2.8	3.2.2.7
3.2.3.1.A	3.2.3.3, 3.2.3.4
3.2.3.1.B	3.2.3.2 through 3.2.3.2.2.B.3
3.2.3.2.1.A	3.2.3.1.1.A
3.2.3.2.1.B	3.2.3.1.1.B
3.2.3.2.2.A	3.2.3.1.2.A
3.2.3.2.2.B	3.2.3.1.2.B
3.2.3.2.2.C	3.2.3.1.2.C
3.2.3.2.2.D	3.2.3.1.2.D
3.2.3.2.2.E	3.2.3.1.2.E
3.2.3.2.3.A	3.2.3.1.3.C
3.2.3.2.3.B	3.2.3.1.3.D
3.2.3.2.3.C	3.2.3.1.3.E
3.2.3.2.3.D	3.2.3.1.3.F
3.2.3.2.3.E	3.2.3.1.3.G
3.2.3.2.3.F	3.2.3.1.3.H

Table A-1 Mined Geologic Disposal System Requirements Document
Traceability Matrix (continued)

MGDS-RD PARAGRAPH	RDRD PARAGRAPH
3.2.3.2.3.G	3.2.3.1.3.I
3.2.3.2.3.H	3.2.3.1.3.J
3.2.3.2.3.I	3.2.3.1.3.K
3.2.4	3.2.4
3.2.4.1	3.2.4.1
3.2.4.2.1	3.2.4.2.1
3.2.4.2.2	3.2.4.2.2
3.2.4.2.3	3.2.4.2.3
3.2.4.2.4	3.2.4.2.4
3.2.4.2.5	3.2.4.2.5
3.2.4.2.6	3.2.4.2.6
3.2.4.3.1.1	3.2.4.3.1.1
3.2.4.3.1.2.A	3.2.4.3.1.2.A
3.2.4.3.1.2.B	3.2.4.3.1.2.B
3.2.4.3.1.2.C	3.2.4.3.1.2.C
3.2.4.3.1.2.D	3.2.4.3.1.2.D
3.2.4.3.1.2.E	3.2.4.3.1.2.E
3.2.4.3.1.2.F	3.2.4.3.1.2.F
3.2.4.3.1.3.A	3.2.4.3.1.3.A
3.2.4.3.1.3.B	3.2.4.3.1.3.B
3.2.4.3.1.3.C	3.2.4.3.1.3.C
3.2.4.3.1.3.D	3.2.4.3.1.3.D
3.2.4.3.1.3.E	3.2.4.3.1.3.E
3.2.4.3.1.4	3.2.4.3.1.4
3.2.4.3.2.A	3.2.4.3.2.A
3.2.4.3.2.B.1.a	3.2.4.3.2.B.1.a
3.2.4.3.2.B.1.b	3.2.4.3.2.B.1.b
3.2.4.3.2.B.1.c	3.2.4.3.2.B.1.c

Table A-1 Mined Geologic Disposal System Requirements Document
Traceability Matrix (continued)

MGDS-RD PARAGRAPH	RDRD PARAGRAPH
3.2.4.3.2.B.2	3.2.4.3.2.B.2
3.2.4.3.2.B.3	3.2.4.3.2.B.3
3.2.4.3.2.B.4	3.2.4.3.2.B.4
3.2.4.3.2.B.5	3.2.4.3.2.B.5
3.2.4.3.3	3.2.4.3.3
3.2.4.4	3.2.4.4
3.2.4.5.1.A	3.2.4.5.1.A
3.2.4.5.1.B	3.2.4.5.1.B
3.2.4.5.1.C	3.2.4.5.1.C
3.2.4.5.1.D	3.2.4.5.1.D
3.2.4.5.2	3.2.4.5.2
3.2.4.6.A	3.2.4.6.B
3.2.4.6.B	3.2.4.6.C
3.2.4.6.C	3.2.4.6.D
3.2.4.6.D	3.2.4.6.E
3.2.5.1	3.2.5.1
3.2.5.1.1	3.2.5.1.1
3.2.5.1.2	3.2.5.1.2
3.2.5.1.3	3.2.5.1.3
3.2.5.1.4.A	3.2.5.1.4.A
3.2.5.1.4.B	3.2.5.1.4.B
3.2.5.1.5	3.2.5.1.5
3.2.5.2.1	3.2.5.2.1
3.2.5.2.2.A	3.2.5.2.2.A
3.2.5.2.2.B	3.2.5.2.2.B
3.2.5.2.3	3.2.5.2.3
3.2.5.2.4.A	3.2.5.2.4.A
3.2.5.2.4.B	3.2.5.2.4.B

Table A-1 Mined Geologic Disposal System Requirements Document
Traceability Matrix (continued)

MGDS-RD PARAGRAPH	RDRD PARAGRAPH
3.2.5.2.4.C	3.2.5.2.4.C
3.2.5.2.5	3.2.5.2.5.A
3.2.5.2.5	3.2.5.2.5.B
3.2.5.2.5	3.2.5.2.5.C
3.2.5.2.5	3.2.5.2.5.D
3.2.5.2.6	3.2.5.2.6
3.2.5.2.7	3.2.5.2.7
3.2.5.2.8.A	3.2.5.2.8.A
3.2.5.2.8.B	3.2.5.2.8.B
3.2.5.2.8.C	3.2.5.2.8.C
3.2.5.2.8.D	3.2.5.2.8.D
3.2.5.2.8.E	3.2.5.2.8.E
3.2.5.2.9	3.2.5.2.9
3.2.5.3.A	3.2.5.3.A
3.2.5.3.B	3.2.5.3.B
3.2.5.4.A	3.2.5.4.A
3.2.5.4.B	3.2.5.4.B
3.2.5.5.A	3.2.5.5.A
3.2.5.5.B	3.2.5.5.B
3.2.6.1	3.2.6.1
3.2.6.1.A	3.2.6.1.A
3.2.6.1.B	3.2.6.1.B
3.2.6.1.C	3.2.6.1.C
3.2.6.1.D	3.2.6.1.D
3.2.6.1.D	3.7.3.7.H
3.2.6.1.E.1	3.2.6.1.E.1
3.2.6.1.E.2	3.2.6.1.E.2
3.2.6.1.E.3.a	3.2.6.1.E.3.a

Table A-1 Mined Geologic Disposal System Requirements Document
Traceability Matrix (continued)

MGDS-RD PARAGRAPH	RDRD PARAGRAPH
3.2.6.1.E.3.b	3.2.6.1.E.3.b
3.2.6.1.E.3.c	3.2.6.1.E.3.c
3.2.6.1.E.4	3.2.6.1.E.4
3.2.6.1.F	3.2.6.1.F
3.2.6.1.G.1	3.2.6.1.G.1
3.2.6.1.G.2	3.2.6.1.G.2
3.2.6.1.H.1	3.2.6.1.H.1
3.2.6.1.H.2	3.2.6.1.H.2
3.2.6.1.I	3.2.6.1.I
3.2.6.1.J	3.2.6.1.J
3.2.6.2.1.A	3.2.6.2.1.A
3.2.6.2.1.B	3.2.6.2.1.B
3.2.6.2.1.C	3.2.6.2.1.C
3.2.6.2.2.A	3.2.6.2.2.A
3.2.6.2.2.B	3.2.6.2.2.B
3.2.6.2.2.C	3.2.6.2.2.C
3.2.6.2.2.D	3.2.6.2.2.D
3.2.6.2.3	3.2.6.2.3
3.2.6.2.4	3.2.6.2.4
3.2.6.2.5	3.2.6.2.5
3.2.7	3.2.7
3.2.8	3.2.8
3.2.9	3.2.9
3.3.1.A	3.3.1.A
3.3.1.B	3.3.1.B
3.3.1.C	3.3.1.C
3.3.1.C	3.7.3.9.D.1
3.3.1.C	3.7.5.A.6

Table A-1 Mined Geologic Disposal System Requirements Document
Traceability Matrix (continued)

MGDS-RD PARAGRAPH	RDRD PARAGRAPH
3.3.1.D	3.3.1.D
3.3.1.E	3.3.1.E
3.3.1.F	3.3.1.F
3.3.1.G	3.2.2.4.C
3.3.1.G	3.3.1.G
3.3.1.G	3.7.3.6.D
3.3.1.G	3.7.3.6.G
3.3.1.G	3.7.3.7.J
3.3.1.G	3.7.3.7.K
3.3.1.G	3.7.3.7.L
3.3.1.G	3.7.3.9.D.2
3.3.1.G	3.7.3.9.E
3.3.1.G	3.7.4.1.A.7
3.3.1.G	3.7.4.2.G
3.3.1.G	3.7.5.B.8
3.3.2.A	3.3.2.A
3.3.2.B	3.3.2.B
3.3.2.C	3.3.2.C
3.3.2.D	3.3.2.D
3.3.3.A	3.3.3.A
3.3.3.B	3.3.3.B
3.3.3.C	3.3.3.C
3.3.3.D	3.3.3.D
3.3.3.E	3.3.3.E
3.3.3.F	3.3.3.F
3.3.4.A	3.3.4.A
3.3.4.B	3.3.4.B
3.3.5	3.3.5

Table A-1 Mined Geologic Disposal System Requirements Document
Traceability Matrix (continued)

MGDS-RD PARAGRAPH	RDRD PARAGRAPH
3.3.6.1.A	3.3.6.1.A
3.3.6.1.B	3.3.6.1.B
3.3.6.2.A	3.3.6.2.A
3.3.6.2.B	3.3.6.2.B
3.3.6.2.C	3.3.6.2.C
3.3.6.2.D	3.3.6.2.D
3.3.6.2.E.1	3.3.6.2.E.1
3.3.6.2.E.2	3.3.6.2.E.2
3.3.6.3.A	3.3.6.3.A
3.3.6.3.B	3.3.6.3.B
3.3.6.3.C	3.3.6.3.C
3.3.6.3.D	3.3.6.3.D
3.3.6.3.E	3.3.6.3.E
3.3.6.3.F	3.3.6.3.F
3.3.6.3.G	3.3.6.3.G
3.3.6.4.A	3.3.6.4.A
3.3.6.4.B	3.3.6.4.B
3.3.6.4.C	3.3.6.4.C
3.3.6.4.D	3.3.6.4.D
3.3.6.4.E	3.3.6.4.E
3.3.6.5	3.3.6.5
3.3.6.5	3.7.3.7.D
3.3.6.6.A	3.3.6.6.A
3.3.6.6.B	3.3.6.6.B
3.3.6.6.C	3.3.6.6.C
3.3.6.7.A	3.3.6.7.A
3.3.6.7.B	3.3.6.7.B
3.3.6.7.C	3.3.6.7.C

Table A-1 Mined Geologic Disposal System Requirements Document
Traceability Matrix (continued)

MGDS-RD PARAGRAPH	RDRD PARAGRAPH
3.3.6.8.A	3.3.6.8.A
3.3.6.8.B	3.3.6.8.B
3.3.6.8.C	3.3.6.8.C
3.3.6.8.D	3.3.6.8.D
3.3.6.8.E	3.3.6.8.E
3.3.6.8.F	3.3.6.8.F
3.3.6.9.A	3.3.6.9.A
3.3.6.9.B	3.3.6.9.B
3.3.6.9.C	3.3.6.9.C
3.3.6.9.D	3.3.6.9.D
3.3.6.9.E	3.3.6.9.E
3.3.6.10.A	3.3.6.10.A
3.3.6.10.B	3.3.6.10.B
3.3.6.11.A	3.3.6.11.A
3.3.6.11.B	3.3.6.11.B
3.3.6.11.C	3.3.6.11.C
3.3.7.1	3.3.7.1
3.3.7.2	3.3.7.2
3.3.7.3	3.3.7.3
3.3.7.4	3.3.7.4
3.3.7.5	3.3.7.5
3.3.7.6	3.3.7.6
3.3.7.7	3.3.7.7
3.3.7.8	3.3.7.8
3.3.7.9	3.3.7.9
3.3.7.10	3.3.7.10
3.3.7.11	3.3.7.11
3.3.7.12	3.3.7.12

Table A-1 Mined Geologic Disposal System Requirements Document
Traceability Matrix (continued)

MGDS-RD PARAGRAPH	RDRD PARAGRAPH
3.3.7.13.A	3.3.7.13.A
3.3.7.13.B	3.3.7.13.B
3.3.7.14	3.3.7.14
3.3.8.1.A	3.3.8.1.A
3.3.8.1.B	3.3.8.1.B
3.3.8.1.C	3.3.8.1.C
3.3.8.1.D	3.3.8.1.D
3.3.8.2.A	3.3.8.2.A
3.3.8.2.B	3.3.8.2.B
3.3.8.2.C	3.3.8.2.C
3.3.9.A	3.3.9.A
3.3.9.B	3.3.9.B
3.3.9.C	3.3.9.C
3.3.10.A	3.3.10
3.3.10.B	3.3.10
3.3.11.A	3.3.11.A
3.3.11.A	3.3.11.9
3.3.11.A	3.7.3.8.C
3.3.11.B	3.3.11.B
3.3.11.1 (Reserved)	No requirement
3.3.11.2.A	3.3.11.1.A
3.3.11.2.B	3.3.11.1.B
3.3.11.3.A	3.3.11.2.A
3.3.11.3.A.1	3.3.11.2.A.1
3.3.11.3.A.2	3.3.11.2.A.2
3.3.11.3.A.3	3.3.11.2.A.3
3.3.11.3.A.4	3.3.11.2.A.4
3.3.11.3.A.5	3.3.11.2.A.5

Table A-1 Mined Geologic Disposal System Requirements Document
Traceability Matrix (continued)

MGDS-RD PARAGRAPH	RDRD PARAGRAPH
3.3.11.3.B	3.3.11.2.B
3.3.11.4.A	3.3.11.3.A
3.3.11.4.B	3.3.11.3.B
3.3.11.5	3.3.11.4
3.3.11.6	3.3.11.5
3.3.11.7	3.3.11.6
3.3.11.8	3.3.11.7
3.3.11.9	3.3.11.8
3.4.1.A (Reserved)	No requirement
3.4.1.B	3.4.1.A
3.4.1.C	3.4.1.B
3.4.2	3.4.2
3.4.3	3.4.3
3.4.4	3.4.4
3.4.5	3.4.5
3.4.6.A	3.4.6.A
3.4.6.B	3.4.6.B
3.4.7	3.4.7
3.4.8	3.4.8
3.5.1	3.5.1
3.5.1.1.1.A	3.5.1.1.1.A
3.5.1.1.1.B	3.5.1.1.1.B
3.5.1.1.1.C	3.5.1.1.1.C
3.5.1.1.1.D	3.5.1.1.1.D
3.5.1.1.1.E	3.5.1.1.1.E
3.5.1.1.2.A	3.5.1.1.2.A
3.5.1.1.2.B	3.5.1.1.2.B
3.5.1.1.3	3.5.1.1.3

Table A-1 Mined Geologic Disposal System Requirements Document
Traceability Matrix (continued)

MGDS-RD PARAGRAPH	RDRD PARAGRAPH
3.5.1.2.A	3.5.1.2.A
3.5.1.2.B	3.5.1.2.B
3.5.1.3	3.5.1.3
3.5.1.4.A	3.5.1.4.A
3.5.1.4.B	3.5.1.4.B
3.5.1.5	3.5.1.5
3.5.2	3.5.2
3.5.3.1	3.5.3.1
3.5.3.2.A	3.5.3.2.A
3.5.3.2.B	3.5.3.2.B
3.5.3.3	3.5.3.3
3.5.3.4	3.5.3.4
3.5.3.5	3.5.3.5
3.5.4	3.5.4
3.6.1	3.6.1
3.6.1.A	3.6.1.A
3.6.1.B (Reserved)	No requirement
3.6.1.C	3.6.1.B
3.6.2	3.6.2
3.6.2.1.A	3.6.2.1.A
3.6.2.1.B	3.6.2.1.B
3.6.2.1.C	3.6.2.1.C
3.6.2.2.A	3.6.2.2
3.6.2.2.B (Reserved)	No requirement
3.7.1.1.A	Allocated to Site Segment
3.7.1.1.B	Allocated to Site Segment
3.7.1.2	Allocated to Site Segment
3.7.1.3.A	Allocated to Site Segment

Table A-1 Mined Geologic Disposal System Requirements Document
Traceability Matrix (continued)

MGDS-RD PARAGRAPH	RDRD PARAGRAPH
3.7.1.3.B	Allocated to Site Segment
3.7.1.3.B.1	Allocated to Site Segment
3.7.1.3.B.2	Allocated to Site Segment
3.7.1.3.B.3	Allocated to Site Segment
3.7.1.3.C	Allocated to Site Segment
3.7.2	3.2
3.7.2.1.A	3.7 and following
3.7.2.1.B	3.7 and following
3.7.2.1.C	3.2.3.2.1 and 3.2.3.2.2
3.7.2.2.A	3.7.1.A
3.7.2.2.B	3.7.1.B
3.7.2.2.C	3.7.1.C
3.7.2.2.D	3.7.1.D
3.7.2.2.E	3.7.1.E
3.7.2.2.E	3.7.1.E.1
3.7.2.2.E	3.7.1.E.2
3.7.2.3.A	3.7.2.A
3.7.2.3.B.1	3.7.2.B.1
3.7.2.3.B.2	3.7.2.B.2
3.7.2.3.B.3	3.7.2.B.3
3.7.2.3.C.1	3.7.2.C.1
3.7.2.3.C.2	3.7.2.C.2
3.7.2.3.D.1	3.7.2.D.1
3.7.2.3.D.2	3.7.2.D.2
3.7.2.3.E	3.7.2.E
3.7.2.3.F	3.7.2.F
3.7.2.4	3.7.3
3.7.2.4.1.A	3.7.3.2.A

Table A-1 Mined Geologic Disposal System Requirements Document
Traceability Matrix (continued)

MGDS-RD PARAGRAPH	RDRD PARAGRAPH
3.7.2.4.1.B	3.7.3.2.B
3.7.2.4.1.C	3.7.3.2.C
3.7.2.4.1.D	3.7.3.2.D
3.7.2.4.2.A	3.7.3.3.A
3.7.2.4.2.B	3.7.3.3.B
3.7.2.4.2.C	3.7.3.3.C
3.7.2.4.3.A	3.7.3.4.A
3.7.2.4.3.B	3.7.3.4.B
3.7.2.4.3.C	3.7.3.4.C
3.7.2.4.3.D	3.7.3.4.D
3.7.2.4.3.E (Reserved)	No requirement
3.7.2.4.3.F	3.7.3.4.E
3.7.2.4.3.G	3.7.3.4.F
3.7.2.4.3.H	3.7.3.4.G
3.7.2.4.4.A	3.7.3.5.A
3.7.2.4.4.B	3.7.3.5.B
3.7.2.4.5	3.7.3.6.A
3.7.2.4.6.A (Reserved)	No requirement
3.7.2.4.6.B	3.7.3.7.A
3.7.2.4.6.C	3.7.3.7.B
3.7.2.4.7.A	3.7.3.8.A
3.7.2.4.7.B	3.7.3.8.B
3.7.2.4.8.A	3.7.3.9.A
3.7.2.4.8.B	3.7.3.9.B
3.7.2.5.1.A.1	3.7.4.1.A.1
3.7.2.5.1.A.2	3.7.4.1.A.5
3.7.2.5.1.B	3.7.4.1.B
3.7.2.5.1.C	3.7.4.1.C

Table A-1 Mined Geologic Disposal System Requirements Document
Traceability Matrix (continued)

MGDS-RD PARAGRAPH	RDRD PARAGRAPH
3.7.2.5.2.A	3.7.4.2.A
3.7.2.5.2.B	3.7.4.2.B
3.7.2.5.2.C	3.7.4.2.C
3.7.2.5.2.D	3.7.4.2.D
3.7.2.5.2.E	3.7.4.2.E
3.7.2.5.2.F	3.7.4.2.F
3.7.2.5.3 (Reserved)	No requirement
3.7.2.5.4.A	3.7.4.3.A
3.7.2.5.4.B	3.7.4.3.B
3.7.2.5.4.C	3.7.4.3.C
3.7.2.5.4.D	3.7.4.3.D
3.7.2.5.5 (Reserved)	No requirement
3.7.2.5.6.A	3.7.4.4.A
3.7.2.5.6.B	3.7.4.4.B
3.7.2.5.6.C	3.7.4.4.C
3.7.2.5.6.D	3.7.4.4.D
3.7.2.5.6.E.1	3.7.4.4.E.1
3.7.2.5.6.E.2 (Reserved)	No requirement
3.7.2.5.6.E.3	3.7.4.4.E.2
3.7.2.5.6.E.4	3.7.4.4.E.3
3.7.2.5.6.F.1	3.7.4.4.F.1
3.7.2.5.6.F.2	3.7.4.4.F.2
3.7.2.5.6.F.3	3.7.4.4.F.3
3.7.2.5.6.F.4	3.7.4.4.F.4
3.7.2.5.6.F.5	3.7.4.4.F.5
3.7.2.5.6.G	3.7.4.4.G
3.7.2.5.6.H	3.7.4.4.H
3.7.2.5.6.I.1	3.7.4.4.I.1

Table A-1 Mined Geologic Disposal System Requirements Document
Traceability Matrix (continued)

MGDS-RD PARAGRAPH	RDRD PARAGRAPH
3.7.2.5.6.I.2	3.7.4.4.I.2
3.7.2.5.6.I.3	3.7.4.4.I.3
3.7.2.5.6.J.1	3.7.4.4.J.1
3.7.2.5.6.J.2.a	3.7.4.4.J.2.a
3.7.2.5.6.J.2.b	3.7.4.4.J.2.b
3.7.2.5.6.K	3.7.4.4.K
3.7.2.5.6.L.1	3.7.4.4.L.1
3.7.2.5.6.L.2	3.7.4.4.L.2
3.7.2.6.A.1	3.7.5.A.1
3.7.2.6.A.2	3.7.5.A.2
3.7.2.6.A.3	3.7.5.A.3
3.7.2.6.A.4	3.7.5.A.4
3.7.2.6.B.1	3.7.5.B.1
3.7.2.6.B.2	3.7.5.B.2
3.7.2.6.B.3	3.7.5.B.3
3.7.2.6.C.1	3.7.5.C.1
3.7.2.6.C.2	3.7.5.C.2
3.7.2.6.C.3	3.7.5.C.3
3.7.2.6.D	3.7.5.D
3.7.2.6.E.1	3.7.5.E.1
3.7.2.6.E.2	3.7.5.E.2
3.7.2.6.F.1	3.7.5.F.1
3.7.2.6.F.2	3.7.5.F.2
3.7.2.6.F.3	3.7.5.F.3
3.7.2.6.F.4	3.7.5.F.4
3.7.2.6.F.5	3.7.3.7.E
3.7.2.6.F.5	3.7.5.F.5
3.7.2.6.F.6	3.7.5.F.6

Table A-1 Mined Geologic Disposal System Requirements Document
Traceability Matrix (continued)

MGDS-RD PARAGRAPH	RDRD PARAGRAPH
3.7.2.6.F.7	3.7.5.F.7
3.7.2.6.G.1	3.7.5.G.1
3.7.2.6.G.2	3.7.5.G.2
3.7.2.6.H	3.7.5.H
3.7.2.6.I	3.7.5.I
3.7.2.6.J.1	3.7.5.J.1
3.7.2.6.J.2	3.7.5.J.2
3.7.2.6.J.3	3.7.5.J.3
3.7.2.6.K	3.7.5.K.1
3.7.2.6.L.1	3.7.5.L.1
3.7.2.6.L.2	3.7.5.L.2
3.7.2.6.L.3	3.7.5.L.3
3.7.2.6.L.4	3.7.5.L.4
3.7.2.6.M	3.7.5.M
3.7.2.7.A.1	3.7.6.A.1
3.7.2.7.A.2	3.7.6.A.3
3.7.2.7.A.3	3.7.6.A.4
3.7.2.7.A.4	3.7.6.A.5
3.7.2.7.A.5	3.7.6.A.6
3.7.2.7.A.6	3.7.6.A.7
3.7.2.7.B	3.7.6.B
3.7.2.7.C	3.7.6.C
3.7.2.7.D	3.7.6.D
3.7.2.7.E	3.7.6.E
3.7.2.7.F	3.7.6.F
3.7.2.7.G	3.7.6.G
3.7.2.8.A.1	3.7.7.A.1
3.7.2.8.A.2	3.7.7.A.2

Table A-1 Mined Geologic Disposal System Requirements Document
Traceability Matrix (continued)

MGDS-RD PARAGRAPH	RDRD PARAGRAPH
3.7.2.8.A.3	3.7.7.A.3
3.7.2.8.A.4	3.7.7.A.4
3.7.2.8.A.5	3.7.7.A.5
3.7.2.8.A.6	3.7.7.A.6
3.7.2.8.B	3.7.7.B
3.7.2.8.C	3.7.7.C
3.7.2.8.D	3.7.7.D
3.7.2.8.E	3.7.7.E
3.7.2.8.F	3.7.7.F
3.7.2.8.G	3.7.7.G
3.7.3.1.A	Allocated to Engineered Barrier Segment
3.7.3.1.B	Allocated to Engineered Barrier Segment
3.7.3.1.C	Allocated to Engineered Barrier Segment
3.7.3.2.A	3.2.3.2.3.A
3.7.3.2.B	3.2.3.2.3.B
3.7.3.2.C	3.2.3.2.2.A.13
3.7.3.2.D	3.2.3.2.3.C
3.7.3.2.E.1	3.7.5.J.1
3.7.3.2.E.2	3.7.5.J.2
3.7.3.2.E.3	3.7.5.J.3
3.7.3.3.A	Allocated to Engineered Barrier Segment
3.7.3.3.B	Allocated to Engineered Barrier Segment
3.7.3.3.C	Allocated to Engineered Barrier Segment
3.7.3.3.D	Allocated to Engineered Barrier Segment

Table A-1 Mined Geologic Disposal System Requirements Document
Traceability Matrix (continued)

MGDS-RD PARAGRAPH	RDRD PARAGRAPH
3.7.3.3.E	Allocated to Engineered Barrier Segment
3.7.3.3.F	Allocated to Engineered Barrier Segment
3.7.3.3.G.1	Allocated to Engineered Barrier Segment
3.7.3.3.G.2	Allocated to Engineered Barrier Segment
3.7.3.3.G.3	Allocated to Engineered Barrier Segment
3.7.3.3.G.4	Allocated to Engineered Barrier Segment
3.7.3.4.A	3.7.5.E.3
3.7.3.4.B (Reserved)	No requirement
3.7.3.4.C	3.7.5.E.7
3.7.3.4.D	3.7.5.K.1
3.8.A	3.8.A
3.8.B	3.8.B
3.8.C	3.8.C
3.9	3.9
5.1	5.1
5.2	5.2
Appendix A	Allocated to Site Segment
Appendix B	Allocated to Site Segment

YMP-108-R1
11/30/92YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT
DOCUMENT ACTION REQUEST
(DAR)Page 1 of 1Date 5/24/93 DAR No. 800

Signatures on this document represent signers' acknowledgement that the applicable procedure has been read, understood, and complied with.

SECTION I - ACTION REQUEST

1. DOCUMENT TITLE: Repository Design Requirements	2. DOCUMENT NO.: YMP/CM-0023	3. REV/CHN: (current) 0	4. ☒ Q ☐ NON-Q
5. TYPE OF ACTION REQUESTED: ☒ Develop New Document ☐ Change Existing Document ☐ Cancel Document ☐ Review Only (attach document)			
6. DESCRIPTION OF ACTION REQUESTED: OCRWM QAP 6.2 Review		7. DOCUMENTS AFFECTED: To be identified as part of the impact analysis for change control board action.	
8. REASON FOR ACTION REQUEST: Document needed for transition to the new technical baseline. QAP 6.2 document due 5/21/93.		10. RELATED REPORT NUMBER: N/A	
☐ Additional Material Attached 9. DELIVERABLE DUE DATE:		11. REQUESTED BY: <u>Jeff Gardner</u> <small>Print Name</small> <u>M&O/Requirements</u> <small>Organization</small> <u>4-7435</u> <small>Phone No.</small> <u>5-21/93</u> <small>Date</small>	

SECTION II - ACTION INITIATION

12. REQUEST: ☒ Approved ☐ Rejected	13. MAJOR CHANGES: ☐ Yes ☒ No	14. PRIORITY: ☒ Immediate ☐ Hold
15. MODIFICATION METHOD: ☐ ICN ☐ Revision ☐ Cancel ☒ N/A		16. CCBA ACTION: ☒ Yes ☐ No
17. TRAINING RECOMMENDATION: ☐ Self-Study ☐ Classroom Trng. ☒ N/A ☐ Other _____		
18. COMMENTS		

19. PREPARER ASSIGNED: Jeff Gardner	20. RESPONSIBLE DIRECTOR: <u>W.B. Sanchez</u> <small>Signature</small> <u>5/24/93</u> <small>Date</small>
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SECTION III - ACTION CONCURRENCE

21. PROJECT CONTROL BRANCH CHIEF CONCURRENCE: Request ☒ Approved ☐ Rejected	<u>W.B. Sanchez</u> <small>Signature</small> <u>5/24/93</u> <small>Date</small>
COMMENTS:	

SECTION IV - ACTION REVIEW

22. TRAINING REQUIREMENTS: ☐ N/A* ☐ Yes - Number of Days Required for Trng.: _____ COMMENTS:	* Requires Justification in Comment Section
23. Training Officer/Training Manager: _____ <small>Signature</small> <small>Date</small>	24. CRWMS M&O PLANS AND PROCEDURES (DAR Completion) _____ <small>Signature</small> <small>Date</small>

Attachment 2

REVIEWING ORGANIZATIONS
REPOSITORY DESIGN REQUIREMENTS DOCUMENT
YMP/CM-0023

<u>Reviewing Organizations:</u>	<u>Attention of:</u>	<u>Assigned Review Criteria TDPP (Pages 16-19)</u>
CRWMS M&O, NV	K.L. Ashe	A, I
CRWMS M&O, NV	K.K. Bhattacharyya	A, D
CRWMS M&O, NV	C.B. Buckey	A, H
CRWMS M&O, NV	B.R. Justice	A, G
CRWMS M&O, NV	L.J. Olguin	A, C
CRWMS M&O, NV	David Stahl	A, E
CRWMS M&O, NV	A.E. Van Luik (E.B. Mann)	A
CRWMS M&O, VA	N.C. Henderson	A, I
SNL, NV	J.F. Schelling	A, H
YMP/HQ, DC	Dean Stucker	A, D
YMP, NV	R.B. Baumeister	A
YMP, NV	J. Blaylock (S.R. Dana)	A, G
YMP, NV	W.R. Dixon (P.J. Mudra)	A
YMP, NV	J.C. De La Garza	A, B
YMP, NV	S.B. Jones	A, I
YMP, NV	J.M. Replogle	A, C
YMP, NV	J.M. White	A, D

United States Government

Department of Energy

memorandum

DATE:

JUN 6 8 1993

REPLY TO

ATTN OF: RW-321

SUBJECT: RW-30 Review of YMPD Design Requirements Documents

TO: Project Manager, Yucca Mountain Project Office

This memorandum is to confirm our telephone conversation on Friday June 4, 1993, regarding RW-30's role in participating in QAP 6.2 technical reviews of various YMP Design Requirements Documents. As we discussed, the use of approximately four RW-30's FTEs to perform traceability on five documents since November, 1992 has diminished our personnel resources to the point where we have to discontinue our high level of participation in order to meet our primary responsibilities.

As in the past, I would appreciate RW-321 being retained on the distribution list for your final documents, in order that they may keep current on YMP document activities. We will of course retain our functional responsibility for participating in design reviews and periodically conduct reviews of the lower-level documents to ensure traceability and flow-down of all source level requirements.

Attached for your information are copies of our most recent comments submitted to your document preparation group. Comments previously submitted (see attachments) on the Engineered Barrier System and the Surface-Based Testing Facility Requirements Documents will be resolved in accordance with QAP 6.2.

If you have any questions please call me on 586-6046.

Dwight E. Shelor
Associate Director
Office of Systems and Compliance

Attachments

CC:

L. Barrett, RW-1, w/attachments
L. Smith, RW-20, w/o attachments
J. Hale, RW-32, w/o attachments
W. Lemeschewsky, RW-321, w/o attachments
A. Kubo, M&O\TRW, w/o attachments

Attachment 3

Repository Design Requirements Document (RDRD) Traceability Matrix

RDRD, YMP/CM-0018 PARAGRAPH	RDRD, YMP/CM-0023 PARAGRAPH
1.0 Description only	No requirements
1.1 Description only	No requirements
2.0 Description only	No requirements
2.1 Description only	No requirements
2.2 Description only	No requirements
2.2.1 Description only	No requirements
2.2.2 Description only	No requirements
2.2.3 Description only	No requirements
2.2.4 Description only	No requirements
2.2.5 Description only	No requirements
2.3 Description only	No requirements
3.0 Repository Design Requirements	1.4.2 (Description) 3.1.1, 3.1.5D, 3.2.4.5.2B, 3.2.5.3A, 3.2.6.E, 3.2.6.1G
3.1 Subsystem Elements	3.1.1.4.3 (Controlled Area), 1.3.2, 3.2.1.6D, 3.7.2, 3.7.2.3.7.3.6C, 1.3.3, 3.7.5.B.6, 3.7.5.E4, 3.7.5F through 3.7.5.F7
3.2 Definition (Site)	3.1.5F, 3.2.1.6B, 3.2.2.1D, 3.2.2.1I, 3.2.2.2B, 3.7.1D, 3.7.1E, 3.1.1.4.3, 1.3.3, 3.1.1.4, Table 3-1, 3.1.1.4, 3.1.1.4.2, Table 3-2, 3.2.1.5
3.3 Boundaries and Interfaces	1.2.2, 1.4.2, 3., 3.1.2, 3.1.3, 3.2.3, 3.2.3.1, 3.2.3.2, 3.2.3.3, 3.2.3.4
3.3.1 ESF	1.3.3, 3.1.1
3.3.1.1 Site Characterization (Requirements)	1.3.2, 1.3.5, 1.4.2, 3.1
3.3.1.2 Site Characterization (Requirements)	1.3.5, 1.4.2, 3.1.1
3.3.1.3 Site Characterization (Requirements)	1.3.5, 1.4.2, 3.1.1
3.3.2 Waste Package (Requirements)	1.3.3, 3.1.1.2, 3.1.1.2.1, 3.1.5D, 3.1.5I, 3.2.1.1A, 3.2.1.4, Table 3-6, 3.2.3.2.2, 3.2.5.2.2, 3.2.6.1, 3.2.6.1I, 3.3.1.H, 3.3.1, 3.7.5, 3.7.6
3.3.3 Site (Requirements)	1.3.2, 3.1.1, 3.1.1.4.3, 3.2.1, 3.1.1.4.2, 3.2.1
3.4 Applicable Regulations, Codes and Specifications	2., 2.1, 2.2, 2.3, 2.4, 2.5
3.5 Function	3.1.1
3.5.1 Construction	3.1.1
3.5.2 Operation	3.1.1.1, 3.1.1.1.1, 3.1.1.1.2
3.5.3 Performance Confirmation	3.1.1.3.4

Repository Design Requirements Document (RDRD) Traceability Matrix (continued)

3.5 4	Closure	3.1.1.4, 3.1.1.4.1
3.5 5	Decommissioning Activities	3.1.1.4, 3.1.1.4.1, 3.1.1.4.2
3.6	Functional Requirements	3.1.1, 3.1.1.1, 3.1.1.1.1, 3.1.1.1.2, 3.1.1.2, 3.1.1.2.1, 3.1.1.2.2, 3.1.1.3, 3.1.1.3.1, 3.1.1.3.2, 3.1.1.3.3, 3.1.1.3.4, 3.1.1.4, 3.1.1.4.1, 3.1.1.4.2, 3.1.1.4.3, 3.1.1.4.4
3.6 1 A	Provide Repository	1.1, 1.2.1, 1.2.2, 3., 3.1, 3.1.1
3.6 1 B	Receive Waste	Table 3-1, 3.1.1.1, 3.1.1.1.1
3.6 1 C	Unload Waste (handle waste)	Table 3-1, 3.1.1.1.1
3.6 1 D	Store waste	1.3.3, 3.1.2, 3.1.1.2.1
3.6 1 E	Dispose of Waste	1.3.3, 3.1.1, 3.1.1.2.1, 3.1.1.2.2
3.6 2	Siting, design, construction and operation requirements	3.1.1
3.6 2 A	Geologic setting	3.1.1
3.6 2 B	GROA radiation exposures and levels	3.1.1.2.2, 3.2.1.D, 3.2.1.2C, 3.2.1.3, 3.2.1.4C
3.6 2 C	Effluent monitoring	
3.6 2 D	GROA radiation dose levels	3.1.1.2.2, 3.2.2.1, 3.2.2.1A, 3.2.2.1B, 3.2.2.1D, 3.2.2.2, 3.2.2.2C
3.6 2 E	Radiation exposure standards	3.1.1.2.2, 3.2.1.1D, 3.2.1.2C, 3.2.1.3
3.6 2 F	MGDS after permanent closure	1.3.3, 1.3.4, 3.1.1.1, 3.1.1.1.1, 3.1.1.3, 3.1.1.4
3.6 2 G	Boreholes and seals	1.3.3, 3.1.1.4, 3.1.1.4.1, 3.2.3.2.1, 3.7.5J
3.6 2 H	Engineered barriers	1.3, 1.3.3, 3.1.1, 3.1.1.2, 3.1.1.2.1, 3.1.1.2.2, 3.1.3, 3.1.5I, 3.2.3, 3.2.3.2, 3.2.3.2.2, Table 3-6, 3.2.3.2.B
3.6 2 I	Materials and placement of seals	3.7.5J, 3.7.5J2
3.6 2 J	Waste package containment and isolation	3.1.1.2, 3.1.1.2.1, 3.2.3.2.2.A.11, 3.1.5
3.6 2 K	MGDS adverse chemical reactions	3.7.3.7 K
3.6 2 L	MGDS radioactive release/accessable environment	1.3.3, 3.1.1, 3.1.1.2, 3.2.1.6C, 3.2.3.2.3.B, 3.7.1
3.6 2 M	Engineered barrier system anticipated process and events	3.1.5H, 3.2.2.1D, 3.2.3.2.2
3.6 2 N	Engineered barrier system (1000 year) containment	3.1.1.4.3, 3.2.1.6C
3.6 3	Other federal, state, and local laws	2.1, 2.1.1, 2.1.3, 2.2, 2.3
3.7	Constraints	3.1, 3.1.5
3.7 A	Siting, design, and construction	1.3.3, 1.3.5, 1.4.1C

Repository Design Requirements Document (RDRD) Traceability Matrix (continued)

3.7 B	Use of access and underground openings shall not interfere with monitoring and experiments	3.1.1.3.1. 3.2.3.2.2.3B, 3.2.2.5
3.7 C	MGDS utilities	1.3.3, 1.3.5, Table 3-1, 3.1., 3.1.1.1.1, 3.2.3, 3.2.3.4, 3.2.5.4.4
3.7 D	Explosives and magazines	3.7.4.4J
3.7 E	Underground drilling	3.2.6.2.5
3.7 F	Ground control	3.2.6.2.5
3.8	Assumptions	3.1, 3.1.5, 3.2.3.2.2

OCRWM Document Hierarchy

Attachment 6

Engineering and Development Division Change Page

2. APPLICABLE DOCUMENTS

This section, specifically Sections 2.1 through 2.4, identifies documents which have been referenced as sources of requirements for the RDRD.

~~For each document, the issue in effect on the date of the approval of the RDRD, forms a part of the RDRD requirements to the degree specified herein. Each derivative specification is to use revisions and issues of source documents in effect on the date of approval of that specification.~~

THE REPOSITORY SEGMENT DESIGN SHALL COMPLY WITH THE LATEST VERSION OF ALL FEDERAL LAWS AND DOCUMENTS, STATE LAWS AND STANDARDS, AND LOCAL ORDINANCES. FOR ALL NON-GOVERNMENT DOCUMENTS, THE ISSUE IN EFFECT ON THE DATE OF APPROVAL OF THE RDRD FORMS A PART OF THE REQUIREMENTS.

OMISSION OF ANY APPLICABLE DOCUMENTS FROM THIS SHALL NOT RELIEVE THE DESIGNER OF THE RESPONSIBILITY TO MEET THOSE OMITTED REQUIREMENTS.

Section 2.5 identifies reference materials that have not been used as sources of requirements, but are provided here for reference.

2.1 FEDERAL LAWS AND DOCUMENTS

In this category, the following are used as sources of requirements in the RDRD.

2.1.1 LAWS, STATUTES, U.S. CODES, AND TREATIES¹

<u>Identifier</u>	<u>Title or Description</u>
A. 7 USC 136 et seq.	Federal Insecticide, Fungicide, and Rodenticide Act of 1988
B. 15 USC 2601 et seq.	Toxic Substances Control Act
C. 29 USC 651 et seq.	Occupational Safety and Health Act (OSHA)
D. 33 USC 1251 et seq.	Clean Water Act of 1977 (CWA)
E. 42 USC 300f et seq.	Safe Drinking Water Act
F. 42 USC 4901 et seq.	Noise Control Act of 1972

¹Treaties will be included in this section, if and when applicable.

Attachment 6

Engineering and Development Division Change Page

- B. Unless specifically waived in writing by OCRWM, design and construction of all Repository Segment facilities and equipment shall be based on the criteria specified in the appropriate section of DOE Order 6430.1A. ~~unless those requirements pertain to areas under NRC jurisdiction~~ FOR FACILITIES OVER WHICH THE NRC HAS REGULATORY AUTHORITY, NRC REQUIREMENTS SHALL BE THE ONLY CONTROLLING NUCLEAR SAFETY REQUIREMENTS. The following components are addressed in DOE Order 6430.1A:

1. General Requirements.
2. Site and Civil Engineering.
3. Concrete.
4. Masonry.
5. Metals.
6. Woods and Plastics.
7. Thermal and Moisture Protection.
8. Doors and Windows.
9. Finishes.
10. Specialties.
11. Equipment.
12. Furnishings.
13. Special Facilities.
14. Conveying Systems.
15. Mechanical.
16. Electrical.

[MGDS-RD 3.3.1.B][CRD 3.3.1.B]

- C. State, county, municipal, and other local regulations, building and zoning codes, and ordinances shall be reviewed and incorporated, as appropriate, in the Repository Segment designs whenever those practices are not in conflict with the requirements of DOE Order 6430.1A.

[MGDS-RD 3.3.1.C]

- D. Should conflicts exist between DOE Order 6430.1A and state, county, municipal, or local codes or regulations, a deviation shall be requested in accordance with Section 0101-2, Criteria Deviations, of DOE Order 6430.1A. All deviations from DOE Order 6430.1A to meet NRC requirements or current engineering practices must be documented.

[MGDS-RD 3.3.1.D][DOE Order 6430.1A, 0101-2]