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Physical System Requirements - Dispose of Waste

June 21, 1991

Prepared for

U.S. Department of Energy

Office of Civilian Radioactive Waste Management

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DRAFT DOCUMENT

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Table of Contents

1.0 INTRODUCTION	1
1.1 Background	1
1.2 Objective	2
1.3 Approach	2
1.4 Mission	5
1.5 Scope	5
2.0 FUNCTIONS AND REQUIREMENTS	12
3.0 ARCHITECTURE DESCRIPTION	125
4.0 INTERFACES	139

APPENDICES

Appendix A	Glossary	186
Appendix B	Bibliography	198
Appendix C	Decision Documentation	201
Appendix D	Acronyms	202
Appendix E	Dispose of Waste Interfaces	203
Appendix F1	Waste Acceptance Schedule	205
Appendix F2	Waste Characteristics For Geologic Repository Design	206
Appendix F3	Waste Transportation Rates to Geologic Repository By Mode ..	207
Appendix G	Indentured List of Dispose of Waste Functions	208

LIST OF TABLES

Table 1.	Source Documents Containing Requirements in this Report	4
Tables F1.-F1.4.3.4	Function Descriptions	16
Tables A1.-A1.4.X	Architecture Descriptions	127

LIST OF FIGURES

Figure 1	Physical System Functional Analysis Approach	3
Figure 2	Manage Waste Disposal Boundaries	6
Figure 3	Dispose of Waste Boundaries	7
Figure 4	Operate Geologic Repository Boundaries	8
Figure 5	Isolate Waste Boundaries	9
Figure 6	Multiple Barrier System Boundaries	10
Figure 7	Dispose of Waste Function Hierarchy (Fourth Level)	13
Figure 8	Dispose of Waste Function Hierarchy	14
Figure 9	Dispose of Waste Conceptual Architecture Hierarchy	126
Figures 10-31	N-Square Charts	140
Figures 32-54	Functional Flow Diagrams	162

1.0 INTRODUCTION

1.1 Background

The Nuclear Waste Policy Act (NWPA) of 1982 assigned to the Department of Energy (DOE) the responsibility for managing the disposal of spent nuclear fuel and high-level radioactive waste and established the Office of Civilian Radioactive Waste Management (OCRWM) for that purpose. The Secretary of Energy, in his November 1989 report to Congress (DOE/RW-0247), announced three new initiatives for conduct of the Civilian Radioactive Waste Management (CRWM) program. One of these initiatives was to establish improved management structure and procedures. In response, OCRWM performed a management study and the Director subsequently issued the Management Systems Improvement Strategy (MSIS) on August 10, 1990, calling for a rigorous implementation of systems engineering principles with a special emphasis on functional analysis.

The functional analysis approach establishes a framework for integrating the program management efforts with the technical requirements analysis into a single, unified, and consistent program. This approach recognizes that just as the facilities and equipment comprising the physical waste management system must perform certain functions, so must certain programmatic and management functions be performed within the program in order to successfully bring the physical system into being.

Thus, two separate but coordinated systems engineering efforts have been undertaken: (1) a functional analysis of the operating phase of the waste management system and; (2) a functional analysis of the program. The physical system functional analysis is intended to:

- Identify the functions that must be performed by the physical system to fulfill the waste disposal mission;
- Identify the corresponding requirements imposed on each of the functions; and
- Identify the conceptual architecture that will be used to satisfy the requirements.

The principal purpose of this requirements document is to present the results that were obtained from the conduct of a physical system functional analysis effort for the Dispose of Waste mission. The starting point for this functional analysis was the further decomposition of the Dispose of Waste function from the "Physical

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System Requirement - Overall System" report. The Physical System Requirements/Functional Analysis Management Plan defines the criteria and activities for the preparation, review, and approval of this report. The document hierarchy when finalized will be shown in one of the OCRWM programmatic documents.

1.2 Objective

The objective of this document is to establish the essential functions, requirements, interfaces, and system architecture for the Dispose of Waste mission. This document will be baselined and the technical requirements contained herein will be the basis for future stages of design (Advanced Conceptual Design, License Application Design, Final Procurement and Construction Design) of a Geologic Repository.

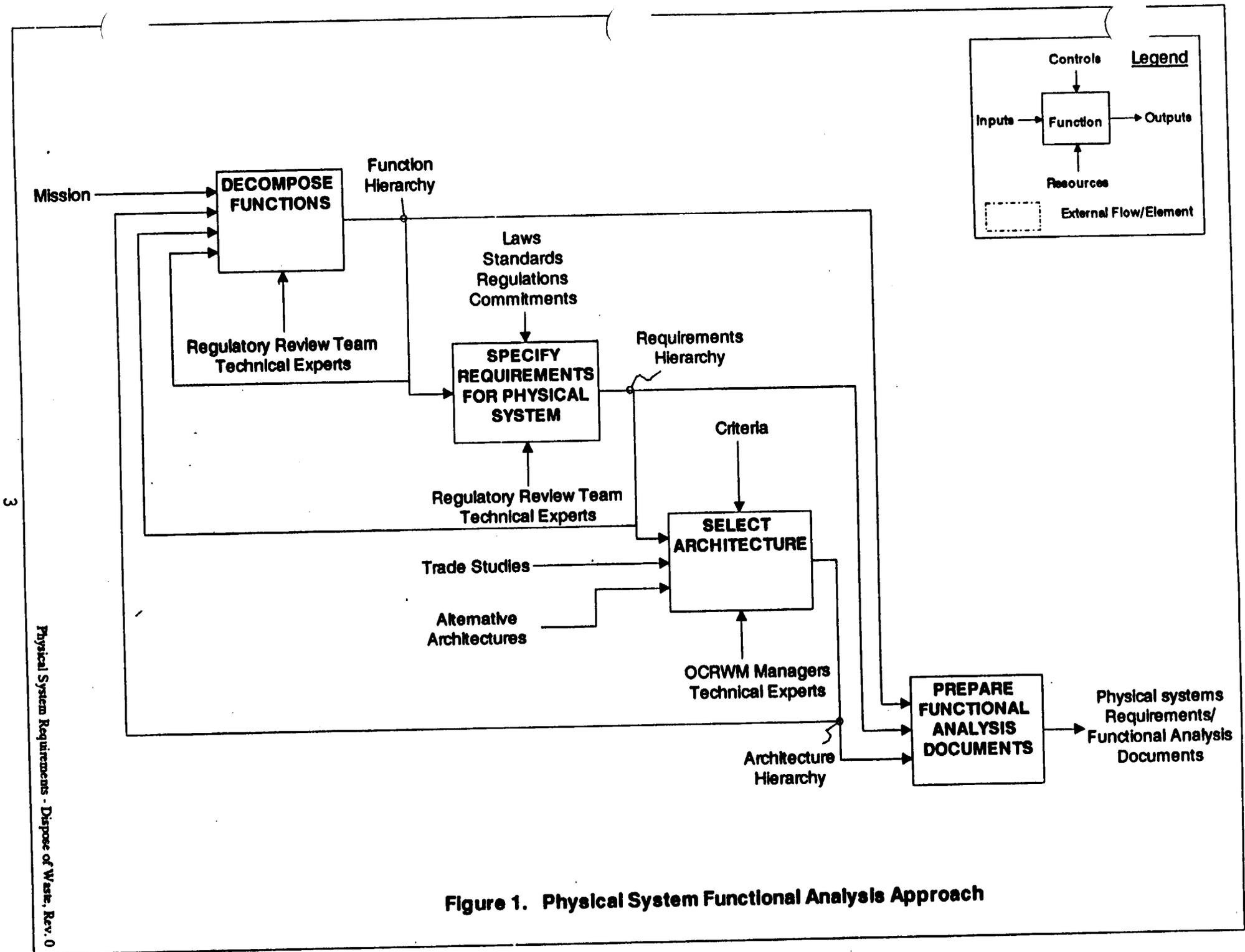
1.3 Approach

A comprehensive functional analysis of the physical system begins with a statement of the mission, from which all essential functions that the system must perform are derived. The functional analysis process is sequential. Thus, there are several distinct steps, each containing progressively more detail, and each leading to three important pieces of information:

- Functions,
- Requirements, and
- Architecture.

Functions are simple statements of purpose, defining what the system must do; requirements indicate how well the function must be accomplished; and architecture represents a piece of the actual physical system that satisfies a corresponding requirement. This triad of functions (F), requirements (R), and architecture (A) is needed to completely describe and understand the physical system at each level and to set the stage for the next lower level.

Figure 1 illustrates the sequential F-R-A approach that was implemented by a team of technical experts from across the OCRWM program, in accordance with the Physical System Requirements/Functional Analysis Management Plan. These experts were supported by a regulatory review team who extracted all potentially relevant physical system requirements from the source documents identified in Table 1.



1 **Table 1. Source Documents Containing Requirements in this Dispose of Waste Report**

2 <u>Document Identifier</u>	<u>Document Description</u>
3 29 USC 651 et.seq.	Occupational Safety and Health Act
4 30 USC 801 et.seq.	Mine Safety and Health
5 33 USC 1251 et.seq.	Clean Water Act ¹
6 42 USC 300f et.seq.	Safe Drinking Water Act ¹
7 NWPA-42 USC 10101 et.seq.	Nuclear Waste Policy Act of 1982
8 10 CFR 60	Disposal of High-Level Radioactive Wastes in Geologic Repositories
9 10 CFR 960	General Guidelines for the Recommendation of Sites for Nuclear Waste
10	Repositories
11 10 CFR 73	Physical Protection of Plants and Materials ¹
12 10 CFR 961	Standard Contract for Disposal of Spent Nuclear Fuel and/or High-Level
13	Radioactive Waste
14 40 CFR 191	Environmental Radiation Protection Standards for Management and
15	Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive
16	Wastes
17 DOE/RW-0247	Report to Congress on Reassessment of the CRWM Program
18 DOE ORDER 3790.1A	Federal Employee Occupational Safety and Health Program
19 DOE ORDER 5480.11	Radiation Protection for Occupational Workers ¹
MOA RW/DP	Memorandum of 7/14/86 on Policy for Shipping Defense High-Level Waste
	(DHLW) to a Civilian Radioactive Waste Repository
22 Presidential Memo	Memorandum of 4/30/85 on Disposal of Defense Waste in a Commercial
23	Repository

24 1. Additional requirements may result from a final document review.

25 Beginning with the mission statement, the technical experts assigned a set of
 26 applicable requirements from those provided by the regulatory review team, and
 27 provided an architectural concept. At this point, the mission statement became the
 28 parent function which the technical experts decomposed into a set of functions that
 29 are both necessary and sufficient to satisfy the parent. Physical system requirements
 30 were assigned and architectural concepts provided for each function, establishing
 31 the basis for further decomposition. Eventually, a level of detail is reached within
 32 the function hierarchy that cannot be supported with either specific requirements
 33 or specific architecture, until a geologic repository design is prepared. This can lead
 34 to some differences in the level of detail for functions, requirements, and
 35 architecture contained within this document.

36 The starting point for the further decomposition of the Dispose of Waste function
 37 was the Overall System report.

1.4 Mission

Based upon the Nuclear Waste Policy Act, the mission of DOE's operating Geologic Repository is to emplace spent nuclear fuel and high-level radioactive waste in a geologic repository in a timely manner that protects the health and safety of the public and maintains the quality of the environment.

1.5 Scope

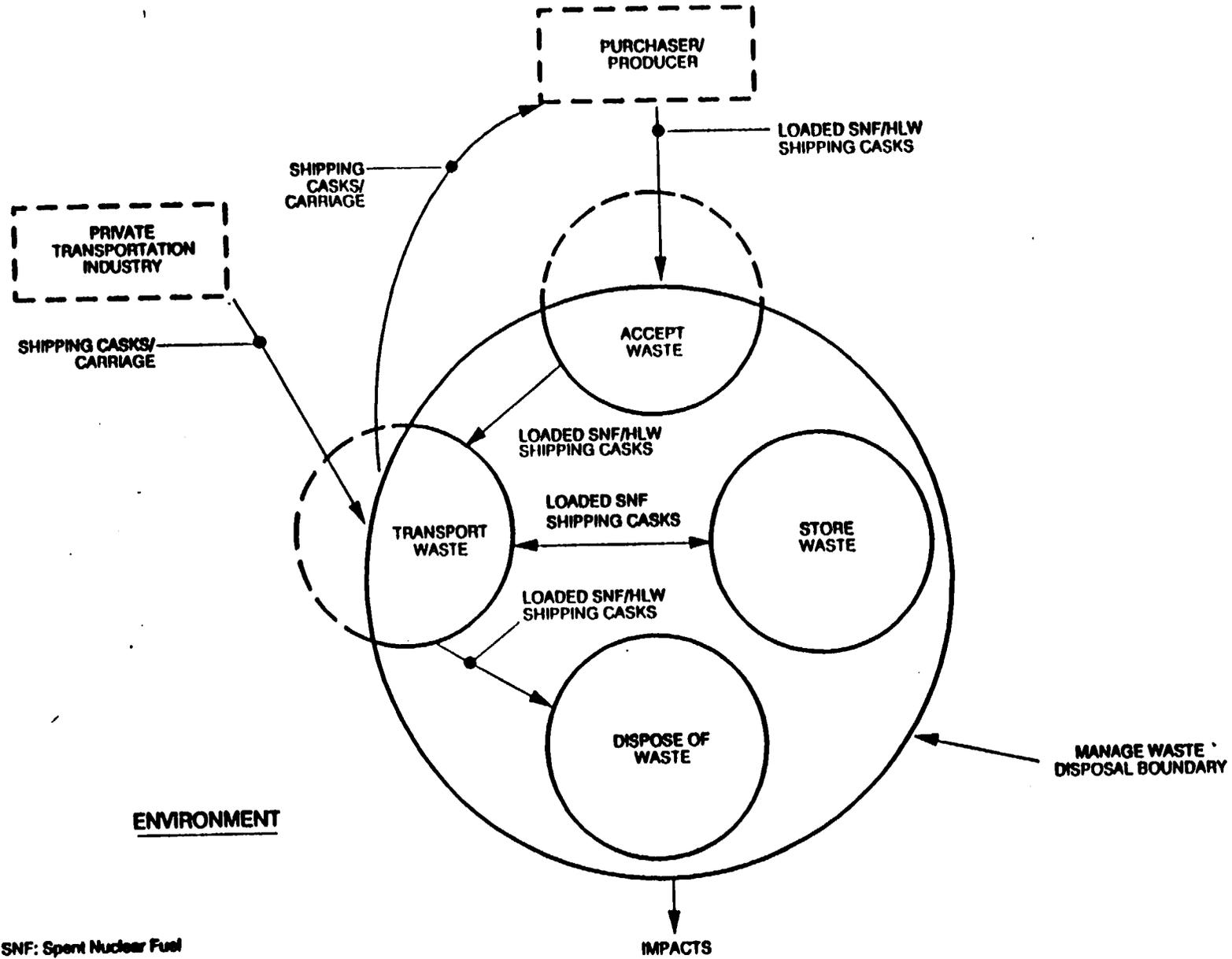
1.5.1 Scope of Functional Analysis

The functional analysis process must eventually consider all phases of a system's life cycle. However, it should begin with an analysis of that phase having the greatest impact on the satisfaction of the mission. For the Dispose of Waste mission, that phase was determined to be the operating phase of the repository. Thus, the time period covered by this functional analysis is from the initial acceptance of spent fuel at a geologic repository through at least 10,000 years following permanent closure, as defined by 40 CFR 191.13.

Figure 2 illustrates the boundaries between the Manage Waste Disposal function and its environment. The dispose of waste subfunction is contained entirely within the overall system boundary. There are potential impacts across the boundary from each of the four subfunctions. The environment identified on Figure 2 is intended to mean anything and everything outside the direct control of the DOE/OCRWM program. The boundaries for the Dispose of Waste subfunction are shown in Figure 3. The boundary of the controlled area coincides with that of the geologic repository or site. The extent of the controlled area is specified by 40 CFR 191.12(g) as " (1) A surface location ... that encompasses 100 square kilometers and extends horizontally no more than five kilometers in any direction from the outer boundary of the original location of the radioactive wastes in a disposal system; and (2) the subsurface underlying such a surface location." The controlled area boundary demarcates the geologic repository or the site from the accessible environment. Subsequent level boundary diagrams are shown in Figures 4, 5, and 6 for completeness.

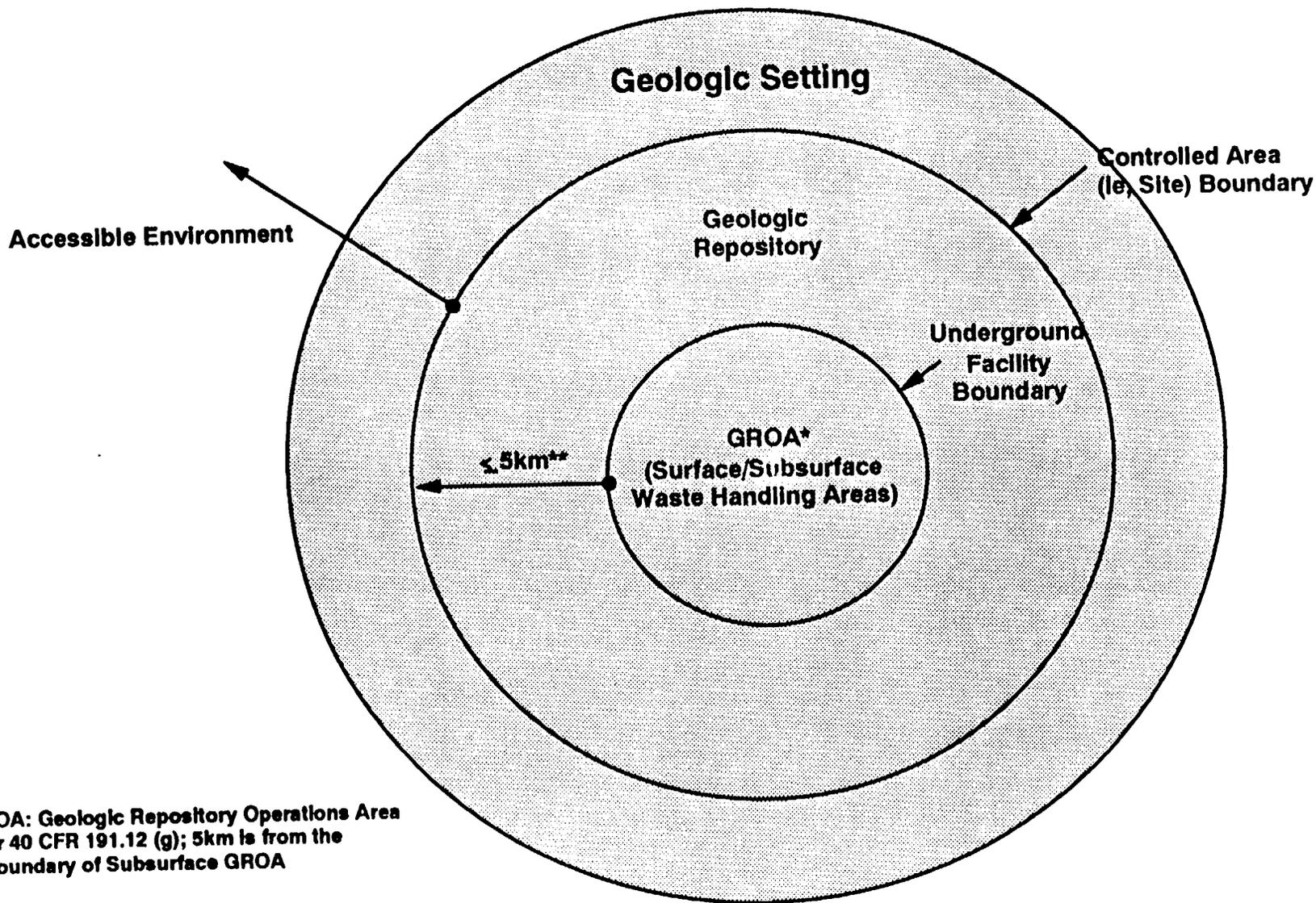
1.5.2 Organization of Document

Section 2.0 of this document contains an explicit description for each of the Dispose of Waste subfunctions plus the higher level - Manage Waste Disposal function; an identification of the key interfaces (inputs/outputs) between these functions; and a specification of the corresponding requirements (constraints, performance and interface). All of this information is presented in the form of a single table for each function. The Manage Waste Disposal function is included to provide



SNF: Spent Nuclear Fuel
HLW: High Level Waste

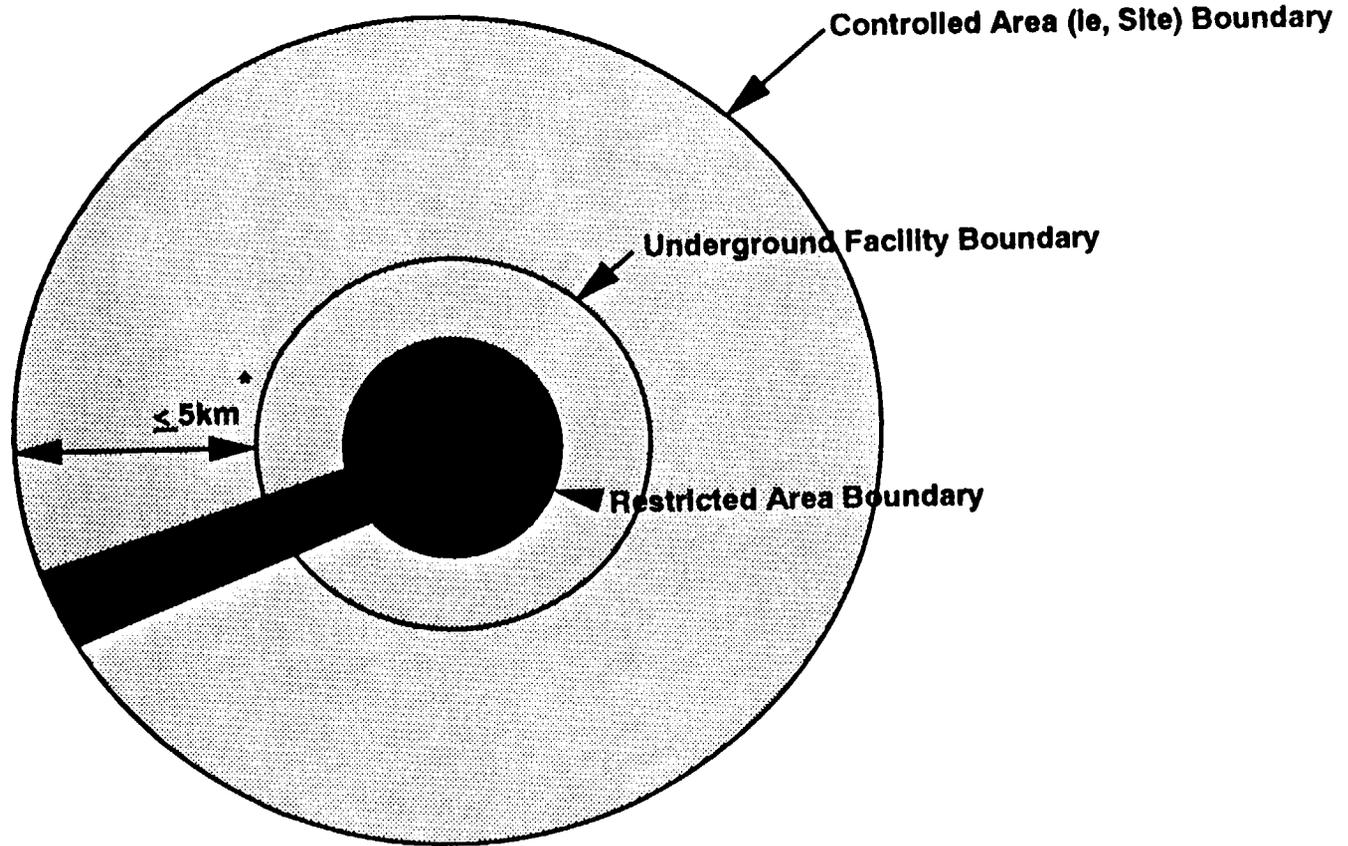
FIGURE 2. MANAGE WASTE DISPOSAL BOUNDARIES



*GROA: Geologic Repository Operations Area
 **per 40 CFR 191.12 (g); 5km is from the Boundary of Subsurface GROA

Figure 3. Dispose of Waste Boundaries
 (Based on 10 CFR 60 Except as Otherwise Noted)

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* per 40 CFR 191.12 (g)

■ Restricted Area

Figure 4. Operate Geologic Repository Boundaries
(Based on 10 CFR 60 Except as Otherwise Noted)

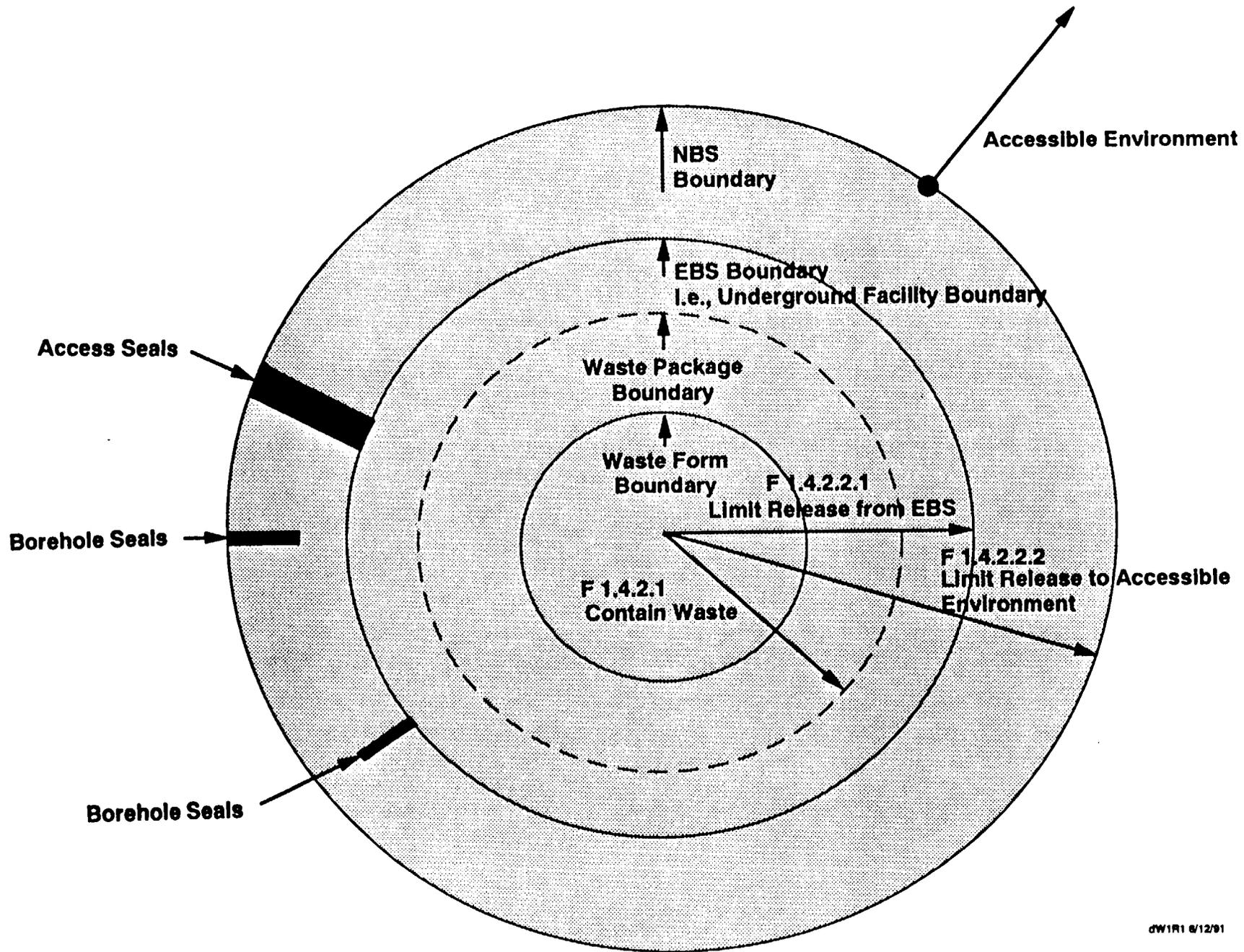
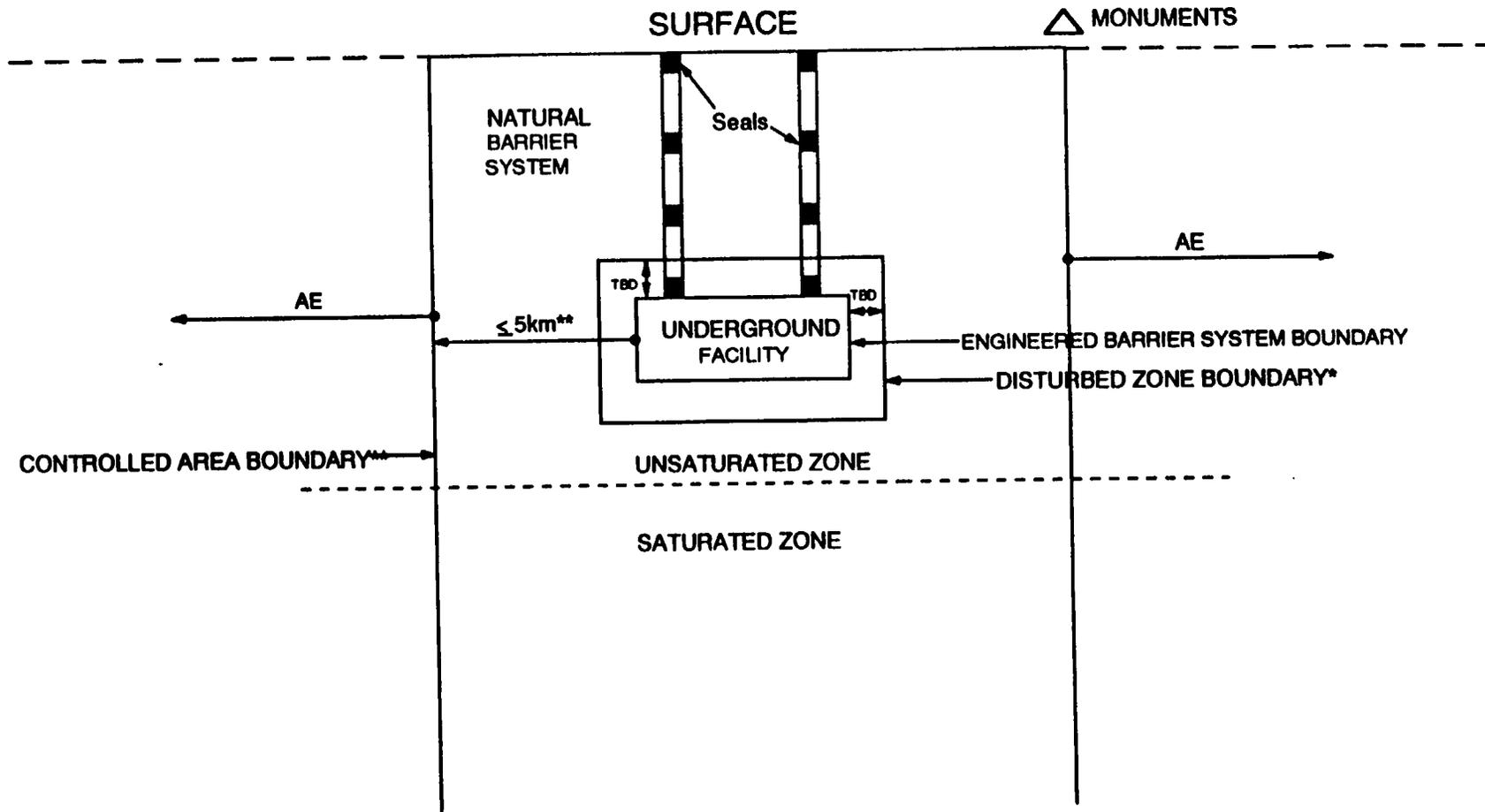


Figure 5. Isolate Waste Boundaries

ACCESSIBLE ENVIRONMENT (AE)



* PER 40 CFR 191.12 (g)

Figure 6. Multiple Barrier System Boundaries

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1 continuity from the Overall System Report and for complete traceability of functions
2 from top to bottom.

3 Section 3.0 contains individual architectural description tables for each physical
4 system element of a Geologic Repository plus the higher level - Nuclear Waste
5 Management System. These tables present the rationale justifying the need for, or
6 the selection of, a particular architecture and a brief description of the concept.

7 Section 4.0 contains a more illustrative description of the important functional
8 interfaces that have been identified within the Dispose of Waste mission. This
9 includes interfaces between the lower level functions and between a function and
10 the external environment. The interfaces at the Manage Waste Disposal level are
11 also included for continuity with the Overall System Report. Two types of diagrams
12 are used to illustrate these functional interfaces: N-square charts and functional
13 flow diagrams.

14 A number of appendices are included in this document. Appendix A is a Data
15 Dictionary containing a glossary of terms that are used throughout the functional
16 analysis effort; Appendix B, a Bibliography of reference documents used in this
17 effort; Appendix C, Decision Documentation, indicates the basis for any
18 DOE/OCRWM decisions that have been made in support of this effort; Appendix
19 D, a list of the Acronyms that are used throughout this document; Appendix E,
20 Dispose of Waste Interfaces, contains a list of the important inputs and outputs
21 from the Dispose of Waste function; Appendix F, a reserved section for the Waste
22 Acceptance Schedule, including the transportation modal split and SNF/high-level
23 waste characteristics; and Appendix G, an indented list of Dispose of Waste
24 functions. In addition, Supplemental Appendices, which are not intended to be
25 approved and controlled, are included as separate attachments for completeness.

2.0 FUNCTIONS AND REQUIREMENTS

4 Figures 7 and 8 display the functions, at increasing levels of detail, deemed
5 necessary to fulfill the Dispose of Waste mission. As indicated, the numbering
6 scheme which uniquely identifies function titles is based on using a 1. at the first
7 level, a 1.4 at the second level, a 1.4.X at the third level, etc. This scheme, which
permits traceability between functions and subfunctions, is used throughout the
physical system functional analysis.

8 Table 1 contains a list of source documents from which the requirements contained
9 in this document were extracted. Although additional source documents have been
10 and will continue to be reviewed, it was determined that the scope and detail
11 contained in the documents referenced in Table 1 are sufficient to specify an initial
12 set of requirements in the Dispose of Waste functional analysis document. Other
13 supplementary documents have been identified as potential source documents, which
14 will be reviewed to identify requirements. Any applicable results of these reviews
15 will be incorporated into subsequent revisions to this functional analysis document.
16

17 Tables F1. through F1.4.3.4 contain descriptions for each of the functions, including
18 an identification of inputs to, and outputs from, each of the functions. A
19 compilation of key inputs and outputs is provided in Appendix E, and an
20 indented list of all Dispose of Waste functions is provided in Appendix G. Tables
F1. through F1.4.3.4 also include a compilation of the corresponding requirements
that are determined to be appropriate for each function. In general, if a
23 requirement is applicable to all functions at a given level in the hierarchy, it is
24 assigned to their parent function in order to avoid unnecessary repetition.

25 Requirements can be one of three types: **constraints**, which are requirements
26 imposed on the function by sources external to OCRWM (e.g., Congress,
27 Environmental Protection Agency, Nuclear Regulatory Commission, other DOE
28 offices); **performance requirements** which are imposed on the function by OCRWM;
29 and **interface requirements** which apply to the inputs to, or outputs from, the
30 functions and may be imposed either by external sources or by OCRWM. The
31 numbering convention used for the identification of requirements in these tables is
32 as follows: For example, 1.4C1: The first constraint (C) assigned to function 1.4;
33 1.4P1: The first performance requirement (P) assigned to output from function 1.4;
34 and 1.4O1: The first interface requirement assigned to output (O) 1 from function
35 1.4. Each requirement that has been extracted from a source document has the
36 appropriate reference noted. In case of conflicting requirements 10 CFR 60 will
37 take precedence over 10 CFR 960. Others that have not yet been firmly decided
38 are noted as "TBD" or "No requirements specified at this time". Some

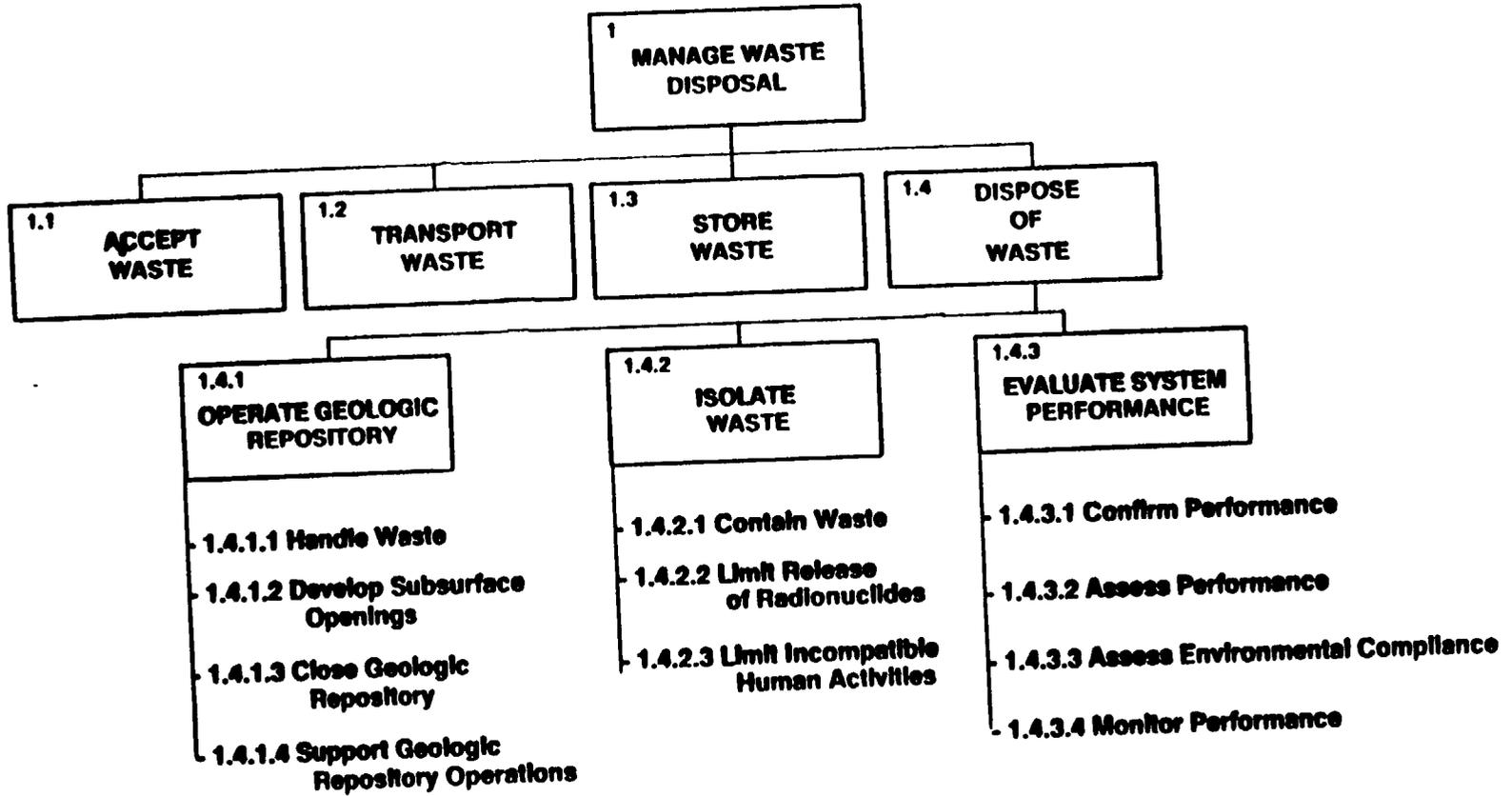


Figure 7. Dispose of Waste Function Hierarchy (Fourth Level)

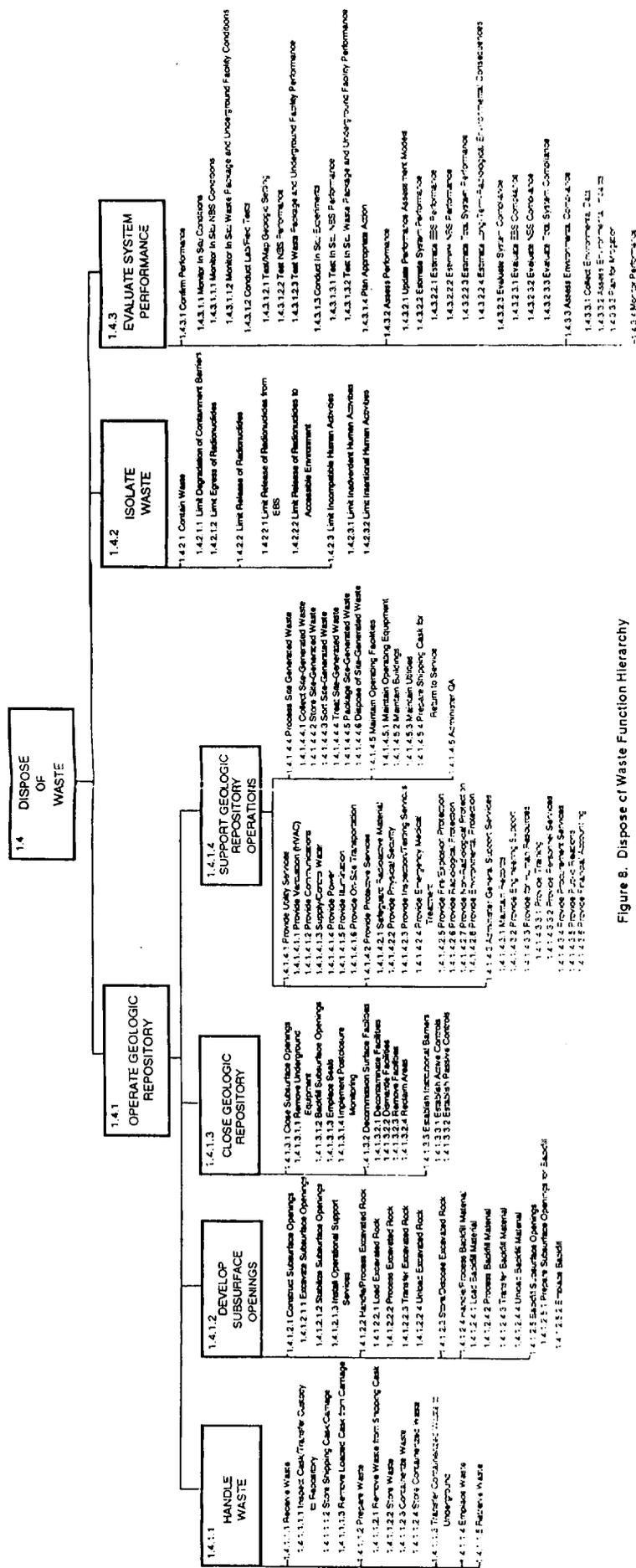


Figure 8. Dispose of Waste Function Hierarchy

1 requirements specified are administrative in nature which support the operating
2 phase. Note that for any reference to an appendix, a different section number or
paragraph number within a particular requirement refers to the appendix, a section,
or paragraph in the source document itself.

5 OCRWM recognizes that this initial version of the Dispose of Waste requirements
6 document contains a limited number of performance requirements and no State and
7 local regulatory requirements. Furthermore, many of the interfaces currently have
8 no requirements specified, pending future decisions to be made by OCRWM.
9 These decisions will be based on the results of both prior and future systems
10 studies. Subsequent revisions to this document will include additional specific
11 requirements as they are identified and resolved. To be included, performance and
12 interface requirements tied to quality affecting activities must be developed and
13 documented in accordance with an approved Quality Assurance (QA) program
14 which meets the requirements of 10 CFR 50 Subpart B and NQA-1.

Table F1. Function Description: Manage Waste Disposal

I. Function ID Number: 1.

II. Function Title: Manage Waste Disposal

III. Function Definition:

Manage waste disposal means to conduct any physical activity, operation, or process to accept, transport, store, or dispose of spent nuclear fuel or high-level waste.

The mission of the Nuclear Waste Management System (NWMS) is to permanently isolate spent nuclear fuel and high-level radioactive waste in a geologic repository in a timely manner that protects the health and safety of the public and maintains the quality of the environment.

The NWSA defines spent nuclear fuel as the fuel that has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated by reprocessing. High-level radioactive waste is defined as (A) 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 (B) other highly radioactive material that the Commission, consistent with existing law, determines by rule requires permanent isolation. [NWSA Sec. 2 (23) and (12)]

IV. Interfaces:

A. Inputs:

1.I1 SNF
1.I2 CHLW
1.I3 DHLW

From: Purchaser
From: Producer
From: Producer

B. Outputs:

1.O1 Federally-Permitted Radiation Exposure To: Accessible Environment
1.O2 Federally-Permitted Release of Radionuclides To: Accessible Environment

V. Function Requirements:

A. Constraints:

1.C1 This requirement intentionally left blank.

1.C2 ... the Secretary is authorized to enter into contracts with any person who generates or holds title to high-level radioactive waste, or spent nuclear fuel, of domestic origin for the acceptance of title, subsequent transportation, and disposal of such waste or spent fuel.

[NWSA Sec. 302 (a)(1)]

1.C3 This requirement intentionally left blank.

1.C4 The design objectives for personnel exposure from external sources of radiation in continuously occupied controlled areas are ALARA and not exceeding 0.5 mrem (5 microsieverts) per hour on average. The design objectives for exposure rates for potential exposure to a radiation worker where occupancy is generally not continuous are ALARA and not exceeding 20 percent of the applicable standard in paragraphs 9b(1) and (2).

[DOE ORDER 5480.11(9)(j)(1)(b)]

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1.C5 (a) Each employer - (1) shall furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing or likely to cause death or serious physical harm to his employees; (2) shall comply with occupational safety and health standards promulgated under this chapter. (b) Each employee shall comply with occupational safety and health standards and all rules, regulations, and orders issued pursuant to this chapter which are applicable to his own actions and conduct.

[29 USC 651 et seq., (654 (a)(b))]

B. Performance:

1.P1 DOE shall accept title to all SNF and/or HLW, of domestic origin, generated by the civilian nuclear power reactor(s) specified in Appendix A, provide subsequent transportation for such material to the DOE facility, and dispose of such material in accordance with the terms of this contract.

[10 CFR 961.11, IV B.1.]

C. Interface:

1.I1 Contracts entered into under this section shall provide that-

(A) Following commencement of operation of a repository, the Secretary shall take title to the ... spent nuclear fuel involved as expeditiously as practicable upon the request of the generator or owner of such ... spent fuel; and

(B) in return for the payment of fees established by this section, the Secretary, beginning not later than January 31, 1998, will dispose of the ... spent nuclear fuel involved as provided in this subtitle

[NWPA Sec. 302 (a)(5)]

1.I2 Contracts entered into under this section shall provide that-

(A) Following commencement of operation of a repository, the Secretary shall take title to the high-level radioactive waste... involved as expeditiously as practicable upon the request of the generator or owner of such waste ... ; and

(B) in return for the payment of fees established by this section, the Secretary, beginning not later than January 31, 1998, will dispose of the high-level radioactive waste ... involved as provided in this subtitle

[NWPA Sec. 302 (a)(5)]

1.I3 ... the Department of Energy ...plans... to dispose of defense waste in a commercial repository.

[Presidential Memo, 1985]

1.O1 ... the Federal Government has the responsibility to provide for the permanent disposal of high-level radioactive waste and such spent nuclear fuel as may be disposed of in order to protect the public health and safety and the environment, ...

[NWPA Sec. 111(a)(4)]

1.O2 ... the Federal Government has the responsibility to provide for the permanent disposal of high-level radioactive waste and such spent nuclear fuel as may be disposed of in order to protect the public health and safety and the environment, ...

[NWPA Sec. 111(a)(4)]

1 Table F1.4 Function Description: Dispose of Waste

2 I. Function ID Number: 1.4

3 II. Function Title: Dispose of Waste

4 III. Function Definition:

5 To emplace spent fuel/high-level radioactive waste in a geologic medium and to isolate such
6 wastes from the accessible environment.

7 The term disposal means the emplacement in a repository of high-level radioactive waste,
8 spent nuclear fuel, or other highly radioactive material with no foreseeable intent of
9 recovery, whether or not such emplacement permits the recovery of such waste. [NWPA
10 Sec. 2 (9)]

11 "Disposal System" means any combination of engineered and natural barriers that isolate
12 spent nuclear fuel or radioactive waste after disposal. [40 CFR 191.12(a)]

13 "Disposal" means the isolation of radioactive wastes from the accessible environment. [10
14 CFR 60.2]

15 IV. Interfaces:

16 A. Inputs:

17 1.4I1 Loaded SNF Cask/Carriage From: 1.2
18 1.4I2 Loaded CHLW Cask/Carriage From: 1.2
19 1.4I3 Loaded DHLW Cask/Carriage From: 1.2

20 B. Outputs:

21 1.4O1 Empty Cask/Carriage To: 1.2
22 1.4O2 Federally-Permitted Radiation To: Accessible Environment
23 Exposure
24 1.4O3 Federally-Permitted Release of To: Accessible Environment
25 Radionuclides

26 V. Function Requirements:

27 A. Constraints:

28 1.4C1 ... repositories that will provide a reasonable assurance that the public and the
29 environment will be adequately protected from the hazards posed by high-level radioactive
30 waste and such spent nuclear fuel as may be disposed of in a repository;

31 [NWPA Sec. 111 (b)(1)]

32 1.4C2 ... shall prohibit the emplacement in the first repository of a quantity of spent fuel
33 containing in excess of 70,000 metric tons of heavy metal or a quantity of solidified
34 high-level radioactive waste resulting from the reprocessing of such a quantity of spent fuel
35 until such time as a second repository is in operation. In the event that a monitored
36 retrievable storage facility, approved pursuant to subtitle C of this Act, shall be located, or
37 is planned to be located, within 50 miles of the first repository, ... shall prohibit the
38 emplacement of a quantity of spent fuel containing in excess of 70,000 metric tons of heavy
39 metal or a quantity of solidified high-level radioactive waste resulting from the reprocessing
40 of spent fuel in both the repository and monitored retrievable storage facility until such
41 time as a second repository is in operation.

42 [NWPA Sec. 114(d)]

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1.4C3 ... any repository constructed on a site approved under this subtitle shall be designed and constructed to permit the retrieval of any spent nuclear fuel placed in such repository, during an appropriate period of operation of the facility, for any reason pertaining to the public health and safety, or the environment, or for the purpose of permitting the recovery of the economically valuable contents of such spent fuel.

[NWPA Sec. 122]

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1.4C4 Criticality control. All systems for processing, transporting, handling, storage, retrieval, emplacement, and isolation of 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 (k_{eff}) 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.

[10 CFR 60.131(b)(7)]

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1.4C5 The quality assurance program applies to all systems, structures and components important to safety, to design and characterization of barriers important to waste isolation and to activities related thereto. These activities include: site characterization, facility and equipment construction, facility operation, performance confirmation, permanent closure, and decontamination and dismantling of surface facilities.

[10 CFR 60.151]

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1.4C6 DOE shall implement a quality assurance program based on the criteria of Appendix B of 10 CFR Part 50 as applicable, and appropriately supplemented by additional criteria as required by 10 CFR 60.151.

[10 CFR 60.152]

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1.4C7 Environmental impacts shall be considered by the DOE throughout the site characterization, site selection, and repository development process. The DOE shall mitigate significant adverse environmental impacts, to the extent practicable, during site characterization and repository construction, operation, closure, and decommissioning.

[10 CFR 960.3-4]

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B. Performance:

1.4P1 This requirement intentionally left blank.

1.4P2 ...the start of repository operations is...2010.

[DOE/RW-0247]

C. Interface:

1.4I1 The SNF acceptance rate at the geologic repository will be in accordance with Appendix F of this document.

[TBD, pending DOE/OCRWM decision]

1.4I2 The CHLW acceptance rate at the geologic repository will be in accordance with Appendix F of this document.

[TBD, pending DOE/OCRWM decision]

1.4I3 The DHLW acceptance rate at the geologic repository will be in accordance with Appendix F of this document.

[TBD, pending DOE/OCRWM decision]

1 1.401 Requirements at this level to be specified

2 1.402 Management and storage of spent nuclear fuel or high-level or transuranic
3 radioactive wastes at all facilities regulated by the Commission or by Agreement States shall
4 be conducted in such a manner as to provide reasonable assurance that the combined
5 annual dose equivalent to any member of the public in the general environment resulting
6 from: (1) Discharges of radioactive material and direct radiation from such management and
7 storage and (2) all operations covered by Part 190; shall not exceed 25 millirems to the
8 whole body, 75 millirems to the thyroid, and 25 millirems to any other critical organ.....
9

10 [40 CFR 191.03(a)]

11 1.403a Management and storage of spent nuclear fuel or high-level or transuranic
12 radioactive wastes at all facilities regulated by the Commission or by Agreement States shall
13 be conducted in such a manner as to provide reasonable assurance that the combined
14 annual dose equivalent to any member of the public in the general environment resulting
15 from: (1) Discharges of radioactive material and direct radiation from such management and
16 storage and (2) all operations covered by Part 190; shall not exceed 25 millirems to the
17 whole body, 75 millirems to the thyroid, and 25 millirems to any other critical organ.
18

19 [40 CFR 191.03(a)]

20 1.403b (a) Disposal systems for spent nuclear fuel or high level or transuranic radioactive
21 wastes shall be designed to provide a reasonable expectation, based upon performance
22 assessments, that the cumulative releases of radionuclides to the accessible environment
23 for 10,000 years after disposal from all significant processes and events that may affect the
24 disposal system shall: (1) Have a likelihood of less than one chance in 10 of exceeding the
25 quantities calculated according to Table 1 (Appendix A); and (2) Have a likelihood of less
26 than one chance in 1,000 of exceeding ten times the quantities calculated according to Table
27 1 (Appendix A).
28

[40 CFR 191.13]

29 This table is reproduced here, together with its accompanying notes.

30 Table 1 - Release Limits for Containment Requirements

(Cumulative releases to the accessible environment for 10,000 years after disposal)

Radionuclide	Release limit, per 1,000 MTHM or other unit of waste (see notes)(curies)
Americium-241 or 243	100
Carbon-14	100
Cesium-135 or -137	1,000
Iodine-129	100
Neptunium-237	100
Plutonium-238, -239,-240, or -242	100
Radium-226	100
Strontium-90	1,000
Technetium-99	10,000
Thorium-230, or -232	10
Tin-126	1,000
Uranium-233, -234, -236, or -238	100
Any other alpha-emitting radionuclide with a half-life greater than 20 years	100
Any other radionuclide with a half-life greater than 20 years that does not emit alpha particles	1,000

52 Application of Table 1

53 Note 1: Units of Waste. The Release Limits in Table 1 apply to the amount of wastes in
54 any one of the following:

1 (a) an amount of spent nuclear fuel containing 1,000 metric tons of heavy metal (MTHM)
2 exposed to a burnup between 25,000 megawatt-days per metric ton of heavy metal
3 (MWd/MTHM) and 40,000 MWd/MTHM;

4 (b) The high-level radioactive wastes generated from reprocessing each 1,000 MTHM
5 exposed to a burnup between 25,000 MWd/MTHM and 40,000 MWd/MTHM;

6 (c) Each 100,000,000 curies of gamma or beta-emitting radionuclides with half-lives greater
7 than 20 years but less than 100 years (for use as discussed in Note 5 or with materials that
8 are identified by the Commission as high-level radioactive waste in accordance with part
9 B of the definition of high-level waste in the NWPA);

10 (d) Each 1,000,000 curies of other radionuclides (i.e., gamma or beta emitters with half-
11 lives greater than 100 years or any alpha-emitters with half-lives greater than 20 years) (for
12 use as discussed in Note 5 or with materials that are identified by the Commission as high-
13 level radioactive waste in accordance with part B of the definition of high-level waste in
14 the NWPA); or

15 (e) An amount of transuranic (TRU) waste containing one million curies of alpha-emitting
16 transuranic radionuclides with half-lives greater than 20 years.

17 Note 2: Release Limits for Specific Disposal Systems. To develop Release Limits for a
18 particular disposal system, the quantities in Table 1 shall be adjusted for the amount of
19 waste included in the disposal system compared to the various units of waste defined in
20 Note 1. For example:

21 (a) If a particular disposal system contained the high-level wastes from 50,000 MTHM, the
22 Release Limits for that system would be the quantities in Table 1 multiplied by 50 (50,000
23 MTHM divided by 1,000 MTHM).

24 (b) If a particular disposal system contained three million curies of alpha-emitting
25 transuranic wastes, the Release Limits for that system would be the quantities in Table 1
26 multiplied by three (three million curies divided by one million curies).

27 (c) If a particular disposal system contained both the high-level wastes from 50,000 MTHM
28 and 5 million curies of alpha emitting transuranic wastes, the Release Limits for that
29 system would be the quantities in Table 1 multiplied by 55:

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$$\frac{50,000 \text{ MTHM}}{1,000 \text{ MTHM}} + \frac{5,000,000 \text{ curies TRU}}{1,000,000 \text{ curies TRU}} = 55$$

33 Note 3: Adjustments for Reactor Fuels with Different Burnup. For disposal systems
34 containing reactor fuels (or the high-level wastes from reactor fuels) exposed to an average
35 burnup of less than 25,000 MWd/MTHM or greater than 40,000 MWd/MTHM, the units
36 of waste defined in (a) and (b) of Note 1 shall be adjusted. The unit shall be multiplied
37 by the ratio of 30,000 MWd/MTHM divided by the fuel's actual average burnup, except
38 that a value of 5,000 MWd/MTHM may be used when the average fuel burnup is below
39 5,000 MWd/MTHM and a value of 100,000 MWd/MTHM shall be used when the average
40 fuel burnup is above 100,000 MWd/MTHM. This adjusted unit of waste shall then be used
41 in determining the Release Limits for the disposal system.

42 For example, if a particular disposal system contained only high-level wastes with an average
43 burnup of 3,000 MWd/MTHM, the unit of waste for that disposal system would be:

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$$1,000 \text{ MTHM} \times \frac{(30,000)}{(5,000)} = 6,000 \text{ MTHM}$$

45 If that disposal system contained the high-level wastes from 60,000 MTHM (with an average
46 burnup of 3,000 MWd/MTHM), then the Release Limits for that system would be the
47 quantities in Table 1 multiplied by ten:

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$$\frac{60,000 \text{ MTHM}}{6,000 \text{ MTHM}} = 10$$

49 which is the same as:

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$$\frac{60,000 \text{ MTHM}}{1,000 \text{ MTHM}} \times \frac{(5,000 \text{ MWd/MTHM})}{(30,000 \text{ MWd/MTHM})} = 10$$

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Note 4: Treatment of Fractionated High-Level Wastes. In some cases, a high-level waste stream from reprocessing spent nuclear fuel may have been (or will be) separated into two or more high-level waste components destined for different disposal systems. In such cases, the implementing agency may allocate the Release Limit multiplier (based upon the original MTHM and the average fuel burnup of the high-level waste stream) among the various disposal systems as it chooses, provided that the total Release Limit multiplier used for that waste stream at all of the disposal systems may not exceed the Release Limit multiplier that would be used if the entire waste stream were disposed of in one disposal system.

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Note 5: Treatment of Wastes with Poorly Known Burnups or Original MTHM. In some cases, the records associated with particular high-level waste streams may not be adequate to accurately determine the original metric tons of heavy metal in the reactor fuel that created the waste, or to determine the average burnup that the fuel was exposed to. If the uncertainties are such that the original amount of heavy metal or the average fuel burnup for particular high-level waste streams cannot be quantified, the units of waste derived from (a) and (b) of Note 1 shall no longer be used. Instead, the units of waste defined in (c) and (d) of Note 1 shall be used for such high-level waste streams. If the uncertainties in such information allow a range of values to be associated with the original amount of heavy metal or the average fuel burnup, then the calculations described in previous Notes will be conducted using the values that result in the smallest Release Limits, except that the Release Limits need not be smaller than those that would be calculated using the units of waste defined in (c) and (d) of Note 1.

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Note 6: Uses of Release Limits to Determine Compliance with 191.13. Once release limits for a particular disposal system have been determined in accordance with Notes 1 through 5, these release limits shall be used to determine compliance with the requirements of 191.13 as follows. In cases where a mixture of radionuclides is projected to be released to the accessible environment, the limiting values shall be determined as follows: For each radionuclide in the mixture, determine the ratio between the cumulative release quantity projected over 10,000 years and the limit for that radionuclide as determined from Table 1 and Notes 1 through 5. The sum of such ratios for all the radionuclides in the mixture may not exceed one with regard to 191.13(a)(1) and may not exceed ten with regard to 191.13(a)(2).

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For example, if radionuclides A, B, and C are projected to be released in amounts Q_a , Q_b , and Q_c and if the applicable Release Limits are RL_a , RL_b , and RL_c , then the cumulative releases over 10,000 years shall be limited so that the following relationship exists:

$$\frac{Q_a}{RL_a} + \frac{Q_b}{RL_b} + \frac{Q_c}{RL_c} \leq 1$$

[40 CFR 191.13, Appendix A]

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1.403c (a) Qualifying condition. The present and expected characteristics of the host rock and surrounding units shall be capable of accommodating the thermal, chemical, mechanical, and radiation stresses expected to be induced by repository construction, operation, and closure and by expected interactions among the waste, host rock, ground water, and engineered components. The characteristics of and the processes operating within the geologic setting shall permit compliance with (1) the requirements specified in Sec. 960.4-1 for radionuclide releases to the accessible environment and (2) the requirements set forth in 10 CFR 60.113 for radionuclide releases from the engineered-barrier system using reasonably available technology.

[10 CFR 960.4-2-3(a)]

1 Table F1.4.1 Function Description: Operate Geologic Repository

2 I. Function ID Number: 1.4.1

3 II. Function Title: Operate Geologic Repository

4 III. Function Definition:

5 To operate surface and subsurface facilities to: (1) handle radioactive wastes (including
6 receiving, preparing, transferring, emplacing, and retrieving (if required) radioactive wastes),
7 (2) develop subsurface openings, (3) close the repository at the end of the operational
8 period, and (4) support geologic repository operations.

9 This function begins at the time the waste is received at the repository and ends after
10 repository closure when the last institutional barrier is established.

11 "Geologic Repository" means a system which is intended to be used for, or may be used
12 for, the disposal of radioactive wastes in excavated geologic media. A geologic repository
13 includes: (1) The geologic repository operations area, and (2) the portion of the geologic
14 setting that provides isolation of the radioactive waste. [10 CFR 60.2]

15 "Geologic Repository Operations Area" means a high-level radioactive waste facility that
16 is part of a geologic repository, including both surface and subsurface areas, where waste
17 handling activities are conducted. [10 CFR 60.2]

18 "Retrieval" means the act of intentionally removing radioactive waste from the underground
19 location at which the waste had been previously emplaced for disposal. [10 CFR 60.2]

20 IV. Interfaces:

21 A. Inputs:

22 1.4.1I1	Loaded SNF Cask/Carriage	From:	Function 1.2
23 1.4.1I2	Loaded CHLW Cask/Carriage	From:	Function 1.2
24 1.4.1I3	Loaded DHLW Cask/Carriage	From:	Function 1.2
25 1.4.1I4	Waste Containers	From:	Outside System Boundary
26 1.4.1I5	Corrective Action	From:	Function 1.4.3

27 B. Outputs:

28 1.4.1O1	Disposed Site Generated Waste	To:	Outside System Boundary
29 1.4.1O2	Empty Cask/Carriage	To:	Function 1.2
30 1.4.1O3	Heat	To:	Accessible Environment
31 1.4.1O4	Federally-Permitted Radiation 32 Exposure	To:	Accessible Environment
33 1.4.1O5	Federally-Permitted Release of 34 Radionuclides	To:	Accessible Environment
35 1.4.1O6	[Retrieved Waste]	To:	Outside System Boundary
36 1.4.1O7	Waste Packages	To:	Function 1.4.2
37 1.4.1O8	Engineered Barriers	To:	Function 1.4.2 [Resources]
38 1.4.1O9	Sealed Accesses/Boreholes	To:	Function 1.4.2 [Resources]
39 1.4.1O10	Institutional Barriers	To:	Function 1.4.2 [Resources]
40 1.4.1O11	Operations Data	To:	Function 1.4.3

41 V. Function Requirements:

42 A. Constraints:

43 1.4.1C1 (b) Retrievability of waste.

44 (1) The geologic repository operations area shall be designed to preserve the
45 option of waste retrieval throughout the period during which wastes are being
46 emplaced and, thereafter, until the completion of a performance confirmation
47 program and Commission review of the information obtained from such a program.
48 To satisfy this objective, the geologic repository operations area shall be designed
49 so that any or all of the emplaced waste could be retrieved on a reasonable
50 schedule starting at any time up to 50 years after waste emplacement operations
51 are initiated, unless a different time period is approved or specified by the
Commission. This different time period may be established on a case-by-case basis

consistent with the emplacement schedule and the planned performance confirmation program.

(2) This requirement shall not preclude decisions by the Commission to allow backfilling part or all of, or permanent closure of, the geologic repository operations area prior to the end of the period of design for retrievability.

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

[10 CFR 60.111]

1.4.1C2 Sections 60.131 through 60.134 specify minimum criteria for the design of the geologic repository operations area. These design criteria are not intended to be exhaustive, however. Omissions in Sections 60.131 through 60.134 do not relieve DOE from any obligation to provide such safety features in a specific facility needed to achieve the performance objectives [10 CFR 60.130]

(a) Radiological protection. The geologic repository operations area shall be designed to maintain radiation doses, levels, and concentrations of radioactive material in air in restricted areas within the limits specified in Part 20 of this chapter. Design shall include:

(1) Means to limit concentrations of radioactive material in air;

(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;

(3) Suitable shielding;

(4) Means to monitor and control the dispersal of radioactive contamination;

(5) Means to control access to high radiation areas or airborne radioactivity areas; and

(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.

[10 CFR 60.131]

1.4.1C3 Sections 60.131 through 60.134 specify minimum criteria for the design of the geologic repository operations area. These design criteria are not intended to be exhaustive, however. Omissions in Sections 60.131 through 60.134 do not relieve DOE from any obligation to provide such safety features in a specific facility needed to achieve the performance objectives [10 CFR 60.130]

(b) Structures, systems, and components important to safety --

(1) Protection against natural phenomena and environmental conditions. The structures, systems, and components important to safety shall be designed so that natural phenomena and environmental conditions anticipated at the geologic repository operations area will not interfere with necessary safety functions.

(2) Protection against dynamic effects of equipment failure and similar events. The structures, systems, and components important to safety shall be designed to withstand dynamic effects such as missile impacts, that could result from equipment failure, and similar events and conditions that could lead to loss of their safety functions.

(3) Protection against fires and explosions.

(i) The structures, systems, and components important to safety shall be designed to perform their safety functions during and after credible fires or explosions in the geologic repository operations area.

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(ii) To the extent practicable, the geologic repository operations area shall be designed to incorporate the use of noncombustible and heat resistant materials.

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

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

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(4) Emergency capability.

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(i) The structures, systems, and components important to safety shall be designed to maintain control of radioactive waste and radioactive effluent, and permit prompt termination of operations and evacuation of personnel during an emergency

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(6) Inspection, testing, and maintenance. The structures, systems, and components important to safety shall be designed to permit periodic inspection, testing, and maintenance, as necessary, to ensure their continued functioning and readiness

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(8) Instrumentation and control systems. The design shall include provisions for instrumentation and control systems to monitor and control the behavior of systems important to safety over anticipated ranges for normal operation and for accident conditions.

[10 CFR 60.131]

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1.4.1C4 This requirement intentionally left blank.

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1.4.1C5 Sections 60.131 through 60.134 specify minimum criteria for the design of the geologic repository operations area. These design criteria are not intended to be exhaustive, however. Omissions in Sections 60.131 through 60.134 do not relieve DOE from any obligation to provide such safety features in a specific facility needed to achieve the performance objectives [10 CFR 60.130]

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

[10 CFR 60.131(b)]

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1.4.1C6 The geologic repository operations area shall be designed so as to permit implementation of a performance confirmation program that meets the requirements of Subpart F of this part.

[10 CFR 60.137]

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1.4.1C7 Operations of systems and components that have been identified as important to safety in the Safety Analysis Report 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. Supervisory personnel who direct operations that are important to safety must also be certified in such operations.

[10 CFR 60.160]

1 1.4.1C8 The physical condition and the general health of personnel certified for operations
2 that are important to safety shall not be such as might cause operational errors that could
3 endanger the public health and safety. Any condition which might cause impaired judgment
or motor coordination must 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.

[10 CFR 60.162]

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8 1.4.1C9 (a) Qualifying Conditions --

9 (2) Environment, Socioeconomics, and Transportation. During repository siting,
10 construction, operation, closure, and decommissioning the public and the
11 environment shall be adequately protected from the hazards posed by the disposal
12 of radioactive waste.

13 (3) Ease and Cost of Siting, Construction, Operation, and Closure. Repository
14 siting, construction, operation, and closure shall be demonstrated to be technically
15 feasible on the basis of reasonably available technology, and the associated costs
16 shall be demonstrated to be reasonable relative to other available and comparable
17 siting options.

[10 CFR 960.5-1]

19 1.4.1C10 (d) Disqualifying Conditions. A site shall be disqualified if --

20 (1) Any surface facility of a repository would be located in a highly populated
21 area; or

22 (2) Any surface facility of a repository would be located adjacent to an area 1 mile
23 by 1 mile having a population of not less than 1,000 individuals as enumerated by
24 the most recent U.S. census; or

25 (3) The DOE could not develop an emergency preparedness program which meets
26 the requirements specified in DOE Order 5500.3 (Reactor and Non-Reactor Facility
27 Emergency Planning, Preparedness, and Response Program for Department of
28 Energy Operations) and related guides or, when issued by the NRC, in 10 CFR
Part 60, Subpart I, "Emergency Planning Criteria."

[10 CFR 960.5-2-1]

31 1.4.1C11 (a) Qualifying Condition. The site shall be located such that present projected
32 effects from nearby industrial, transportation, and military installations and operations,
33 including atomic energy defense activities,

34 (1) will not significantly affect repository siting, construction, operation, closure, or
35 decommissioning or can be accommodated by engineering measures and ...

36 (d) Disqualifying Condition. A site shall be disqualified if atomic energy defense activities
37 in proximity to the site are expected to conflict irreconcilably with repository siting,
38 construction, operation, closure, or decommissioning.

[10 CFR 960.5-2-4]

40 1.4.1C12 (a) Qualifying Condition. The site shall be located such that

41 (1) the quality of the environment in the affected area during this and future
42 generations will be adequately protected during repository siting, construction,
43 operation, closure, and decommissioning, and projected environmental impacts in
44 the affected area can be mitigated to an acceptable degree, taking into account
45 programmatic, technical, social, economic, and environmental factors; and

46 (2) the requirements specified in Section 960.5-1(a)(2) can be met

47 (d) Disqualifying Conditions. Any of the following conditions shall disqualify a site:

48 (1) During repository siting, construction, operation, closure, or decommissioning
49 the quality of the environment in the affected area could not be adequately
50 protected or projected environmental impacts in the affected area could not be
51 mitigated to an acceptable degree, taking into account programmatic, technical,

1 social, economic, and environmental factors.

2 (2) Any part of the restricted area or repository support facilities would be located
within the boundaries of a component of the National Park System, the National
Wildlife Refuge System, the National Wilderness Preservation System, or the
National Wild and Scenic Rivers System.

6 (3) The presence of the restricted area or the repository support facilities would
7 conflict irreconcilably with the previously designated resource-preservation use of
8 a component of the National Park System, the National Wildlife Refuge System,
9 the National Wilderness Preservation System, the National Wild and Scenic Rivers
10 System, or National Forest Lands, or any comparably significant State protected
11 resource that was dedicated to resource preservation at the time of the enactment
12 of the Act.

13 [10 CFR 960.5-2-5]

14 1.4.1C13 (a) Qualifying Condition. The site shall be located such that

15 (1) any significant adverse social and/or economic impacts induced in communities
16 and surrounding regions by repository siting, construction, operation, closure, and
17 decommissioning can be offset by reasonable mitigation or compensation, as
18 determined by a process of analysis, planning, and consultation among the DOE,
19 affected State and local government jurisdictions, and affected Indian tribes; and

20 (2) the requirements specified in Section 960.5-1(a)(2) can be met ...

21 (d) Disqualifying Condition. A site shall be disqualified if repository construction, operation,
22 or closure would significantly degrade the quality, or significantly reduce the quantity, of
23 water from major sources of offsite supplies presently suitable for human consumption or
24 crop irrigation and such impacts cannot be compensated for, or mitigated by, reasonable
25 measures.

26 [10 CFR 960.5-2-6]

27 1.4.1C14 (a) Qualifying Condition. The site shall be located such that

28 (1) the access routes constructed from existing local highways and railroads to the
29 site (i) will not conflict irreconcilably with the previously designated use of any
30 resource listed in Section 960.5-2-5(d) (2) and (3); (ii) can be designed and
31 constructed using reasonably available technology; (iii) will not require
32 transportation system components to meet performance standards more stringent
33 than those specified in the applicable DOT and NRC regulations, nor require the
34 development of new packaging containment technology; (iv) will allow
35 transportation operations to be conducted without causing an unacceptable risk to
36 the public or unacceptable environmental impacts, taking into account
37 programmatic, technical, social, economic, and environmental factors; and (2) the
38 requirements of Section 960.5-1(a)(2) can be met.

39 [10 CFR 960.5-2-7]

40 1.4.1C15 (a) Qualifying Condition. The site shall be located such that, considering the
41 surface characteristics and conditions of the site and surrounding area, including surface-
42 water systems and the terrain, the requirements specified in Section 960.5-1(a)(3) can be
43 met during repository siting, construction, operation, and closure.

44 [10 CFR 960.5-2-8]

45 1.4.1C16 (a) Qualifying Condition. The site shall be located such that

46 (1) the thickness and lateral extent and the characteristics and composition of the
47 host rock will be suitable for accommodation of the underground facility;

48 (2) repository construction, operation, and closure will not cause undue hazard to
49 personnel; and

50 (3) the requirements specified in Section 960.5-1(a)(3) can be met.

51 (d) Disqualifying Condition. The site shall be disqualified if the rock characteristics are such
52 that the activities associated with repository construction, operation, or closure are predicted
53 to cause significant risk to the health and safety of personnel, taking into account mitigating

measures that use reasonably available technology.

[10 CFR 960.5-2-9]

1.4.1C17 (a) Qualifying Condition. The site shall be located such that the geohydrologic setting of the site will

(1) be compatible with the activities required for repository construction, operation, and closure;

(2) not compromise the intended functions of the shaft liners and seals; and

(3) permit the requirements specified in Section 960.5-1(a)(3) to be met.

(d) Disqualifying Condition. A site shall be disqualified if, based on expected ground-water conditions, it is likely that engineering measures that are beyond reasonably available technology will be required for exploratory-shaft construction or for repository construction, operation, or closure.

[10 CFR 960.5-2-10]

1.4.1C18 (a) Qualifying Conditions. The site shall be located in a geologic setting in which any projected effects of expected tectonic phenomena or igneous activity on repository construction, operation, or closure will be such that the requirements specified in Section 960.5-1(a)(3) can be met.

(d) Disqualifying Condition. A site shall be disqualified if, based on the expected nature and rates of fault movement or other ground motion, it is likely that engineering measures that are beyond reasonably available technology will be required for exploratory-shaft construction or for repository construction, operation, or closure.

[10 CFR 960.5-2-11]

B. Performance: Requirements at this level to be specified

C. Interface:

1.4.1I1 The SNF acceptance rate, characteristics and transportation mode will be in accordance with Appendix F of this document.

[TBD, pending DOE/OCRWM decision]

1.4.1I2 The CHLW acceptance rate, characteristics and transportation mode will be in accordance with Appendix F of this document.

[TBD, pending DOE/OCRWM decision]

1.4.1I3 The DHLW acceptance rate, characteristics and transportation mode will be in accordance with Appendix F of this document.

[TBD, pending DOE/OCRWM decision]

1.4.1I4 Requirements at this level to be specified

1.4.1I5 Requirements at this level to be specified

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1.4.1O2 Requirements at this level to be specified

1.4.1O3 Requirements at this level to be specified

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1.4.104a (a) Protection against radiation exposures and releases of radioactive material. The geologic repository operations area shall be designed so that until permanent closure has been completed, radiation exposures and radiation levels, and releases of radioactive materials to unrestricted areas, will at all times be maintained within the limits specified in Part 20 of this chapter and such generally applicable environmental standards for radioactivity as may have been established by the Environmental Protection Agency.

[10 CFR 60.111]

1.4.104b (a) Qualifying Conditions --

(1) **Preclosure Radiological Safety.** Any projected radiological exposures of the general public and any projected releases of radioactive materials to restricted and unrestricted areas during repository operation and closure shall meet the applicable safety requirements set forth in 10 CFR Part 20, 10 CFR Part 60, and 40 CFR 191, Subpart A (see Appendix II of this part).

[10 CFR 960.5-1]

1.4.104c (a) Qualifying Condition. The site shall be located such that, during repository operation and closure,

(1) the expected average radiation dose to members of the public within any highly populated area will not be likely to exceed a small fraction of the limits allowable under the requirements specified in Section 960.5-1(a)(1), and

(2) the expected radiation dose to any member of the public in an unrestricted area will not be likely to exceed the limit allowable under the requirements specified in Sec. 960.5-1(a)(1).

[10 CFR 960.5-2-1]

1.4.105a (a) Protection against radiation exposures and releases of radioactive material. The geologic repository operations area shall be designed so that until permanent closure has been completed, radiation exposures and radiation levels, and releases of radioactive materials to unrestricted areas, will at all times be maintained within the limits specified in Part 20 of this chapter and such generally applicable environmental standards for radioactivity as may have been established by the Environmental Protection Agency.

[10 CFR 60.111]

1.4.105b (a) Qualifying Conditions --

(1) **Preclosure Radiological Safety.** Any projected radiological exposures of the general public and any projected releases of radioactive materials to restricted and unrestricted areas during repository operation and closure shall meet the applicable safety requirements set forth in 10 CFR Part 20, 10 CFR Part 60, and 40 CFR 191, Subpart A (see Appendix II of this part).

[10 CFR 960.5-1]

1.4.105c (a) Qualifying Condition. The site shall be located on land for which the DOE can obtain, in accordance with the requirements of 10 CFR 60.121, ownership, surface and subsurface rights, and control of access that are required in order that surface and subsurface activities during repository operation and closure will not be likely to lead to radionuclide releases to an unrestricted area greater than those allowable under the requirements specified in Sec. 960.5-1(a)(1).

[10 CFR 960.5-2-2]

1.4.105d (a) Qualifying Condition. The site shall be located such that expected meteorological conditions during repository operation and closure will not be likely to lead to radionuclide releases to an unrestricted area greater than those allowable under the requirements specified in Sec. 960.5-1(a)(1).

[10 CFR 960.5-2-3]

1 1.4.105e (a) Qualifying Condition. The site shall be located such that present projected
2 effects from nearby industrial, transportation, and military installations and operations,
3 including atomic energy defense activities,

(2), when considered together with emissions from repository operation and closure,
will not be likely to lead to radionuclide releases to an unrestricted area greater
than those allowable under the requirements specified in Section 960.5-1(a)(1).

7 [10 CFR 960.5-2-4]

8 1.4.106 Requirements at this level to be specified

9 1.4.107 Requirements at this level to be specified

10 1.4.108 Requirements at this level to be specified

11 1.4.109 Requirements at this level to be specified

12 1.4.1010 Requirements at this level to be specified

13 1.4.1011a (d) Accident investigations; records.

14 All accidents, including unintentional roof falls (except in any abandoned panels or in areas
15 which are inaccessible or unsafe for inspections), shall be investigated by the operator or
16 his agent to determine the cause and the means of preventing a recurrence. Records of
17 such accidents and investigations shall be kept and the information shall be made available
18 to the Secretary (of Labor) or his authorized representative and the appropriate State
19 agency. Such records shall be open for inspection by interested persons. Such records shall
20 include man-hours worked and shall be reported at a frequency determined by the Secretary
21 (of Labor), but at least annually.

22 [30 USC 801 et.seq., Section 813]

23 1.4.1.011b (h) Records and reports; compilation and publication; availability.

24 In addition to such records as are specifically required by this chapter, every operator of
25 a coal or other mine shall establish and maintain such records, make such reports, and
26 provide such information, as the Secretary (of Labor) or the Secretary of Health and
27 Human Services may reasonably require from time to time to enable him to perform his
28 functions under this chapter.

29 [30 USC 801 et.seq., Section 813]

30 Table F1.4.1.1 Function Description: Handle Waste

31 I. Function ID Number: 1.4.1.1

32 II. Function Title: Handle Waste

33 III. Function Definition:

34 To receive, prepare, transfer between surface and underground locations, emplace, and (if
35 required) retrieve radioactive waste.

36 The capability for performing this function is necessary from the start of waste receipt at
37 the geologic repository. Each shipment requires this capability from the time of transfer
38 of the shipment to the repository until completion of emplacement to satisfy the possibility
39 of retrieval. The capability must remain available through the start of permanent closure.

1 **IV. Interfaces:**

2 **A. Inputs:**

3 1.4.1.111 Loaded SNF Cask/Carriage From: Function 1.2
4 1.4.1.112 Loaded CHLW Cask/Carriage From: Function 1.2
5 1.4.1.113 Loaded DHLW Cask/Carriage From: Function 1.2
6 1.4.1.114 Waste Container From: Function 1.4.1.4
7 1.4.1.115 Intake Air From: Function 1.4.1.4
8 1.4.1.116 Subsurface Openings From: Function 1.4.1.2

9 **B. Outputs:**

10 1.4.1.101 Empty Cask/Carriage To: Function 1.2
11 1.4.1.102 Site Generated Waste (Rad) To: Function 1.4.1.4
12 1.4.1.103 Emplaced Waste Package To: Function 1.4.1.3
13 1.4.1.104 Surface Facilities To: Function 1.4.1.3
14 1.4.1.105 Exhaust Air To: Function 1.4.1.4
15 1.4.1.106 Records (verified) To: Function 1.4.1.4
16 1.4.1.107 Heat To: Accessible Environment
17 1.4.1.108 [Retrieved Waste] To: Outside System Boundary

18 **V. Function Requirements:**

19 **A. Constraints:**

20 1.4.1.1C1 Sections 60.131 through 60.134 specify minimum criteria for the design of the
21 geologic repository operations area. These design criteria are not intended to be exhaustive,
22 however. Omissions in 60.131 through 60.134 do not relieve DOE from any obligation to
23 provide such safety features in a specific facility needed to achieve the performance
24 objectives. ... [10 CFR 60.130]

25 (a) Facilities for receipt and retrieval of waste. Surface facilities in the geologic repository
26 operations area shall be designed to allow safe handling and storage of wastes at the
27 geologic repository operations area, whether these wastes are on the surface before
28 emplacement or as a result of retrieval from the underground facility.

[10 CFR 60.132]

29
30 1.4.1.1C2 (2) Free liquids. The waste package shall not contain free liquids in an amount
31 that could compromise the ability of the waste packages to achieve the performance
32 objectives relating to containment of HLW (because of chemical interactions or formation
33 of pressurized vapor) or result in spillage and spread of contamination in the event of waste
34 package perforation during the period through permanent closure.

[10 CFR 60.135(b)]

35
36 1.4.1.1C3 (3) Handling. Waste packages shall be designed to maintain waste containment
37 during transportation, emplacement, and retrieval.

[10 CFR 60.135(b)]

38
39 1.4.1.1C4 (4) Unique identification. A label or other means of identification shall be
40 provided for each waste package. The identification shall not impair the integrity of the
41 waste package and shall be applied in such a way that the information shall be legible at
42 least to the end of the period of retrievability. Each waste package identification shall be
43 consistent with the waste package's permanent written records.
44

[10 CFR 60.135(b)]

45 **B. Performance:** Requirements at this level to be specified

C. Interface:

1.4.1.1I1 Same requirements as specified for 1.4.1I01

1.4.1.1I2 Same requirements as specified for 1.4.1I02

1.4.1.1I3 Same requirements as specified for 1.4.1I03

1.4.1.1I4 Requirements at this level to be specified

1.4.1.1I5 Requirements at this level to be specified

1.4.1.1I6 Requirements at this level to be specified

1.4.1.1O1 Requirements at this level to be specified

1.4.1.1O2 Requirements at this level to be specified

1.4.1.1O3 Requirements at this level to be specified

1.4.1.1O4 Requirements at this level to be specified

1.4.1.1O5 Requirements at this level to be specified

1.4.1.1O6 (b) Records of the receipt, handling, and disposition of radioactive waste at a geologic repository operations area shall contain sufficient information to provide a complete history of the movement of the waste from the shipper through all phases of storage and disposal. DOE shall retain these records in a manner that ensures their useability for future generations in accordance with 60.51(a)(2).

[10 CFR 60.71]

1.4.1.1O7 Requirements at this level to be specified

1.4.1.1O8 Requirements at this level to be specified

Table F1.4.1.1.1 Function Description: Receive Waste

I. Function ID Number: 1.4.1.1.1

II. Function Title: Receive Waste

III. Function Definition:

To receive and assume custody of radioactive waste shipments at the repository from the external transportation system; perform inspections of incoming transportation system components before receipt; inspect, identify, and document all radioactive waste received from offsite; separate and provide temporary storage for transportation system components; and remove loaded shipping casks for subsequent processing.

DOE shall not receive or possess source, special nuclear, or byproduct material at a geologic repository operations area except as authorized by a license issued by the Commission pursuant to this part. [10 CFR 60.3(a)]

IV. Interfaces:

A. Inputs:

1.4.1.1.I1	Loaded SNF Cask/Carriage	From: Function 1.2
1.4.1.1.I2	Loaded CHLW Cask/Carriage	From: Function 1.2
1.4.1.1.I3	Loaded DHLW Cask/Carriage	From: Function 1.2
1.4.1.1.I4	Records	From: Function 1.2

B. Outputs:

1.4.1.1.1O1	Empty Carriage	To:	Function 1.2
1.4.1.1.1O2	Loaded Shipping Cask	To:	Function 1.4.1.1.2
1.4.1.1.1O3	Accepted Records	To:	Function 1.4.1.1.2

V. Function Requirements:

A. Constraints:

1.4.1.1.1C1 DOE shall not receive or possess source, special nuclear, or byproduct material at a geologic repository operations area except as authorized by a license issued by the Commission pursuant to this part. [10 CFR 60.3(a)]

B. Performance: Requirements at this level to be specified

C. Interface:

1.4.1.1.1I1 Same requirements as specified in 1.4.1.1O1
1.4.1.1.1I2 Same requirements as specified in 1.4.1.1O2
1.4.1.1.1I3 Same requirements as specified in 1.4.1.1O3
1.4.1.1.1I4 Requirements at this level to be specified
1.4.1.1.1O1 Requirements at this level to be specified
1.4.1.1.1O2 Requirements at this level to be specified
1.4.1.1.1O3 Requirements at this level to be specified

Table F1.4.1.1.1.1 Function Description: Inspect Cask/Transfer Custody To Repository

I. Function ID Number: 1.4.1.1.1.1

II. Function Title: Inspect Cask/Transfer Custody to Repository

III. Function Definition:

Upon arrival of a loaded shipping cask/carriage, at the repository boundary, the accompanying waste records are transferred to repository personnel, and the shipping cask is inspected for the presence of explosives or other unauthorized material and radiation leakage. Any abnormal casks are disposed and handled appropriately.

IV. Interfaces:

A. Inputs:

1.4.1.1.1.1I1	Loaded SNF Cask/Carriage	From:	Function 1.2
1.4.1.1.1.1I2	Loaded CHLW Cask/Carriage	From:	Function 1.2
1.4.1.1.1.1I3	Loaded DHLW Cask/Carriage	From:	Function 1.2
1.4.1.1.1.1I4	Records	From:	Function 1.2

B. Outputs:

1.4.1.1.1.1O1	Accepted Records	To:	Function 1.4.1.1.2
1.4.1.1.1.1O2	Loaded Shipping Cask/Carriage	To:	Function 1.4.1.1.2/1.4.1.1.3

V. Function Requirements:

A. Constraints: Requirements at this level to be specified

B. Performance: Requirements at this level to be specified

C. Interface:

- 1.4.1.1.1I1 Same requirements as specified in 1.4.1I1
1.4.1.1.1I2 Same requirements as specified in 1.4.1I2
1.4.1.1.1I3 Same requirements as specified in 1.4.1I3
1.4.1.1.1I4 Requirements at this level to be specified
1.4.1.1.1O1 Requirements at this level to be specified
1.4.1.1.1O2 Requirements at this level to be specified
-
-

8 **Table F1.4.1.1.2 Function Description: Store Shipping Cask/Carriage**

9 **I. Function ID Number:** 1.4.1.1.2

10 **II. Function Title:** Store Shipping Cask/Carriage

11 **III. Function Definition:**

12 The shipping cask/carriage is temporarily stored onsite at a location for either normal or
13 abnormal casks - awaiting packaging for permanent disposal.

14 **IV. Interfaces:**

15 **A. Inputs:**

16 1.4.1.1.2I1 Loaded Shipping Cask/Carriage **From:** Function 1.4.1.1.1

17 **B. Outputs:**

1.4.1.1.2O1 Loaded Shipping Cask/Carriage **To:** Function 1.4.1.1.3

18 **V. Function Requirements:** Requirements at this level to be specified

20 **Table F1.4.1.1.3 Function Description: Remove Loaded Cask From Carriage**

21 **I. Function ID Number:** 1.4.1.1.3

22 **II. Function Title:** Remove Loaded Cask from Carriage

23 **III. Function Definition:**

24 The loaded shipping cask is removed from the carriage to facilitate cask opening and waste
25 processing.

26 **IV. Interfaces:**

27 **A. Inputs:**

28 1.4.1.1.3I1 Loaded Shipping Cask/Carriage **From:** Function 1.4.1.1.1
29 Function 1.4.1.1.2

B. Outputs:

1.4.1.1.3O1	Empty Carriage	To:	Function 1.2
1.4.1.1.3O2	Loaded Shipping Cask	To:	Function 1.4.1.1.2

V. Function Requirements: Requirements at this level to be specified

Table F1.4.1.1.2 Function Description: Prepare Waste

I. Function ID Number: 1.4.1.1.2

II. Function Title: Prepare Waste

III. Function Definition:

To prepare radioactive wastes as received from the transportation system for repository emplacement by: removing and containerizing (if necessary) radioactive wastes received in transportation shipping casks. This function includes providing lag storage capacity for both incoming radioactive wastes and for prepared containers awaiting transport and emplacement. To prepare radioactive waste as received from offsite for emplacement; and repair damaged waste canisters.

IV. Interfaces:

A. Inputs:

1.4.1.1.2I1	Loaded Shipping Cask	From:	Function 1.4.1.1.1
1.4.1.1.2I2	Accepted Records	From:	Function 1.4.1.1.1
1.4.1.1.2I3	Waste Container	From:	Function 1.4.1.4

B. Outputs:

1.4.1.1.2O1	Records (verified)	To:	Function 1.4.1.4
1.4.1.1.2O2	Site Generated Waste (Rad)	To:	Function 1.4.1.4
1.4.1.1.2O3	Heat	To:	Accessible Environment
1.4.1.1.2O4	Empty Cask/Carriage	To:	Function 1.2
1.4.1.1.2O5	Containerized Waste	To:	Function 1.4.1.1.3

V. Function Requirements: Requirements at this level to be specified

Table F1.4.1.1.2.1 Function Description: Remove Waste From Shipping Cask

I. Function ID Number: 1.4.1.1.2.1

II. Function Title: Remove Waste from Shipping Cask

III. Function Definition:

The high level waste or spent nuclear fuel is removed from the shipping cask.

IV. Interfaces:

A. Inputs:

1.4.1.1.2.1I1	Loaded Shipping Cask	From:	Function 1.4.1.1.1.3
1.4.1.1.2.1I2	Accepted Records	From:	Function 1.4.1.1.1

B. Outputs:

1.4.1.1.2.1O1	Records (Verified)	To:	Function 1.4.1.4
1.4.1.1.2.1O2	Empty Shipping cask	To:	Function 1.2
1.4.1.1.2.1O3	Waste	To:	Function 1.4.1.1.2.2/ 1.4.1.1.2.3
1.4.1.1.2.1O4	Site Generated Waste (Rad)	To:	Function 1.4.1.4
1.4.1.1.2.1O5	Heat	To:	Accessible Environment

V. Function Requirements: Requirements at this level to be specified

Table F1.4.1.1.2.2 Function Description: Store Waste

I. Function ID Number: 1.4.1.1.2.2

II. Function Title: Store Waste

III. Function Definition:

The canistered waste is temporarily stored in lag storage - awaiting containerization.

IV. Interfaces:

A. Inputs:

1.4.1.1.2.2I1	Waste	From:	Function 1.4.1.1.2.1
---------------	-------	-------	----------------------

B. Outputs:

1.4.1.1.2.2O1	Waste	To:	Function 1.4.1.1.2.3
1.4.1.1.2.2O2	Heat	To:	Accessible Environment

V. Function Requirements:

A. Constraints:

1.4.1.1.2.2C1 (b) The geologic repository operations area. (3) The exercise of Commission authority requires that the geologic repository operations area be used for storage (which includes disposal) of high-level radioactive wastes (HLW).

[10 CFR 60.102]

B. Performance: Requirements at this level to be specified

C. Interface: Requirements at this level to be specified

Table F1.4.1.1.2.3 Function Description: Containerize Waste

I. Function ID Number: 1.4.1.1.2.3

II. Function Title: Containerize Waste

III. Function Definition:

The high level waste or spent nuclear fuel is placed into a permanent disposal container along with any other engineered barriers (if necessary) such as fillers, liners, etc., sealed and inspected for container integrity.

1 **IV. Interfaces:**

2 **A. Inputs:**

1.4.1.1.2.3I1 Waste From: Function 1.4.1.1.2.1/
1.4.1.1.2.3I2 Waste Container From: Function 1.4.1.1.2.2
1.4.1.1.2.3I2 From: Function 1.4.1.4

6 **B. Outputs:**

7 1.4.1.1.2.3O1 This output intentionally left blank
8 1.4.1.1.2.3O2 Heat To: Accessible Environment
9 1.4.1.1.2.3O3 Containerized Waste To: Function 1.4.1.1.2.4/
10 1.4.1.1.2.3O4 Site Generated Waste To: Function 1.4.1.4
11 (Rad)
12

13 **V. Function Requirements:**

14 **Constraints:** Requirements at this level to be specified

15 **Performance:** Requirements at this level to be specified

16 **Interface:**

17 1.4.1.1.2.3I1 Requirements at this level to be specified

18 1.4.1.1.2.3I2 Requirements at this level to be specified

19 1.4.1.1.2.3O1 This requirement intentionally left blank

20 1.4.1.1.2.3O2 Requirements at this level to be specified

21 1.4.1.1.2.3O3a Specific criteria for HLW package design. (1) Explosive, pyrophoric, and
22 chemically reactive materials. The waste package shall not contain explosive or pyrophoric
23 materials or chemically reactive materials in an amount that could compromise the ability
24 of the underground facility to contribute to waste isolation or the ability of the geologic
25 repository to satisfy the performance objectives. (2) Free liquids. The waste package shall
not contain free liquids in an amount that could compromise the ability of the waste
packages to achieve the performance objectives relating to containment of HLW (because
of chemical interactions or formation of pressurized vapor) or result in spillage and spread
of contamination in the event of waste package perforation during the period through
permanent closure.

[10 CFR 60.135(b)]

31 1.4.1.1.2.3O3b (c) Waste form criteria for HLW. High-level radioactive waste that is
32 emplaced in the underground facility shall be designed to meet the following criteria:
33

34 (1) Solidification. All such radioactive wastes shall be in solid form and placed in
35 sealed containers.

36 (2) Consolidation. Particulate waste forms shall be consolidated (for example, by
37 incorporation into an encapsulated matrix) to limit the availability and generation
38 of particulates.

39 (3) Combustibles. All combustible radioactive wastes shall be reduced to a
40 noncombustible form unless it can be demonstrated that a fire involving the waste
41 packages containing combustibles will not compromise the integrity of other waste
42 packages, adversely affect any structures, systems, or components important to
43 safety, or compromise the ability of the underground facility to contribute to waste
44 isolation.
45

[10 CFR 60.135]

46 1.4.1.1.2.3O4 Requirements at this level to be specified

1 **Table F1.4.1.1.2.4 Function Description: Store Containerized Waste**

2 **I. Function ID Number:** 1.4.1.1.2.4

3 **II. Function Title:** Store Containerized Waste

4 **III. Function Definition:**

5 The containerized waste is temporarily stored onsite -awaiting transfer underground.

6 **IV. Interfaces:**

7 **A. Inputs:**

8 1.4.1.1.2.4I1 Containerized Waste **From:** Function 1.4.1.1.2.3

9 **B. Outputs:**

10 1.4.1.1.2.4O1 Containerized Waste **To:** Function 1.4.1.1.3
11 1.4.1.1.2.4O2 Heat **To:** Accessible Environment

12 **V. Function Requirements:**

13 **A. Constraints:**

14 1.4.1.1.2.4C1 (b) The geologic repository operations area. (3) The exercise of
15 Commission authority requires that the geologic repository operations area
16 be used for storage (which includes disposal) of high-level radioactive wastes
17 (HLW).

18 [10 CFR 60.102]

19 **B. Performance:** Requirements at this level to be specified

20 **C. Interface:** Requirements at this level to be specified

21 **Table F1.4.1.1.3 Function Description: Transfer Containerized Waste to Underground**

22 **I. Function ID Number:** 1.4.1.1.3

23 **II. Function Title:** Transfer Containerized Waste to Underground

24 **III. Function Definition:**

25 To transfer containerized radioactive waste between surface preparation and storage areas
26 and underground waste-handling areas.

27 **IV. Interfaces:**

28 **A. Inputs:**

29 1.4.1.1.3I1 Containerized Waste **From:** Function 1.4.1.1.2

30 **B. Outputs:**

31 1.4.1.1.3O1 Containerized Waste **To:** Function 1.4.1.1.4

1 **V. Function Requirements:**

2 **A. Constraints:**

3 1.4.1.1.3C1 Sections 60.131 through 60.134 specify minimum criteria for the design of the
4 geologic repository operations area. These design criteria are not intended to be exhaustive,
5 however. Omissions in 60.131 through 60.134 do not relieve DOE from any obligation to
6 provide such safety features in a specific facility needed to achieve the performance
7 objectives [10 CFR 60.130]

8 (10) Shaft conveyances used in radioactive waste handling.

9 (i) Hoists important to safety shall be designed to preclude cage free fall.

10 (ii) Hoists important to safety shall be designed with a reliable cage location
11 system.

12 (iii) Loading and unloading systems for hoists important to safety shall be
13 designed with a reliable system of interlocks that will fail safely upon
14 malfunction.

15 (iv) Hoists important to safety shall be designed to include two independent
16 indicators to indicate when waste packages are in place and ready for transfer.

17 [10 CFR 60.131(b)]

18 **B. Performance:** Requirements at this level to be specified

19 **C. Interface:** Requirements at this level to be specified

20 **Table F1.4.1.1.4 Function Description: Emplace Waste**

21 **I. Function ID Number:** 1.4.1.1.4

22 **II. Function Title:** Emplace Waste

23 **III. Function Definition:**

24 To place radioactive wastes underground after designated emplacement locations are
25 prepared. Engineered barriers (if necessary) such as buffers, overpacks etc. are also
26 emplaced.

27 **IV. Interfaces:**

28 **A. Inputs:**

29 1.4.1.1.4I1 Containerized Waste From: Function 1.4.1.1.3
30 1.4.1.1.4I2 Subsurface Openings From: Function 1.4.1.2

31 **B. Outputs:**

32 1.4.1.1.4O1 Heat To: Accessible Environment
33 1.4.1.1.4O2 Emplaced Waste Packages To: Function 1.4.1.3/
34 1.4.1.1.5
35 1.4.1.1.4O3 Records (Verified) To: Function 1.4.1.4

36 **V. Function Requirements:** Requirements at this level to be specified

1 **Table F1.4.1.1.5 Function Description: Retrieve Waste**

2 **I. Function ID Number: 1.4.1.1.5**

3 **II. Function Title: Retrieve Waste**

4 **III. Function Definition:**

5 "Retrieval" means the act of intentionally removing radioactive waste from the underground
6 location at which the waste had been previously emplaced for disposal. [10 CFR 60.2]

7 A description of plans for retrieval and alternate storage of the radioactive wastes should
8 the geologic repository prove to be unsuitable for disposal of radioactive wastes. [10 CFR
9 60.21(c)(12)]

10 **IV. Interfaces:**

11 **A. Inputs:**

12 1.4.1.1.5I1 Emplaced Waste Packages From: 1.4.1.1.4

13 **B. Outputs:**

14 1.4.1.1.5O1 [Retrieved Waste] To: Outside System Boundary

15 **V. Function Requirements: Requirements at this level to be specified**

16 **Table F1.4.1.2 Function Description: Develop Subsurface Openings**

17 **I. Function ID Number: 1.4.1.2**

18 **II. Function Title: Develop Subsurface Openings**

19 **III. Function Definition:**

20 To continue and complete development of necessary subsurface openings required for
21 geologic repository operations and to backfill openings, if required, prior to the start of
22 closure of the repository - This includes performing all operations needed to construct the
23 subsurface openings, handle excavated rock and backfill materials, and (if required) to
24 backfill subsurface openings.

25 The time period covered under this function is from the start of waste receipt at the
26 geologic repository to the beginning of permanent closure.

27 "Underground facility" means the underground structure, including openings and backfill
28 materials, but excluding shafts, boreholes and their seals. [10 CFR 60.2]

29 "Host rock" means the geologic medium in which the waste is emplaced. [10 CFR 60.2]

30 **IV. Interfaces:**

31 **A. Inputs:**

32 1.4.1.2I1 Site From: Controlled Area
33 1.4.1.2I2 Intake Air From: Function 1.4.1.4

B. Outputs:

1.4.1.2O1	Subsurface Openings	To:	Function 1.4.1.1/1.4.1.3
1.4.1.2O2	Excavated Rock	To:	Outside System Boundary
1.4.1.2O3	Site Generated Waste (Non-Rad)	To:	Function 1.4.1.4
1.4.1.2O4	Exhaust Air	To:	Function 1.4.1.4
1.4.1.2O5	Records	To:	Function 1.4.1.4

V. Function Requirements:

A. Constraints:

1.4.1.2C1 Sections 60.131 through 60.134 specify minimum criteria for the design of the geologic repository operations area. These design criteria are not intended to be exhaustive, however. Omissions in Sections 60.131 through 60.134 do not relieve DOE from any obligation to provide such safety features in a specific facility needed to achieve the performance objectives [10 CFR 60.130]

(a) General criteria for the underground facility.

(1) The orientation, geometry, layout, and depth of the underground facility, and the design of any engineered barriers that are part of the underground facility shall contribute to the containment and isolation of radionuclides.

(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.

[10 CFR 60.133]

1.4.1.2C2 Sections 60.131 through 60.134 specify minimum criteria for the design of the geologic repository operations area. These design criteria are not intended to be exhaustive, however. Omissions in Sections 60.131 through 60.134 do not relieve DOE from any obligation to provide such safety features in a specific facility needed to achieve the performance objectives [10 CFR 60.130]

(b) Flexibility of design. The underground facility shall be designed with sufficient flexibility to allow adjustments where necessary to accommodate specific site conditions identified through in situ monitoring, testing, or excavation.

[10 CFR 60.133]

1.4.1.2C3 Sections 60.131 through 60.134 specify minimum criteria for the design of the geologic repository operations area. These design criteria are not intended to be exhaustive, however. Omissions in Sections 60.131 through 60.134 do not relieve DOE from any obligation to provide such safety features in a specific facility needed to achieve the performance objectives [10 CFR 60.130]

(c) Retrieval of waste. The underground facility shall be designed to permit retrieval of waste in accordance with the performance objectives of Section 60.111.

[10 CFR 60.133]

1.4.1.2C4 Sections 60.131 through 60.134 specify minimum criteria for the design of the geologic repository operations area. These design criteria are not intended to be exhaustive, however. Omissions in 60.131 through 60.134 do not relieve DOE from any obligation to provide such safety features in a specific facility needed to achieve the performance objectives [10 CFR 60.130]

(d) Control of water and gas. The design of the underground facility shall provide for control of water or gas intrusion.

[10 CFR 60.133]

1 1.4.1.2C5 Sections 60.131 through 60.134 specify minimum criteria for the design of the
2 geologic repository operations area. These design criteria are not intended to be exhaustive,
3 however. Omissions in Sections 60.131 through 60.134 do not relieve DOE from any
4 obligation to provide such safety features in a specific facility needed to achieve the
5 performance objectives [10 CFR 60.130]

(e) Underground openings.

7 (1) Openings in the underground facility shall be designed so that operations
8 can be carried out safely and the retrievability option maintained.

9 [10 CFR 60.133]

10 1.4.1.2C6 Sections 60.131 through 60.134 specify minimum criteria for the design of the
11 geologic repository operations area. These design criteria are not intended to be exhaustive,
12 however. Omissions in Sections 60.131 through 60.134 do not relieve DOE from any
13 obligation to provide such safety features in a specific facility needed to achieve the
14 performance objectives [10 CFR 60.130]

15 (i) Thermal loads. The underground facility shall be designed so that the
16 performance objectives will be met taking into account the predicted thermal and
17 thermomechanical response of the host rock, and surrounding strata, groundwater
18 system.

19 [10 CFR 60.133]

20 1.4.1.2C7 (c) A backfill test section shall be constructed to test the effectiveness of backfill
21 placement and compaction procedures against design requirements before permanent backfill
22 placement is begun.

23 (d) Test sections shall be established to test the effectiveness of borehole and shaft seals
24 before full-scale operation proceeds to seal boreholes and shafts.

25 [10 CFR 60.142]

26 1.4.1.2C8 (a) Qualifying condition. The present and expected characteristics of the host
27 rock and surrounding units shall be capable of accommodating the thermal, chemical,
mechanical, and radiation stresses expected to be induced by repository construction,
operation, and closure and by expected interactions among the waste, host rock, ground
water, and engineered components. The characteristics of and the processes operating within
the geologic setting shall permit compliance with (1) the requirements specified in Section
960.4-1 for radionuclide releases to the accessible environment and (2) the requirements
set forth in 10 CFR 60.113 for radionuclide releases from the engineered-barrier system
using reasonably available technology.

30 [10 CFR 960.4-2-3]

36 1.4.1.2C9 (d) Disqualifying condition. The site shall be disqualified if site conditions do not
37 allow all portions of the underground facility to be situated at least 200 meters below the
38 directly overlying ground surface.

39 [10 CFR 960.4-2-5]

40 B. Performance: Requirements at this level to be specified

C. Interface:

1.4.1.211 Requirements at this level to be specified

1.4.1.212 Sections 60.131 through 60.134 specify minimum criteria for the design of the geologic repository operations area. These design criteria are not intended to be exhaustive, however. Omissions in Sections 60.131 through 60.134 do not relieve DOE from any obligation to provide such safety features in a specific facility needed to achieve the performance objectives [10 CFR 60.130]

(g) Underground facility ventilation. The ventilation system shall be designed to: ...

- (3) Separate the ventilation of excavation and waste emplacement areas.

[10 CFR 60.133]

1.4.1.201 Requirements at this level to be specified

1.4.1.202 Requirements at this level to be specified

1.4.1.203 Requirements at this level to be specified

1.4.1.204 Sections 60.131 through 60.134 specify minimum criteria for the design of the geologic repository operations area. These design criteria are not intended to be exhaustive, however. Omissions in Sections 60.131 through 60.134 do not relieve DOE from any obligation to provide such safety features in a specific facility needed to achieve the performance objectives [10 CFR 60.130]

(g) Underground facility ventilation. The ventilation system shall be designed to:

- (3) Separate the ventilation of excavation and waste emplacement areas.

[10 CFR 60.133]

1.4.1.205 (a) DOE shall maintain records of construction of the geologic repository operations area in a manner that ensures their useability for future generations in accordance with Section 60.51(a)(2).

(b) The records required under paragraph (a) shall include at least the following:

- 1) Surveys of the underground facility excavations, shafts, and boreholes referenced to readily identifiable surface 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; and
- 11) Details, methods of emplacement, and location of seals used.

[10 CFR 60.72]

1 **Table F1.4.1.2.1 Function Description: Construct Subsurface Openings**

2 **I. Function ID Number:** 1.4.1.2.1

3 **II. Function Title:** Construct Subsurface Openings

4 **III. Function Definition:**

5 To continue and complete the excavation and stabilization of all necessary subsurface
6 openings required for supporting waste handling systems after the start of repository
7 operations and to install any support services needed for these operations.

8 The time period covered under this function is from the start of waste receipt at the
9 geologic repository to the time when the need for construction of such openings ceases
10 prior to the permanent closure of the repository.

11 **IV. Interfaces:**

12 **A. Inputs:**

13 1.4.1.2.1I1 Site From: Controlled Area

14 **B. Outputs:**

15 1.4.1.2.1O1 Rock Samples To: Outside System Boundary
16 1.4.1.2.1O2 Lost Fluids To: Accessible Environment
17 1.4.1.2.1O3 Excavated Rock To: Function 1.4.1.2.2
18 1.4.1.2.1O4 Subsurface Openings To: Function 1.4.1.2.5/1.4.1.1/1.4.1.3/
19 1.4.1.4
20 1.4.1.2.1O5 Records To: Function 1.4.1.4
21 1.4.1.2.1O6 Site-Generated Waste To: Function 1.4.1.4
22 (Non-Rad)

23 **V. Function Requirements:**

24 **A. Constraints:**

25 1.4.1.2.1C1 Sections 60.131 through 60.134 specify minimum criteria for the design of the
26 geologic repository operations area. These design criteria are not intended to be exhaustive,
27 however. Omissions in Sections 60.131 through 60.134 do not relieve DOE from any
28 obligation to provide such safety features in a specific facility needed to achieve the
29 performance objectives [10 CFR 60.130]

30 (e) Underground openings ...

31 (2) Openings in the underground facility shall be designed to reduce the
32 potential for deleterious rock movement or fracturing of overlying or
33 surrounding rock.
34 [10 CFR 60.133]

35 1.4.1.2.1C2 Sections 60.131 through 60.134 specify minimum criteria for the design of the
36 geologic repository operations area. These design criteria are not intended to be exhaustive,
37 however. Omissions in Sections 60.131 through 60.134 do not relieve DOE from any
38 obligation to provide such safety features in a specific facility needed to achieve the
39 performance objectives [10 CFR 60.130]

40 (f) Rock excavation. The design of the underground facility shall incorporate
41 excavation methods that will limit the potential for creating a preferential pathway
42 for groundwater to contact the waste packages or radionuclide migration to the
43 accessible environment.
44 [10 CFR 60.133]

45 **B. Performance:** Requirements at this level to be specified

46 **C. Interface:** Requirements at this level to be specified

1 Table F1.4.1.2.1.1 Function Description: Excavate Subsurface Openings

2 I. Function ID Number: 1.4.1.2.1.1

3 II. Function Title: Excavate Subsurface Openings

4 III. Function Definition:

5 To continue and complete excavation of all necessary subsurface openings required for
6 supporting waste-handling systems after start of repository operations.

7 The time period covered under this function is from the start of waste receipt at the
8 geologic repository to the time when the need for excavation of such openings ceases prior
9 to the permanent closure of the repository.

10 IV. Interfaces:

11 A. Inputs:

12 1.4.1.2.1.1I1 Site From: Controlled Area

13 B. Outputs:

14 1.4.1.2.1.1O1 Rock Samples To: Outside System Boundary
15 1.4.1.2.1.1O2 Excavated Rock To: Function 1.4.1.2.2
16 1.4.1.2.1.1O3 Unsupported Subsurface To: Function 1.4.1.2.1.2
17 Openings
18 1.4.1.2.1.1O4 Lost Fluids To: Accessible Environment
19 1.4.1.2.1.1O5 Site Generated Waste To: Function 1.4.1.4
20 (Non-Rad)
21 1.4.1.2.1.1O6 Dust To: Accessible Environment

22 V. Function Requirements:

23 A. Constraints: Requirements at this level to be specified

24 B. Performance: Requirements at this level to be specified

25 C. Interface:

26 1.4.1.2.1.1I1 Requirements at this level to be specified

27 1.4.1.2.1.1O1 Requirements at this level to be specified

28 1.4.1.2.1.1O2 Rock dust and gas hazards; controls.

29 The dust resulting from drilling in rock shall be controlled by the use of permissible dust
30 collectors, or by water or water with a wetting agent, or by ventilation, or by any other
31 method or device approved by the Secretary (of Labor) which is at least as effective in
32 controlling such dust. Respiratory equipment approved by the Secretary (of Labor) and the
33 Secretary of Health and Human Services shall be provided persons exposed for short
34 periods to inhalation hazards from gas, dusts, fumes or mist. When the exposure is for
35 prolonged periods, other measures to protect such persons or to reduce the hazard shall
36 be taken.

[30 USC 801 et.seq., Section 844]

38 1.4.1.2.1.1O3 Requirements at this level to be specified

39 1.4.1.2.1.1O4 Requirements at this level to be specified

40 1.4.1.2.1.1O5 Requirements at this level to be specified

Table F1.4.1.2.1.2 Function Description: Stabilize Subsurface Openings

2 **I. Function ID Number:** 1.4.1.2.1.2

3 **II. Function Title:** Stabilize Subsurface Openings

4 **III. Function Definition:**

5 To continue and complete stabilization (ground support) as necessary excavated subsurface
6 openings required for supporting waste-handling systems, and, if necessary, retrieval systems,
7 after start of repository operations.

8 The time period covered under this function is from the start of waste receipt at the
9 geologic repository to the time when the need for stabilization of such openings ceases prior
10 to the permanent closure of the repository.

11 **IV. Interfaces:**

12 **A. Inputs:**

13 1.4.1.2.1.2I1 Unsupported Subsurface **From:** Function 1.4.1.2.1.1
14 1.4.1.2.1.2I2 Ground Support Materials **From:** Outside System Boundary

15 **B. Outputs:**

16 1.4.1.2.1.2O1 Site Generated Waste **To:** Function 1.4.1.4
17 1.4.1.2.1.2O2 Stabilized Subsurface **To:** Function 1.4.1.2.1.3
18 Openings
19 1.4.1.2.1.2O3 Records **To:** Function 1.4.1.4

20 **V. Function Requirements:** Requirements at this level to be specified

21 **Table F1.4.1.2.1.3 Function Description: Install Operational Support Services**

22 **I. Function ID Number:** 1.4.1.2.1.3

23 **II. Function Title:** Install Operational Support Services

24 **III. Function Definition:**

25 To continue and complete installation of necessary operational support services during the
26 construction of such openings after start of repository operations.

27 The time period covered under this function is from the start of waste receipt at the
28 geologic repository to the time when the needed construction of such openings is completed
29 prior to permanent closure of the repository.

30 **IV. Interfaces:**

31 **A. Inputs:**

32 1.4.1.2.1.3I1 Stabilized Subsurface **From:** Function 1.4.1.2.1.2
33 Openings

34 **B. Outputs:**

35 1.4.1.2.1.3O1 Subsurface Openings **To:** Function 1.4.1.1/1.4.1.3/1.4.1.2.5

V. Function Requirements: Requirements at this level to be specified

2 Table F1.4.1.2.2 Function Description: Handle/Process Excavated Rock

3 I. Function ID Number: 1.4.1.2.2

4 II. Function Title: Handle/Process Excavated Rock

5 III. Function Definition:

6 To provide for loading, processing, transferring, and unloading excavated rock from new
7 subsurface openings in the geologic repository.

8 The time period covered under this function is from the start of repository operations to
9 the time when all the needed subsurface openings have been excavated prior to the closure
10 of geologic repository.

11 IV. Interfaces:

12 A. Inputs:

13 1.4.1.2.2I1 Excavated Rock From: Function 1.4.1.2.1

14 B. Outputs:

1.4.1.2.2O1 Excavated Rock To: Function 1.4.1.2.3/1.4.1.2.4
1.4.1.2.2O2 Dust To: Accessible Environment
1.4.1.2.2O3 Noise To: Accessible Environment

18 V. Function Requirements: Requirements at this level to be specified

19 Table F1.4.1.2.2.1 Function Description: Load Excavated Rock

20 I. Function ID Number: 1.4.1.2.2.1

21 II. Function Title: Load Excavated Rock

22 III. Function Definition:

23 To provide for loading excavated rock for further handling/processing from the newly
24 excavated subsurface openings in the geologic repository.

25 The time period covered under this function is from the start of repository operations to
26 the time when all needed subsurface openings have been excavated prior to the closure of
27 the geologic repository.

28 IV. Interfaces:

29 A. Inputs:

30 1.4.1.2.2.1I1 Excavated Rock From: Function 1.4.1.2.1

B. Outputs:

1.4.1.2.2.1O1	Noise	To:	Accessible Environment
1.4.1.2.2.1O2	Dust	To:	Accessible Environment
1.4.1.2.2.1O3	Excavated Rock	To:	Function 1.4.1.2.2.2/1.4.1.2.2.3

V. Function Requirements: Requirements at this level to be specified

Table F1.4.1.2.2.2 Function Description: Process Excavated Rock

I. Function ID Number: 1.4.1.2.2.2

II. Function Title: Process Excavated Rock

III. Function Definition:

To provide for processing (such as sizing) of the excavated rock for further handling, from the newly excavated subsurface openings in the geologic repository.

The time period covered under this function is from the start of repository operations to the time when all needed subsurface openings have been excavated prior to the closure of the geologic repository.

IV. Interfaces:

A. Inputs:

1.4.1.2.2.2I1	Excavated Rock	From:	Function 1.4.1.2.2.1
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B. Outputs:

1.4.1.2.2.2O1	Dust	To:	Accessible Environment
1.4.1.2.2.2O2	Noise	To:	Accessible Environment
1.4.1.2.2.2O3	[Sized Rock]	To:	Function 1.4.1.2.2.3

V. Function Requirements: Requirements at this level to be specified

Table F1.4.1.2.2.3 Function Description: Transfer Excavated Rock

I. Function ID Number: 1.4.1.2.2.3

II. Function Title: Transfer Excavated Rock

III. Function Definition:

To provide for transferring excavated rock (sized if required) between points from the newly excavated subsurface openings in the geologic repository.

The time period covered under this function is from the start of repository operations to the time when all needed subsurface openings have been excavated prior to the closure of the geologic repository.

IV. Interfaces:

A. Inputs:

1.4.1.2.2.3I1	[Sized Rock]	From:	Function 1.4.1.2.2.2
1.4.1.2.2.3I2	Excavated Rock	From:	Function 1.4.1.2.2.1

B. Outputs:

1.4.1.2.2.3O1	Dust	To:	Accessible Environment
1.4.1.2.2.3O2	Noise	To:	Accessible Environment
1.4.1.2.2.3O3	Excavated Rock	To:	Function 1.4.1.2.2.4

V. Function Requirements: Requirements at this level to be specified

Table F1.4.1.2.2.4 Function Description: Unload Excavated Rock

I. Function ID Number: 1.4.1.2.2.4

II. Function Title: Unload Excavated Rock

III. Function Definition:

To provide for unloading the excavated rock after transfer from the newly excavated subsurface openings in the geologic repository.

The time period covered under this function is from the start of repository operations to the time when all needed subsurface openings have been excavated prior to the closure of the geologic repository.

IV. Interfaces:

A. Inputs:

1.4.1.2.2.4I1	Excavated Rock	From:	Function 1.4.1.2.2.3
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B. Outputs:

1.4.1.2.2.4O1	Noise	To:	Accessible Environment
1.4.1.2.2.4O2	Excavated Rock	To:	Function 1.4.1.2.3/1.4.1.2.4
1.4.1.2.2.4O3	Dust	To:	Accessible Environment

V. Function Requirements: Requirements at this level to be specified

Table F1.4.1.2.3 Function Description: Store/Dispose Excavated Rock

I. Function ID Number: 1.4.1.2.3

II. Function Title: Store/Dispose Excavated Rock

III. Function Definition:

To provide for surface storage and/or disposal of excavated rock resulting from the newly created subsurface openings in the geologic repository.

The time period covered under this function is from the start of repository operations to the time when all subsurface openings have been excavated and disposal (if required) of the stored rock has been accomplished.

1 **IV. Interfaces:**

2 **A. Inputs:**

3 1.4.1.2.3I1 Excavated Rock From: Function 1.4.1.2.2

4 **B. Outputs:**

5 1.4.1.2.3O1 Excavated Rock To: Function 1.4.1.2.4/
6 Outside System Boundary

7 **V. Function Requirements:** Requirements at this level to be specified

8 **Table F1.4.1.2.4 Function Description: Handle/Process Backfill Material**

9 **I. Function ID Number:** 1.4.1.2.4

10 **II. Function Title:** Handle/Process Backfill Material

11 **III. Function Definition:**

12 To provide for necessary equipment and facilities for processing, loading, unloading, and
13 transferring backfill material. Backfill materials will be processed either from excavated
14 subsurface rock or from other external materials, for use as backfill for the subsurface
15 openings.

16 The time period covered under this function is from the start of repository operations to
17 the time when all selected subsurface openings have been backfilled prior to start of closure
18 of the geologic repository.

19 **IV. Interfaces:**

20 **A. Inputs:**

21 1.4.1.2.4I1 Excavated Rock From: Function 1.4.1.2.2/1.4.1.2.3
22 1.4.1.2.4I2 [Additional Backfill Material] From: Outside System Boundary

23 **B. Outputs:**

24 1.4.1.2.4O1 [Processed Backfill Material] To: Function 1.4.1.2.5
25 1.4.1.2.4O2 Noise To: Accessible Environment
26 1.4.1.2.4O3 Dust To: Accessible Environment

27 **V. Function Requirements:** Requirements at this level to be specified

28 **Table F1.4.1.2.4.1 Function Description: Load Backfill Material**

29 **I. Function ID Number:** 1.4.1.2.4.1

30 **II. Function Title:** Load Backfill Material

1 **III. Function Definition:**

To provide for loading either the excavated rock (from storage) or other external materials for further processing/handling for use as backfill for the subsurface openings.

4 The time period covered under this function is from the start of repository operations to
5 the time when all selected subsurface openings have been backfilled prior to start of closure
6 of the geologic repository.

7 **IV. Interfaces:**

8 **A. Inputs:**

9 1.4.1.2.4.1I1 Excavated Rock From: Function 1.4.1.2.2/1.4.1.2.3
10 1.4.1.2.4.1I2 [Additional Backfill Material] From: Outside System Boundary

11 **B. Outputs:**

12 1.4.1.2.4.1O1 Backfill Material To: Function 1.4.1.2.4.2/1.4.1.2.4.3
13 1.4.1.2.4.1O2 Dust To: Accessible Environment
14 1.4.1.2.4.1O3 Noise To: Accessible Environment

15 **V. Function Requirements:** Requirements at this level to be specified

16 **Table F1.4.1.2.4.2 Function Description: Process Backfill Material**

17 **I. Function ID Number:** 1.4.1.2.4.2

18 **II. Function Title:** Process Backfill Material

19 **III. Function Definition:**

22 To provide for processing (preparing) backfill material for further handling either from excavated rock (from storage) or other external materials for use as backfill for the subsurface openings.

23 The time period covered under this function is from the start of repository operations to
24 the time when all selected subsurface openings have been backfilled prior to start of closure
25 of the geologic repository.

26 **IV. Interfaces:**

27 **A. Inputs:**

28 1.4.1.2.4.2I1 Backfill Material From: Function 1.4.1.2.4.1

29 **B. Outputs:**

30 1.4.1.2.4.2O1 Dust To: Accessible Environment
31 1.4.1.2.4.2O2 Noise To: Accessible Environment
32 1.4.1.2.4.2O3 [Processed Backfill Material] To: Function 1.4.1.2.4.3

33 **V. Function Requirements:** Requirements at this level to be specified

34 **Table F1.4.1.2.4.3 Function Description: Transfer Backfill Material**

35 **I. Function ID Number:** 1.4.1.2.4.3

36 **II. Function Title:** Transfer Backfill Material

III. Function Definition:

To provide for facilities for transferring backfill material (processed or otherwise) between points for use as backfill for the subsurface openings.

The time period covered under this function is from the start of repository operations to the time when all selected subsurface openings have been backfilled prior to start of closure of the geologic repository.

IV. Interfaces:

A. Inputs:

1.4.1.2.4.3I1	[Processed Backfill Material]	From: Function 1.4.1.2.4.2
1.4.1.2.4.3I2	Backfill Material	From: Function 1.4.1.2.4.1

B. Outputs:

1.4.1.2.4.3O1	Dust	To: Accessible Environment
1.4.1.2.4.3O2	Noise	To: Accessible Environment
1.4.1.2.4.3O3	[Processed Backfill Material]	To: Function 1.4.1.2.4.4

V. Function Requirements: Requirements at this level to be specified

Table F1.4.1.2.4.4 Function Description: Unload Backfill Material

I. Function ID Number: 1.4.1.2.4.4

II. Function Title: Unload Backfill Material

III. Function Definition:

To provide for unloading the backfill material (processed or otherwise) for use as backfill for the subsurface openings.

The time period covered under this function is from the start of repository operations to the time when all selected subsurface openings have been backfilled prior to start of closure of the geologic repository.

IV. Interfaces:

A. Inputs:

1.4.1.2.4.4I1	[Processed Backfill Material]	From: Function 1.4.1.2.4.3
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B. Outputs:

1.4.1.2.4.4O1	Dust	To: Accessible Environment
1.4.1.2.4.4O2	Noise	To: Accessible Environment
1.4.1.2.4.4O3	[Processed Backfill Material]	To: Function 1.4.1.2.5

V. Function Requirements: Requirements at this level to be specified

Table F1.4.1.2.5 Function Description: Backfill Subsurface Openings

2 I. Function ID Number: 1.4.1.2.5

3 II. Function Title: Backfill Subsurface Openings

4 III. Function Definition:

5 To provide for backfilling of the geologic repository.

6 The time period covered under this function is from the start of repository operations to
7 the time when all selected subsurface openings have been backfilled prior to start of closure
8 of the geologic repository.

9 IV. Function Interfaces:

10 A. Inputs:

11 1.4.1.2.5I1 Processed Backfill Material From: Function 1.4.1.2.4
12 1.4.1.2.5I2 Subsurface Openings From: Function 1.4.1.2.1

13 B. Outputs:

14 1.4.1.2.5O1 Dust To: Accessible Environment
15 1.4.1.2.5O2 Noise To: Accessible Environment
16 1.4.1.2.5O3 [Backfilled Subsurface To: Function 1.4.1.3
17 Openings]

18 V. Function Requirements: Requirements at this level to be specified

Table F1.4.1.2.5.1 Function Description: Prepare Subsurface Openings For Backfill

20 I. Function ID Number: 1.4.1.2.5.1

21 II. Function Title: Prepare Subsurface Openings for Backfill

22 III. Function Definition:

23 To take necessary measures for preparing the subsurface openings for backfilling prior to
24 the start of permanent closure of the repository.

25 The time period covered under this function is from the start of repository operations to
26 the time when all selected subsurface openings have been backfilled prior to start of closure
27 of the geologic repository.

28 IV. Function Interfaces:

29 A. Inputs:

30 1.4.1.2.5.II1 Subsurface Openings From: Function 1.4.1.2.1

31 B. Outputs:

32 1.4.1.2.5.IO1 Prepared Subsurface Openings To: Function 1.4.1.2.5.2

33 V. Function Requirements: Requirements at this level to be specified

Table F1.4.1.2.5.2 Function Description: Emplace Backfill

2 I. Function ID Number: 1.4.1.2.5.2

3 II. Function Title: Emplace Backfill

4 III. Function Definition:

5 To provide for emplacing backfill material in the subsurface openings of the geologic
6 repository prior to the start of permanent closure of the repository.

7 The time period covered under this function is from the start of repository operations to
8 the time when all selected subsurface openings have been backfilled prior to start of closure
9 of the geologic repository.

10 IV. Function Interfaces:

11 A. Inputs:

12 1.4.1.2.5.2I1	Prepared Subsurface Openings	From:	Function 1.4.1.2.5.1
13 1.4.1.2.5.2I2	[Processed Backfill Material]	From:	Function 1.4.1.2.4
14 1.4.1.2.5.2I3	Processed Backfill Data	From:	1.4.3 Subfunction(s)

15 B. Outputs:

16 1.4.1.2.5.2O1 [Backfilled Subsurface Openings] To: 1.4.1.3

17 V. Function Requirements:

18 A. Constraints:

19 1.4.1.2.5.2C1 (c) A backfill test section shall be constructed to test the effectiveness of
20 backfill placement and compaction procedures against design requirements before permanent
backfill placement is begun. [10 CFR 60.142]

23 B. Performance: Requirements at this level to be specified

24 C. Interface: Requirements at this level to be specified

25 Table F1.4.1.3 Function Description: Close Geologic Repository

26 I. Function ID Number: 1.4.1.3

27 II. Function Title: Close Geologic Repository

28 III. Function Definition:

29 To permanently close the geologic repository for human access by: closing subsurface
30 openings; decommissioning the surface facilities; and establishing institutional barriers.

31 The time period covered under this function is from the date of receipt of the license
32 amendment for closure of the geologic repository until the last institutional barrier is
33 established.

34 "Permanent closure" means final backfilling of the underground facility and the sealing of
35 shafts and boreholes. [10 CFR 60.2]

36 "... and permanent closure, which includes sealing of shafts. Permanent closure represents
37 the end of active human intervention with respect to the engineered barrier system. [10
38 CFR 60.102(d)]

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IV. Function Interfaces:

A. Inputs:

1.4.1.311	Subsurface Openings	From: Function 1.4.1.2
1.4.1.312	Surface Areas	From: Function 1.4.1.1
1.4.1.313	Emplaced Waste Packages	From: Function 1.4.1.1
1.4.1.314	Intake Air	From: Function 1.4.1.4

B. Outputs:

1.4.1.301	Site Generated Waste	To: Function 1.4.1.4
1.4.1.302	Institutional Barriers	To: Function 1.4.2 (Resource)
1.4.1.303	Engineered Barriers	To: Function 1.4.2 (Resource)
1.4.1.304	Sealed Accesses/Boreholes	To: Function 1.4.2 (Resource)
1.4.1.305	Exhaust Air	To: Function 1.4.1.4

V. Function Requirements:

A. Constraints:

1.4.1.3C1 (b) If necessary, so as to take into account the environmental impact of any substantial changes in the permanent closure activities proposed to be carried out or any significant new information regarding the environmental impacts of such closure, DOE shall also supplement its environmental impact statement and submit such statement, as supplemented, with the application for license amendment. [10 CFR 60.51]

B. Performance: Requirements at this level to be specified

C. Interface: Requirements at this level to be specified

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Table F1.4.1.3.1 Function Description: Close Subsurface Openings

I. Function ID Number: 1.4.1.3.1

II. Function Title: Close Subsurface Openings

III. Function Definition:

"Closure" means final backfilling of the remaining open operational areas of the underground facility and boreholes after the termination of waste emplacement, culminating in the sealing of shafts. [10 CFR 960.2]

The time period covered under this function is from the date the license amendment to close the geologic repository is received to the time when the last access/borehole is sealed.

IV. Function Interfaces:

A. Inputs:

1.4.1.3.111	[Processed Backfill Material]	From: Function 1.4.1.2.4
1.4.1.3.112	Emplaced Waste Package	From: Function 1.4.1.1
1.4.1.3.113	Sealing Materials	From: Outside System Boundary
1.4.1.3.114	Subsurface Openings	From: Function 1.4.1.2

B. Outputs:

1.4.1.3.1O1	[PostClosure Performance Monitoring System]	To:	Function Outside System Boundary
1.4.1.3.1O2	Sealed Accesses/Boreholes	To:	Function 1.4.2/1.4.3
1.4.1.3.1O3	Site Generated Waste	To:	Function 1.4.1.4
1.4.1.3.1O4	Records	To:	Function 1.4.1.3.3
1.4.1.3.1O5	Salvaged Equipment	To:	Outside System Boundary

V. Function Requirements: Requirements at this level to be specified

Table F1.4.1.3.1.1 Function Description: Remove Underground Equipment

I. Function ID Number: 1.4.1.3.1.1

II. Function Title: Remove Underground Equipment

III. Function Definition:

To provide for removing underground equipment from the subsurface openings after the receipt of the license amendment to close the geologic repository.

The time period covered under this function is from the date the license amendment to close the geologic repository is received to the time when the last access/borehole is sealed.

IV. Function Interfaces:

A. Inputs:

1.4.1.3.1.1I1 Subsurface Openings **From:** Function 1.4.1.2.1

B. Outputs:

1.4.1.3.1.1O1	Salvaged Equipment	To:	Outside System Boundary
1.4.1.3.1.1O2	Site Generated Waste	To:	Function 1.4.1.4
1.4.1.3.1.1O3	Records	To:	Function 1.4.1.3.3
1.4.1.3.1.1O4	Prepared Subsurface Openings	To:	Function 1.4.1.3.1.2
1.4.1.3.1.1O5	Accesses/Boreholes	To:	Function 1.4.1.3.1.3

V. Function Requirements: Requirements at this level to be specified

Table F1.4.1.3.1.2 Function Description: Backfill Subsurface Openings

I. Function ID Number: 1.4.1.3.1.2

II. Function Title: Backfill Subsurface Openings

III. Function Definition:

To provide for backfilling subsurface openings after the receipt of the license amendment to close the geologic repository.

The time period covered under this function is from the date the license amendment to close the geologic repository is received to the time when the last access/borehole is sealed.

IV. Interfaces:

A. Inputs:

1.4.1.3.1.2I1	Prepared Subsurface Openings	From:	Function 1.4.1.3.1.1
1.4.1.3.1.2I2	[Processed Backfill Material]	From:	
1.4.1.3.1.2I3	Emplaced Waste Packages	From:	Function 1.4.1

B. Outputs:

1.4.1.3.1.2O1	Records	To:	Function 1.4.1.3.3
1.4.1.3.1.2O2	Engineered Barriers	To:	Function 1.4.2 (Resource)/ 1.4.1.3.1.4

V. Function Requirements:

A. Constraints:

1.4.1.3.1.2C1 (c) 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.

[10 CFR 60.142]

B. Performance: Requirements at this level to be specified

C. Interface: Requirements at this level to be specified

Table F1.4.1.3.1.3 Function Description: Emplace Seals

2 I. Function ID Number: 1.4.1.3.1.3

3 II. Function Title: Emplace Seals

4 III. Function Definition:

5 To provide for emplacing seals in the accesses/boreholes of the geologic repository after the
6 receipt of the license amendment to close the geologic repository.

7 The time period covered under this function is from the date the license amendment to
8 close the geologic repository is received to the time when the last access/borehole is sealed.

9 IV. Interfaces:

10 A. Inputs:

11 1.4.1.3.1.3I1	Accesses/Boreholes	From: Function 1.4.1.3.1.1
12 1.4.1.3.1.3I2	Sealing Materials	From: Outside System Boundary
13 1.4.1.3.1.3I3	Seals Data	From: 1.4.3 Subfunction(s)

14 B. Outputs:

15 1.4.1.3.1.3O1	Sealed Accesses/Boreholes	To: Function 1.4.2 (Resource)
16 1.4.1.3.1.3O2	Records	To: Function 1.4.1.3.3

17 V. Function Requirements:

18 A. Constraints:

19 1.4.1.3.1.3C1 (a) DOE shall maintain records of construction of the geologic repository
20 operations area in a manner that ensures their useability for future generations in
21 accordance with 60.51(a)(2).

22 (b) The records required under paragraph (a) shall include at least the following: ...

23 1) Details, methods of emplacement, and location of seals used.

24 *[10 CFR 60.72]*

25 1.4.1.3.1.3C2 Sections 60.131 through 60.134 specify minimum criteria for the design of
26 the geologic repository operations area. These design criteria are not intended to be
27 exhaustive, however. Omissions in 60.131 through 60.134 do not relieve DOE from any
28 obligation to provide such safety features in a specific facility needed to achieve the
29 performance objectives. ... [10 CFR 60.130]

30 (b) Selection of materials and placement methods. Materials and placement methods for
31 seals shall be selected to reduce to the extent practicable:

32 (1) The potential for creating a preferential pathway for ground water to contact
33 the waste packages or

34 (2) for radionuclide migration through existing pathways.

35 *[10 CFR 60.134]*

36 1.4.1.3.1.3C3 (d) Test sections shall be established to test the effectiveness of borehole
37 and shaft seals before full-scale operation proceeds to seal boreholes and shafts.

38 *[10 CFR 60.142]*

39 B. Performance: Requirements at this level to be specified

40 C. Interface: Requirements at this level to be specified

Table F1.4.1.3.1.4 Function Description: Implement Postclosure Monitoring

2 **I. Function ID Number:** 1.4.1.3.1.4

3 **II. Function Title:** Implement Postclosure Monitoring

4 **III. Function Definition:**

5 To provide for implementing postclosure monitoring plans of the geologic repository
6 described in the license amendment to close the geologic repository.

7 The time period covered under this function is from the date the license amendment to
8 close the geologic repository is received to the time the last access/borehole is sealed.

9 Part 60 currently requires DOE to carry out a performance confirmation program which
10 is to continue until repository closure. Part 60 does not now require monitoring after
11 repository closure because of the likelihood that post-closure monitoring of the underground
12 facility would degrade repository performance. The Commission proposes to add a new
13 Section 60.144 to Part 60 which would require post-closure monitoring of repository
14 characteristics provided that such monitoring can be expected to provide material
15 confirmatory information regarding long-term repository performance and provided that the
16 means for conducting such monitoring will not degrade repository performance. [10 CFR
17 60 Proposed Rulemaking: 51FR 22288 (June 19, 1986)]

18 **IV. Interfaces:**

19 **A. Inputs:**

20 1.4.1.3.1.4I1 Engineered Barriers From: Function 1.4.1.3.1.2

21 **B. Outputs:**

22 1.4.1.3.1.4O1 Records To: Function 1.4.1.3.3
23 1.4.1.3.1.4O2 PostClosure Performance To: 1.4.3 Subfunction(s)
24 Monitoring System

25 **V. Function Requirements:** Requirements at this level to be specified

1 Table F1.4.1.3.2 Function Description: Decommission Surface Facilities

2 I. Function ID Number: 1.4.1.3.2

3 II. Function Title: Decommission Surface Facilities

4 III. Function Definition:

5 This function starts at the receipt of the license amendment to close the repository and
6 ends when the site is reclaimed.

7 "Decommissioning" means the permanent removal from service of surface facilities and
8 components necessary for preclosure operations only, after repository closure, in accordance
9 with regulatory requirements and environmental policies. [10 CFR 960.2]

10 IV. Interfaces:

11 A. Inputs:

12 1.4.1.3.2I1 Surface Facilities
13 1.4.1.3.2I2 Offsite Facilities

From: Function 1.4.1.1
From: Outside System Boundary

14 B. Outputs:

15 1.4.1.3.2O1 Site Generated Waste
16 1.4.1.3.2O2 Reclaimed Areas
17 1.4.1.3.2O3 Salvaged Equipment
18 1.4.1.3.2O4 Records

To: Function 1.4.1.4
To: Function 1.4.1.3.3
To: Outside System Boundary
To: Function 1.4.1.3.3

19 V. Function Requirements:

20 A. Constraints:

21 1.4.1.3.2C1 (e) Consideration of decommissioning. The surface facility shall be designed
22 to facilitate decontamination or dismantlement to the same extent as would be required,
under other parts of this chapter, with respect to equivalent activities licensed thereunder.

[10 CFR 60.132]

25 B. Performance: Requirements at this level to be specified

26 C. Interface: Requirements at this level to be specified

27 Table F1.4.1.3.2.1 Function Description: Decontaminate Facilities

28 I. Function ID Number: 1.4.1.3.2.1

29 II. Function Title: Decontaminate Facilities

30 III. Function Definition:

31 "Decontamination", the act of removing a chemical, biological, or radiological contaminant
32 from, or neutralizing its potential effect on, a person, object or environment by washing,
33 chemical action, mechanical cleaning, or other techniques. [DOE Order 6430.1A, Glossary]

34 The time period covered under this function is from the date the license amendment to
35 close the geologic repository is received to the time when the decommissioning of the
36 surface facilities is completed.

IV. Interfaces:

A. Inputs:

1.4.1.3.2.1I1 Contaminated Surface Facilities From: Function 1.4.1.1

B. Outputs:

1.4.1.3.2.1O1 Site Generated Waste To: Function 1.4.1.4
(Rad, Non-Rad)

1.4.1.3.2.1O2 Decontaminated Surface Facilities To: Function 1.4.1.3.2.2/
1.4.1.3.2.3

V. Function Requirements: Requirements at this level to be specified

Table F1.4.1.3.2.2 Function Description: Dismantle Facilities

I. Function ID Number: 1.4.1.3.2.2

II. Function Title: Dismantle Facilities

III. Function Definition:

To provide for dismantling (stripping) surface facilities of the geologic repository after the receipt of the license amendment to close the geologic repository.

The time period covered under this function is from the date the license amendment to close the geologic repository is received to the time when the decommissioning of the surface facilities is completed.

IV. Interfaces:

A. Inputs:

1.4.1.3.2.2I1 Decontaminated Surface Facilities From: Function 1.4.1.3.2.1

1.4.1.3.2.2I2 Uncontaminated Surface Facilities From: Function 1.4.1.1

1.4.1.3.2.2I3 Offsite Facilities From: Outside System Boundary

B. Outputs:

1.4.1.3.2.2O1 [Dismantled facilities] To: Function 1.4.1.3.2.3

1.4.1.3.2.2O2 Site Generated Waste To: Function 1.4.1.4

V. Function Requirements: Requirements at this level to be specified

Table F1.4.1.3.2.3 Function Description: Remove Facilities

I. Function ID Number: 1.4.1.3.2.3

II. Function Title: Remove Facilities

III. Function Definition:

To provide equipment and facilities for removal all relevant surface facilities of the geologic repository after the receipt of license amendment to close the geologic repository.

The time period covered under this function is from the date the license amendment to close the geologic repository is received to the time when the decommissioning of the surface facilities is completed.

IV. Interfaces:

A. Inputs:

1.4.1.3.2.3I1	Dismantled Facilities	From: Function 1.4.1.3.2.2
1.4.1.3.2.3I2	Decontaminated Surface Facilities	From: Function 1.4.1.3.2.1
1.4.1.3.2.3I3	Uncontaminated Surface Facilities	From: Function 1.4.1.1
1.4.1.3.2.3I4	Offsite Facilities	From: Outside System Boundary

B. Outputs:

1.4.1.3.2.3O1	Site Generated Waste (Rad, Non-Rad)	To: Function 1.4.1.4
1.4.1.3.2.3O2	Salvaged Equipment	To: Outside System Boundary
1.4.1.3.2.3O3	Razed Onsite/Offsite Areas	To: Function 1.4.1.3.2.4

V. Function Requirements: Requirements at this level to be specified

Table F1.4.1.3.2.4 Function Description: Reclaim Areas

I. Function ID Number: 1.4.1.3.2.4

II. Function Title: Reclaim Areas

III. Function Definition:

To provide for returning the geologic repository site as nearly as practical, to its original condition after the receipt of the license amendment to close the geologic repository.

The time period covered under this function is from the date the license amendment to close the geologic repository is received to the time when decommissioning of the surface facilities is completed.

IV. Interfaces:

A. Inputs:

1.4.1.3.2.4I1	Razed Onsite/Offsite Areas	From: Function 1.4.1.3.2.3
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B. Outputs:

1.4.1.3.2.4O1	Reclaimed Areas	To: Function 1.4.1.3.3
1.4.1.3.2.4O2	Records	To: Function 1.4.1.3.3

V. Function Requirements: Requirements at this level to be specified

Table F1.4.1.3.3 Function Description: Establish Institutional Barriers

I. Function ID Number: 1.4.1.3.3

II. Function Title: Establish Institutional Barriers

1 **III. Function Definition:**

2 "Passive institutional control" means: (1) Permanent markers at a disposal site, (2) public
3 records and archives, (3) government ownership and regulations regarding land or resource
4 use, and (4) other methods of preserving knowledge about the location, design, and contents
5 of a disposal system. [40 CFR 191.12(e)]

6 "Active institutional control" means: (1) Controlling access to a disposal site by any means
7 other than passive institutional controls; (2) performing maintenance operations or remedial
8 actions at a site, (3) controlling or cleaning up releases from a site, or (4) monitoring
9 parameters related to disposal system performance. [40 CFR 191.12(f)]

10 License conditions shall include items in the following categories:

11 (5) Controls to be applied to restricted access and to avoid disturbance to the
12 controlled area and to areas outside the controlled area where conditions may affect
13 isolation within the controlled area. [10 CFR 60.43 (b)]

14 Appropriate controls shall be established outside of the controlled area. DOE shall exercise
15 any jurisdiction and control over surface and subsurface estates necessary to prevent adverse
16 human actions that could significantly reduce the geologic repository's ability to achieve
17 isolation. The rights of DOE may take the form of appropriate possessory interests,
18 servitudes, or withdrawals from location or patent under the general mining laws. [10 CFR
19 60.121(b)]

20 This function begins at the receipt of the license amendment to close and ends when the
21 last institutional barrier system is emplaced.

22 **IV. Interfaces:**

23 **A. Inputs:**

24 1.4.1.3.3I1 Reclaimed Areas From: Function 1.4.1.3.2
25 1.4.1.3.3I2 Records From: Function 1.4.1.3.1/
26 1.4.1.3.2
27 1.4.1.3.3I3 Markers/Monuments From: Outside System Boundary

28 **B. Outputs:**

29 1.4.1.3.3O1 Institutional Barriers To: Function 1.4.2 (Resource)

30 **V. Function Requirements:**

31 **A. Constraints:**

32 1.4.1.3.3C1 (a) DOE shall submit an application to amend the license prior to permanent
33 closure. The submission shall consist of an update of the license application submitted
34 under Sections 60.21 and 60.22, including:

35 (2) A detailed description of the measures to be employed - such as land use
36 controls, construction of monuments, and preservation of records - to regulate or
37 prevent activities that could impair the long-term isolation of emplaced waste within
38 the geologic repository and to assure that relevant information will be preserved
39 for the use of future generations. As a minimum, such measures shall include -

40 (i) Identification of the controlled area and geologic repository operations area
41 by monuments that have been designed, fabricated, and emplaced to be as
42 permanent as is practicable; and

43 (ii) Placement of records in the archives and land records systems of local State,
44 and Federal government agencies, and archives elsewhere in the world, that
45 would be likely to be consulted by potential human intruders - such records to
46 identify the location of the geologic repository operations area, including the
47 underground facility, boreholes and shafts, and the boundaries of the controlled
48 area, and the nature and hazard of the waste.
49 [10 CFR 60.51]

50 **B. Performance:** Requirements at this level to be specified

C. Interface: Requirements at this level to be specified

Table F1.4.1.3.3.1 Function Description: Establish Active Controls

I. Function ID Number: 1.4.1.3.3.1

II. Function Title: Establish Active Controls

III. Function Definition:

To provide for the establishment of active institutional controls at the geologic repository site after receipt of the license amendment to close the geologic repository.

The time period covered under this function is from the date the license amendment to close the geologic repository is received to the time when the last institutional barrier system is emplaced.

IV. Interfaces:

A. Inputs:

1.4.1.3.3.1I1	Control System	From: Outside System Boundary
1.4.1.3.3.1I2	Reclaimed Areas	From: Function 1.4.1.3.2

B. Outputs:

1.4.1.3.3.1O1	Active Controls (Institutional Barriers)	To: Outside System Boundary/ 1.4.2 (Resource)
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V. Function Requirements: Requirements at this level to be specified

Table F1.4.1.3.3.2 Function Description: Establish Passive Controls

I. Function ID Number: 1.4.1.3.3.2

II. Function Title: Establish Passive Controls

III. Function Definition:

To provide for the establishment of passive institutional controls at the geologic repository site after receipt of the license amendment to close the geologic repository.

The time period covered under this function is from the date the license amendment to close the geologic repository is received to the time when the last institutional barrier system is emplaced.

IV. Interfaces:

A. Inputs:

1.4.1.3.3.2I1	Reclaimed Areas	From: Function 1.4.1.3.2
1.4.1.3.3.2I2	Markers/Monument	From: Outside System Boundary
1.4.1.3.3.2I3	Records	From: Function 1.4.1.3.1/1.4.1.3.2

B. Outputs:

1.4.1.3.3.2O1	Permanent Markers/ Monuments (Institutional Barriers)	To: Function 1.4.2 (Resource)
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1.4.1.3.3.2O2	Land Use Controls (Institutional Barriers)	To: Function 1.4.2 (Resource)
1.4.1.3.3.2O3	Records (Archived) (Institutional Barriers)	To: Function 1.4.2 (Resource)

V. Function Requirements:

A. Constraints:

1.4.1.3.3.2C1 A description of the controls that the applicant will apply to restrict access and to regulate land use at the site and adjacent areas, including a conceptual design of monuments which would be used to identify the controlled area after permanent closure.

[10 CFR 60.21(c)(8)]

B. Performance: Requirements at this level to be specified

C. Interface: Requirements at this level to be specified

Table F1.4.1.4 Function Description: Support Geologic Repository Operations

I. Function ID Number: 1.4.1.4

II. Function Title: Support Geologic Repository Operations

III. Function Definition:

To provide necessary operational and administrative support for operating and maintaining the geologic repository.

This function begins at the time the waste is received at the repository and ends when the NRC terminates the DOE's license.

IV. Interfaces:

A. Inputs:

1.4.1.4I1	Site Generated Waste	From: Function 1.4.1.1/1.4.1.2/1.4.1.3
1.4.1.4I2	Exhaust Air	From: Function 1.4.1.1/1.4.1.2/1.4.1.3
1.4.1.4I3	Records (Verified)	From: Function 1.4.1.1/1.4.1.2
1.4.1.4I4	Waste Container	From: Outside System Boundary
1.4.1.4I5	Intake Air	From: Accessible Environment

B. Outputs:

1.4.1.4O1	Disposed Site Generated	To: Outside System Boundary
1.4.1.4O2	Utilities, Operational & Administrative Support	To: Function 1.4.1.1 (Resources) Function 1.4.1.2 (Resources)/ 1.4.1.3 (Resources)
1.4.1.4O3	Operations Data	To: Function 1.4.3
1.4.1.4O4	Intake Air	To: Function 1.4.1.2 Function 1.4.1.3
1.4.1.4O5	Waste Container	To: Function 1.4.1.1
1.4.1.4O6	Exhaust Air	To: Accessible Environment

V. Function Requirements: Requirements at this level to be specified

1 **Table F1.4.1.4.1 Function Description: Provide Utility Services**

2 **I. Function ID Number:** 1.4.1.4.1

3 **II. Function Title:** Provide Utility Services

4 **III. Function Definition:**

5 To provide utilities, including ventilation, communications, water, power, illumination, and
6 on-site transportation in support of geologic repository operations. Ongoing maintenance
7 of utilities is not included in this function (See function 1.4.1.4.5).

8 **IV. Interfaces:**

9 **A. Inputs:** None identified at this time

10 **B. Outputs:** None identified at this time

11 **V. Function Requirements:**

12 **A. Constraints:**

13 1.4.1.4.1C1 (b)(5) Utility services.

14 (i) Each utility service system that is important to safety shall be designed so that
15 essential safety functions can be performed under both normal and accident
16 conditions.

17 (ii) The utility services important to safety shall include redundant systems to the
18 extent necessary to maintain, with adequate capacity, the ability to perform their
19 safety functions.

20 (iii) Provisions shall be made so that, if there is a loss of the primary electric power
21 source or circuit, reliable and timely emergency power can be provided to
22 instruments, utility service systems, and operating systems, including alarm systems,
23 important to safety.

[10 CFR 60.131]

24 **B. Performance:** No requirements specified at this time

25 **C. Interfaces:** No requirements specified at this time

26
27 **Table F1.4.1.4.1.1 Function Description: Provide Ventilation (HVAC)**

28 **I. Function ID Number:** 1.4.1.4.1.1

29 **II. Function Title:** Provide Ventilation (HVAC)

30 **III. Function Definition:**

31 To install and operate ventilation utilities for both surface and subsurface areas in support
32 of geologic repository operations. This function includes any necessary conditioning of air
33 and monitoring of ventilation systems.

34 **IV. Interfaces:**

35 **A. Inputs:** None identified at this time

36 **B. Outputs:** None identified at this time

V. Function Requirements:

A. Constraints:

1.4.1.4.1.1C1 (b) 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 offsite releases as provided in Section 60.111(a). *[10 CFR 60.132]*

1.4.1.4.1.1C2 (g) Underground facility ventilation. The ventilation system shall be designed to:

(1) Control the transport of radioactive particulates and gases within and releases from the underground facility in accordance with the performance objectives of Section 60.111(a),

(2) Assure continued function during normal operations and under accident conditions; and

(3) Separate the ventilation of excavation and waste emplacement areas.

[10 CFR 60.133]

B. Performance: No requirements specified at this time

C. Interfaces: No requirements specified at this time

Table F1.4.1.4.1.2 Function Description: Provide Communications

I. Function ID Number: 1.4.1.4.1.2

II. Function Title: Provide Communications

III. Function Definition:

To install and operate communication services in support of geologic repository operations, including establishing connections as needed with external communication systems.

IV. Interfaces:

A. Inputs: None identified at this time

B. Outputs: None identified at this time

V. Function Requirements:

A. Constraints:

1.4.1.4.1.2C1 (e)(1) Each guard or watchman on duty shall be capable of maintaining continuous communication with an individual in a continuously manned central alarm station within the protected area, who shall be capable of calling for assistance from other guards and watchmen and from local law enforcement authorities.

(2) The alarm stations required by paragraph (d)(1) of this section shall have conventional telephone service for communication with the law enforcement authorities as described in paragraph (e)(1) of this section.

(3) 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 continuously manned central alarm station within the protected area.

(4) All communications equipment, including offsite equipment, shall remain operable from

1 independent power sources in the event of loss of primary power.

2 [10 CFR 73.50]

B. Performance: No requirements specified at this time

C. Interfaces: No requirements specified at this time

5 Table F1.4.1.4.1.3 Function Description: Supply/Control Water

6 I. Function ID Number: 1.4.1.4.1.3

7 II. Function Title: Supply/Control Water

8 III. Function Definition:

9 To install and operate facilities and services needed to supply and control water in support
10 of geologic repository operations. These utility services are provided for all operational
11 uses, including drinking water, industrial water, sewage processing, and emergency uses.

12 IV. Interfaces:

13 A. Inputs: None identified at this time

14 B. Outputs: None identified at this time

15 V. Function Requirements:

16 A. Constraints:

17 1.4.1.4.1.3C1 (b)(1) In the survey of planning of any reservoir by the Corps of Engineers,
18 Bureau of Reclamation, or other Federal agency, consideration shall be given to inclusion
of storage for regulation of streamflow, except that any such storage and water releases
shall not be provided as a substitute for adequate treatment or other methods of controlling
waste at the source.

[33 USC 1251 et seq., Section 1252]

23 1.4.1.4.1.3C2 Prohibition On Use of Lead Pipes, Solder, and Flux.

24 (a) In General --

25 (1) Prohibition. -- Any pipe, solder, or flux, which is used after the enactment of
26 the Safe Drinking Water Act Amendments of 1986, in the installation or repair
27 of -

28 (A) any public water system, or

29 (B) any plumbing in a residential or nonresidential facility providing water
30 for human consumption which is connected to a public water system, shall
31 be lead free (within the meaning of subsection (d)). This paragraph shall
32 not apply to leaded joints necessary for the repair of cast iron pipes.
33

34 (d) Definition of lead free. -- For purposes of this section, the term lead free

35 (1) when used with respect to solders and flux refers to solders and flux containing
36 not more than 0.2 percent lead, and

37 (2) when used with respect to pipes and pipe fittings refers to pipes and pipe fitting
38 containing not more than 8.0 percent lead.

[42 USC 300f et seq., Section 300g-6]

1.4.1.4.1.3C3 Records And Inspections

(a)(1) Every person who is a supplier of water, who is or may be otherwise subject to a primary drinking water regulation prescribed under section 1412 or to an applicable underground injection control program (as defined in section 1422(c)), who is or may be subject to the permit requirement of section 1424 or to an order issued under section 1441, or who is a grantee, shall establish and maintain such records, make such reports, conduct such monitoring, and provide such information as the Administrator may reasonably require by regulation under this title, in determining whether such person has acted or is acting in compliance with this title, in administering any program of financial assistance under this title in evaluating the health risks of unregulated contaminants, or in advising the public of such risks.

[42 USC 300f et.seq., Section 300j-4]

1.4.1.4.1.3C4 Each Federal agency (1) having jurisdiction over any federally owned or maintained public water system or (2) engaged in any activity resulting, or which may result in, underground injection which endangers drinking water (within the meaning of section 300h(d)(2)) shall be subject to and comply with, all Federal, State, and local requirements, administrative authorities, and process and sanctions respecting the provision of safe drinking water and respecting any underground injection program in the same manner, and to the same extent, as any nongovernmental entity.

[42 USC 300f et.seq., Section 300j-6]

B. Performance: No requirements specified at this time

C. Interfaces: No requirements specified at this time

Table F1.4.1.4.1.4 Function Description: Provide Power

I. Function ID Number: 1.4.1.4.1.4

II. Function Title: Provide Power

III. Function Definition:

To distribute electrical and other forms of power for use in geologic repository operations from power sources to the necessary locations. This function may include establishing connections to external power grids and installing onsite power generation systems.

IV. Interfaces:

A. Inputs: None identified at this time

B. Outputs: None identified at this time

V. Function Requirements: No requirements specified at this time

Table F1.4.1.4.1.5 Function Description: Provide Illumination

I. Function ID Number: 1.4.1.4.1.5

II. Function Title: Provide Illumination

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III. Function Definition:

To install and operate facilities and services needed to provide lighting in support of geologic repository operations.

IV. Interfaces:

A. Inputs: None identified at this time

B. Outputs: None identified at this time

V. Function Requirements: No requirements specified at this time

Table F1.4.1.4.1.6 Function Description: Provide On-Site Transportation

I. Function ID Number: 1.4.1.4.1.6

II. Function Title: Provide On-Site Transportation

III. Function Definition:

To provide auxiliary facilities and services needed to transport men and materials within the geologic repository on the surface, between the surface and underground, and underground. This function does not include transportation needs which are specific to other functions, such as transportation of waste containers, excavated rock and backfill, and assembly lines.

IV. Interfaces:

A. Inputs: None identified at this time

B. Outputs: None identified at this time

V. Function Requirements: No requirements specified at this time

Table F1.4.1.4.2 Function Description: Provide Protective Services

I. Function ID Number: 1.4.1.4.2

II. Function Title: Provide Protective Services

III. Function Definition:

To establish general protective services and provide facilities needed to ensure the safety and security of men, materials, and operations at the geologic repository under both normal and off-normal conditions.

IV. Interfaces:

A. Inputs: None identified at this time

B. Outputs: None identified at this time

V. Function Requirements:

A. Constraints:

1.4.1.4.2C1 (b)(4)(ii) The geologic repository operations area shall be designed to include onsite facilities and services that ensure a safe and timely response to emergency conditions and that facilitate the use of available offsite services (such as fire, police, medical and

1 ambulance service) that may aid in recovery from emergencies.

2 [10 CFR 60.131]

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1.4.1.4.2C2 (d) Detection aids.

(1) All alarms required pursuant to this part shall annunciate in a continuously manned central alarm station located within the protected area and in at least one other continuously manned 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. All alarms shall be self-checking and tamper indicating. The annunciation of an alarm at the onsite central alarm station shall indicate the type of alarm (e.g., intrusion alarm, emergency exit alarm, etc.) and location. All intrusion alarms, emergency exit alarms, alarm systems, and line supervisory systems shall at minimum meet the performance and reliability levels indicated by GSA Interim Federal Specification W-A-00450 B (GSA-FSS).

(2) All emergency exits in each protected area and each vital area shall be alarmed.

[10 CFR 73.50]

B. Performance: No requirements specified at this time

C. Interfaces: No requirements specified at this time

Table F1.4.1.4.2.1 Function Description: Safeguard Radioactive Material

I. Function ID Number: 1.4.1.4.2.1

II. Function Title: Safeguard Radioactive Material

III. Function Definition:

To establish services and facilities needed to adequately safeguard radioactive materials, which are in the custody of the geologic repository.

The general information shall include: - (3) A certification that DOE will provide at the geologic repository operations area such safeguards as it requires at comparable surface facilities (of DOE) to promote the common defense and security. [10 CFR 60.21(b)(3)]

A description of the nuclear material control and accounting program.
[10 CFR 60.21(c)(10)]

IV. Interfaces:

A. Inputs: None identified at this time

B. Outputs: None identified at this time

V. Function Requirements:

A. Constraints:

1.4.1.4.2.1C1 Physical protection: general requirements at fixed sites.

(a) Each licensee shall provide physical protection against radiological sabotage and against theft of special nuclear material at the fixed sites where licensed activities are conducted. Physical security systems shall be established and maintained by the licensee in accordance with security plans approved by the Nuclear Regulatory Commission.

[10 CFR 73.40]

1 1.4.1.4.2.1C2 (b) ...The safeguards contingency plan must include plans for dealing with
2 threats, thefts, and radiological sabotage relating to nuclear facilities licensed under Part
3 50 or to the possession of special nuclear material licensed under Part 70 of this chapter...

4 (c) Prior to the plan becoming effective, the licensee shall have:

(1) All safeguards capabilities specified in his safeguards contingency plan available
and functional,

7 (2) Detailed procedures developed according to Appendix C to this part available
8 at the licensee's site. The licensee shall retain a copy of the current procedures as
9 a record until the Commission terminates the license for which the procedures were
10 developed and, if any portion of the procedures is superseded, retain the superseded
11 material for three years after each change, and

12 (3) All appropriate personnel trained to respond to safeguards incidents as outlined
13 in the plan and specified in the detailed Procedures.

14 [10 CFR 73.40]

15 B. Performance: No requirements specified at this time

16 C. Interfaces: No requirements specified at this time

17 Table F1.4.1.4.2.2 Function Description: Provide Physical Security

18 I. Function ID Number: 1.4.1.4.2.2

19 II. Function Title: Provide Physical Security

20 III. Function Definition:

21 To establish services and facilities needed to ensure adequate physical security for the
geologic repository and repository operations.

22 A description of the physical security plan for protection against radiological sabotage. Since
23 the radiation hazards associated with high-level wastes make them inherently unattractive
24 as a target for theft or diversion, no detailed information need be submitted on protection
25 against theft or diversion. [10 CFR 60.21(b)(4)]
26

27 A description of the controls that the applicant will apply to restrict access and to regulate
28 land use at the site and adjacent areas, including a conceptual design of monuments which
29 would be used to identify the controlled area after permanent closure. [10 CFR 60.21(c)(8)]

30 IV. Function Interfaces:

31 A. Inputs: None identified at this time

32 B. Outputs: None identified at this time

33 V. Function Requirements:

34 A. Constraints:

35 1.4.1.4.2.2C1 (a) Radiological protection. The geologic repository operations area shall
36 be designed to maintain radiation doses, levels, and concentrations of radioactive material
37 in air in restricted areas within the limits specified in Part 20 of this chapter. Design shall
38 include: ...

39 (5) Means to control access to high radiation areas or airborne radioactivity areas;

40 [10 CFR 60.131]

1.4.1.4.2.2C2 Physical protection: general requirements at fixed sites.

(a) Each licensee shall provide physical protection against radiological sabotage and against theft of special nuclear material at the fixed sites where licensed activities are conducted. Physical security systems shall be established and maintained by the licensee in accordance with security plans approved by the Nuclear Regulatory Commission.

[10 CFR 73.40]

1.4.1.4.2.2C3 (d) The licensee shall provide for the implementation, revision, and maintenance of this safeguards contingency plan. To this end, the licensee shall provide for a review at least every twelve months of the safeguards contingency plan by individuals independent of both security program management and personnel who have direct responsibility for implementation of the security program. The review must include a review and audit of safeguards contingency procedures and practices, an audit of the security system testing and maintenance program, and a test of the safeguards system along with commitments established for response by local law enforcement authorities. The results of the review and audit, along with recommendations for improvements must be documented, reported to the licensee's corporate and plant management, and kept available at the plant for inspection for a period of three years from the date of the review or audit.

[10 CFR 73.40]

1.4.1.4.2.2C4 (c) Access requirements. The licensee shall control all points of personnel and vehicle access into a protected area, including shipping or receiving areas, and into each vital area. Identification of personnel and vehicles shall be made and authorization shall be checked at such points.

(1) At the point of personnel and vehicle access into a protected area, all individuals, except employees who possess a NRC or United States Department of Energy access authorization, and all hand-carried packages shall be searched for devices such as firearms, explosives, and incendiary devices, or other items which could be used for radiological sabotage. The search shall be conducted either by a physical search or by the use of equipment capable of detecting such devices. Employees who possess an NRC or Department of Energy access authorization shall be searched at random intervals. Subsequent to search, drivers of delivery and service vehicles shall be escorted at all times while within the protection area.

(2) All packages being delivered into the protected area shall be checked for proper identification and authorization. Packages other than hand-carried packages shall be searched at random intervals.

(3) A picture badge identification system shall be used for all individuals who are authorized access to protected areas without escort.

(4) Access to vital areas and material access areas shall be limited to individuals who are authorized access to vital equipment or special nuclear material and who require such access to perform their duties. Authorization for such individuals shall be provided by the issuance of specially coded numbered badges indicating vital areas and material access areas to which access is authorized. Unoccupied vital areas and material access areas shall be protected by an active intrusion alarm system.

(5) Individuals not employed by the licensee must be escorted by a watchman, or other individual designated by the licensee, while in a protected area and must be badged to indicate that an escort is required. In addition, the licensee shall require that each individual not employed by the licensee register his or her name, date, time, purpose of visit, employment affiliation, citizenship, name and badge number of the escort, and name of the individual to be visited. The licensee shall retain the register of information for three years after the last entry is made in the register. Except for a driver of a delivery or service vehicle, an individual not employed by the licensee who requires frequent and extended access to a protected area or a vital area need not be escorted if the individual is provided with a picture badge, which the individual must receive upon entrance into the protected area and return each time he or she leaves the protected area, that indicates-- (i) Nonemployee-no escort required, (ii) Areas to which access is authorized, and (iii) The period for which access has been authorized.

(6) No vehicles used primarily for the conveyance of individuals shall be permitted within a protected area except under emergency conditions.

(7) Keys, locks, combinations, and related equipment shall be controlled to minimize the possibility of compromise and promptly changed whenever there is evidence that they have been compromised. Upon termination of employment of any employee, keys, locks, combinations, and related equipment to which that employee had access shall be changed.

[10 CFR 73.50]

- B. Performance: No requirements specified at this time
- C. Interfaces: No requirements specified at this time

Table F1.4.1.4.2.3 Function Description: Provide Inspection/Testing Services

I. Function ID Number: 1.4.1.4.2.3

II. Function Title: Provide Inspection/Testing Services

III. Function Definition:

To establish services and facilities needed for performing inspection and testing of geologic repository services, equipment, and operations.

IV. Interfaces:

A. Inputs: None identified at this time

B. Outputs: None identified at this time

V. Function Requirements:

A. Constraints:

1.4.1.4.2.3C1 (1) DOE shall upon requests by the Director, Office of Nuclear Material Safety and Safeguards, provide rent-free office space for the exclusive use of the Commission inspection personnel. Heat, air-conditioning, light, electrical outlets and janitorial services shall be furnished by DOE. The office shall be convenient to and have full access to the facility and shall provide the inspector both visual and acoustic privacy.

(2) The space provided shall be adequate to accommodate a full-time inspector, a part-time secretary and transient NRC personnel and will be generally commensurate with other office facilities at the geologic repository operations area. A space of 250 square feet either within the geologic repository operations area's office complex or in an office trailer or other onsite space at the geologic repository operations area is suggested as a guide. For locations at which activities are carried out under licenses issued under other parts of this chapter, additional space may be requested to accommodate additional full-time inspectors. The Office space that is provided shall be subject to the approval of the Director, Office of Nuclear Material Safety and Safeguards. All furniture, supplies and communication equipment will be furnished by the Commission.

[10 CFR 60.75(c)]

1.4.1.4.2.3C2 (6) Inspection, testing, and maintenance. The structures, systems, and components important to safety shall be designed to permit periodic inspection, testing, and maintenance, as necessary, to ensure their continued functioning and readiness.

[10 CFR 60.131(b)]

1.4.1.4.2.3C3 (8) Instrumentation and control systems. The design shall include provisions for instrumentation and control systems to monitor and control the behavior of systems important to safety over anticipated ranges for normal operation and for accident conditions.

[10 CFR 60.131(b)]

1.4.1.4.2.3C4 (1) Within 15 days of completion of an inspection (30 days for items dealing with health), a written notice shall be conspicuously posted at or near each place a hazardous working condition exists until the condition has been abated or for 3 working days, whichever is longer. Where it is not practical to post the notice at or near each place, such notice shall be posted in a prominent place where it will be readily observable by all affected employees. The notice shall:

- (a) Describe with particularity the nature and extent of the unsafe or unhealthful working condition(s);
- (b) Reference any safety or health standard violated;
- (c) Establish a reasonable time for abatement of the hazardous condition(s).
- (d) Be provided to the appropriate levels of management and the employee representative(s) who participated in the closing conference.

[DOE Order 3790.1A, page 1-2]

B. Performance: No requirements specified at this time

C. Interfaces: No requirements specified at this time

Table F1.4.1.4.2.4 Function Description: Provide Emergency Medical Treatment

I. Function ID Number: 1.4.1.4.2.4

II. Function Title: Provide Emergency Medical Treatment

III. Function Definition:

To establish and provide emergency medical response and treatment services at the geologic repository.

IV. Interfaces:

A. Inputs: None identified at this time

B. Outputs: None identified at this time

V. Function Requirements:

A. Constraints:

1.4.1.4.2.4C1 1. Medical Emergency Response. Areas with the potential for emergencies shall be identified and a written emergency planning, preparedness, and response program shall be prepared. The medical emergency response capability must include the following:

(1) The ability to treat the initial consequences of potential medical emergencies which might occur on the site and, if necessary, the ability to process injured or sick personnel for transfer to offsite medical emergency facilities; and

(2) The capacity to treat the number of patients and types of illnesses or injuries which are likely to occur on the site.

m. Emergency Tests and Exercises. Medical response capabilities shall be conducted periodically for the identified potential emergencies. When practicable, tests and exercises shall be conducted under simulated emergency conditions.

[DOE Order 3790.1A, page VIII-5]

B. Performance: No requirements specified at this time

C. Interfaces: No requirements specified at this time

Table F1.4.1.4.2.5 Function Description: Provide Fire/Explosion Protection

I. Function ID Number: 1.4.1.4.2.5

II. Function Title: Provide Fire/Explosion Protection

III. Function Definition:

To establish and operate services to respond to fires, explosions, and similar emergencies at the geological repository.

IV. Interfaces:

A. Inputs: None identified at this time

B. Outputs: None identified at this time

V. Function Requirements:

A. Constraints:

1.4.1.4.2.5C1 (3) Protection against fires and explosions ...

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

[10 CFR 60.131(b)]

B. Performance: No requirements specified at this time

C. Interfaces: No requirements specified at this time

Table F1.4.1.4.2.6 Function Description: Provide Radiological Protection

I. Function ID Number: 1.4.1.4.2.6

II. Function Title: Provide Radiological Protection

III. Function Definition:

To establish and operate services for routine radiological health monitoring and to respond to radiological emergencies at the geologic repository.

A description of the program for control and monitoring of radioactive effluents and occupational radiation exposures to maintain such effluent and exposures in accordance with the requirements of Part 20 of this chapter. [10 CFR 60.21(c)(7)]

Plans for coping with radiological emergencies at any time prior to permanent closure and decontamination or dismantlement of surface facilities. [10 CFR 60.21(c)(9)]

IV. Interfaces:

A. Inputs: None identified at this time

B. Outputs: None identified at this time

V. Function Requirements:

A. Constraints:

1.4.1.4.2.6C1 Sections 60.131 through 60.134 specify minimum criteria for the design of the geologic repository operations area. These design criteria are not intended to be exhaustive, however. Omissions in Sections 60.131 through 60.134 do not relieve DOE from any obligation to provide such safety features in a specific facility needed to achieve the performance objectives [10 CFR 60.130]

(a) Radiological protection. The geologic repository operations area shall be designed to maintain radiation doses, levels, and concentrations of radioactive material in air in restricted areas within the limits specified in Part 20 of this chapter. Design shall include:

(1) Means to limit concentrations of radioactive material in air;

[10 CFR 60.131]

1.4.1.4.2.6C2 Sections 60.131 through 60.134 specify minimum criteria for the design of the geologic repository operations area. These design criteria are not intended to be exhaustive, however. Omissions in Sections 60.131 through 60.134 do not relieve DOE from any obligation to provide such safety features in a specific facility needed to achieve the performance objectives [10 CFR 60.130]

(a) Radiological protection. The geologic repository operations area shall be designed to maintain radiation doses, levels, and concentrations of radioactive material in air in restricted areas within the limits specified in Part 20 of this chapter. Design shall include:

(4) Means to monitor and control the dispersal of radioactive contamination;

[10 CFR 60.131]

1.4.1.4.2.6C3 Sections 60.131 through 60.134 specify minimum criteria for the design of the geologic repository operations area. These design criteria are not intended to be exhaustive, however. Omissions in Sections 60.131 through 60.134 do not relieve DOE from any obligation to provide such safety features in a specific facility needed to achieve the performance objectives [10 CFR 60.130]

(a) Radiological protection. The geologic repository operations area shall be designed to maintain radiation doses, levels, and concentrations of radioactive material in air in restricted areas within the limits specified in Part 20 of this chapter. Design shall include:

(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 effluents. The alarm system shall be designed with provisions for calibration and for testing its operability.

[10 CFR 60.131]

1.4.1.4.2.6C4 Sections 60.131 through 60.134 specify minimum criteria for the design of the geologic repository operations area. These design criteria are not intended to be exhaustive, however. Omissions in Sections 60.131 through 60.134 do not relieve DOE from any obligation to provide such safety features in a specific facility needed to achieve the performance objectives [10 CFR 60.130]

(b) 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 offsite releases as provided in Section 60.111(a).

[10 CFR 60.132]

1.4.1.4.2.6C5 Sections 60.131 through 60.134 specify minimum criteria for the design of the geologic repository operations area. These design criteria are not intended to be exhaustive, however. Omissions in Sections 60.131 through 60.134 do not relieve DOE from any obligation to provide such safety features in a specific facility needed to achieve the performance objectives [10 CFR 60.130]

(c) Radiation control and monitoring

(1) Effluent control. The surface facilities shall be designed to control the release of radioactive materials in effluent during normal operations so as to meet the performance objectives of Section 60.111(a).

(2) Effluent monitoring. 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.

[10 CFR 60.132]

1.4.1.4.2.6C6 (5) Sampling of work environments shall be conducted where there is reason to suspect that work processes are creating health hazards.

[DOE Order 3790.1A, page 1-2]

B. Performance: No requirements specified at this time

C. Interfaces: No requirements specified at this time

Table F1.4.1.4.2.7 Function Description: Provide Non-Radiological Protection

I. Function ID Number: 1.4.1.4.2.7

II. Function Title: Provide Non-Radiological Protection

III. Function Definition:

To establish and operate services for routine non-radiological hygiene and to respond to emergencies other than security, radiological, fire and explosion, and medical at the geologic repository.

IV. Interfaces:

A. Inputs: None identified at this time

B. Outputs: None identified at this time

V. Function Requirements:

A. Constraints:

1.4.1.4.2.7C1 Rock dust and gas hazards; controls.

The dust resulting from drilling in rock shall be controlled by the use of permissible dust collectors, or by water or water with a wetting agent, or by ventilation, or by any other method or device approved by the Secretary (of Labor) which is at least as effective in controlling such dust. Respiratory equipment approved by the Secretary (of Labor) and the Secretary of Health and Human Services shall be provided persons exposed for short

1 periods to inhalation hazards from gas, dusts, fumes or mist. When the exposure is for
2 prolonged periods, other measures to protect such persons or to reduce the hazard shall
3 be taken.
4

[30 USC 801 et seq., Section 844]

1.4.1.4.2.7C2 (5) Sampling of work environments shall be conducted where there is reason
to suspect that work processes are creating health hazards.

[DOE Order 3790.1A, page 1-2]

7
8 **B. Performance:** No requirements specified at this time

9 **C. Interfaces:** No requirements specified at this time

10 **Table F1.4.1.4.2.8 Function Description: Provide Environmental Protection**

11 **I. Function ID Number:** 1.4.1.4.2.8

12 **II. Function Title:** Provide Environmental Protection

13 **III. Function Definition:**

14 To establish and operate services to mitigate environmental hazards and to respond to
15 environmental hazard emergencies at the geologic repository.

16 **IV. Interfaces:**

17 **A. Inputs:** None identified at this time

18 **B. Outputs:** None identified at this time

19 **V. Function Requirements:**

A. Constraints:

21 1.4.1.4.2.8C1 Sections 60.131 through 60.134 specify minimum criteria for the design of
22 the geologic repository operations area. These design criteria are not intended to be
23 exhaustive, however. Omissions in Sections 60.131 through 60.134 do not relieve DOE from
24 any obligation to provide such safety features in a specific facility needed to achieve the
25 performance objectives [10 CFR 60.130]

26 (c) Radiation control and monitoring.

27 (1) Effluent control. The surface facilities shall be designed to control the release of
28 radioactive materials in effluents during normal operations so as to meet the performance
29 objectives of Section 60.111(a).

30 (2) Effluent monitoring. The effluent monitoring systems shall be designed to measure the
31 amount and concentration of radionuclides in any effluent with sufficient precision to
32 determine whether releases conform to the design requirement for effluent control. The
33 monitoring systems shall be designed to include alarms that can be periodically tested.:

[10 CFR 60.132]

34
35 **B. Performance:** No requirements specified at this time

36 **C. Interfaces:** No requirements specified at this time

1 Table F1.4.1.4.3 Function Description: Administer General Support Services

2 I. Function ID Number: 1.4.1.4.3

3 II. Function Title: Administer General Support Services

4 III. Function Definition:

5 To provide general administrative support services at the geologic repository.

6 IV. Interfaces:

7 A. Inputs: None identified at this time

8 B. Outputs: None identified at this time

9 V. Function Requirements:

10 A. Constraints:

11 1.4.1.4.3C1 (b) License conditions shall include items in the following categories:

12 (6) Administrative controls, which are the provisions relating to organization and
13 management, procedures, recordkeeping, review and audit, and reporting necessary to assure
14 that activities at the facility are conducted in a safe manner and in conformity with the
15 other license specifications.
16

[10 CFR 60.43]

17 B. Performance: No requirements specified at this time

18 C. Interfaces: No requirements specified at this time

19 Table F1.4.1.4.3.1 Function Description: Maintain Records

20 I. Function ID Number: 1.4.1.4.3.1

21 II. Function Title: Maintain Records

22 III. Function Definition:

23 To maintain records of the geologic repository and operations and to provide other records
24 management services.

25 IV. Interfaces:

26 A. Inputs: None identified at this time

27 B. Outputs: None identified at this time

28 V. Function Requirements:

29 A. Constraints:

30 1.4.1.4.3.1C1 (c) Maintenance, preservation, and availability of records; issuance of
31 regulations; scope of records; periodic inspections by employer; posting of notices by
32 employer; notification of employee of corrective action. (1) Each employer shall make,
33 keep and preserve, and make available to the Secretary (of Labor) or the Secretary of
34 Health and Human Services, such records regarding his activities relating to this chapter
35 as the Secretary, in cooperation with the Secretary of Health and Human Services, may
36 prescribe by regulation as necessary or appropriate for the enforcement of this chapter or
37 for developing information regarding the causes and prevention of occupational accidents
38 and illnesses. In order to carry out the provisions of this paragraph such regulations may
39 include provisions requiring employers to conduct periodic inspections. The Secretary shall
40 also issue regulations requiring that employers, through posting of notices or other
41 appropriate means, keep their employees informed of their protections and obligations

under this chapter, including the provisions of applicable standards.

[29 USC 651 et.seq., Section 657]

1.4.1.4.3.1C2 (h) Records and reports; compilation and publication; availability.

In addition to such records as are specifically required by this chapter, every operator of a coal or other mine shall establish and maintain such records, make such reports, and provide such information, as the Secretary (of Labor) or the Secretary of Health and Human Services may reasonably require from time to time to enable him to perform his functions under this chapter.

[30 USC 801 et.seq., Section 813]

1.4.1.4.3.1C3 (d) Accident investigations; records

All accidents, including unintentional roof falls (except in any abandoned panels or in areas which are inaccessible or unsafe for inspections), shall be investigated by the operator or his agent to determine the cause and the means of preventing a recurrence. Records of such accidents and investigations shall be kept and the information shall be made available to the Secretary (of Labor) or his authorized representative and the appropriate State agency. Such records shall be open for inspection by interested persons. Such records shall include man-hours worked and shall be reported at a frequency determined by the Secretary (of Labor), but at least annually.

[30 USC 801 et.seq., Section 813]

1.4.1.4.3.1C4 (c) Certificate

Upon completion of each training program, each operator shall certify, on a form approved by the Secretary, that the miner has received the specified training in each subject area of the approved health and safety training plan. A certificate for each miner shall be maintained by the operator, and shall be available for inspection at the mine site, and a copy thereof shall be given to each miner at the completion of such training. When a miner leaves the operator's employ, he shall be entitled to a copy of his health and safety training certificates. False certification by an operator that training was given shall be punishable under section 820(a) and (f) of this title; and each health and safety training certificate shall indicate on its face, in bold letters, printed in a conspicuous manner the fact that such false certification is so punishable.

[30 USC 801 et.seq., Section 825]

1.4.1.4.3.1C5 Records And Inspections

(a)(1) Every person who is a supplier of water, who is or may be otherwise subject to a primary drinking water regulation prescribed under section 1412 or to an applicable underground injection control program (as defined in section 1422(c)), who is or may be subject to the permit requirement of section 1424 or to an order issued under section 1441, or who is a grantee, shall establish and maintain such records, make such reports, conduct such monitoring, and provide such information as the Administrator may reasonably require by regulation under this title, in determining whether such person has acted or is acting in compliance with this title, in administering any program of financial assistance under this title, in evaluating the health risks of unregulated contaminants, or in advising the public of such risks.

[42 USC 300f et.seq., Section 300j-4]

1.4.1.4.3.1C6 (b) Each record required by this part must be legible throughout the retention period specified by each Commission regulation. The record may be the original or a reproduced copy or a microform provided that the copy or microform is authenticated by authorized personnel and that the microform is capable of producing a clear copy throughout the required retention period. The record may also be stored in electronic media with the capability for producing legible, accurate, and complete records during the required retention period. Records such as letters, drawings, specifications, must include all pertinent information such as stamps, initials, and signatures. The licensee shall maintain adequate safeguards against tampering with and loss of records.

[10 CFR 60.4]

1 1.4.1.4.3.1C7 (b) The DOE shall maintain records of changes in the geologic repository
2 operations area and of changes in procedures made pursuant to this section, to the extent
3 that such changes constitute changes in the geologic repository operations area or
4 procedures as described in the application. Records of tests and experiments carried out
5 pursuant to paragraph (a) of this section shall also be maintained. These records shall
6 include a written safety evaluation which provides the basis for the determination that the
7 change, test, or experiment does not involve an unreviewed safety question. The DOE shall
8 prepare annually, or at such shorter intervals as may be specified in the license, a report
9 containing a brief description of such changes, tests, and experiments, including a summary
10 of the safety evaluation of each. The DOE shall furnish the report to the appropriate NRC
11 Regional Office shown in Appendix D of Part 20 of this chapter with a copy to the
12 Director, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory
13 Commission, Washington, D.C. 20555. Any report submitted pursuant to this paragraph
14 shall be made a part of the public record of the licensing proceedings.

15 [10 CFR 60.44 (b)]

16 1.4.1.4.3.1C8 (a) DOE shall maintain such records and make such reports in connection
17 with the licensed activity as may be required by the conditions of the license or by rules,
18 regulations, and orders of the Commission as authorized by the Atomic Energy Act and
19 the Energy Reorganization Act.

20 (b) Records of the receipt, handling, and disposition of radioactive waste at a geologic
21 repository operations area shall contain sufficient information to provide a complete history
22 of the movement of the waste from the shipper through all phases of storage and disposal.
23 DOE shall retain these records in a manner that ensures their useability for future
24 generations in accordance with Sec. 60.51(a)(2).
25

[10 CFR 60.71]

26 1.4.1.4.3.1C9 (a) DOE shall maintain records of construction of the geologic repository
27 operations area in a manner that ensures their useability for future generations in
28 accordance with Section 60.51(a)(2).

29 (b) The records required under paragraph (a) shall include at least the following:

- 30 1) Surveys of the underground facility excavations, shafts, and boreholes referenced
31 to readily identifiable surface features or monuments;
32
33 2) A description of the materials encountered;
34 3) Geologic maps and geologic cross sections;
35 4) Locations and amount of seepage;
36 5) Details of equipment, methods, progress, and sequence of work;
37 6) Construction problems;
38 7) Anomalous conditions encountered;
39 8) Instrument locations, readings, and analysis;
40 9) Location and description of structural support systems;
41 10) Location and description of dewatering systems; and
42 11) Details, methods of emplacement, and location of seals used.

[10 CFR 60.72]

43 1.4.1.4.3.1C10 3. Records Maintenance. Records shall be maintained in accordance with
44 DOE 1324.2, Records Disposition.
45

[DOE Order 3790.1A, page VII-8]

46 B. Performance: No requirements specified at this time

47 C. Interfaces: No requirements specified at this time

1 Table F1.4.1.4.3.2 Function Description: Provide Engineering Support

2 I. Function ID Number: 1.4.1.4.3.2

3 II. Function Title: Provide Engineering Support

4 III. Function Definition:

5 To establish services and facilities needed to provide engineering support for geologic
6 repository operations.

7 IV. Interfaces:

8 A. Inputs: None identified at this time

9 B. Outputs: None identified at this time

10 V. Function Requirements: No requirements specified at this time

11 Table F1.4.1.4.3.3 Function Description: Provide For Human Resources

12 I. Function ID Number: 1.4.1.4.3.3

13 II. Function Title: Provide for Human Resources

14 III. Function Definition:

15 To establish services and facilities to administer human resource services at the geologic
16 repository.

17 IV. Interfaces:

18 A. Inputs: None identified at this time

19 B. Outputs: None identified at this time

20 V. Function Requirements:

21 A. Constraints:

22 1.4.1.4.3.3C1 (c) Maintenance, preservation, and availability of records; issuance of
23 regulations; scope of records; periodic inspections by employer; posting of notices by
24 employer; notification of employee of corrective action.

25 (1) Each employer shall make, keep and preserve, and make available to the Secretary (of
26 Labor) or the Secretary of Health and Human Services, such records regarding his activities
27 relating to this chapter as the Secretary, in cooperation with the Secretary of Health and
28 Human Services, may prescribe by regulation as necessary or appropriate for the
29 enforcement of this chapter or for developing information regarding the causes and
30 prevention of occupational accidents and illnesses. In order to carry out the provisions of
31 this paragraph such regulations may include provisions requiring employers to conduct
32 periodic inspections. The Secretary shall also issue regulations requiring that employers,
33 through posting of notices or other appropriate means, keep their employees informed of
34 their protections and obligations under this chapter, including the provisions of applicable
35 standards.

36 [29 USC 651 et.seq., Section 657]

37 1.4.1.4.3.3C2 (a) Mine office; bulletin board.

38 At each coal or other mine there shall be maintained an office with a conspicuous sign
39 designating it as the office of such mine. There shall be a bulletin board at such office or
40 located at a conspicuous place near an entrance of such mine, in such manner that orders,
41 citations, notices and decisions required by law or regulation to be posted, may be posted
42 thereon, and be easily visible to all persons desiring to read them, and be protected against

1 damage by weather and against unauthorized removal. A copy of any order, citation,
2 notice or decision required by this chapter to be given to an operator shall be delivered to
3 the office of the affected mine, and a copy shall be immediately posted on the bulletin
4 board of such mine by the operator or his agent.

[30 USC 801 et.seq., Section 819]

6 **B. Performance:** No requirements specified at this time

7 **C. Interfaces:** No requirements specified at this time

8 **Table F1.4.1.4.3.3.1 Function Description: Provide Training**

9 **I. Function ID Number:** 1.4.1.4.3.3.1

10 **II. Function Title:** Provide Training

11 **III. Function Definition:**

12 To provide services and resources needed to provide training to geologic repository
13 personnel.

14 **IV. Interfaces:**

15 **A. Inputs:** None identified at this time

16 **B. Outputs:** None identified at this time

17 **V. Function Requirements:**

18 **A. Constraints:**

19 1.4.1.4.3.3.1C1 Each operator of a coal or other mine shall have a health and safety
20 training program which shall be approved by the Secretary.

[30 USC 801 et.seq., Section 825]

21
22 1.4.1.4.3.3.1C2 Each training program approved by the Secretary (of Labor) shall provide
23 as a minimum that -

24 (1) new miners having no underground mining experience shall receive no less than
25 40 hours of training if they are to work underground. Such training shall include
26 instruction in the statutory rights of miners and their representatives under this
27 chapter, use of the self-rescue device and use of respiratory devices, hazard
28 recognition, escapeway, walk around training, emergency procedures, basic
29 ventilation, basic roof control, electrical hazards, first aid, and the health and safety
30 aspects of the task to which he will be assigned;

31 (2) new miners having no surface mining experience shall receive no less than 24
32 hours of training if they are to work on the surface. Such training shall include
33 instruction in the statutory rights of miners and their representatives under this
34 chapter, use of the self-rescue device where appropriate, hazard recognition,
35 emergency procedures, electrical hazards, first aid, walk around training and the
36 health and safety aspects of the task to which he will be assigned;

37 (3) all miners shall receive no less than eight hours of refresher training no less
38 frequently than once each 12 months, except that miners already employed on the
39 effective date of the Federal Mine Safety and Health Amendments Act of 1977 shall
40 receive this refresher training no more than 90 days after the date of approval of
41 the training plan required by this section;

42 (4) any miner who is reassigned to a new task in which he has had no previous

1 work experience shall receive training in accordance with a training plan approved
2 by the Secretary (of Labor) under this subsection in the safety and health aspects
3 specific to that task prior to performing that task;

4 (5) any training required by paragraphs (1), (2) or (4) shall include a period of
training as closely related as is practicable to the work in which the miner is to be
engaged.

[30 USC 801 et.seq., Section 825]

8 **1.4.1.4.3.3.1C3 (c) Certificate**

9 Upon completion of each training program, each operator shall certify, on a form approved
10 by the Secretary, that the miner has received the specified training in each subject area of
11 the approved health and safety training plan. A certificate for each miner shall be
12 maintained by the operator, and shall be available for inspection at the mine site, and a
13 copy thereof shall be given to each miner at the completion of such training. When a
14 miner leaves the operator's employ, he shall be entitled to a copy of his health and safety
15 training certificates. False certification by an operator that training was given shall be
16 punishable under section 820(a) and (f) of this title; and each health and safety training
17 certificate shall indicate on its face, in bold letters, printed in a conspicuous manner the
18 fact that such false certification is so punishable.

[30 USC 801 et.seq., Section 825]

20 **1.4.1.4.3.3.1C4** DOE shall establish a program for training, proficiency testing, certification
21 and requalification of operating and supervisory personnel.

[10 CFR 60.161]

23 **1.4.1.4.3.3.1C5 (1) Training for Top Management.** Top management shall be provided
24 orientation training which will enable them to manage their programs in a safe manner.
25 Such orientation training should include coverage under section 19 of the Occupational
26 Safety and Health Act of 1970, Executive Order 12196, 29 CFR part 1960, and the DOE's
27 Federal Employee Occupational Safety and Health Program.

28 (2) **Training for Supervisors.** Supervisors shall be trained through introductory and
29 specialized courses and materials to recognize and eliminate occupational safety and health
hazards in their work units. Such training should also include the development of requisite
skills in managing the safety and health program within their work unit, including the
training and motivation of subordinates toward safe and healthful work practices.

33 (3) **Training for Employees.** Occupational safety and health training for employees shall
34 include specialized job safety and health training appropriate to the work performed. Such
35 training shall also include informing employees of their rights and responsibilities under
36 section 19 of the Occupational Safety and Health Act of 1970, Executive Order 12196, 29
37 CFR part 1960, and the DOE's Federal Employee Occupational Safety and Health Program.

38 (4) **Training for Representatives of Employees.** Training for employees who are
39 representatives of employee groups, such as labor organizations which are recognized by the
40 Department, shall include introductory and specialized courses and materials which will
41 enable such groups to function appropriately in the interest of ensuring safe and healthful
42 working conditions and practices in the workplace and, in particular, to enable them to
43 effectively assist in the conduct of workplace safety and health inspections. Nothing in this
44 paragraph shall be construed to alter the provisions of the Federal Service Labor-
45 Management Relations Statute, other provisions of law providing for collective bargaining
46 agreements and procedures, or any agreements entered into pursuant to such provisions.

47 (5) **Training for Safety and Health Professionals.** Safety and health personnel shall be
48 trained through courses, laboratory experiences, field study, and other learning experiences
49 to perform the necessary technical monitoring, consulting, testing, inspection, designing, and
50 other tasks which will enable them to determine whether applicable standards are being met
51 in the workplace. Training should be designed so as to develop skills in hazard recognition,
52 obtaining qualified evaluations, recommending corrective action, and functioning as
53 consultants to management.

54 (6) **Training for Collateral Duty Safety Personnel.** Training should be designed so as to
55 develop skills in hazard recognition, obtaining qualified evaluations, recommending
56 corrective action, and functioning as consultants to management.

[DOE Order 3790.1A, page V-1]

1
2
3

1.4.1.4.3.3.1C6 k. Emergency Training. Employees shall have the opportunity to receive training in the basic elements of first aid and cardiopulmonary resuscitation (CPR) and CPR refresher training, at no cost to the employee. *[DOE Order 3790.1A, page VIII-5]*

5

B. Performance: No requirements specified at this time

6

C. Interfaces: No requirements specified at this time

7

1 **Table F1.4.1.4.3.3.2 Function Description: Provide Personnel Services**

2 **I. Function ID Number:** 1.4.1.4.3.3.2

3 **II. Function Title:** Provide Personnel Services

4 **III. Function Definition:**

5 To provide services and resources needed to perform administrative personnel services for
6 the geologic repository.

7 **IV. Interfaces:**

8 **A. Inputs:** None identified at this time

9 **B. Outputs:** None identified at this time

10 **V. Function Requirements:**

11 **A. Constraints:**

12 1.4.1.4.3.3.2C1 (1) Within 15 days of completion of an inspection (30 days for items
13 dealing with health), a written notice shall be conspicuously posted at or near each place
14 a hazardous working condition exists until the condition has been abated or for 3 working
15 days, whichever is longer. Where it is not practical to post the notice at or near each
16 place, such notice shall be posted in a prominent place where it will be readily observable
17 by all affected employees. The notice shall:

18 (a) Describe with particularity the nature and extent of the unsafe or unhealthful
19 working condition(s);

20 (b) Reference any safety or health standard violated;

21 (c) Establish a reasonable time for abatement of the hazardous condition(s).

22 (d) Be provided to the appropriate levels of management and the employee
23 representative(s) who participated in the closing conference.

24 *[DOE Order 3790.1A, page I-2]*

26 1.4.1.4.3.3.2C2 a. Health Services Personnel. (1) Health services shall be provided under
27 the direction of a licensed physician, and nursing services shall be provided by licensed
28 professional nurses. To the maximum extent feasible, such physicians and nurses shall be
qualified in occupational medicine and occupational nursing.

29 (2) As an alternative, Heads of Field Organizations may elect to contract for
30 medical services. When this option is selected, licensed physicians and nurses shall
31 be qualified in occupational medicine and occupational nursing, if possible, and
32 programs shall comply with the requirements of this chapter.

33 b. Preplacement Health Evaluation. Prior to employment, where a hazard is associated
34 with job performance, each employee shall have a complete health evaluation, with special
35 emphasis placed upon the health and physical factors that relate to the hazards of the
36 position. The purpose of this examination is to determine an employee's health status prior
37 to any exposures associated with a job. In addition, it is to determine the employee's
38 physical capabilities and any required accommodations necessary for safe and healthy job
39 performance. The health evaluation shall be performed by the health services staff at no
40 cost to the employee.

41 c. Health Screening Evaluation. Each employee age 45 and over shall be offered a
42 complete health evaluation annually at no cost to the employee.

43 d. Job Change or Transfer Health Evaluation.

44 (1) Employees who change or transfer job functions with associated hazards (e.g.,
45 electrician to lineman or lineman to crane operator) shall have their health status
46 and physical fitness reviewed with emphasis on the effects of the position vacated
47 and the health and physical factors that relate to the new job tasks and demands.
48 The evaluation shall be at no cost to the employee.

(2) Employees who change or transfer from a job function with associated hazards to a job function with negligible associated hazards or vice versa (e.g., courier to file clerk or draftsman to lineman) shall have their health status and physical fitness reviewed with emphasis on the effects of the position vacated or the health and physical factors that relate to the new job tasks and demands, for whichever involves hazards. The evaluation shall be at no cost to the employee.

e. Retirement or Separation Health Evaluation. The health status of an employee who is retiring or separating from a position where there is an associated hazard shall be determined by a health evaluation, with emphasis placed upon the health and physical factors of that position. The evaluation shall be at no cost to the employee.

f. Return to Work (Fitness-for-Duty) Evaluation. An employee who occupies a position with an associated hazard, who is absent from work more than 3 consecutive workdays due to either an occupational or a nonoccupational illness or injury, shall submit either a health status report from a personal physician (obtained at the employee's expense) to the employee's supervisor stating that the employee is fit to work, or shall undergo a health evaluation by the health services staff (at no cost to the employee) sufficient to ensure that the employee's return to work will be without undue health hazard or accident risk to the employee or others.

g. Treatment and Medications. The health services staff shall at their discretion administer the following at no cost to the employee:

(1) Vaccines or other medications furnished by the employee and prescribed in writing by the employee's personal physician as reasonably necessary to maintain the employee's health and well-being while at work; and

(2) Treatment prescribed by a physician providing medical care in performance-of-duty injury or illness cases under the Federal Employee's Compensation Act.

h. Screening Examinations. Tests and immunizations for specific diseases shall be provided as necessary by health services personnel.

i. Health Education and Counseling, provided at no cost to employees, shall include:

(1) Lectures on health and health education materials to promote and encourage employees to improve and maintain personal health;

(2) Individual counseling on health matters; and

(3) Utilization of available Employee Assistance Program services.

j. Treatment of Injuries or Illnesses.

(1) Occupational Injury or Illness. Any employee with an occupationally related injury or illness shall be initially examined and treated to allay pain, discomfort, and anxiety without undue delay and at no cost to the employee. The scope and content of the examination and treatment shall be based upon the nature and extent of the injury or illness, and shall be sufficient to determine whether the employee may return to work without undue health hazard or accident risk to the workforce. If necessary, conveyance of the employee to a local hospital emergency room shall be provided.

(2) Nonoccupational Injury or Illness. On-the-job care is given, at no cost to the employee, as necessary to allay pain, discomfort, and anxiety; to allow completion of the workday, and to provide interim care prior to referral of the employee to his or her physician for private medical attention.

[DOE Order 3790.1A, page VIII-3]

B. Performance: Requirements at this level to be specified

C. Interfaces: Requirements at this level to be specified

1 **Table F1.4.1.4.3.4 Function Description: Provide Procurement Services**

2 **I. Function ID Number:** 1.4.1.4.3.4

3 **II. Function Title:** Provide Procurement Services

4 **III. Function Definition:**

5 To provide services and resources needed for the procurement of materials and personnel
6 services for the geologic repository.

7 **IV. Interfaces:**

8 **A. Inputs:** None identified at this time

9 **B. Outputs:** None identified at this time

10 **V. Function Requirements:** Requirements at this level to be specified

11 **Table F1.4.1.4.3.5 Function Description: Provide Public Relations**

12 **I. Function ID Number:** 1.4.1.4.3.5

13 **II. Function Title:** Provide Public Relations

14 **III. Function Definition:**

15 To provide services and facilities to administrate public relations activities for the geologic
16 repository.

17 **IV. Interfaces:**

18 **A. Inputs:** None identified at this time

19 **B. Outputs:** None identified at this time

20 **V. Function Requirements:** Requirements at this level to be specified

21 **Table F1.4.1.4.3.6 Function Description: Provide Financial Accounting**

22 **I. Function ID Number:** 1.4.1.4.3.6

23 **II. Function Title:** Provide Financial Accounting

24 **III. Function Definition:**

25 To provide financial accounting services for the geologic repository.

26 **IV. Interfaces:**

27 **A. Inputs:** None identified at this time

28 **B. Outputs:** None identified at this time

29 **V. Function Requirements:** Requirements at this level to be specified

1 **Table F1.4.1.4.4 Function Description: Process Site-Generated Waste**

2 **I. Function ID Number:** 1.4.1.4.4

3 **II. Function Title:** Process Site-Generated Waste

4 **III. Function Definition:**

5 To prepare and dispose of wastes that are generated at the geologic repository site. Site-
6 generated waste includes all forms of waste, including radioactive, hazardous, and non-
7 hazardous wastes.

8 **IV. Interfaces:**

9 **A. Inputs:**

10 1.4.1.4.4I1 Site-Generated Waste **From:** Function1.4.1.1/1.4.1.2/1.4.1.3

11 **B. Outputs:**

12 1.4.1.4.4O1 Disposed Site-Generated **To:** Outside System Boundary

13 **V. Function Requirements:**

14 **A. Constraints:**

15 1.4.1.4.4C1 Sections 60.131 through 60.134 specify minimum criteria for the design of the
16 geologic repository operations area. These design criteria are not intended to be exhaustive,
17 however. Omissions in Sections 60.131 through 60.134 do not relieve DOE from any
18 obligation to provide such safety features in a specific facility needed to achieve the
19 performance objectives [10 CFR 60.130]

20 (c) Radiation control and monitoring.

21 (1) Effluent control. The surface facilities shall be designed to control the release of
22 radioactive materials in effluents during normal operations so as to meet the performance
23 objectives of Section 60.111(a).

24 (2) Effluent monitoring. The effluent monitoring systems shall be designed to measure the
25 amount and concentration of radionuclides in any effluent with sufficient precision to
26 determine whether releases conform to the design requirement for effluent control. The
27 monitoring systems shall be designed to include alarms that can be periodically tested.

28 [10 CFR 60.132]

29 1.4.1.4.4C2 Sections 60.131 through 60.134 specify minimum criteria for the design of the
30 geologic repository operations area. These design criteria are not intended to be exhaustive,
31 however. Omissions in Sections 60.131 through 60.134 do not relieve DOE from any
32 obligation to provide such safety features in a specific facility needed to achieve the
33 performance objectives [10 CFR 60.130]

34 (d) Waste treatment. Radioactive waste treatment facilities shall be designed to process any
35 radioactive wastes generated at the geologic repository operations area into a form suitable
36 to permit safe disposal at the geologic repository operations area or to permit safe
37 transportation and conversion to a form suitable for disposal at an alternative site in
38 accordance with any regulations that are applicable.

39 [10 CFR 60.132]

40 **B. Performance:** Requirements at this level to be specified

41 **C. Interfaces:** Requirements at this level to be specified

1 Table F1.4.1.4.4.1 Function Description: Collect Site-Generated Waste

2 I. Function ID Number: 1.4.1.4.4.1

3 II. Function Title: Collect Site-Generated waste

4 III. Function Definition:

5 To safely collect all wastes generated at the geologic repository site.

6 IV. Interfaces:

7 A. Inputs:

8 1.4.1.4.4.1I1 Site Generated Waste From: Function 1.4.1.1/1.4.1.2/1.4.1.3

9 B. Outputs:

10 1.4.1.4.4.1O1 Site Generated Waste To: Function 1.4.1.4.4.2

11 V. Function Requirements: Requirements at this level to be specified

12 Table F1.4.1.4.4.2 Function Description: Store Site-Generated Waste

13 I. Function ID Number: 1.4.1.4.4.2

14 II. Function Title: Store Site-Generated Waste

15 III. Function Definition:

16 To provide interim storage for site-generated wastes in anticipation of further treatment
17 and/or disposal.

18 IV. Interfaces:

19 A. Inputs:

20 1.4.1.4.4.2I1 Site-Generated Waste From: Function 1.4.1.4.4.1

21 B. Outputs:

22 1.4.1.4.4.2O1 Rad Waste (Site-Gen'd) To: Function 1.4.1.4.4.3
23 1.4.1.4.4.2O2 Mixed (Rad/Haz) Waste To: Function 1.4.1.4.4.3
24 1.4.1.4.4.2O3 Non Rad/Hazardous Waste To: Function 1.4.1.4.4.3
25 1.4.1.4.4.2O4 Non Rad/Non Haz Waste To: Function 1.4.1.4.4.3

26 V. Function Requirements: Requirements at this level to be specified

27 Table F1.4.1.4.4.3 Function Description: Sort Site-Generated Waste

28 I. Function ID Number: 1.4.1.4.4.3

29 II. Function Title: Sort Site-Generated Waste

30 III. Function Definition:

31 To separate, as needed, various types of site-generated waste for further treatment or
32 disposal.

1 **IV. Interfaces:**

2 **A. Inputs:**

3 1.4.1.4.4.3I1 Rad Waste (Site-Gen'd) From: Function 1.4.1.4.4.2
1.4.1.4.4.3I2 Mixed (Rad/Haz) Waste From: Function 1.4.1.4.4.2
1.4.1.4.4.3I3 Non Rad/Hazardous Waste From: Function 1.4.1.4.4.2
1.4.1.4.4.3I4 Non Rad/Non Haz Waste From: Function 1.4.1.4.4.2

7 **B. Outputs:**

8 1.4.1.4.4.3O1 Sorted Rad Waste To: Function 1.4.1.4.4.4
9 1.4.1.4.4.3O2 Sorted Mixed Waste To: Function 1.4.1.4.4.4
10 1.4.1.4.4.3O3 Sorted Non Rad/Hazardous Waste To: Function 1.4.1.4.4.4
11 Waste
12 1.4.1.4.4.3O4 Sorted Non Rad/Non Haz Waste To: Function 1.4.1.4.4.6
13 Waste

14 **V. Function Requirements: Requirements at this level to be specified**

15 **Table F1.4.1.4.4.4 Function Description: Treat Site-Generated Waste**

16 **I. Function ID Number: 1.4.1.4.4.4**

17 **II. Function Title: Treat Site-Generated Waste**

18 **III. Function Definition:**

19 To perform any necessary treatment of site-generated wastes prior to disposal.

20 **IV. Interfaces:**

21 **A. Inputs:**

22 1.4.1.4.4.4I1 Sorted Rad Waste From: Function 1.4.1.4.4.3
23 1.4.1.4.4.4I2 Sorted Mixed Waste From: Function 1.4.1.4.4.3
24 1.4.1.4.4.4I3 Sorted Non Rad/Hazardous Waste From: Function 1.4.1.4.4.3
25 Waste

26 **B. Outputs:**

27 1.4.1.4.4.4O1 Treated Rad Waste To: Function 1.4.1.4.4.5
28 1.4.1.4.4.4O2 Treated Mixed Waste To: Function 1.4.1.4.4.5
29 1.4.1.4.4.4O3 Treated Non Rad/Hazardous Waste To: Function 1.4.1.4.4.5
30 Waste

31 **V. Function Requirements: Requirements at this level to be specified**

32 **Table F1.4.1.4.4.5 Function Description: Package Site-Generated Waste**

33 **I. Function ID Number: 1.4.1.4.4.5**

34 **II. Function Title: Package Site-Generated Waste**

35 **III. Function Definition:**

36 To package site-generated waste, as needed, prior to disposal.

1 **IV. Interfaces:**

2 **A. Inputs:**

3 1.4.1.4.4.5I1 Treated Rad Waste From: Function 1.4.1.4.4.4
1.4.1.4.4.5I2 Treated Mixed Waste From: Function 1.4.1.4.4.4
1.4.1.4.4.5I3 Treated Non Rad/Hazardous Waste From: Function 1.4.1.4.4.4

7 **B. Outputs:**

8 1.4.1.4.4.5O1 Packaged Rad Waste To: Function 1.4.1.4.4.6
9 1.4.1.4.4.5O2 Packaged Mixed Waste To: Function 1.4.1.4.4.6
10 1.4.1.4.4.5O3 Packaged Non Rad/
11 Hazardous Waste To: Function 1.4.1.4.4.6

12 **V. Function Requirements:** Requirements at this level to be specified

13 **Table F1.4.1.4.4.6 Function Description: Dispose of Site-Generated Waste**

14 **I. Function ID Number:** 1.4.1.4.4.6

15 **II. Function Title:** Dispose of Site-Generated Waste

16 **III. Function Definition:**

17 To provide services and resources needed to properly dispose of site-generated wastes,
18 including transportation off-site, as appropriate.

19 **IV. Interfaces:**

20 **A. Inputs:**

21 1.4.1.4.4.6I1 Packaged Rad Waste From: Function 1.4.1.4.4.5
1.4.1.4.4.6I2 Packaged Mixed Waste From: Function 1.4.1.4.4.5
1.4.1.4.4.6I3 Packaged Non Rad/
25 Hazardous Waste From: Function 1.4.1.4.4.5
26 1.4.1.4.4.6I4 Sorted Non Rad/Non
Hazardous Waste From: Function 1.4.1.4.4.3

27 **B. Outputs:**

28 1.4.1.4.4.6O1 Disposed Site Generated Waste To: Outside System Boundary
29

30 **V. Function Requirements:** Requirements at this level to be specified

31 **Table F1.4.1.4.5 Function Description: Maintain Operating Facilities**

32 **I. Function ID Number:** 1.4.1.4.5

33 **II. Function Title:** Maintain Operating Facilities

34 **III. Function Definition:**

35 To maintain geologic repository operating facilities, including operating equipment,
36 buildings, and utilities.

1 **IV. Interfaces:**

2 **A. Inputs:** None identified at this time

B. Outputs: None identified at this time

V. Function Requirements: Requirements at this level to be specified

5 **Table F1.4.1.4.5.1 Function Description: Maintain Operating Equipment**

6 **I. Function ID Number:** 1.4.1.4.5.1

7 **II. Function Title:** Maintain Operating Equipment

8 **III. Function Definition:**

9 To provide services and facilities needed to maintain geologic repository operating
10 equipment.

11 **IV. Interfaces:**

12 **A. Inputs:** None identified at this time

13 **B. Outputs:** None identified at this time

14 **V. Function Requirements:**

15 **A. Constraints:**

16 **1.4.1.4.5.1C1 (f) Testing and maintenance.**

17 Each licensee shall test and maintain intrusion alarms, emergency alarms, communications
equipment, physical barriers, and other security related devices or equipment utilized
pursuant to this section as follows:

18 (1) All alarms, communications equipment, physical barriers, and other security
19 related devices or equipment shall be maintained in operable and effective
20 condition.

21 (2) Each intrusion alarm shall be functionally tested for operability and required
22 performance at the beginning and end of each interval during which it is used for
23 security, but not less frequently than once every seven (7) days.

24 (3) Communications equipment shall be tested for operability and performance not
25 less frequently than once at the beginning of each security personnel work shift.

26 [10 CFR 73.50]

27 **1.4.1.4.5.1C2 (v) Plans for conduct of normal activities, including maintenance,
28 surveillance, and periodic testing of structures, systems, and components of the geologic
29 repository operation area.**

30 [10 CFR 60.21 (C)(15)(v)]

31 **B. Performance:** Requirements at this level to be specified

32 **C. Interfaces:** Requirements at this level to be specified

1 Table F1.4.1.4.5.2 Function Description: Maintain Buildings

2 I. Function ID Number: 1.4.1.4.5.2

3 II. Function Title: Maintain Buildings

4 III. Function Definition:

5 To provide services and resources needed to maintain buildings and structures at the
6 geologic repository.

7 IV. Interfaces: Requirements at this level to be specified

8 A. Inputs: None identified at this time

9 B. Outputs: None identified at this time

10 V. Function Requirements: Requirements at this level to be specified

11 Table F1.4.1.4.5.3 Function Description: Maintain Utilities

12 I. Function ID Number: 1.4.1.4.5.3

13 II. Function Title: Maintain Utilities

14 III. Function Definition:

15 To provide services and resources needed to maintain utility services at the geologic
16 repository.

17 IV. Interfaces:

18 A. Inputs: None identified at this time

19 B. Outputs: None identified at this time

20 V. Function Requirements: Requirements at this level to be specified

21 Table F1.4.1.4.5.4 Function Description: Prepare Shipping Cask For Return To Service

22 I. Function ID Number: 1.4.1.4.5.4

23 II. Function Title: Prepare Shipping Cask for Return to Service.

24 III. Function Definition:

25 To perform any actions needed to prepare empty shipping casks for return to operational
26 service by the external transportation system.

27 IV. Interfaces:

28 A. Inputs: None identified at this time

29 B. Outputs: None identified at this time

30 V. Function Requirements: Requirements at this level to be specified

1 **Table F1.4.1.4.6 Function Description: Administer QA**

2 **I. Function ID Number:** 1.4.1.4.6

3 **II. Function Title:** Administer QA

4 **III. Function Definition:**

5 To provide services and resources to administer the quality assurance needs of the geologic
6 repository.

7 **IV. Interfaces:**

8 **A. Inputs:** None identified at this time

9 **B. Outputs:** None identified at this time

10 **V. Function Requirements:** Requirements at this level to be specified

11 **Table F1.4.2 Function Description: Isolate Waste**

12 **I. Function ID Number:** 1.4.2

13 **II. Function Title:** Isolate Waste

14 **III. Function Definition:**

15 Isolation means inhibiting the transport of radioactive material so that amounts and
16 concentrations of this material entering the accessible environment will be kept within
17 prescribed limits. [10 CFR 60.2]

18 Isolation begins at permanent closure and continues up to at least 10,000 years. Some
19 constraints are included outside this time period because they contribute to the waste
20 isolation function.

21 **IV. Interfaces:**

22 **A. Inputs:**

23 1.4.2I1	Waste Packages	From: Function 1.4.1
24 1.4.2I2	Natural Transport Media	From: Site
25 1.4.2I3	Human Intentions	From: Outside System Boundary

26 **B. Outputs:**

27 1.4.2O1	Heat	To: Accessible Environment
28 1.4.2O2	Intruded Multiple Barrier System	To: Function 1.4.2.1/1.4.2.2 [Resources]
29 1.4.2O3	Federally-Permitted Radiation Exposure	To: Accessible Environment
30 1.4.2O4	Federally-Permitted Release of Radionuclides	To: Accessible Environment
31 1.4.2O5	[Migration Data]	To: Function 1.4.3
32 1.4.2O6	[Containment Data]	To: Function 1.4.3

33 **V. Function Requirements:**

34 **A. Constraints:**

35 **1.4.2C1 (c) The Safety Analysis Report shall include:**

36 (1) A description and assessment of the site at which the proposed geologic repository
37 operations area is to be located with appropriate attention to those features of the site that
38 might affect geologic repository operations area design and performance....

39 (ii) The assessment shall contain:
40
41
42

1 (D) The effectiveness of engineered and natural barriers, including barriers that may not
2 be themselves a part of the geologic repository operations area, against the release of
3 radioactive material to the environment. The analysis shall also include a comparative
4 evaluation of alternatives to the major design features that are important to waste isolation,
with particular attention to the alternatives that would provide longer radionuclide
containment and isolation.

[10 CFR 60.21]

8 1.4.2C2 This requirement intentionally left blank.

9 1.4.2C3 Sections 60.131 through 60.134 specify minimum criteria for the design of the
10 geologic repository operations area. These design criteria are not intended to be exhaustive,
11 however. Omissions in Sections 60.131 through 60.134 do not relieve DOE from any
12 obligation to provide such safety features in a specific facility needed to achieve the
13 performance objectives [10 CFR 60.130]

14 (a) General criteria for the underground facility.

15 (1) The orientation, geometry, layout, and depth of the underground facility, and
16 the design of any engineered barriers that are part of the underground facility shall
17 contribute to the containment and isolation of radionuclides.

[10 CFR 60.133]

19 1.4.2C4 Sections 60.131 through 60.134 specify minimum criteria for the design of the
20 geologic repository operations area. These design criteria are not intended to be exhaustive,
21 however. Omissions in Sections 60.131 through 60.134 do not relieve DOE from any
22 obligation to provide such safety features in a specific facility needed to achieve the
23 performance objectives [10 CFR 60.130]

24 (b) Flexibility of design. The underground facility shall be designed with sufficient flexibility
25 to allow adjustments where necessary to accommodate specific site conditions identified
26 through in situ monitoring, testing, or excavation.

[10 CFR 60.133]

30 1.4.2C5 Sections 60.131 through 60.134 specify minimum criteria for the design of the
31 geologic repository operations area. These design criteria are not intended to be exhaustive,
32 however. Omissions in Sections 60.131 through 60.134 do not relieve DOE from any
obligation to provide such safety features in a specific facility needed to achieve the
performance objectives [10 CFR 60.130]

33 (e) Underground openings (2) Openings in the underground facility shall be designed to
34 reduce the potential for deleterious rock movement or fracturing of overlying or
35 surrounding rock.

[10 CFR 60.133]

37 1.4.2C6 Sections 60.131 through 60.134 specify minimum criteria for the design of the
38 geologic repository operations area. These design criteria are not intended to be exhaustive,
39 however. Omissions in Sections 60.131 through 60.134 do not relieve DOE from any
40 obligation to provide such safety features in a specific facility needed to achieve the
41 performance objectives [10 CFR 60.130]

42 (f) Rock excavation. The design of the underground facility shall incorporate excavation
43 methods that will limit the potential for creating a preferential pathway for groundwater
44 to contact the waste packages or radionuclide migration to the accessible environment.

[10 CFR 60.133]

46 1.4.2C7 Sections 60.131 through 60.134 specify minimum criteria for the design of the
47 geologic repository operations area. These design criteria are not intended to be exhaustive,
48 however. Omissions in Sections 60.131 through 60.134 do not relieve DOE from any
49 obligation to provide such safety features in a specific facility needed to achieve the
50 performance objectives [10 CFR 60.130]

1 (h) Engineered Barriers. Engineered barriers shall be designed to assist the geologic setting
2 in meeting the performance objectives for the period following permanent closure.

[10 CFR 60.133]

4 1.4.2C8 Sections 60.131 through 60.134 specify minimum criteria for the design of the
5 geologic repository operations area. These design criteria are not intended to be exhaustive,
6 however. Omissions in Sections 60.131 through 60.134 do not relieve DOE from any
7 obligation to provide such safety features in a specific facility needed to achieve the
8 performance objectives [10 CFR 60.130]

9 (i) Thermal loads. The underground facility shall be designed so that the performance
10 objectives will be met taking into account the predicted thermal and thermomechanical
11 response of the host rock, and surrounding strata, and groundwater system.

[10 CFR 60.133]

13 1.4.2C9 Sections 60.131 through 60.134 specify minimum criteria for the design of the
14 geologic repository operations area. These design criteria are not intended to be exhaustive,
15 however. Omissions in Sections 60.131 through 60.134 do not relieve DOE from any
16 obligation to provide such safety features in a specific facility needed to achieve the
17 performance objectives [10 CFR 60.130]

18 a) General design criterion. Seals for shafts and boreholes shall be designed so that
19 following permanent closure they do not become pathways that compromise the geologic
20 repository's ability to meet the performance objectives or the period following permanent
21 closure.

22 b) Selection of materials and placement methods. Materials and placement methods for
23 seals shall be selected to reduced to the extent practicable:

24 (1) The potential for creating a preferential pathway for ground water to contact
25 the waste packages or

26 (2) for radionuclide migration through existing pathways.

[10 CFR 60.134]

28 1.4.2C10 (b) Specific criteria for HLW package design. (1) Explosive, pyrophoric, and
29 chemically reactive materials. The waste package shall not contain explosive or pyrophoric
30 materials or chemically reactive materials in an amount that could compromise the ability
31 of the underground facility to contribute to waste isolation or the ability of the geologic
32 repository to satisfy the performance objectives. (2) Free liquids. The waste package shall
33 not contain free liquids in an amount that could compromise the ability of the waste
34 packages to achieve the performance objectives relating to containment of HLW (because
35 of chemical interactions or formation of pressurized vapor) or result in spillage and spread
36 of contamination in the event of waste package perforation during the period through
37 permanent closure.

[10 CFR 60.135]

39 1.4.2C11 (c) Waste form criteria for HLW. High-level radioactive waste that is emplaced
40 in the underground facility shall be designed to meet the following criteria: (3)
41 Combustibles. All combustible radioactive wastes shall be reduced to a noncombustible form
42 unless it can be demonstrated that a fire involving the waste packages containing
43 combustibles will not compromise the integrity of other waste packages, adversely affect any
44 structures, systems, or components important to safety, or compromise the ability of the
45 underground facility to contribute to waste isolation.

[10 CFR 60.135]

47 1.4.2C12 (a) Qualifying Condition. The geologic setting at the site shall allow for the
48 physical separation of radioactive waste from the accessible environment after closure in
49 accordance with the requirements of 40 CFR Part 191, Subpart B, as implemented by the
50 provisions of 10 CFR Part 60. The geologic setting at the site will allow for the use of
51 engineered barriers to ensure compliance with the requirements of 40 CFR Part 191 and

1 10 CFR Part 60 (see Appendix I of this part)¹.

2 ¹ Appendix I refers to that in 10 CFR 960.

3 [10 CFR 960.4-1]

4 1.4.2C13 (d) Disqualifying Condition. A site shall be disqualified if the pre-waste-
5 emplacement ground-water travel time from the disturbed zone to the accessible
6 environment is expected to be less than 1,000 years along any pathway of likely and
7 significant radionuclide travel.

8 [10 CFR 960.4-2-1(d)]

9 1.4.2C14 (d) Disqualifying Condition. The site shall be disqualified if site conditions do
10 not allow all portions of the underground facility to be situated at least 200 meters below
11 the directly overlying ground surface.

12 [10 CFR 960.4-2-5]

13 1.4.2C15 (d) Disqualifying Condition. The site shall be disqualified if it is likely that,
14 during the first 10,000 years after closure, active dissolution, as predicted on the basis of
15 the geologic record, would result in a loss of waste isolation.

16 [10 CFR 960.4-2-6]

17 1.4.2C16 (d) Disqualifying Condition. A site shall be disqualified if, based on the geologic
18 record during the Quaternary Period, the nature and rates of fault movement or other
19 ground motion are expected to be such that a loss of waste isolation is likely to occur.

20 [10 CFR 960.4-2-7]

21 1.4.2C17 Sections 60.131 through 60.134 specify minimum criteria for the design of the
22 geologic repository operations area. These design criteria are not intended to be exhaustive,
23 however. Omissions in 60.131 through 60.134 do not relieve DOE from any obligations
24 to provide such safety features in a specific facility needed to achieve the performance
25 objectives.... [10 CFR 60.130]

26 (d) Control of water and gas. The design of the underground facility shall provide
27 for control of water or gas intrusion.

[10 CFR 60.133]

29 B. Performance: Requirements at this level to be specified

30 C. Interfaces:

31 1.4.2I1 Requirements at this level to be specified

32 1.4.2I2 Requirements at this level to be specified

33 1.4.2O1 Requirements at this level to be specified

34 1.4.2O2 Requirements at this level to be specified

35 1.4.2O3 Requirements at this level to be specified

36 1.4.2O4a The geologic setting shall be selected and the engineered barrier system and the
37 shafts, boreholes and their seals shall be designed to assure that releases of radioactive
38 materials to the accessible environment following permanent closure conform to such
39 generally applicable environmental standards for radioactivity as may have been established
40 by the Environmental Protection Agency with respect to both anticipated processes and
41 events and unanticipated processes and events.

42 [10 CFR 60.112]

43 *"Unanticipated processes and events" means those processes and events affecting the geologic*
44 *setting that are judged not to be reasonably likely to occur during the period the intended*
45 *performance objective must be achieved, but which are nevertheless sufficiently credible to*
46 *warrant consideration. Unanticipated processes and events may be either natural processes or*

1 events or processes and events initiated by human activities other than those activities licensed
2 under this part. Processes and events initiated by human activities may only be found to be
3 sufficiently credible to warrant consideration if it is assumed that: (1) The monuments provided
4 for by this part are sufficiently permanent to serve their intended purpose; (2) the value to future
5 generations of potential resources within the site can be assessed adequately under the applicable
6 provisions of this part; (3) and understanding of the nature of radioactivity, and an appreciation
7 of its hazards have been retained in some functioning institutions; (4) institutions are able to
8 assess risk and to take remedial action at a level of social organization and technological
9 competence equivalent to, or superior to, that which was applied in initiating the processes or
10 events concerned; (5) relevant records are preserved, and remain accessible, for several hundred
11 years after permanent closure. [10 CFR 60.2]

12 1.4.204b (a) Qualifying Condition. The present and expected geohydrologic setting of a
13 site shall be compatible with waste containment and isolation. The geohydrologic setting,
14 considering the characteristics of and the processes operating within the geologic setting,
15 shall permit compliance with (1) the requirements specified in Section 960.4-1 for
16 radionuclide releases to the accessible environment and (2) the requirements specified in
17 10 CFR 60.113 for radionuclide releases from the engineered barrier system using
18 reasonably achievable technology.
19

[10 CFR 960.4-2-1(a)]

20 1.4.204c (a) Qualifying Condition. The present and expected geochemical characteristics
21 of a site shall be compatible with waste containment and isolation. Considering the likely
22 chemical interactions among radionuclides, the host rock, and the ground water, the
23 characteristics of and the processes operating within the geologic setting shall permit
24 compliance with (1) the requirements specified in Sec. 960.4-1 for radionuclide releases to
25 the accessible environment and (2) the requirements specified in 10 CFR 60.113 for
26 radionuclide releases from the engineered-barrier system using reasonably available
27 technology.
28

[10 CFR 960.4-2-2]

29 1.4.204d (a) Qualifying condition. The present and expected characteristics of the host
30 rock and surrounding units shall be capable of accommodating the thermal, chemical,
31 mechanical, and radiation stresses expected to be induced by repository construction,
32 operation, and closure and by expected interactions among the waste, host rock, ground
33 water, and engineered components. The characteristics of and the processes operating within
34 the geologic setting shall permit compliance with (1) the requirements specified in Sec.
35 960.4-1 for radionuclide releases to the accessible environment and (2) the requirements
36 set forth in 10 CFR 60.113 for radionuclide releases from the engineered-barrier system
37 using reasonably available technology.
38

[10 CFR 960.4-2-3]

39 1.4.204e (a) Qualifying Condition. The site shall be located where future climatic
40 conditions will not be likely to lead to radionuclide releases greater than those allowable
41 under the requirements specified in Sec. 960.4-1. In predicting the likely future climatic
42 conditions at a site, the DOE will consider the global, regional, and site climatic patterns
43 during the Quaternary Period, considering the geomorphic evidence of the climatic
44 conditions in the geologic setting.
45

[10 CFR 960.4-2-4]

46 1.4.204f (a) Qualifying Condition. The site shall allow the underground facility to be
47 placed at a depth such that erosional processes acting upon the surface will not be likely
48 to lead to radionuclide releases greater than those allowable under the requirements
49 specified in Sec. 960.4-1. In predicting the likelihood of potentially disruptive erosional
50 processes, the DOE will consider the climatic, tectonic, and geomorphic evidence of rates
51 and patterns of erosion in the geologic setting during the Quaternary Period.
52

[10 CFR 960.4-2-5]

53 1.4.204g (a) Qualifying Condition. The site shall be located such that any subsurface rock
54 dissolution will not be likely to lead to radionuclide releases greater than those allowable
55 under the requirements specified in Sec. 960.4-1. In predicting the likelihood of dissolution
56 within the geologic setting at a site, the DOE will consider the evidence of dissolution
57 within that setting during the Quaternary Period, including the locations and characteristics

of dissolution fronts or other dissolution features, if identified.

[10 CFR 960.4-2-6]

1.4.204h (a) Qualifying Condition. The site shall be located in a geologic setting where future tectonic processes or events will not be likely to lead to radionuclide releases greater than those allowable under the requirements specified in Sec. 960.4-1. In predicting the likelihood of potentially disruptive tectonic processes or events, the DOE will consider the structural, stratigraphic, geophysical, and seismic evidence for the nature and rates of tectonic processes and events in the geologic setting during the Quaternary Period.

[10 CFR 960.4-2-7]

1.4.205 Requirements at this level to be specified

1.4.206 Requirements at this level to be specified

Table F1.4.2.1 Function Description: Contain Waste

I. Function ID Number: 1.4.2.1

II. Function Title: Contain Waste

III. Function Definition:

Containment means the confinement of radioactive waste within a designated boundary area. [10 CFR 60.2]

During the first several hundred years following permanent closure of a geologic repository, when radiation and thermal levels are high and the uncertainties in assessing repository performance are large, special emphasis is placed upon the ability to contain the wastes by waste packages within an engineered barrier system. This is known as the containment period. [10 CFR 60.102]

This function begins at permanent closure; and ends when the time period of the requirement in 10 CFR 60.113(a)(1)(ii)(A) ends, i.e. at least 300 to 1000 years after repository closure as determined by the Commission.

"The requirement in 10 CFR 60.113(a)(1)(ii)(A) for substantially complete containment of high-level wastes within the waste packages for a period not less than 300 years nor more than 1000 years following repository closure is a minimum performance requirement which is not intended, and should not be interpreted, as a cap on the waste package lifetime or a limitation on the credit that can be taken (in engineered barrier system and overall repository system performance assessments) if the waste package is designed to provide containment in excess of 1000 years." (NRC Staff Position 60-001, July 27, 1990.)

IV. Interfaces:

A. Inputs:

1.4.2.1I1	Waste Packages	From: Function 1.4.1
1.4.2.1I2	Near Field	From: Site
1.4.2.1I3	Internal Container Environment	From: Waste Package
1.4.2.1I4	Natural Transport Media	From: Site

B. Outputs:

1.4.2.1O1	Federally-Permitted Radiation Exposure	To: Accessible Environment/1.4.2.2
1.4.2.1O2	Heat	To: Accessible Environment/1.4.2.2
1.4.2.1O3	[Containment Data]	To: Function 1.4.3
1.4.2.1O4	Uncontained Radionuclides	To: Function 1.4.2.2

V. Function Requirements:

A. Constraints:

1.4.2.1C1 (ii) In satisfying the preceding requirement, [10 CFR 60.113(a)(1)] the engineered barrier system shall be designed, assuming anticipated processes and events, so that:

(A) Containment of HLW within the waste packages will be substantially complete for a period to be determined by the Commission taking into account the factors specified in 60.113(b) provided, that such period shall be not less than 300 years nor more than 1,000 years after permanent closure of the geologic repository; and

[10 CFR 60.113(a)(1)]

1.4.2.1C2 (1) Packages for HLW shall be designed so that the in situ chemical, physical, and nuclear properties of the waste package and its interactions with the emplacement environment do not compromise the function of the waste packages or the performance of the underground facility or the geologic setting.

[10 CFR 60.135(a)]

1.4.2.1C3 (2) The design shall include but not be limited to consideration of the following factors: solubility, oxidation/reduction reactions, corrosion, hydriding, gas generation, thermal effects, mechanical strength, mechanical stress, radiolysis, radiation damage, radionuclide retardation, leaching, fire and explosion hazards, thermal loads, and synergistic interactions.

[10 CFR 60.135(a)]

1.4.2.1C4 (2) Free liquids. The waste package shall not contain free liquids in an amount that could compromise the ability of the waste packages to achieve the performance objectives relating to containment of HLW (because of chemical interactions or formation of pressurized vapor) or result in spillage and spread of contamination in the event of waste package perforation during the period through permanent closure.

[10 CFR 60.135(b)]

1.4.2.1C5 (b)(4) Unique identification. A label or other means of identification shall be provided for each waste package. The identification shall not impair the integrity of the waste package and shall be applied in such a way that the information shall be legible at least to the end of the period of retrievability. Each waste package identification shall be consistent with the waste package's permanent written records.

[10 CFR 60.135]

B. Performance: Requirements at this level to be specified

C. Interfaces: Requirements at this level to be specified

Table F1.4.2.1.1 Function Description: Limit Degradation of Containment Barriers

I. Function ID Number: 1.4.2.1.1

II. Function Title: Limit Degradation of Containment Barriers

III. Function Definition:

To limit the degradation of containment barriers in order to contain the radioactive waste.

This function begins at permanent closure; and ends when the time period of the requirement in 10 CFR 60.113(a)(1)(ii)(A) ends, i.e. at least 300 to 1000 years after repository closure as determined by the Commission.

IV. Interfaces:

A. Inputs:

1.4.2.1.1I1	Natural Transport Media	From:	Site
1.4.2.1.1I2	Internal Waste Package Environment	From:	Waste Package
1.4.2.1.1I3	Containment Barriers	From:	Function 1.4.1
1.4.2.1.1I4	Near Field	From:	Site
1.4.2.1.1I5	Radiation	From:	Function 1.4.2.1.2
1.4.2.1.1I6	Modified Nearfield	From:	Function 1.4.2.1.2
1.4.2.1.1I7	Modified Internal Waste Package Environment	From:	Function 1.4.2.1.2

B. Outputs:

1.4.2.1.1O1	Heat	To:	Accessible Environment
1.4.2.1.1O2	Degraded Containment Barriers	To:	Function 1.4.2.1.2
1.4.2.1.1O3	Modified Near Field	To:	Function 1.4.2.1.2
1.4.2.1.1O4	Modified Internal Waste Package Environment	To:	Function 1.4.2.1.2
1.4.2.1.1O5	Federally-Permitted Radiation Exposure	To:	Accessible Environment
1.4.2.1.1O6	Exposed Waste Form	To:	Function 1.4.2.1.2
1.4.2.1.1O7	Uncontained Radio-	To:	Function 1.4.2.2

V. Function Requirements: Requirements at this level to be specified.

Table F1.4.2.1.2 Function Description: Limit Egress of Radionuclides

I. Function ID Number: 1.4.2.1.2

II. Function Title: Limit Egress of Radionuclides

III. Function Definition:

To limit the egress of radionuclides in order to contain the radioactive waste.

This function begins at permanent closure; and ends when the time period of the requirement in 10 CFR 60.113(a)(1)(ii)(A) ends, i.e. at least 300 to 1000 years after repository closure as determined by the Commission.

IV. Interfaces:

A. Inputs:

1.4.2.1.2I1	Modified Near Field	From:	Function 1.4.2.1.1
1.4.2.1.2I2	Degraded Containment Barriers	From:	Function 1.4.2.1.1
1.4.2.1.2I3	Modified Internal Waste Package Environment	From:	Function 1.4.2.1.1
1.4.2.1.2I4	Exposed Waste Form	From:	Function 1.4.2.1.1
1.4.2.1.2I5	Natural Transport Media	From:	Site

1 This function begins at permanent closure and will continue to beyond 10,000 years. Some
2 requirements mandate 10,000 years performance period. In accordance with 10 CFR 960.3-
3 1-5, DOE will conduct performance assessments of repository expected performance through
4 100,000 years, but no release limits have been specified beyond 10,000 years.

7 Following the containment period, special emphasis is placed on the ability to achieve
8 isolation of the wastes by virtue of the characteristics of the geologic repository. There are
9 two subfunctions to achieve isolation of the waste. The first is to limit mobilization and
10 release of radionuclides from the EBS to the geologic setting. This is effected during the
11 early part of this period by the engineered barrier system. The second subfunction operates
on these radionuclides released from the EBS, and limits their release to the accessible
environment. This is effected by natural barriers.

12 IV. Interfaces:

13 A. Inputs:

14 1.4.2.2I1	Uncontained Radionuclides	From:	Function 1.4.2.1
15 1.4.2.2I2	Heat	From:	Function 1.4.2.1
16 1.4.2.2I3	Federally-Permitted Radiation Exposure	From:	Function 1.4.2.1
17 1.4.2.2I4	Natural Transport Media	From:	Site

19 B. Outputs:

20 1.4.2.2O1	Federally-Permitted Release of Radionuclides	To:	Accessible Environment
21 1.4.2.2O2	[Migration Data]	To:	Function 1.4.3

23 V. Function Requirements:

24 A. Constraints: Requirements at this level to be specified

25 B. Performance: Requirements at this level to be specified

26 C. Interfaces:

27 1.4.2.2I1	Requirements at this level to be specified
1.4.2.2I2	Requirements at this level to be specified
1.4.2.2I3	Requirements at this level to be specified
30 1.4.2.2I4	Requirements at this level to be specified
31 1.4.2.2O1	Individual protection requirements.

32 Disposal systems for spent nuclear fuel or high-level or transuranic radioactive wastes shall
33 be designed to provide a reasonable expectation that, for 1,000 years after disposal,
34 undisturbed performance of the disposal system shall not cause the annual dose equivalent
35 from the disposal system to any member of the public in the accessible environment to
36 exceed 25 millirems to the whole body or 75 millirems to any critical organ. All potential
37 pathways (associated with undisturbed performance) from the disposal system to people
38 shall be considered, including the assumption that individuals consume 2 liters per day of
39 drinking water from any significant source of ground water outside of the controlled area.

40 [40 CFR 191.15]

41 1.4.2.2O2 Ground water protection requirements

42 (a) Disposal systems for spent nuclear fuel or high level or transuranic radioactive wastes
43 shall be designed to provide a reasonable expectation that, for 1,000 years after disposal,
44 undisturbed performance of the disposal system shall not cause the radionuclide
45 concentrations averaged over any year in water withdrawn from any portion of a special
46 source of groundwater to exceed:

47 (1) 5 picocuries per liter of radium-226 and radium-228;

(2) 15 picocuries per liter of alpha-emitting radionuclides (including radium-226 and radium-228 but excluding radon); or (3) The combined concentrations of radionuclides that emit either beta or gamma radiation that would produce an annual dose equivalent to the total body or any internal organ greater than 4 millirems per year if an individual consumed 2 liters per day of drinking water from such a source of ground water.

(b) If any of the average annual radionuclide concentrations existing in a special source of ground water before construction of the disposal system already exceed the limits in 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 that special source of ground water by more than the limits established in 191.16(a).

[40 CFR 191.16]

"Special source of ground water," as used in this part, means those Class I ground waters identified in accordance with the Agency's Ground-Water Protection Strategy published in August 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 Department 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 alternative source of drinking water is available to that population.

[40 CFR 191.12(o)]

Table F1.4.2.2.1 Function Description: Limit Release of Radionuclides From EBS

I. Function ID Number: 1.4.2.2.1

II. Function Title: Limit Release of Radionuclides from EBS

III. Function Definition:

To limit the release rate of radionuclides from the EBS to the geologic setting.

This function begins at permanent closure and will continue to beyond 10,000 years.

IV. Interfaces:

A. Inputs:

1.4.2.2.1I1	Uncontained Radionuclides	From: Function 1.4.2.1
1.4.2.2.1I2	Heat	From: Function 1.4.2.1
1.4.2.2.1I3	Federally-Permitted Radiation Exposure	From: Function 1.4.2.1
1.4.2.2.1I4	Natural Transport Media	From: Site

B. Outputs:

1.4.2.2.1O1	[Migration Data]	To: Function 1.4.3
1.4.2.2.1O2	Federally-Permitted Release of Radionuclides (From EBS)	To: Function 1.4.2.2.2
1.4.2.2.1O3	Heat	To: Function 1.4.2.2.2
1.4.2.2.1O4	Federally Permitted Radiation Exposure	To: Function 1.4.2.2.2

V. Function Requirements:

A. Constraints: Requirements at this level to be specified

B. Performance: Requirements at this level to be specified

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C. Interfaces:

1.4.2.2.1I1 Requirements at this level to be specified

1.4.2.2.1I2 Requirements at this level to be specified

1.4.2.2.1I3 Requirements at this level to be specified

1.4.2.2.1I4 Requirements at this level to be specified

1.4.2.2.1O1 Requirements at this level to be specified

1.4.2.2.1O2 (ii) In satisfying the preceding requirement, [10 CFR 60.113(a)(1)(i)] the engineered barrier system shall be designed, assuming anticipated processes and events so that:

(B) the release rate of any radionuclide from the engineered barrier system following the containment period shall not exceed one part in 10,000 per year of the inventory of that radionuclide calculated to be present at 1,000 years following permanent closure, or such other fraction of the inventory as may be approved or specified by the Commission: provided that this requirement does not apply to any radionuclide which is released at a rate less than 0.1% of the calculated total release rate limit. The calculated total release rate limit shall be taken to be one part in 100,000 per year of the inventory of radioactive waste, originally emplaced in the underground facility, that remains after 1,000 years of radioactive decay.

[10 CFR 60.113(a)(1)]

1.4.2.2.1O3 Requirements at this level to be specified

1.4.2.2.1O4 Requirements at this level to be specified

B. Performance: Requirements at this level to be specified

C. Interfaces: Requirements at this level to be specified

1 Table F1.4.2.2.2 Function Description: Limit Release of Radionuclides To Accessible Environment

2 I. Function ID Number: 1.4.2.2.2

3 II. Function Title: Limit Release of Radionuclides to Accessible Environment

4 III. Function Definition:

5 To limit the time for the release of radionuclides to the accessible environment.

6 This function begins at permanent closure and will continue to beyond 10,000 years.

7 IV. Interfaces:

8 A. Inputs:

9 1.4.2.2.2I1 Federally-Permitted Release of Radionuclides (From EBS) From: Function 1.4.2.2.1
10 1.4.2.2.2I2 Heat From: Function 1.4.2.2.1
11 1.4.2.2.2I3 Federally Permitted Radiation Exposure From: Function 1.4.2.2.1
12 1.4.2.2.2I4 Natural Transport Media From: Site

15 B. Outputs:

16 1.4.2.2.2O1 [Migration Data] To: Function 1.4.3
17 1.4.2.2.2O2 Federally-Permitted Release of Radionuclides To: Accessible Environment

19 V. Function Requirements:

20 A. Constraints:

21 1.4.2.2.2C1 (2) Geologic setting. The geologic repository shall be located so that prewaste
22 emplacement groundwater travel time along the fastest path of likely radionuclide travel
23 from the undisturbed zone to the accessible environment shall be at least 1,000 years or
24 such other travel time as may be approved or specified by the Commission.

[10 CFR 60.113(a)]

26 B. Performance: Requirements at this level to be specified

27 C. Interfaces:

28 1.4.2.2.2I1 Requirements at this level to be specified
29 1.4.2.2.2I2 Requirements at this level to be specified
30 1.4.2.2.2I3 Requirements at this level to be specified
31 1.4.2.2.2I4 Requirements at this level to be specified
32 1.4.2.2.2O1 Requirements at this level to be specified
33 1.4.2.2.2O2 Same requirement as specified in 1.4O03b

1 Table F1.4.2.3 Function Description: Limit Incompatible Human Activities

2 I. Function ID Number: 1.4.2.3

3 II. Function Title: Limit Incompatible Human Activities

4 III. Function Definition:

5 To minimize or prevent intentional and unintentional human activities.

6 This function begins at permanent closure and will continue to beyond 10,000 years.

7 A description of the controls that the applicant will apply to restrict access and to regulate
8 land use at the site and adjacent areas, including a conceptual design of monuments which
9 would be used to identify the controlled area after permanent closure. [10 CFR 60.21(c)(8)]

10 Appropriate controls shall be established outside of the controlled area. DOE shall exercise
11 any jurisdiction and control over surface and subsurface estates necessary to prevent adverse
12 human actions that could significantly reduce the geologic repository's ability to achieve
13 isolation. The rights of DOE may take the form of appropriate possessory interests,
14 servitudes, or withdrawals from location or patent under the general mining laws.
15 [10 CFR 60.121(b)]

16 IV. Interfaces:

17 A. Inputs:

18 1.4.2.3I1 Human Intentions From: Outside System Boundary

19 B. Outputs:

20 1.4.2.3O1 Intruded Multiple Barrier System To: Function 1.4.2.1/1.4.2.2
21 [Resources]

22 V. Function Requirements:

23 A. Constraints:

24 1.4.2.3C1 (a) Ownership of land.

25 (1) Both the geologic repository operations area and the controlled area shall be
26 located in and on lands that are either acquired lands under the jurisdiction and
27 control of DOE, or lands permanently withdrawn and reserved for its use.

28 (2) These lands shall be held free and clear of all encumbrances, if significant, such
29 as:

30 (i) Rights arising under the general mining laws;

31 (ii) easements for right-of-way; and

32 (iii) all other rights arising under lease, rights of entry, deed, patent,
33 mortgage, appropriation, prescription, or otherwise.

34 (b) Additional controls. Appropriate controls shall be established outside of the controlled
35 area. DOE shall exercise any jurisdiction and control over surface and subsurface estates
36 necessary to prevent adverse human actions that could significantly reduce the geologic
37 repository's ability to achieve isolation. The rights of DOE may take the form of
38 appropriate possessory interests, servitudes, or withdrawals from location or patent under
39 the general mining laws.

40 (c) Water rights.

41 (1) DOE shall also have obtained such water rights as may be needed to accomplish
42 the purpose of the geologic repository operations area.

43 (2) Water rights are included in the additional controls to be established under
44 paragraph (b) of this section.

45 [10 CFR 60.121]

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1.4.2.3C2 (a) Qualifying Condition. This site shall be located such that--considering permanent markers and records and reasonable projections of value, scarcity, and technology -- the natural resources, including ground water suitable for crop irrigation or human consumption without treatment, present at or near the site will not be likely to give rise to interference activities that would lead to radionuclide releases greater than those allowable under the requirements specified in Sec. 960.4-1.

7 (d) Disqualifying Conditions. A site shall be disqualified if --

8 (1) Previous exploration, mining, or extraction activities for resources of commercial
9 importance at the site have created significant pathways between the projected
10 underground facility and the accessible environment; or

11 (2) Ongoing or likely future activities to recover presently valuable natural mineral
12 resources outside the controlled area would be expected to lead to an inadvertent
13 loss of waste isolation.
14

[10 CFR 960.4-2-8-1]

15 1.4.2.3C3 (a) Qualifying Condition. The site shall be located on land for which the DOE
16 can obtain, in accordance with the requirements of 10 CFR Part 60, ownership, surface
17 and subsurface rights, and control of access that are required in order that potential surface
18 and subsurface activities as the site will not be likely to lead to radionuclide releases greater
19 than those allowable under the requirements specified in Sec. 960.4-1.

20 [10 CFR 960.4-2-8-2]

21 B. Performance: Requirements at this level to be specified

22 C. Interfaces: Requirements at this level to be specified

23 Table F1.4.2.3.1 Function Description: Limit Inadvertent Human Activities

I. Function ID Number: 1.4.2.3.1

25 II. Function Title: Limit Inadvertent Human Activities

26 III. Function Definition:

27 To minimize or prevent inadvertent human activities.

28 This function begins at permanent closure and will continue to beyond 10,000 years.

29 IV. Interfaces:

30 A. Inputs: None identified at this time.

31 B. Outputs: None identified at this time.

32 V. Function Requirements:

33 A. Constraints:

34 1.4.2.3.1C1 (a) DOE shall submit an application to amend the license prior to permanent
35 closure. The submission shall consist of an update of the license application submitted
36 under sections 60.21 and 60.22, including: ...

37 (2) A detailed description of the measures to be employed - such as land use
38 controls, construction of monuments, and preservation of records - to regulate or
39 prevent activities that could impair the long term isolation of emplaced waste within
40 the geologic repository and to assure that relevant information will be preserved
41 for the use of future generations. As a minimum, such measures shall include -

(i) Identification of the controlled area and geologic repository operations area by monuments that have been designed, fabricated, and emplaced to be as permanent as is practicable; and

(ii) Placement of records in the archives and land records systems of local State, and Federal government agencies, and archives elsewhere in the world, that would be likely to be consulted by potential human intruders - such records to identify the location of the geologic repository operations area, including the underground facility, boreholes and shafts, and the boundaries of the controlled area, and the nature and hazard of the waste.

[10 CFR 60.51]

B. Performance: Requirements at this level to be specified

C. Interfaces: Requirements at this level to be specified

Table F1.4.2.3.2 Function Description: Limit Intentional Human Activities

I. Function ID Number: 1.4.2.3.2

II. Function Title: Limit Intentional Human Activities

III. Function Definition:

To minimize or prevent intentional human activities.

This function begins at permanent closure and will continue to beyond 10,000 years.

IV. Interfaces:

A. Inputs: None identified at this time.

B. Outputs: None identified at this time.

V. Function Requirements: Requirements at this level to be specified

Table F1.4.3 Function Description: Evaluate System Performance

I. Function ID Number: 1.4.3

II. Function Title: Evaluate System Performance

III. Function Definition:

To estimate the ability of the repository system to comply with regulations governing its preclosure and postclosure performance objectives and its effects on the environment; to use the estimates in updates to compliance documents and in support of the continuing development of the system; to conduct the performance-confirmation and environmental-monitoring programs needed to supply data for the estimates; and to plan for postclosure monitoring of the system.

(c) A license shall be terminated only when the Commission finds with respect to the geologic repository:

(1) That the final disposition of radioactive wastes has been made in conformance with the DOE's plan, as amended and approved as part of the license.

(2) That the final state of the geologic repository operations area conforms to DOE's plans for permanent closure and DOE's plans for the decontamination or dismantlement

of surface facilities, as amended and approved as part of the license. [10 CFR 60.52 (c)(1)(2)]

This program shall have been started during site characterization and continue until termination of license. [Proposed Rulemaking, Monitoring after Permanent Closure, June 30, 1986, section 60.144]

IV. Interfaces:

A. Inputs:

1.4.3I1	[Migration Data]	From: Function 1.4.2
1.4.3I2	[Containment Data]	From: Function 1.4.2
1.4.3I3	Operations Data	From: Function 1.4.1
1.4.3I4	Site Data	From: Site
1.4.3I5	PA Models	From: Outside System Boundary

B. Outputs:

1.4.3O1	License Application to Terminate	To: 1.4.1.4 Subfunction(s)
1.4.3O2	Records	To: Function 1.4.1.4.3.1
1.4.3O3	Corrective Action	To: Function 1.4.1

V. Function Requirements:

A. Constraints:

1.4.3C1 (c) The Safety Analysis Report shall include:

(1) A description and assessment of the site at which the proposed geologic repository operations area is to be located with appropriate attention to those features of the site that might affect geologic repository operations area design and performance. The description of the site shall identify the location of the geologic repository operations area with respect to the boundary of the accessible environment.

(i) The description of the site shall also include the following information regarding subsurface conditions. This description shall, in all cases, include such information with respect to the controlled area. In addition, where subsurface conditions outside the controlled area may affect isolation within the controlled area, the description shall include such information with respect to subsurface conditions outside the controlled area to the extent such information is relevant and material. The detailed information referred to in this paragraph shall include:

(A) The orientation, distribution, aperture in-filling and origin of fractures, discontinuities, and heterogeneities;

(B) The presence and characteristics of other potential pathways such as solution features, breccia pipes, or other potentially permeable features;

(C) The geomechanical properties and conditions, including pore pressure and ambient stress conditions;

(D) The hydrogeologic properties and conditions;

(E) The geochemical properties; and

(F) The anticipated response of the geomechanical, hydrogeologic, and geochemical systems to the maximum design thermal loading, given the pattern of fractures and other discontinuities and the heat transfer properties of the rock mass and groundwater.

[10 CFR 60.21]

1.4.3C2 (c) The Safety Analysis Report shall include:

(1) A description and assessment of the site at which the proposed geologic repository operations area is to be located with appropriate attention to those features of the site that might affect geologic repository operations area design and performance. The description of the site shall identify the location of the geologic repository operations area with respect

1 to the boundary of the accessible environment ...

2 (ii) The assessment shall contain:

5 (A) An analysis of the geology, geophysics, hydrogeology, geochemistry,
6 climatology, and meteorology of the site,

7 (B) Analyses to determine the degree to which each of the favorable and
8 potentially adverse conditions, if present, has been characterized, and the
9 extent to which it contributes to or detracts from isolation. For the purpose
10 of determining the presence of the potentially adverse conditions,
11 investigations shall extend from the surface to a depth sufficient to
12 determine critical pathways for radionuclide migration from the
13 underground facility to the accessible environment. Potentially adverse
conditions shall be investigated outside of the controlled area if they affect
isolation within the controlled area.

14 (C) An evaluation of the performance of the proposed geologic repository
15 for the period after permanent closure, assuming anticipated processes and
16 events, giving the rates and quantities of releases of radionuclides to the
17 accessible environment as a function of time; and a similar evaluation which
18 assumes the occurrence of unanticipated processes and events.

19 (D) The effectiveness of engineered and natural barriers, including barriers
20 that may not be themselves a part of the geologic repository operations
21 area, against the release of radioactive material to the environment. The
22 analysis shall also include a comparative evaluation of alternatives to the
23 major design features that are important to waste isolation, with particular
24 attention to the alternatives that would provide longer radionuclide
25 containment and isolation.

26 (E) An analysis of the performance of the major design structures, systems,
27 and components, both surface and subsurface, to identify those that are
28 important to safety. For the purposes of this analysis, it shall be assumed
29 that operations at the geologic repository operations area will be carried
30 out at the maximum capacity and rate of receipt of radioactive waste stated
31 in the application.

32 (F) An explanation of measures used to support the models used to
33 perform the assessments required in paragraphs (A) through (D). Analyses
34 and models that will be used to predict future conditions and changes in
35 the geologic setting shall be supported by using an appropriate combination
36 of such methods as field tests, in situ tests, laboratory tests which are
37 representative of field conditions, monitoring data, and natural analog
38 studies.

39 [10 CFR 60.21]

40 1.4.3C3 (a) DOE shall submit an application to amend the license prior to permanent
41 closure. The submission shall consist of an update of the license application submitted
42 under sections 6.21 and 6.22, including:

43 (1) A description of the program for post-permanent closure monitoring of the
44 geologic repository.

45 (2) A detailed description of the measures to be employed - such as land use
46 controls, construction of monuments, and preservation of records - to regulate or
47 prevent activities that could impair the long-term isolation of emplaced waste
48 within the geologic repository and to assure that relevant information will be
49 preserved for the use of future generations. As a minimum, such measures shall
50 include:

51 (i) Identification of the controlled area and geologic repository operations
52 area by monuments that have been designed, fabricated, and emplaced to
53 be as permanent as is practicable; and

54 (ii) Placement of records in the archives and land record systems of local
55 State, and Federal government agencies, and archives elsewhere in the
56 world, that would be likely to be consulted by potential human intruders -
57 such records to identify the location of the geologic repository operations
58 area, including the underground facility, boreholes and shafts, and the

boundaries of the controlled area, and the nature and hazard of the waste.

(3) Geologic, geophysical, geochemical, hydrologic, and other site data that are obtained during the operational period pertinent to the long-term isolation of emplaced radioactive wastes.

(4) The results of tests, experiments, and any other analyses relating to backfill of excavated areas, shafts sealing, waste interaction with the host rock, and any other tests, experiments, or analyses pertinent to the long-term isolation of emplaced wastes within the geologic repository.

(5) Any substantial revision of plans for permanent closure.

(6) Other information bearing upon permanent closure that was not available at the time a license was issued.

[10 CFR 60.51]

B. Performance: Requirements at this level to be specified

C. Interfaces: Requirements at this level to be specified

Table F1.4.3.1 Function Description: Confirm Performance

- I. Function ID Number: 1.4.3.1
II. Function Title: Confirm Performance
III. Function Definition:

To conduct the 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.

The (Performance Confirmation) program shall have been started during site characterization and it will continue until permanent closure. [1 CFR 6.14(b)]

"Performance Confirmation" means 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. [1 CFR 6.2]

IV. Interfaces:

A. Inputs:

1.4.3.111	Operations Data	From: Function 1.4.1
1.4.3.112	[Containment Data]	From: Function 1.4.2
1.4.3.113	[Migration Data]	From: Function 1.4.2
1.4.3.114	PA Analyses/Results	From: Function 1.4.3.2
1.4.3.115	Site Data	From: Site

B. Outputs:

1.4.3.101	License Application to Close	To: 1.4.1.4 Subfunction(s)
1.4.3.102	Corrective Action	To: Function 1.4.1
1.4.3.103	Data	To: Function 1.4.3.2

V. Function Requirements:

A. Constraints:

1.4.3.1C1 (a) DOE shall perform, or permit the Commission to perform, such tests as the Commission deems appropriate or necessary for the administration of the regulations in this part. These may include tests of:

-
- (1) Radioactive waste,
(2) The geologic repository including its structures, systems, and components,
(3) Radiation detection and monitoring instruments, and
(4) Other equipment and devices used in connection with the receipt, handling, or storage of radioactive waste.

(b) The tests required under this section shall include a performance confirmation program carried out in accordance with Subpart F of this part.

[10 CFR 60.74]

1.4.3.1C2 (a) The performance confirmation program shall provide data which indicates, where practicable, whether:

- (1) Actual subsurface conditions encountered and changes in those conditions during construction and waste emplacement operations are within the limits assumed in the licensing review; and
(2) Natural and engineered systems and components required for repository operation, or which are designed or assumed to operate as barriers after permanent closure, are functioning as intended and anticipated.

(b) The program shall have been started during site characterization and it will continue until permanent closure.

(c) The program shall include in situ monitoring, laboratory and field testing, and in situ experiments, as may be appropriate to accomplish the objective as stated above.

(d) The program shall be implemented so that:

- (1) It does not adversely affect the ability of the natural and engineered elements of the geologic repository to meet the performance objectives.
(2) It provides 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.
(3) It monitors and analyzes changes from the baseline condition of parameters that could affect the performance of a geologic repository.
(4) It provides an established plan for feedback and analysis of data, and implementation of appropriate action.

[10 CFR 60.141] 140

1.4.3.1C3 (a) During repository construction and operation, a continuing program of surveillance, measurement, testing, and geologic mapping shall be conducted to ensure that geotechnical and design parameters are confirmed and to ensure that appropriate action is taken to inform the Commission of changes needed in design to accommodate actual field conditions encountered.

[10 CFR 60.141]

1.4.3.1C4 (d) The waste package monitoring program shall continue as long as practical up to the time of permanent closure.

[10 CFR 60.143]

B. Performance: Requirements at this level to be specified

C. Interfaces: Requirements at this level to be specified

1 Table F1.4.3.1.1 Function Description: Monitor In Situ Conditions

I. Function ID Number: 1.4.3.1.1

II. Function Title: Monitor In Situ Conditions

4 III. Function Definition:

5 To monitor conditions in the subsurface repository facility, obtaining data on the
6 natural-barrier system, the waste packages, and the underground facility.

7 IV. Interfaces:

8 A. Inputs:

9 1.4.3.1.1I1 [Containment Data] From: Function 1.4.2
10 1.4.3.1.1I2 [Migration Data] From: Function 1.4.2
11 1.4.3.1.1I3 Operations Data From: Function 1.4.1
12 1.4.3.1.1I4 Data Needs From: Function 1.4.3.1.4

13 B. Outputs:

14 1.4.3.1.1O1 Monitoring Data To: Function 1.4.3.2/1.4.3.1.4

15 V. Function Requirements:

16 A. Constraints:

17 1.4.3.1.1C1 (b) Subsurface conditions shall be monitored and evaluated against design
18 assumptions. [10 CFR 60.141]
19

20 1.4.3.1.1C2 (c) As a minimum, measurements shall be made of rock deformations and
21 displacement, changes in rock stress and strain, rate and location of water inflow into
22 subsurface areas, changes in groundwater conditions, rock pore water pressures including
23 those along fractures and joints, and the thermal and thermomechanical response of the
24 rock mass as a result of development and operations of the geologic repository.
25 [10 CFR 60.141]

26 1.4.3.1.1C3 (e) In situ monitoring of the thermomechanical response of the underground
27 facility shall be conducted until permanent closure to ensure that the performance of the
28 natural and engineering features are within design limits.
29 [10 CFR 60.141]

30 B. Performance: Requirements at this level to be specified

31 C. Interfaces:

32 1.4.3.1.1I1 Requirements at this level to be specified
33 1.4.3.1.1I2 Requirements at this level to be specified
34 1.4.3.1.1I3 Requirements at this level to be specified
35 1.4.3.1.1I4 Requirements at this level to be specified

36 1.4.3.1.1O1 (a) DOE shall submit an application to amend the license prior to permanent
37 closure. The submission shall consist of an update of the license application submitted
38 under Sections 6.21 and 6.22, including:

39 (3) Geologic, geophysical, geochemical, hydrologic, and other site data that are obtained
40 during the operational period pertinent to the long-term isolation of emplaced radioactive
41 wastes.
42

[10 CFR 60.51(3)]

1 Table F1.4.3.1.1.1 Function Description: Monitor In Situ NBS Conditions

I. Function ID Number: 1.4.3.1.1.1

II. Function Title: Monitor In Situ NBS Conditions

4 III. Function Definition:

5 To monitor in-situ conditions in the subsurface repository facility to obtain data on the
6 natural barrier system.

7 IV. Interfaces:

8 A. Inputs: None identified at this time.

9 B. Outputs: None identified at this time.

10 V. Function Requirements: Requirements at this level to be specified

11 Table F1.4.3.1.1.2 Function Description: Monitor In Situ Waste Package and Underground
12 Facility Conditions

13 I. Function ID Number: 1.4.3.1.1.2

14 II. Function Title: Monitor In Situ Waste Package and Underground Facility
15 Conditions

16 III. Function Definition:

17 To monitor in-situ conditions in the subsurface repository facility to obtain data on the
18 condition of the waste packages and the underground facility.

19 IV. Interfaces:

20 A. Inputs: Requirements at this level to be specified

21 B. Outputs: Requirements at this level to be specified

22 V. Function Requirements:

23 A. Constraints:

24 1.4.3.1.1.2C1 (a) A program shall be established at the geologic repository operations area
25 for monitoring the condition of the waste packages. Waste packages chosen for the program
26 shall be representative of those to be emplaced in the underground facility.

27 (b) Consistent with safe operation at the geologic repository operations area, the
28 environment of the waste packages selected for the waste package monitoring program shall
29 be representative of the environment in which the wastes are to be emplaced.

30 [10 CFR 60. 143]

31 B. Performance: Requirements at this level to be specified

32 C. Interfaces: Requirements at this level to be specified

1 Table F1.4.3.1.2 Function Description: Conduct Lab/Field Tests

- 2 I. Function ID Number: 1.4.3.1.2
3 II. Function Title: Conduct Lab/Field Tests
4 III. Function Definition:

5 To investigate, in laboratories and in the field (i.e., outside the subsurface repository
6 facility), the performance of the geologic setting, the natural-barrier system, the waste
7 packages, and the underground facility.
8

9 IV. Interfaces:

10 A. Inputs:

11 1.4.3.1.2I1 Data Needs From: Function 1.4.3.1.4
12 1.4.3.1.2I2 Site Data From: Site

13 B. Outputs:

14 1.4.3.1.2O1 Test Data To: Function 1.4.3.2/
15 1.4.3.1.4

16 V. Function Requirements:

17 A. Constraints: Requirements at this level to be specified

18 B. Performance: Requirements at this level to be specified

19 C. Interfaces:

20 1.4.3.1.2I1 Requirements at this level to be specified

21 1.4.3.1.2I2 Requirements at this level to be specified

22 1.4.3.1.2O1 (a) DOE shall submit an application to amend the license prior to permanent
23 closure. The submission shall consist of an update of the license application submitted
24 under Sections 6.21 and 6.22, including:

25 (4) The results of tests, experiments, and any other analyses relating to backfill of excavated
26 areas, shaft sealing, waste interaction with the host rock, and any other tests, experiments,
27 or analyses pertinent to the long-term isolation of emplaced wastes within the geologic
28 repository.
29

[10 CFR 60.51(4)]

30 Table F1.4.3.1.2.1 Function Description: Test/Map Geologic Setting

- 31 I. Function ID Number: 1.4.3.1.2.1
32 II. Function Title: Test/Map Geologic Setting
33 III. Function Definition:

34 To investigate the performance of the geologic setting through laboratory experiments, field
35 tests, and geologic mapping conducted outside of the subsurface repository facility.

36 IV. Interfaces:

37 A. Inputs: None identified at this time.

38 B. Outputs: None identified at this time.

39 V. Function Requirements: Requirements at this level to be specified

1 **Table F1.4.3.1.2.2 Function Description: Test NBS Performance**

2 **I. Function ID Number:** 1.4.3.1.2.2

3 **II. Function Title:** Test NBS Performance

4 **III. Function Definition:**

5 To investigate the performance of the natural barrier system through laboratory experiments
6 and field tests conducted outside of the subsurface repository facility.

7 **IV. Interfaces:**

8 **A. Inputs:** None identified at this time.

9 **B. Outputs:** None identified at this time.

10 **V. Function Requirements:** Requirements at this level to be specified

11 **Table F1.4.3.1.2.3 Function Description: Test Waste Package and Underground Facility**
12 **Performance**

13 **I. Function ID Number:** 1.4.3.1.2.3

14 **II. Function Title:** Test Waste Package and Underground Facility Performance

15 **III. Function Definition:**

16 To investigate the performance of waste packages and the underground facility through
laboratory experiments and field tests conducted outside of the subsurface repository facility.

17 **IV. Interfaces:**

18 **A. Inputs:** None identified at this time.

19 **B. Outputs:** None identified at this time.

20 **V. Function Requirements:**

21 **A. Constraints:**

22 1.4.3.1.2.3C1 (c) The waste package monitoring program shall include laboratory
23 experiments which focus on the internal condition of the waste packages. To the extent
24 practical, the environment experienced by the emplaced waste packages within the
25 underground facility during the waste package monitoring program shall be duplicated in
26 the laboratory experiments.
27

28 [10 CFR 60.143]

29 **B. Performance:** Requirements at this level to be specified

30 **C. Interfaces:** Requirements at this level to be specified

31 **Table F1.4.3.1.3 Function Description: Conduct In Situ Experiments**

32 **I. Function ID Number:** 1.4.3.1.3

33 **II. Function Title:** Conduct In Situ Experiments

III. Function Definition:

To conduct experiments in the subsurface repository facility designed to test the performance of the natural-barrier system, the waste packages, and the underground facility.

IV. Interfaces:

A. Inputs:

1.4.3.1.3I1	Data Needs	From: Function 1.4.3.1.4
1.4.3.1.3I2	Site Data	From: Site

B. Outputs:

1.4.3.1.3O1	Experiment Data	To: Function 1.4.3.2/ 1.4.3.1.4
-------------	-----------------	------------------------------------

V. Function Requirements:

A. Constraints:

1.4.3.1.3C1 (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.

(b) The testing shall be initiated as early as is practicable.

(c) 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.

(d) Test sections shall be established to test the effectiveness of borehole and shaft seals before full-scale operation proceeds to seal boreholes and shafts.

[10 CFR 60.142]

B. Performance: Requirements at this level to be specified

C. Interfaces: Requirements at this level to be specified

Table F1.4.3.1.3.1 Function Description: Test In Situ NBS Performance

I. Function ID Number: 1.4.3.1.3.1

II. Function Title: Test In Situ NBS Performance

III. Function Definition:

To conduct experiments and tests in the subsurface repository facility that are designed to test the performance of the natural barrier system.

IV. Interfaces:

A. Inputs: None identified at this time.

B. Outputs: None identified at this time.

V. Function Requirements: Requirements at this level to be specified

1 Table F1.4.3.2 Function Description: Assess Performance

- 2 I. Function ID Number: 1.4.3.2
- 3 II. Function Title: Assess Performance
- 4 III. Function Definition:

5 To estimate the ability of the system to meet the performance objectives specified in
6 regulations, using updated performance-assessment models and data generated by the
7 performance-confirmation program; to use the estimates in updates to compliance
8 documents needed for licensing and in support of the continuing development of the system.

9 "Performance assessment" means an analysis that: 1) identifies the processes and events that
10 might affect the disposal system; 2) examines the effects of these processes and events on
11 the performance of the disposal system; and 3) estimates the cumulative releases of
12 radionuclides considering the associated uncertainties, caused by all significant processes and
13 events. These estimates shall be incorporated into an overall probability distribution of
14 cumulative release to the extent practicable. [4 CFR 191.12(q)]

15 IV. Interfaces:

16 A. Inputs:

17 1.4.3.2I1 Data From: Function 1.4.3.1

18 B. Outputs:

19 1.4.3.2O1 PA Analyses/Results To: Function 1.4.3.1
20 1.4.3.2O2 Records To: Function 1.4.1.4.3.1

21 V. Function Requirements: Requirements at this level to be specified

22 Table F1.4.3.2.1 Function Description: Update Performance Assessment Models

- 23 I. Function ID Number: 1.4.3.2.1
- 24 II. Function Title: Update Performance Assessment Models
- 25 III. Function Definition:

26 To revise the models used in license-application estimates of the ability of the repository
27 system to meet regulatory performance objectives (preclosure radiation safety, retrievability,
28 and postclosure performance of the system and of particular barriers), using information
29 from the performance-confirmation program and technological advances.

30 IV. Interfaces:

31 A. Inputs:

32 1.4.3.2.II1 PA Models From: Outside System Boundary
33 1.4.3.2.II2 Data From: Function 1.4.3.1
34 1.4.3.2.II3 PA Analyses/Results From: Function 1.4.3.2.2/Outside System
35 Boundary
36

37 B. Outputs:

38 1.4.3.2.IO1 Updated PA Models To: Function 1.4.3.2.2

39 V. Function Requirements: Requirements at this level to be specified

1 Table F1.4.3.2.2 Function Description: Estimate System Performance

2 I. Function ID Number: 1.4.3.2.2

3 II. Function Title: Estimate System Performance

4 III. Function Definition:

5 To use the updated performance-assessment models and data from the
6 performance-confirmation program to estimate the performance of the system in meeting
7 its regulatory performance objectives and (if such estimates are necessary) in controlling
8 health effects in the environment.

9 IV. Interfaces:

10 A. Inputs:

11 1.4.3.2.2I1 Updated PA Models From: Function 1.4.3.2.1
12 1.4.3.2.2I2 Data From: Function 1.4.3.1

13 B. Outputs:

14 1.4.3.2.2O1 PA Analyses/Results To: Outside System Boundary/
15 1.4.3.1/1.4.3.2.1/1.4.3.2.3

16 V. Function Requirements: Requirements at this level to be specified

17 Table F1.4.3.2.2.1 Function Description: Estimate EBS Performance

18 I. Function ID Number: 1.4.3.2.2.1

19 II. Function Title: Estimate EBS Performance

20 III. Function Definition:

21 To use updated performance assessment models and data from the performance
22 confirmation program to estimate the performance of the engineered barrier system in
23 meeting its regulatory performance objectives (if such estimates are necessary).

24 IV. Interfaces:

25 A. Inputs: None identified at this time.

26 B. Outputs: None identified at this time.

27 V. Function Requirements: Requirements at this level to be specified

28 Table F1.4.3.2.2.2 Function Description: Estimate NBS Performance

29 I. Function ID Number: 1.4.3.2.2.2

30 II. Function Title: Estimate NBS Performance

31 III. Function Definition:

32 To use updated performance assessment models and data from the performance
33 confirmation program to estimate the performance of the natural barrier system in meeting
34 its regulatory performance objectives.

IV. Interfaces:

A. Inputs: None identified at this time.

B. Outputs: None identified at this time.

V. Function Requirements: Requirements at this level to be specified

Table F1.4.3.2.2.3 Function Description: Estimate Total System Performance

I. Function ID Number: 1.4.3.2.2.3

II. Function Title: Estimate Total System Performance

III. Function Definition:

To use updated performance assessment models and data from the performance confirmation program to estimate the performance of the total barrier system in meeting its regulatory performance objectives.

IV. Interfaces:

A. Inputs: None identified at this time.

B. Outputs: None identified at this time.

V. Function Requirements: Requirements at this level to be specified

Table F1.4.3.2.2.4 Function Description: Estimate Long-Term Radiological Environmental Consequences

I. Function ID Number: 1.4.3.2.2.4

II. Function Title: Estimate Long-Term Radiological Environmental Consequences

III. Function Definition:

To use updated performance assessment models and data from the performance confirmation program to estimate the long-term radiological environmental consequences of geologic repository disposal of radioactive waste (if such estimates are necessary).

IV. Interfaces:

A. Inputs: None identified at this time.

B. Outputs: None identified at this time.

V. Function Requirements: Requirements at this level to be specified

Table F1.4.3.2.3 Function Description: Evaluate System Compliance

I. Function ID Number: 1.4.3.2.3

II. Function Title: Evaluate System Compliance

III. Function Definition:

3 To use the estimates of system performance in updating evaluations of the ability of the
4 system to comply with regulations, in supporting design-modification studies, and in guiding
5 the performance-confirmation program.

6 IV. Interfaces:

7 A. Inputs:

8 1.4.3.2.3I1 PA Analyses/Results From: Function 1.4.3.2.2

9 B. Outputs:

10 1.4.3.2.3O1 Records To: Function 1.4.1.4.3.1

11 V. Function Requirements: Requirements at this level to be specified

12 Table F1.4.3.2.3.1 Function Description: Evaluate EBS Compliance

13 I. Function ID Number: 1.4.3.2.3.1

14 II. Function Title: Evaluate EBS Compliance

15 III. Function Definition:

16 To use the estimates of engineered barrier system performance in updating evaluations of
the ability of the system to comply with regulations, in supporting design-modification
studies, and in guiding the performance confirmation program.

19 IV. Interfaces:

20 A. Inputs: None identified at this time.

21 B. Outputs: None identified at this time.

22 V. Function Requirements: Requirements at this level to be specified

23 Table F1.4.3.2.3.2 Function Description: Evaluate NBS Compliance

24 I. Function ID Number: 1.4.3.2.3.2

25 II. Function Title: Evaluate NBS Compliance

26 III. Function Definition:

27 To use the estimates of natural barrier system performance in updating evaluations of the
28 ability of the system to comply with regulations, in supporting design-modification studies,
29 and in guiding the performance confirmation program.

30 IV. Interfaces:

31 A. Inputs: None specified at this time.

32 B. Outputs: None specified at this time.

1 1.4.3.3C2 (b) If necessary, so as to take into account the environmental impact of any
substantial changes in the permanent closure activities proposed to be carried out or any
significant new information regarding the environmental impacts of such closure, DOE shall
5 also supplement its environmental impact statement and submit such statement, as
supplemented, with the application for license amendment.

6 [1 CFR 6.51]

7 B. Performance: Requirements at this level to be specified

8 C. Interfaces: Requirements at this level to be specified

9 **Table F1.4.3.3.1 Function Description: Collect Environmental Data**

10 I. Function ID Number: 1.4.3.3.1

11 II. Function Title: Collect Environmental Data

12 III. Function Definition:

13 To collect, through monitoring, data that describe the effects of repository operation on the
14 environment.

15 IV. Interfaces:

16 A. Inputs: None identified at this time.

17 B. Outputs: None identified at this time.

V. Function Requirements: Requirements at this level to be specified

19 **Table F1.4.3.3.2 Function Description: Assess Environmental Impacts**

20 I. Function ID Number: 1.4.3.3.2

21 II. Function Title: Assess Environmental Impacts

22 III. Function Definition:

23 To use the data collected through monitoring to estimate the effects of the repository
24 operation on the environment and to compare them with regulations.

26 IV. Interfaces:

27 A. Inputs: None identified at this time.

28 B. Outputs: None identified at this time.

29 V. Function Requirements: Requirements at this level to be specified

30 **Table F1.4.3.3.3 Function Description: Plan for Mitigation**

31 I. Function ID Number: 1.4.3.3.3

32 II. Function Title: Plan For Mitigation

III. Function Definition:

To use the estimates of effects on the environment to plan measures that will mitigate adverse effects.

IV. Interfaces:

A. Inputs: None identified at this time.

B. Outputs: None identified at this time.

V. Function Requirements: Requirements at this level to be specified

Table F1.4.3.4 Function Description: Monitor Performance

I. Function ID Number: 1.4.3.4

II. Function Title: Monitor Performance

III. Function Definition:

To develop a plan for long-term monitoring of the performance of the geologic repository after it has been permanently closed.

IV. Interfaces:

A. Inputs:

1.4.3.4I1	[Containment Data]	From: Function 1.4.2
1.4.3.4I2	[Mitigation Data]	From: Function 1.4.2

B. Outputs:

1.4.3.4O1	License Application to Terminate	To: 1.4.1.4 Subfunction(s)
-----------	----------------------------------	-----------------------------------

V. Function Requirements:

A. Constraints:

1.4.3.4C1 (a) DOE shall submit an application to amend the license prior to permanent closure. The submission shall consist of an updated of the license application submitted under Sections 6.21 and 6.22, including:

(1) A description of the program for post-permanent closure monitoring of the geologic repository

[10 CFR 60.51]

B. Performance: Requirements at this level to be specified

C. Interfaces: Requirements at this level to be specified

3.0 ARCHITECTURE DESCRIPTION

2 Architecture is defined herein to be that part of the physical system actually built,
3 found, or selected to perform a function subject to its stated requirements. Figure
4 9 portrays the architectural concepts that comprise a geologic repository based on
5 how DOE/OCRWM plans to satisfy its mission.

6 Tables A1 - A1.4.3 identify the specific requirements to be satisfied by each
7 architectural concept, a rationale justifying the need for the architecture, and a
8 description of the concept. A complete description of the geologic repository and
9 its components is not possible until more detailed design efforts are completed.
10 Nevertheless, the concepts identified in Figure 9 should improve understanding of
11 the overall concept. There is a one to one correspondence between architecture
12 and the function numbering at the third level. But at the fourth level and below
13 the relationship between the architecture and function numbering is different.

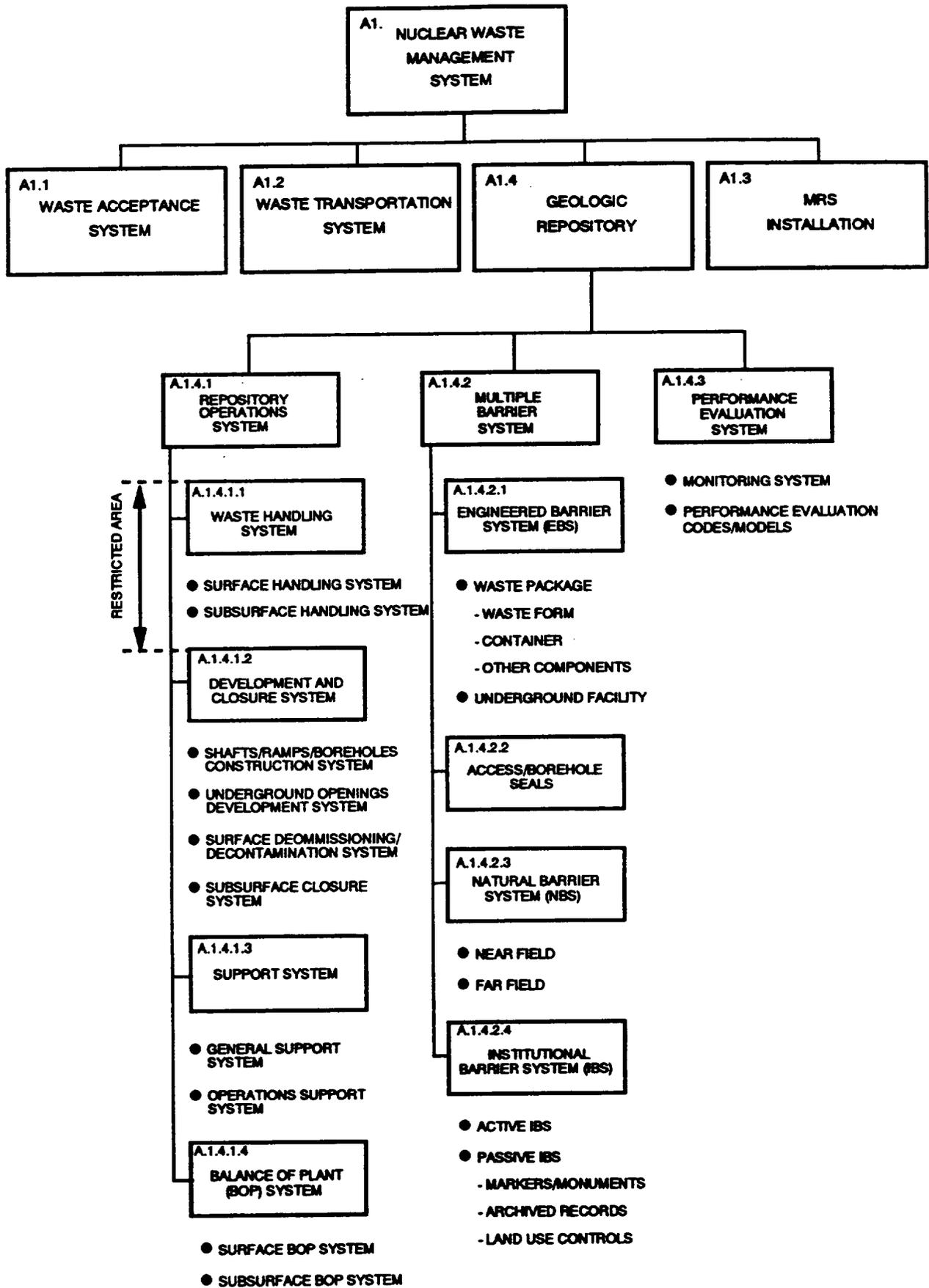


Figure 9. Dispose of Waste Conceptual Architecture Hierarchy

PLADSM 3/781

Table A1. Nuclear Waste Management System

2 ARCHITECTURE: Nuclear Waste Management System

3 REQUIREMENTS SATISFIED:

4 1.C1 - 1.C5; 1.P1; 1.I1 - 1.I3; 1.O1, 1.O2

5 RATIONALE:

- 6 • ... to develop a technically sound integrated waste-management system ...

7 [DOE/RW-0247, Sec. 5]

8 DESCRIPTION:

- 9 • The Nuclear Waste Management System consists of the composite of the sites, and
10 all facilities, systems, equipment, materials, information, activities, and the personnel
11 required to perform those activities necessary to manage waste disposal.

12 Table A1.4 Geologic Repository

13 ARCHITECTURE: Geologic Repository

14 REQUIREMENTS SATISFIED:

15 1.4C1 - 1.4C7; 1.4P1, 1.4P2; 1.4I1 - 1.4I3; 1.4O1 - 1.4O3

16 RATIONALE:

- 17 • To provide for the development of repositories for the disposal of high-level
18 radioactive waste and spent nuclear fuel,...

19 [NWPA Preamble]

- 20 • The DOE is committed to developing a geologic repository for spent fuel and high-
21 level waste...

22 [DOE/RW-0247, Sec. 3]

23 DESCRIPTION:

- 24 • The term "repository" means any system licensed by the Commission that is intended
25 to be used for, or may be used for, the permanent deep geologic disposal of high-level
26 radioactive waste and spent nuclear fuel, whether or not such system is designed to
27 permit the recovery, for a limited period during initial operation, of any materials placed
28 in such system. Such term includes both surface and subsurface areas at which high-
29 level radioactive waste and spent nuclear fuel handling activities are conducted.

30 [NWPA Sec. 2(18)]

- 31 • "Disposal System" means any combination of engineered and natural barriers that
32 isolate spent nuclear fuel or radioactive waste after disposal.

33 [40 CFR 191.12(a)]

Table A1.4.1 Repository Operations System

ARCHITECTURE: Repository Operations System

REQUIREMENTS SATISFIED:

1.4.1C1 - 1.4.1C18; 1.4.1I1 - 1.4.1I5; 1.4.1O1 - 1.4.1O11

RATIONALE:

- ... a geologic repository includes: (1) the geologic repository operations area

[10 CFR 60.2]

DESCRIPTION:

- "Geologic Repository Operations Area" means 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]

- Ownership of land. (1) Both the geologic repository operations area and the controlled area shall be located in and on lands that are either acquired lands under the jurisdiction and control of DOE, or lands permanently withdrawn and reserved for its use.

- (2) These lands shall be held free and clear of all encumbrances, if significant, such as: -

(i) Rights arising under the general mining laws; (ii) easements for right-of-way, and

(iii) all other rights arising under lease, rights of entry, deed, patent, mortgage, appropriation, prescription, or otherwise.

[10 CFR 60.121(a)]

- Water rights. (1) DOE shall also have obtained such water rights as may be needed to accomplish the purpose of the geologic repository operations area.

- (2) Water rights are included in the additional controls to be established under paragraph (b) of this section.

[10 CFR 60.121(c)]

- "Controlled Area" means: (1) a surface location, to be identified by passive institutional controls, that encompasses no more than 100 square kilometers and extends horizontally no more than five kilometers in any direction from the outer boundary of the original location of the radioactive wastes in a disposal system; and (2) the subsurface underlying such a surface location.

[40 CFR 191.12(g)]

Table A1.4.1.1 Waste Handling System

ARCHITECTURE: Waste Handling System

REQUIREMENTS SATISFIED:

1.4.1.1C1 - 1.4.1.1C4; 1.4.1.1I1 - 1.4.1.1I6; 1.4.1.1O1 - 1.4.1.1O8; 1.4.1.1.1C1;
1.4.1.1.1I1 - 1.4.1.1.1I4; 1.4.1.1.1O1 - 1.4.1.1.1O3; 1.4.1.1.1.1I1 - 1.4.1.1.1.1I4;

1 1.4.1.1.1.1O1, 1.4.1.1.1.1O2; 1.4.1.1.2.2C1; 1.4.1.1.2.3I1, 1.4.1.1.2.3I2; 1.4.1.1.2.3O1 -
2 1.4.1.1.2.3O4; 1.4.1.1.2.4C1; 1.4.1.1.3C1

3 **RATIONALE:**

- 4 • "Geologic repository operations area" means ... where waste handling activities are
5 conducted. [10 CFR 60.2]
6

7 **DESCRIPTION:**

- 8 • ... Surface facilities in the geologic repository operations area ... allow safe handling
9 and storage of wastes at the geologic repository operations area ... [10 CFR 60.132(a)]
10

- 11 • "Surface facilities" means repository support facilities within the restricted area.
12 [10 CFR 960.2]
13

- 14 • "Restricted area" means any area access to which is controlled by the licensee for
15 purposes of protection of individuals from exposure to radiation and radioactive
16 materials. "Restricted area" shall not include any areas used as residential quarters,
17 although a separate room or rooms in a residential building may be set apart as a
18 restricted area. [10 CFR 60.2]
19

- 20 • A geologic repository operations area consists of those surface and subsurface areas
21 that are part of a geologic repository where radioactive waste handling activities are
22 conducted. The underground structure, including openings and backfill materials, but
23 excluding shafts, boreholes, and their seals, is designated the underground facility.
[10 CFR 60.102(b)(2)]

- 24 • The waste handling system consists of the surface handling system and the subsurface
25 handling system.
26

27 **Table A1.4.1.2 Development and Closure System**

28 **ARCHITECTURE:** Development and Closure System

29 **REQUIREMENTS SATISFIED:**

30 1.4.1.2C1 - 1.4.1.2C9; 1.4.1.2I1, 1.4.1.2I2; 1.4.1.2O1 - 1.4.1.2O5; 1.4.1.2.1C1, 1.4.1.2.1C2;
31 1.4.1.2.1.1I1; 1.4.1.2.1.1O1 - 1.4.1.2.1.1O5; 1.4.1.2.5.2C1; 1.4.1.3C1; 1.4.1.3.1.2C1;
32 1.4.1.3.1.3C1 - 1.4.1.3.1.3C3; 1.4.1.3.2C1; 1.4.1.3.3C1; 1.4.1.3.3.2C1

33 **RATIONALE:**

- 34 • ... the construction stage would follow, after issuance of a license by the commission.
35 [10 CFR 60.102(d)]
36

- 37 • Construction ... deemed to be substantially complete ... if the construction of (1)
38 surface and interconnecting structures, systems, and components, and (2) any

underground storage space required for initial operation are substantially complete.

[10 CFR 60.41(a)]

- ... and permanent closure, which includes sealing of shafts

[10 CFR 60.102(d)]

- ... The surface facility ... be designed to facilitate decontamination or dismantlement

[10 CFR 60.132]

DESCRIPTION:

- The development and closure system consists of the shafts/ramps/boreholes construction system, underground openings development system, surface decommissioning/decontamination system, and subsurface closure system.

Table A1.4.1.3 Support System

ARCHITECTURE: Support System

REQUIREMENTS SATISFIED:

1.4.1.4.1C1; 1.4.1.4.1.1C1, 1.4.1.4.1.1C2; 1.4.1.4.1.2C1; 1.4.1.4.1.3C1 - 1.4.1.4.1.3C4;
1.4.1.4.2C1, 1.4.1.4.2C2; 1.4.1.4.2.1C1, 1.4.1.4.2.1C2; 1.4.1.4.2.2C1 - 1.4.1.4.2.2C4;
1.4.1.4.2.3C1 - 1.4.1.4.2.3C4; 1.4.1.4.2.4C1; 1.4.1.4.2.5C1; 1.4.1.4.2.6C1 - 1.4.1.4.2.6C6;
1.4.1.4.2.7C1, 1.4.1.4.2.7C2; 1.4.1.4.2.8C1; 1.4.1.4.3C1; 1.4.1.4.3.1C1 - 1.4.1.4.3.1C10;
1.4.1.4.3.3C1, 1.4.1.4.3.3C2; 1.4.1.4.3.3.1C1 - 1.4.1.4.3.3.1C6; 1.4.1.4.3.3.2C1,
1.4.1.4.3.3.2C2; 1.4.1.4.4C1, 1.4.1.4.4C2; 1.4.1.4.5.1C1; 1.4.1.4.5.1C2

RATIONALE:

- (6) Administrative controls, which are the provisions relating to organization and management, procedures, recordkeeping, review and audit, and reporting necessary to assure that activities at the facility are conducted in a safe manner

[10 CFR 60.43(b)]

- (a) Radiological protection. ...

(1) Means to limit concentrations of radioactive material in air; ...

(4) Means to monitor and control the dispersal of radioactive contamination; ...

(5) Means to control access to high radiation areas or airborne radioactivity areas;

(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 effluents

[10 CFR 60.131(a)]

- (ii) ... include onsite facilities and services that ensure a safe and timely response to emergency conditions and that facilitate the use of available offsite services (such as fire, police, medical and ambulance service) that may aid in recovery from emergencies.

[10 CFR 60.131(b)(4)]

• (i) Each utility service system that is important to safety ... be designed so that essential safety functions can be performed

[10 CFR 60.131(b)(5)]

4
5
6 • Inspection, testing, and maintenance. The structures, systems, and components important to safety ... be designed to permit periodic inspection, testing, and maintenance, as necessary, to ensure their continued functioning and readiness.

[10 CFR 131(b)(6)]

8
9 • Instrumentation and control systems. The design ... include provisions for instrumentation and control systems to monitor and control the behavior of systems important to safety over anticipated ranges for normal operation and for accident conditions.

[10 CFR 131(b)(8)]

13
14 • Surface facility ventilation systems supporting waste transfer, inspection, decontamination, processing, or packaging ... be designed to provide protection against radiation exposures and offsite releases

[10 CFR 60.132(b)]

17
18 • (1) Effluent control. The surface facilities ... be designed to control the release of radioactive materials in effluent during normal operation

19
20 (2) Effluent monitoring. The effluent monitoring systems ... 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

[10 CFR 60.132(c)]

25
26 • (d) Waste treatment. Radioactive waste treatment facilities shall be designed to process any radioactive wastes generated at the geologic repository operations area into a form suitable to permit safe disposal at the geologic repository operations area 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.

[10 CFR 60.132]

29
30 • ... Physical security systems ... be established and maintained by the licensee in accordance with security plans approved by the Nuclear Regulatory Commission.

[10 CFR 73.40(a)]

32
33 • All alarms required pursuant to this part ... annunciate in a continuously manned central alarm station located within the protected area and in at least one other continuously manned station, not necessarily within the protected area

[10 CFR 73.50(d)(1)]

36 • ... The alarm stations required by paragraph (d)(1) of this section

37 To provide the capability of continuous communication, two-way radio voice
38 communication ... be established in addition to conventional telephone service
39

[10 CFR 73.50(e)]

1 **DESCRIPTION:**

- 5 • "Repository Support Facilities" means all permanent facilities constructed in support
6 of site-characterization activities and repository construction, operation, and closure
activities, including surface structures, utility lines, roads, railroads, and similar facilities,
but excluding the underground facility. [10 CFR 960.2]

- 7 • The support systems consists of both the general support system and operations
8 support system.
-
-

9 **Table A1.4.1.4 Balance of Plant (BOP) System**

10 **ARCHITECTURE:** Balance of Plant (BOP) System

11 **REQUIREMENTS SATISFIED:**

12 Any remaining requirements of all 1.4.1.X functions and subfunctions that have not been
13 satisfied by A1.4.1.1 - A1.4.1.3.

14 **RATIONALE:**

- 15 • To satisfy any remaining requirements of all 1.4.1.X functions and subfunctions that
16 have not been satisfied by A.1.4.1.1 -A.1.4.1.3

17 **DESCRIPTION:**

- 18 • None available at this time.
19
-
-

20 **Table A1.4.2 Multiple Barrier System**

21 **ARCHITECTURE:** Multiple Barrier System

22 **REQUIREMENTS SATISFIED:**

23 1.4.2C1 - 1.4.2C17; 1.4.2I1, 1.4.2I2; 1.4.2O1 - 1.4.2O6

24 **RATIONALE:**

- 25 • ... provide for the use of a system of multiple barriers in the design of the repository
26 [NWPA Sec. 121 (b)(1)(B)]
27

28 **DESCRIPTION:**

- 29 • "Barrier" means any material or structure that prevents or substantially delays
30 movement of water or radionuclides. [10 CFR 60.2, 10 CFR 960.2]
31

- 32 • "Barrier" means any material or structure that prevents or substantially delays
33 movement of water or radionuclides toward the accessible environment. For example, a
34
-

barrier may be a geologic structure, a canister, a waste form with physical and chemical characteristics that significantly decrease the mobility of radionuclides, or a material placed over and around waste, provide that the material or structure substantially delays movement of water or radionuclides.

[40 CFR 191.12(d)]

• "Multibarrier system" means a system of natural and engineered barriers, operating independently or relatively independently, that acts to contain and isolate the waste.

[DOE/RW-0199, Vol. VIII, page G-67]

• The multiple barrier system consists of the engineered barrier system, access/borehole seals, the natural barrier system and the institutional barrier system.

Table A1.4.2.1 Engineered Barrier System (EBS)

ARCHITECTURE: Engineered Barrier System

REQUIREMENTS SATISFIED:

1.4.2.1C1 - 1.4.2.1C5; 1.4.2.1.2I1 - 1.4.2.1.2I5; 1.4.2.1.2O1 - 1.4.2.1.2O5

RATIONALE:

• "Disposal System" means any combination of engineered ... barriers that isolate spent nuclear fuel or radioactive waste after disposal.

[40 CFR 191.12(a)]

• During the first several hundred years following permanent closure of a geologic repository when radiation and thermal levels are high and the uncertainties in assessing repository performance are large, special emphasis is placed upon the ability to contain the wastes by waste packages within an *engineered barrier system*

[10 CFR 60.102(e)(1)]

• Following the containment period special emphasis is placed upon the ability to achieve isolation of the wastes by virtue of the characteristics of the geologic repository. The engineered barrier system works to control the release of radioactive material to the geologic setting ...

[10 CFR 60.102(e)(2)]

DESCRIPTION:

• "Engineered Barrier" means the manmade components of a disposal system designed to prevent the release of radionuclides into the geologic medium involved. Such term includes the high-level radioactive waste form, high-level radioactive-waste canisters, and other materials placed over and around such canisters.

[NWPA Sect. 2(11)]

• "Engineered Barrier System" means the waste packages and the underground facility.

[10 CFR 60.2]

APPENDIX S5

EXAMPLE WASTE ACCEPTANCE SCHEDULE (Table A-1 from Preliminary Estimates of the Total-System Cost for the Restructured Program)

Table A-1. Waste-acceptance schedule for the single-repository system:
no-new-orders, end-of-reactor-life, intact fuel disposal
(Metric tons of heavy metal)

Year	MRS facility		Single repository		Total annual system acceptance	
	Spent fuel received	Stored at MRS	Spent fuel from MRS	High-level waste	Spent fuel	Spent fuel and high-level waste
1998	400	400			400	400
1999	400	800			400	400
2000	900	1700			900	900
2001	900	2600			900	900
2002	900	3500			900	900
2003	900	4400			900	900
2004	900	5300			900	900
2005	900	6200			900	900
2006	900	7100			900	900
2007	900	8000			900	900
2008	900	8900			900	900
2009	900	9800			900	900
2010	1800	11200	400		1800	1800
2011	1800	12600	400		1800	1800
2012	1800	14000	400		1800	1800
2013	1800	14900	900		1800	1800
2014	1800	14900	1800		1800	1800
2015	3000	14900	3000	400	3000	3400
2016	3000	14900	3000	400	3000	3400
2017	3000	14900	3000	400	3000	3400
2018	3000	14900	3000	400	3000	3400
2019	3000	14900	3000	400	3000	3400
2020	3000	14900	3000	400	3000	3400
2021	3000	14900	3000	400	3000	3400
2022	3000	14900	3000	400	3000	3400
2023	3000	14900	3000	400	3000	3400
2024	3000	14900	3000	400	3000	3400
2025	3000	14900	3000	400	3000	3400
2026	3000	14900	3000	400	3000	3400
2027	3000	14900	3000	400	3000	3400
2028	3000	14900	3000	400	3000	3400
2029	3000	14900	3000	400	3000	3400
2030	3000	14900	3000	400	3000	3400
2031	3000	14900	3000	400	3000	3400
2032	3000	14900	3000	400	3000	3400
2033	3000	14900	3000	400	3000	3400
2034	3000	14900	3000	400	3000	3400
2035	3000	14900	3000	400	3000	3400
2036	3000	14900	3000	400	3000	3400
2037	350	12250	3000	400	350	750
2038	350	9600	3000	315	350	665
2039	350	8950	3000		350	350
2040	350	4300	3000		350	350
2041	350	1650	3000		350	350
2042	267	0	1857		267	267
Totals	86757		86757	9515	86757	96272

Preliminary Estimates of the Total-System Cost for the Restructured Program:
An Addendum to the May 1989 Analysis of the Total System Life Cycle Cost for
the Civilian Radioactive Waste Management Program, DOE/RW-0295P, Dec. 1990.

4 • "Engineered Barrier System" means the manmade components of a disposal system
5 designed to prevent the release of radionuclides from the underground facility or into
6 the geohydrologic setting. Such term includes the radioactive-waste form, radioactive-
waste canisters, any other components of the waste package, and barriers used to seal
penetrations in and into the underground facility.

[10 CFR 960.2]

7 • "Waste Package" means the waste form and any containers, shielding, packing and
8 other absorbent materials immediately surrounding an individual waste container.

[10 CFR 60.2, 10 CFR 960.2]

11 • "Disposal Package" or "Package" means the primary container that holds, and is in
12 contact with, solidified high-level radioactive waste, spent nuclear fuel, or other
13 radioactive materials and any overpacks that are emplaced at a repository.

[NFWPA Sect. 2(10)]

15 • "Canister" means the initial metal receptacle in which solid radioactive waste is
16 placed for transport to the repository.

17 • "Container" means the component of the waste package that is placed around the
18 waste form or the canistered waste form.

19 • "Waste Form" means the radioactive waste materials and any encapsulating or
20 stabilizing matrix.

[10 CFR 60.2, 10 CFR 960.2]

21 • "Waste Form" means the materials comprising the radioactive components of waste
and any encapsulating or stabilizing matrix.

[40 CFR 191.12(c)]

25 • "Underground Facility" means the underground structure, including openings and
26 backfill materials, but excluding shafts, boreholes, and their seals.

[10 CFR 60.2]

28 • "Underground Facility" means the underground structure and the rock required for
29 support, including mined openings and backfill materials, but excluding shafts, boreholes,
30 and their seals.

[10 CFR 960.2]

32 **Table A1.4.2.2 Access/Borehole Seals**

33 **ARCHITECTURE:** Access/Borehole Seals

34 **REQUIREMENTS SATISFIED:**

35 1.4.2.1C1 - 1.4.2.1C5; 1.4.2.1.2I1 - 1.4.2.1.2I5; 1.4.2.1.2O1 - 1.4.2.1.2O5; 1.4.2.2.I1 -
36 1.4.2.2.I4; 1.4.2.2.O1, 1.4.2.2.O2; 1.4.2.2.1I1 - 1.4.2.2.1I4; 1.4.2.2.1O1 - 1.4.2.2.1O4;

1.4.2.2.2C1; 1.4.2.2.2I1 - 1.4.2.2.2I4; 1.4.2.2.2O1, 1.4.2.2.2O2

RATIONALE:

- Seals for shafts and boreholes ... they do not become pathways that compromise the geologic repository's ability to meet the performance objectives [10 CFR 60.135(a)]

DESCRIPTION:

- "Seal" means an engineered component that reduces water flow. [DOE/RW-0199, Vol. VIII, Part B, page G-89]
- "Access Drift" means a drift that connects the mains and the perimeter drifts; it delineates the waste emplacement panels and provides access to the waste emplacement drifts. In the vertical waste emplacement configuration, there is also a midpanel access drift that supplies additional ventilation to the more numerous drifts. [DOE/RW-0199, Vol. VIII, Part B, page G-1]
- "Borehole" means a hole made with a drill, auger, or other tools for exploring strata in search of minerals, supplying water for blasting, emplacing waste, proving the position of old workings or faults, or releasing accumulations of gas or water. Boreholes include core holes, dry-well-monitoring holes, waste-emplacment boreholes, and test holes for geophysical or ground-water characterization. [DOE-RW-0199, Vol. VIII, Part B, page G-9]

Table A1.4.2.3 Natural Barrier System (NBS)

ARCHITECTURE:

Natural Barrier System (NBS)

REQUIREMENTS SATISFIED:

1.4.2.2.I1 - 1.4.2.2.I4; 1.4.2.2.O1, 1.4.2.2.O2; 1.4.2.2.I11 - 1.4.2.2.I14; 1.4.2.2.O1 - 1.4.2.2.O4; 1.4.2.2.C1; 1.4.2.2.I1 - 1.4.2.2.I4; 1.4.2.2.O1, 1.4.2.2.O2

RATIONALE:

- "Disposal System" means any combination of ... natural barriers that isolate spent nuclear fuel or radioactive waste after disposal. [40 CFR 191.12(a)]
- Following the containment period special emphasis is placed upon the ability to achieve isolation of the wastes by virtue of the characteristics of the geologic repository ... the geologic setting works to control the release of radioactive material to the accessible environment ... [10 CFR 60.102(e)(2)]

DESCRIPTION:

4 • "Natural Barrier" means the physical, mechanical, chemical, and hydrologic characteristics of the geologic environment that individually and collectively act to minimize or preclude radionuclide transport. [DOE/RW-0199, Vol. VIII, Part B, page G-67]

5 • "Natural System" means a host rock suitable for repository construction and waste
6 emplacement and the surrounding rock formations. Includes natural barriers that
7 provide containment and isolation by limiting radionuclide transport through the
8 geohydrologic environment to the biosphere and provide conditions that will minimize
9 the potential for human interference in the future. [DOE/RW-0199, Vol. VIII, Part B, page G-68]
10

11 • "Host Rock" means the geologic medium in which the waste is emplaced. [10 CFR 60.2]
12

13 • "Host Rock" means the geologic medium in which the waste is emplaced, specifically
14 the geologic materials that directly encompass and are in close proximity to the
15 underground facility. [10 CFR 960.2]
16

17 • The natural barrier system consists of the near field and the far field.

18 • "Near-field" means that portion of the rock surrounding emplaced waste in which
19 analysis of the thermal and thermomechanical effects of the waste must consider the
20 specific geometric characteristics of the underground facility, including borehole size and
21 orientation, standoff distance, drift shape dimensions and spacing, or overall layout of
22 the facility. [DOE/RW-0199, Vol. VIII, Part B, part G-68]
23

26 • "Far field" means that portion of the host rock surrounding the underground facility
27 within which the thermal effects of the emplaced waste can be analyzed by considering
28 only the areal power density without consideration of the specific geometric
characteristics of the underground facility. [DOE/RW-0199, Vol. VIII, Part B, part G-38]

29 • For the purposes of calculating ground water travel time, credit cannot be taken for
30 the portion of the natural barrier system that lies within the disturbed zone. The
31 disturbed zones is defined as ...that portion of the controlled area the physical or
32 chemical properties of which changed as a result of underground facility construction or
33 as a result of heat generated by the mplace radioactive wastes such that the resultant
34 change of properties may have a significant effect on the performance of the geologic
35 repository [10 CFR 60.2].

36 Table A1.4.2.4 Institutional Barrier System (IBS)

37 ARCHITECTURE: Institutional Barrier System

38 REQUIREMENTS SATISFIED:

39 1.4.2.3C1 - 1.4.2.3C3; 1.4.2.3.1C1

40 RATIONALE:

1 • Active institutional controls over disposal sites ... be maintained for as long a period
of time as is practicable after disposal [40 CFR 191.14(a)]

4 • Disposal sites ... be designated by the most permanent markers, records, and other
5 passive institutional controls practicable to indicated the dangers of the wastes and their
6 location. [40 CFR 191(c)]
7

8 • ... The monuments provided for by this part are sufficiently permanent ... relevant
9 records are preserved, and remain accessible, for several hundred years after permanent
10 closure. [10 CFR 60.2]
11

12 • ... measures to be employed - such as land controls, construction of monuments, and
13 preservation of records - to regulate or prevent activities that could impair the long-
14 term isolation of emplaced waste within the geologic repository [10 CFR 60.51(a)]
15

16 **DESCRIPTION:**

17 • The IBS consists of the active IBS and the passive IBS.
18 • "Active Institutional Control" means: (1) Controlling access to a disposal site by any
19 means other than passive institutional controls; (2) Performing maintenance operations
20 or remedial actions at a site; (3) Controlling or cleaning up releases from a site; or (4)
21 Monitoring parameters related to disposal system performance. [40 CFR 191.12(e)]
22
23

24 • "Passive Institutional Control" means: (1) Permanent markers placed at a disposal
25 site, (2) Public records and archives, (3) Government ownership and regulations
26 regarding land or resource use, and (4) other methods of preserving knowledge about
27 the location, design, and contents of a disposal system. [40 CFR 191.12(e)]
28

29 **Table A1.4.3 Performance Evaluation System**

30 **ARCHITECTURE:** Performance Evaluation System

31 **REQUIREMENTS SATISFIED:**
32 1.4.3C1 - 1.4.3C3; 1.4.3.1C1 - 1.4.3.1C4; 1.4.3.1.1C1 - 1.4.3.1.1C3; 1.4.3.1.1I1 -
33 1.4.3.1.1I4; 1.4.3.1.1O1; 1.4.3.1.12C1; 1.4.3.1.2I1, 1.4.3.1.2I2; 1.4.3.1.2O1;
34 1.4.3.1.23C1; 1.4.3.1.3C1; 1.4.3.1.4C1; 1.4.3.3C1, 1.4.3.3C2; 1.4.3.4C1

35 **RATIONALE:**
36 • ... assessment of the site at which the proposed geologic repository operations area is
37 to be located with appropriate attention to those feature of the site that might affect
38 geologic repository operations area ... performance [10 CFR 60.21(c)(1)]
39

-
- An evaluation of the performance of the proposed geologic repository for the period after permanent closure

[10 CFR 60.21(c)(1)(ii)(C)]

- ... program for post-permanent closure monitoring of the geologic repository.

[10 CFR 60.51(a)(1)]

- The (performance confirmation) program ... started during site characterization ... will continue until permanent closure.

[10 CFR 60.140(b)]

DESCRIPTION:

- The performance evaluation system includes the performance monitoring system and the performance evaluation codes/models.

- "Performance Assessment" means an analyses that: (1) identifies the processes and events that might affect 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 shall be incorporated into an overall probability distribution of cumulative release to the extent practicable.

[40 CFR 191.12(q)]

- "Performance Assessment" means any analysis that predicts the behavior of a system or a system component under a given set of constant and/or transient conditions. Performance assessments will include estimates of the effects of uncertainties in data and modeling.

[10 CFR 960.2]

- "Performance Confirmation" means 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]

4.0 INTERFACES

Interfaces can be either functional interfaces that indicate a flow between functions as in a sequence of activities, or physical interfaces that indicate a necessary fit between architectures. They are also either internal interfaces which are contained entirely within the subfunction structure or external interfaces which interact with functions outside of the subfunction structure. Prior to the preparation of detailed designs, only functional interfaces can be explicitly described.

Figures 10 - 31 show the functional interfaces, both internal and external, at the various levels within the function hierarchy. As depicted in these N-Square charts, functions are located on the diagonal, and functional interfaces are represented as either inputs to a particular function (those items located vertically above or below a function), or outputs from a particular function (those items located horizontally to the right or left of a function). The requirements for each of these interfaces are contained in Tables F1. - F1.4.3.4.

A more visual display of the interfaces is illustrated in the functional flow diagrams (Figures 32 - 54). Functional interfaces enter or exit a box containing a function as either inputs or outputs (see legend on illustration). A compilation of key inputs and outputs of the Dispose of Waste function are provided in Appendix E. Inputs and outputs from functions below the third level are not shown in Appendix E, however, these can be seen in both the N-Square and functional flow diagrams. Each interface is automatically tracked through lower level functional flow diagrams, thus assuring both traceability and consistency in logic and material flows. However, to maintain legibility on these diagrams, only key inputs/outputs, addressing the most important concepts at a particular function level, are explicitly shown on each diagram. Therefore, inputs and outputs not shown on lower level diagrams are bracketed (i.e. tunnelled) on the higher level functions and vice versa. Also, only the important controls and resources are shown at each level.

- SNF
- CHLW
- DHLW

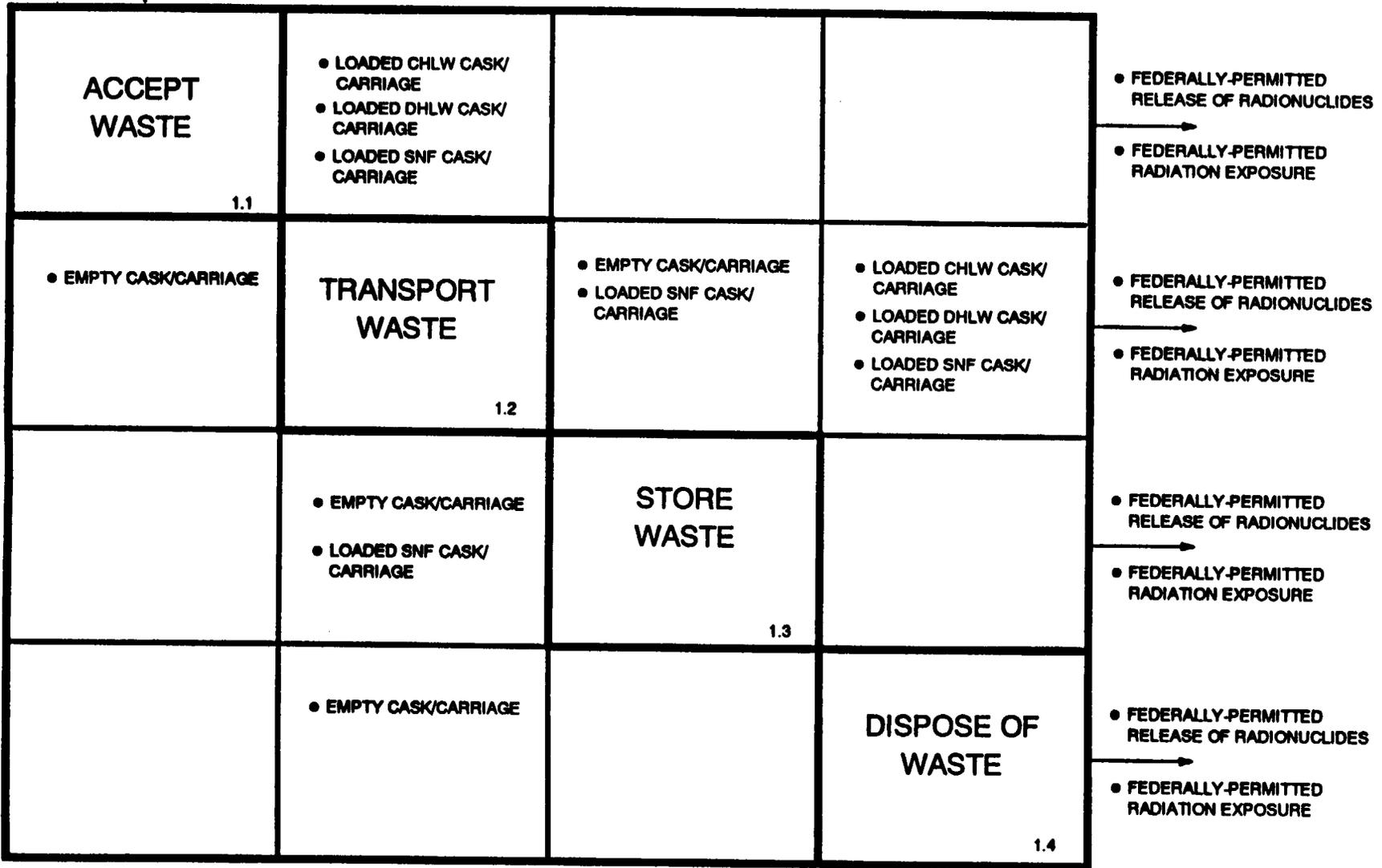


Figure 10. N-Square Chart for 1 - Manage Waste Disposal

MSQ406 01/051

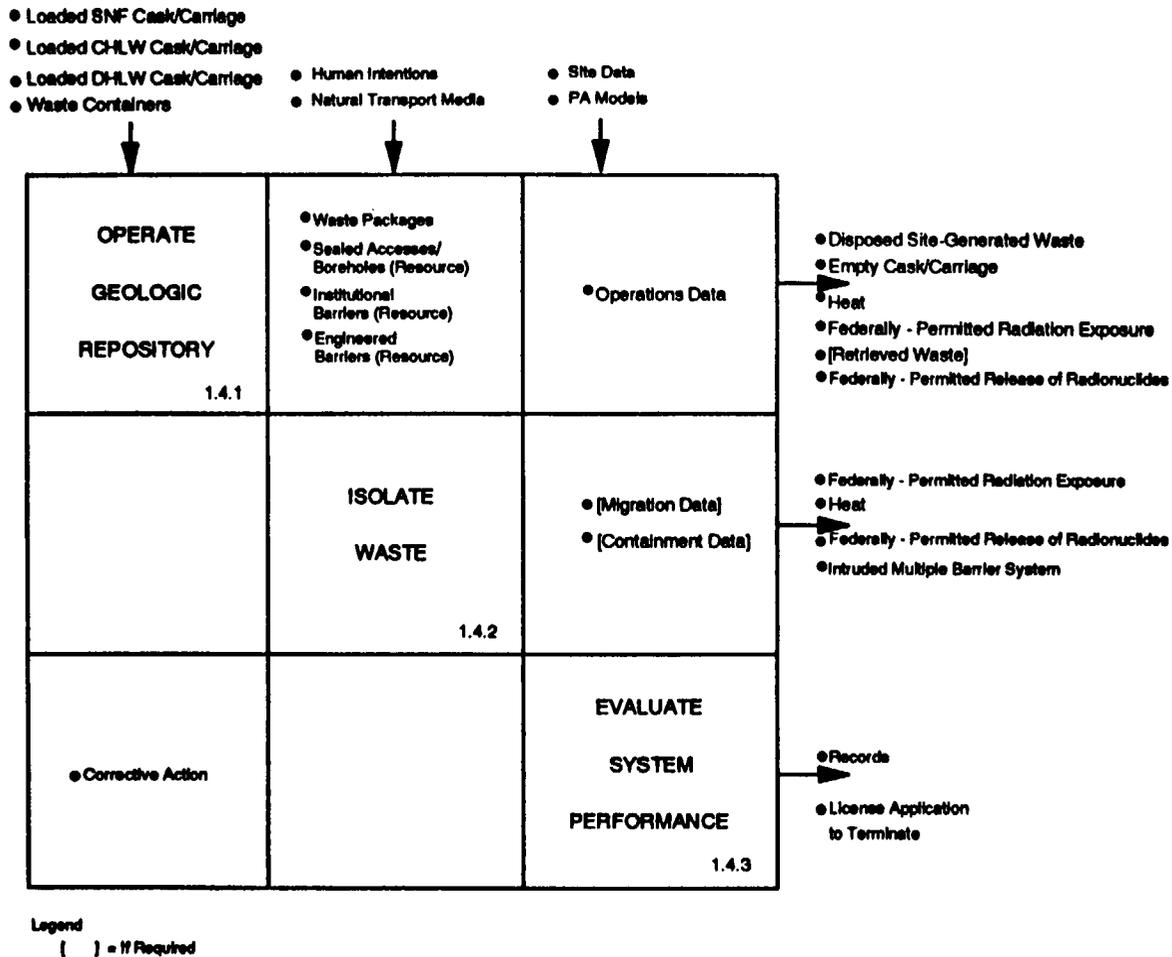


Figure 11. N Square Chart for 1.4 - Dispose of Waste

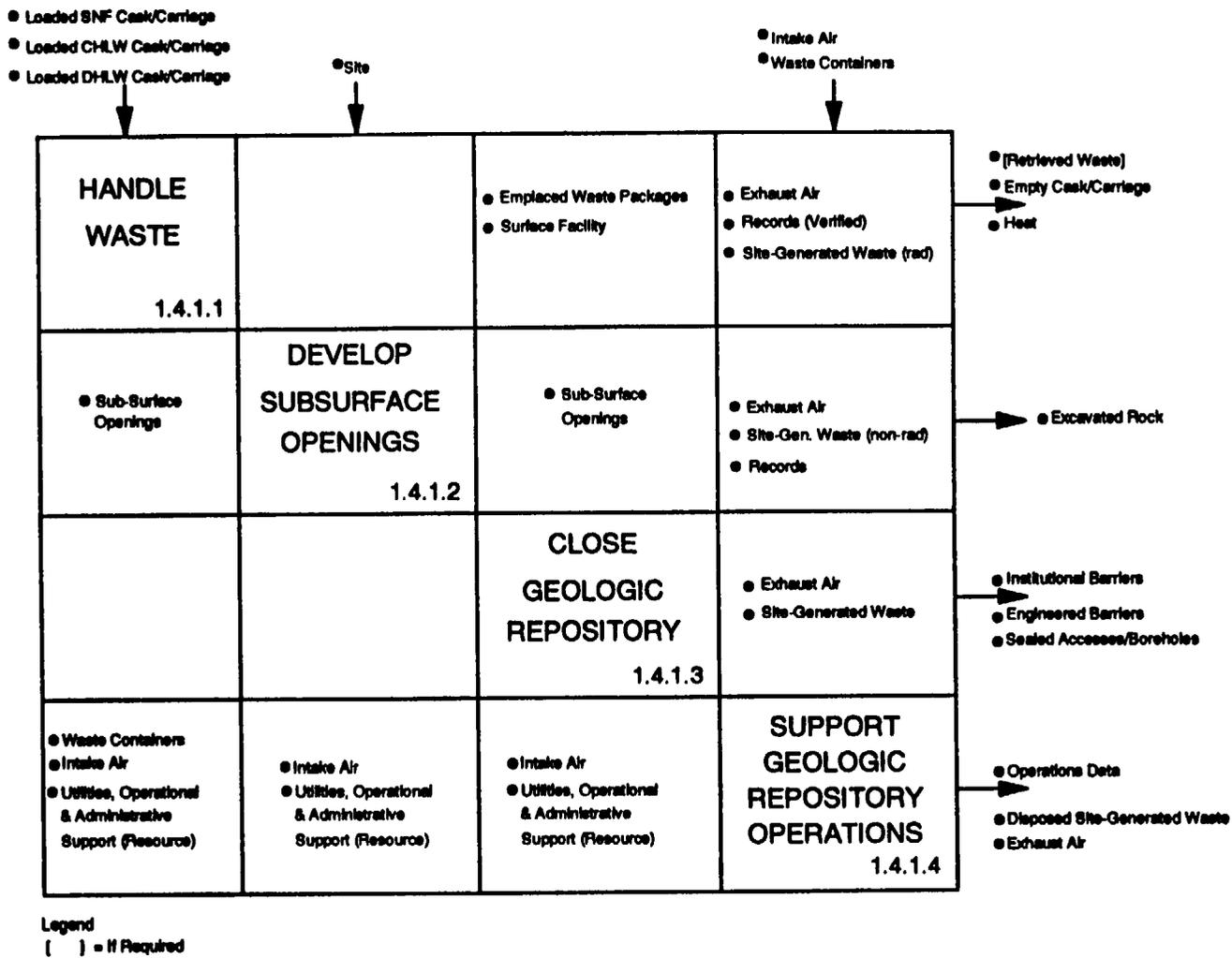
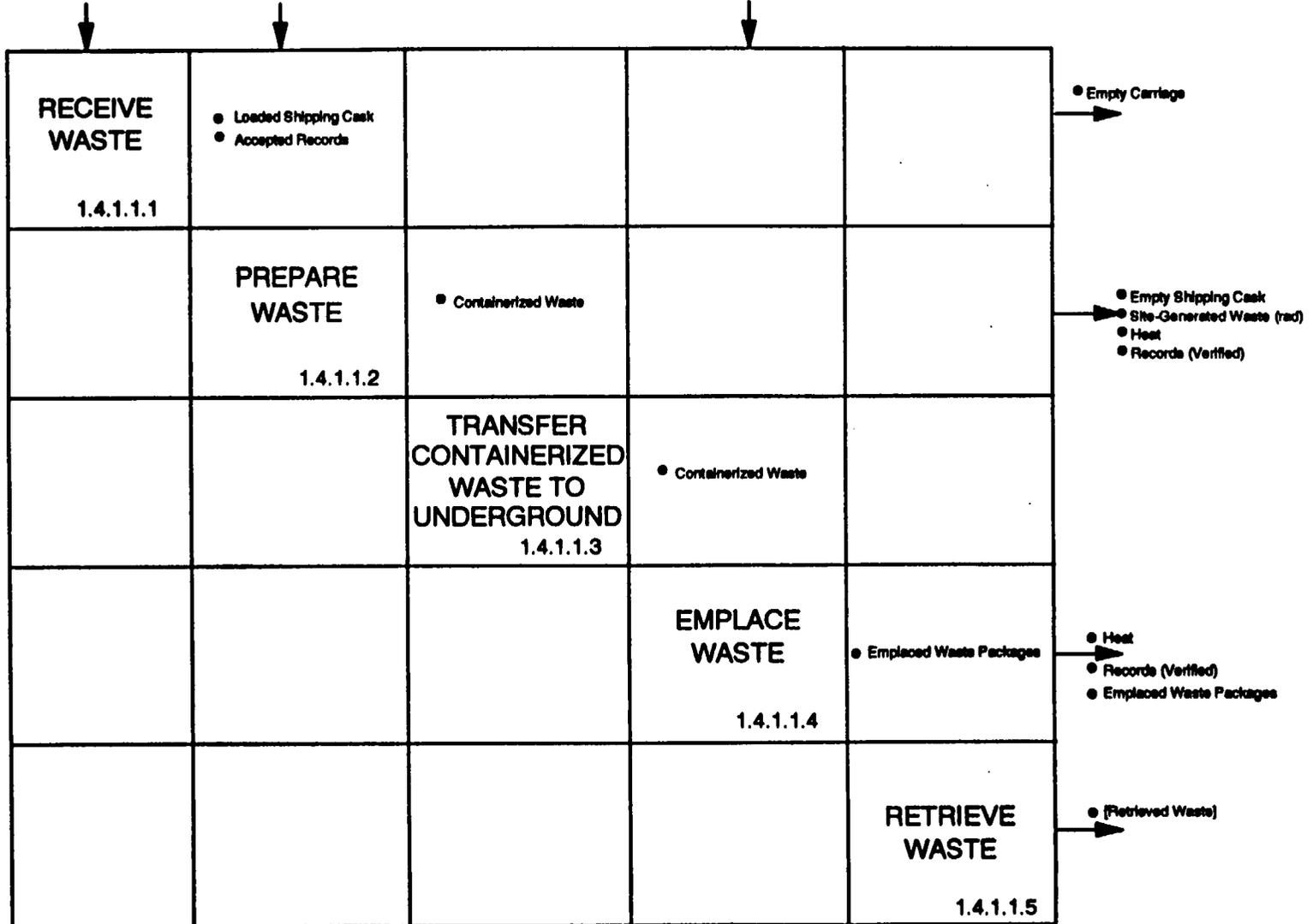


Figure 12. N Square Chart for 1.4.1 - Operate Geologic Repository

- Loaded BNF Cask/Carriage
- Loaded CHLW Cask/Carriage
- Loaded DHLW Cask/Carriage
- Records

● Waste Containers

● Sub-Surface Openings



Legend
 [] = If Required

Figure 13. N Square Chart for 1.4.1.1 - Handle Waste

nd20 8/12/91

- Loaded SNF Cask/Carriage
- Loaded CHLW Cask/Carriage
- Loaded DHLW Cask/Carriage
- Records

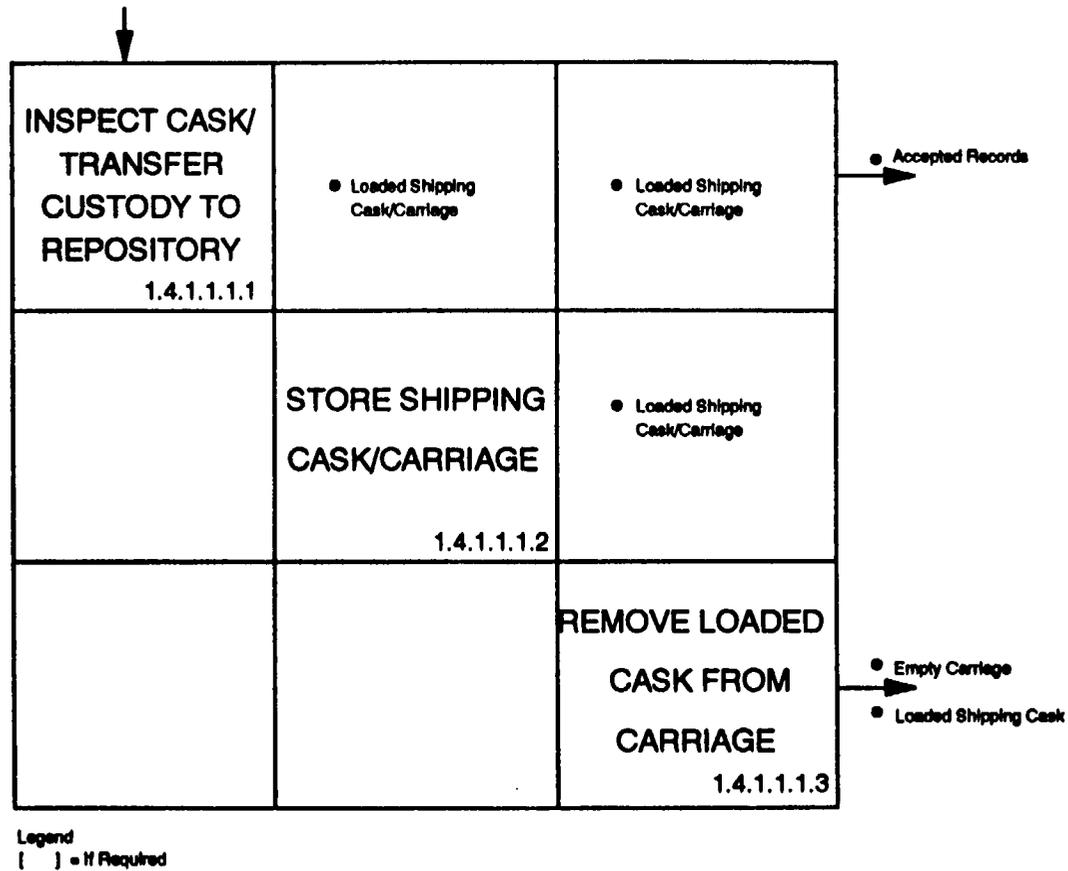


Figure 14. N Square Chart for 1.4.1.1.1 - Receive Waste

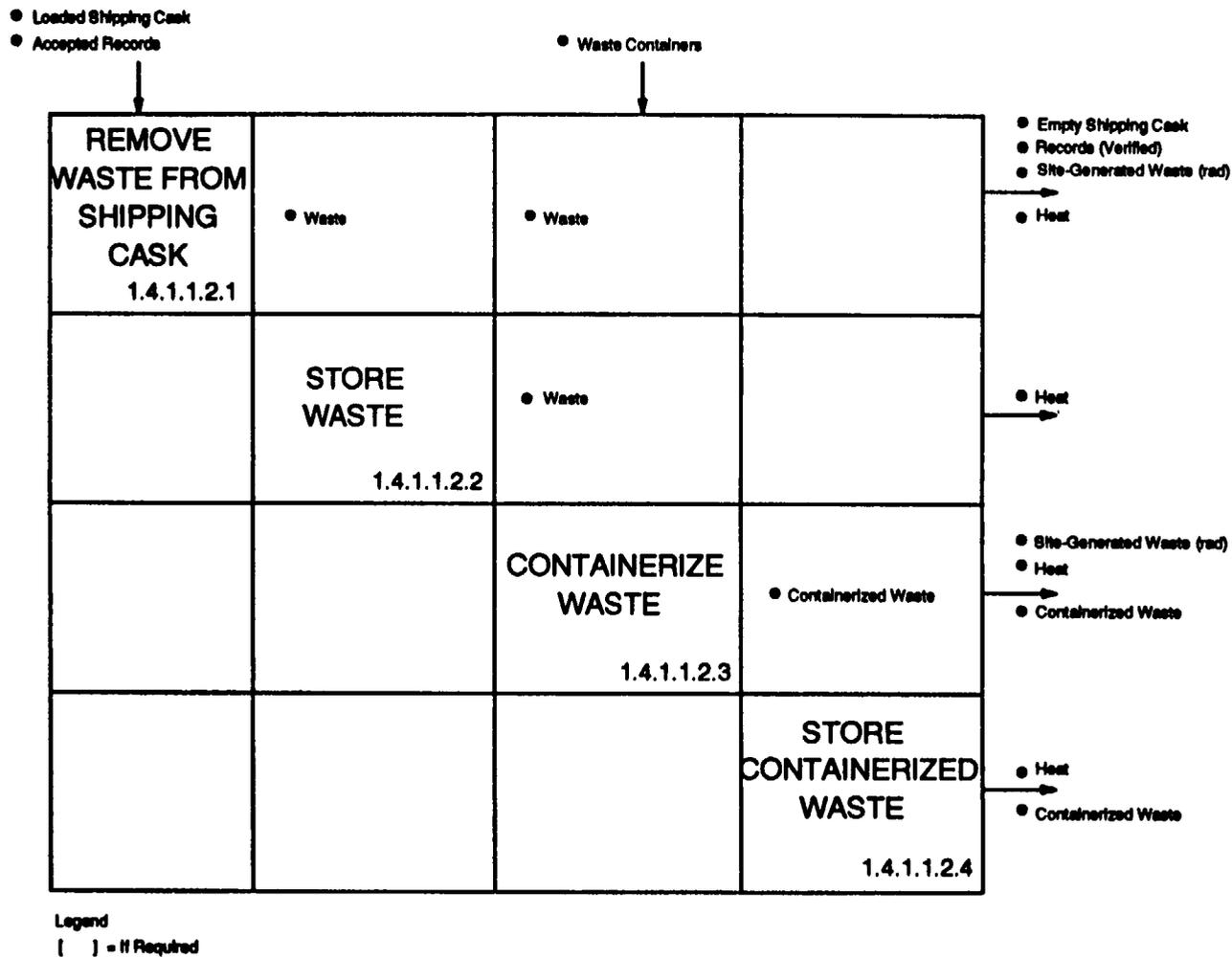


Figure 15. N Square Chart for 1.4.1.1.2 - Prepare Waste

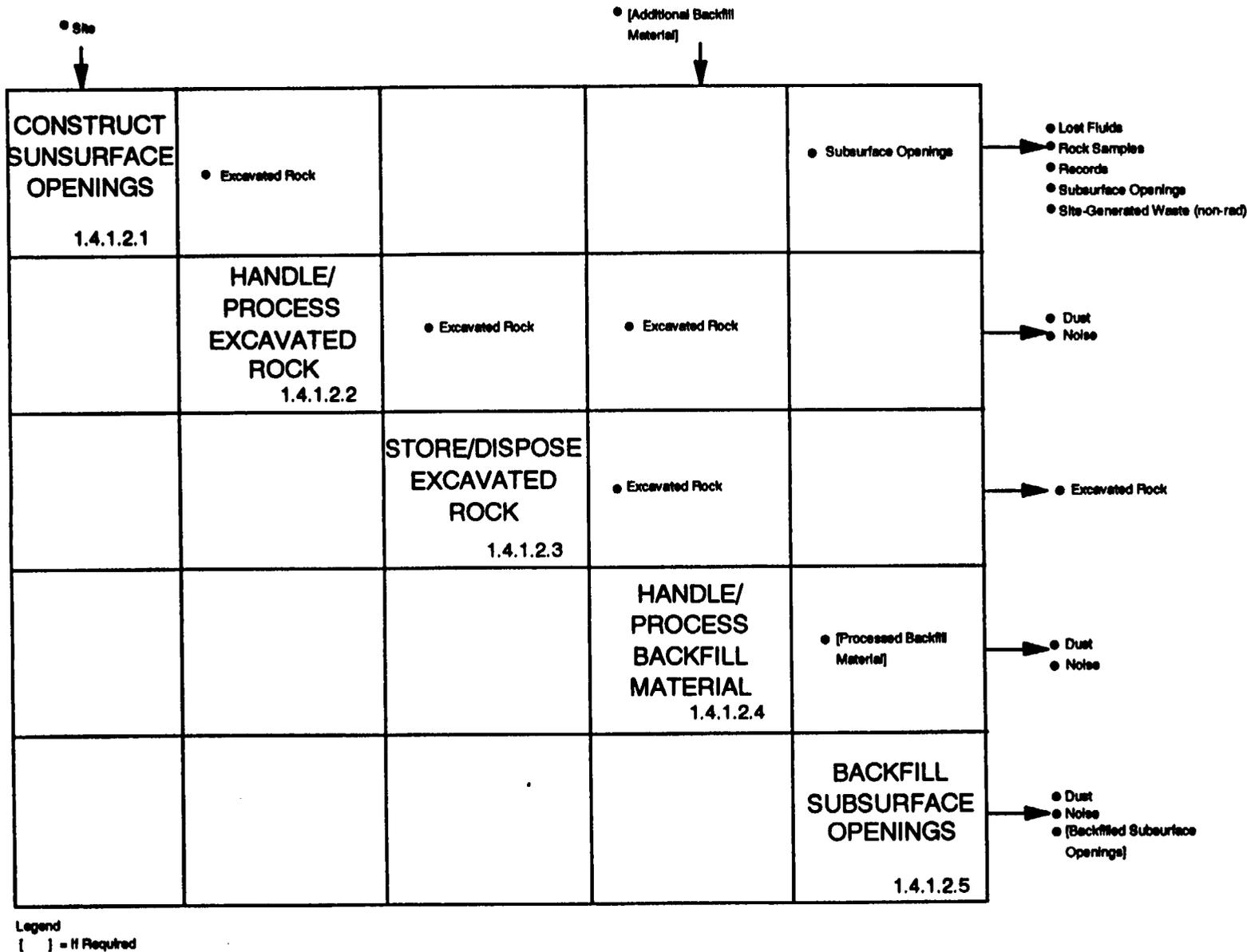
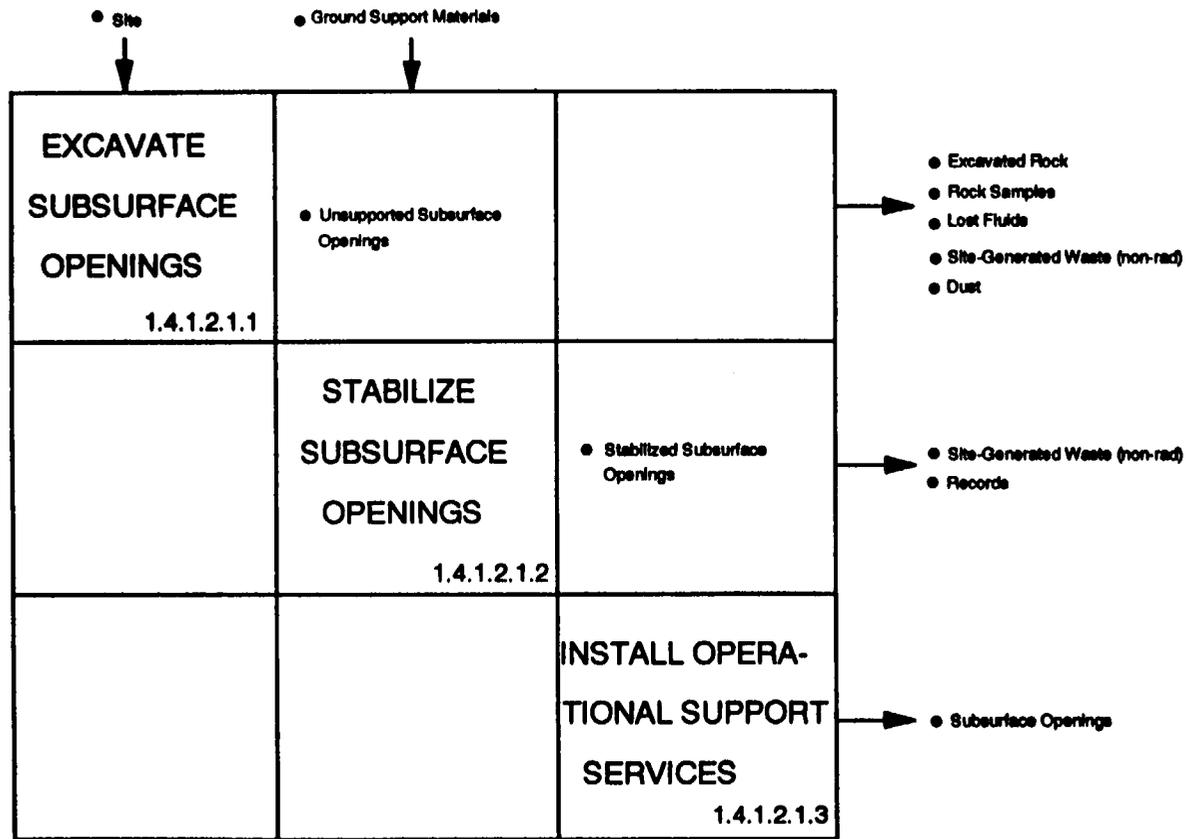


Figure 16. N Square Chart for 1.4.1.2 - Develop Subsurface Openings



Legend
 () = If Required

Figure 17. N Square Chart for 1.4.1.2.1 - Construct Subsurface Openings

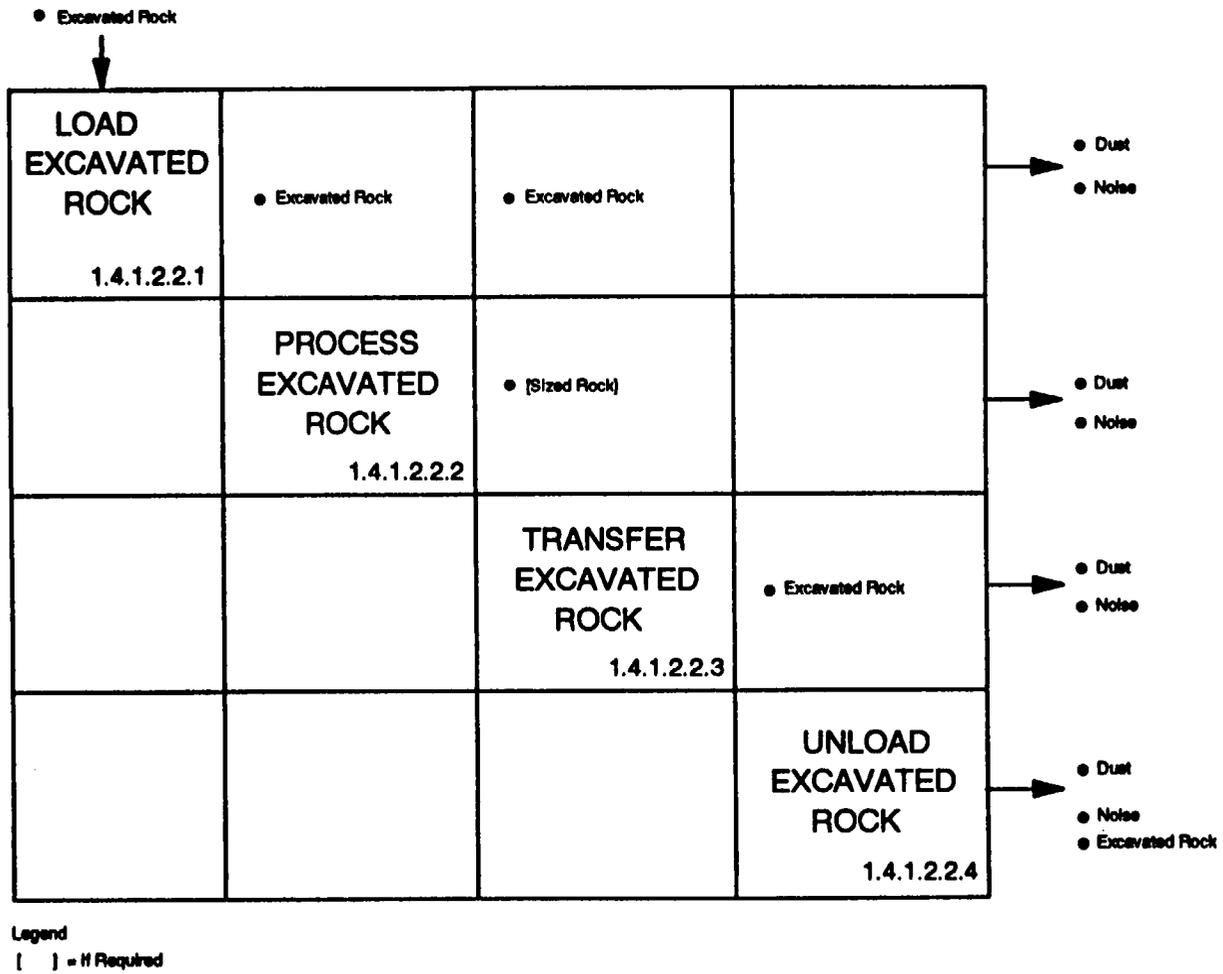


Figure 18. N-Square Chart for 1.4.1.2.2 Handle/Process Excavated Rock

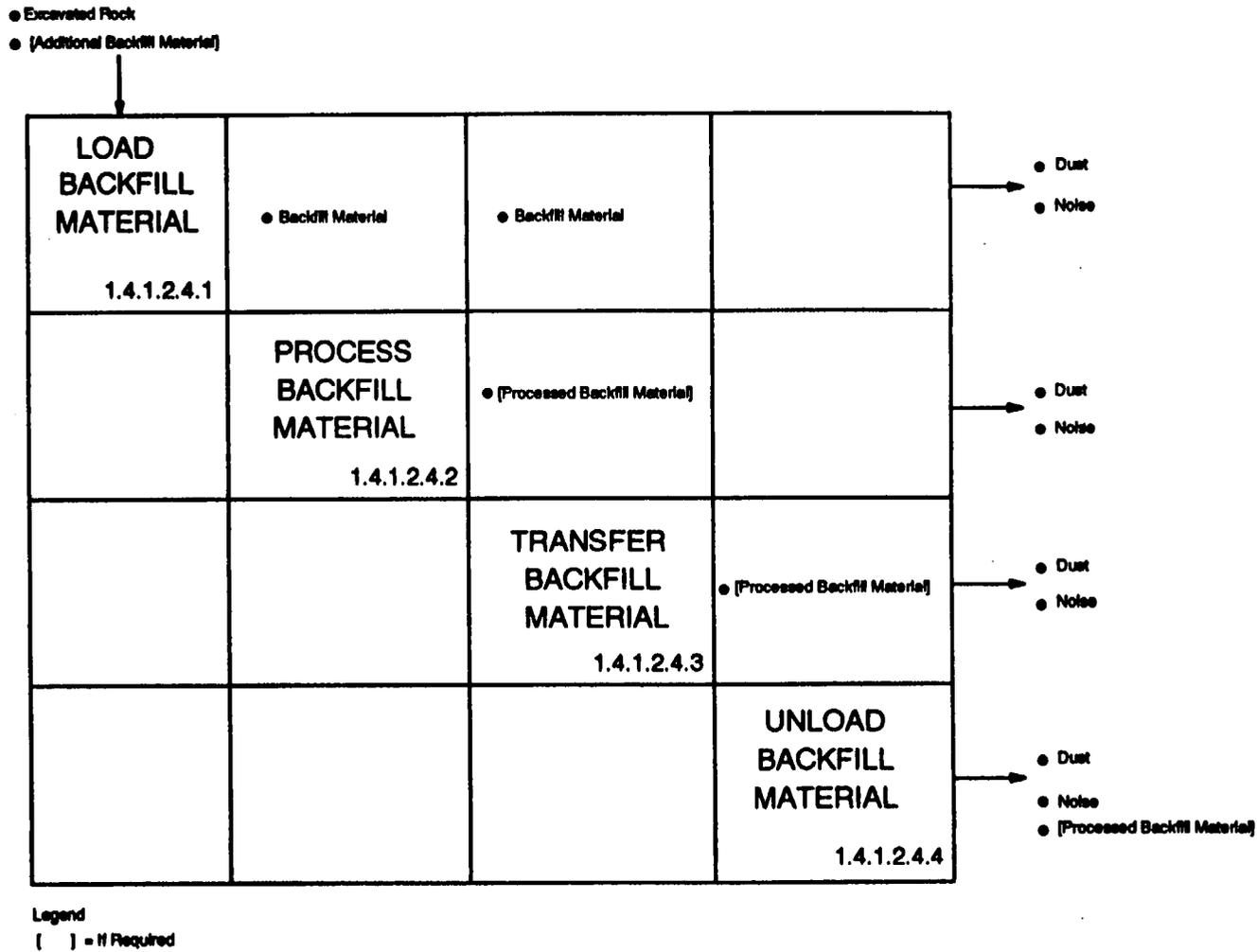


Figure 19. N Square Chart for 1.4.1.2.4 - Handle/Process Backfill Material

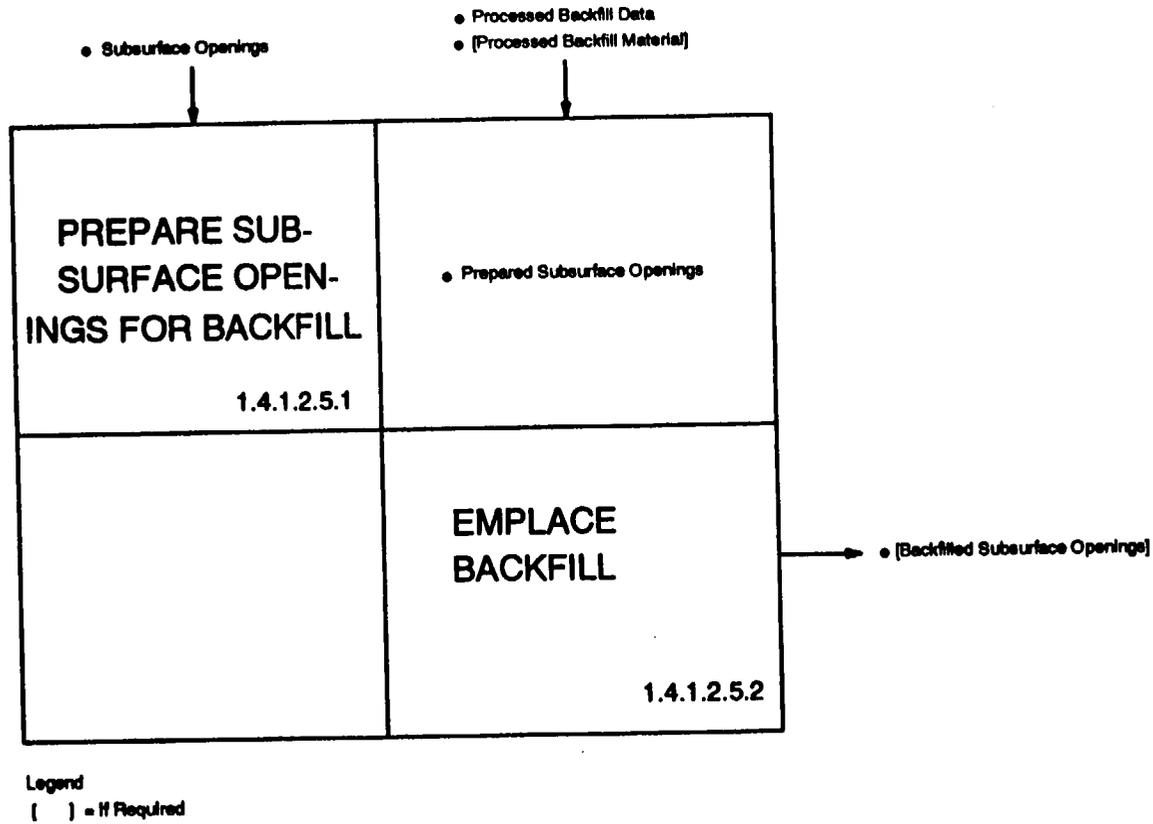


Figure 20. N Square Chart for 1.4.1.2.5 - Backfill Subsurface Openings

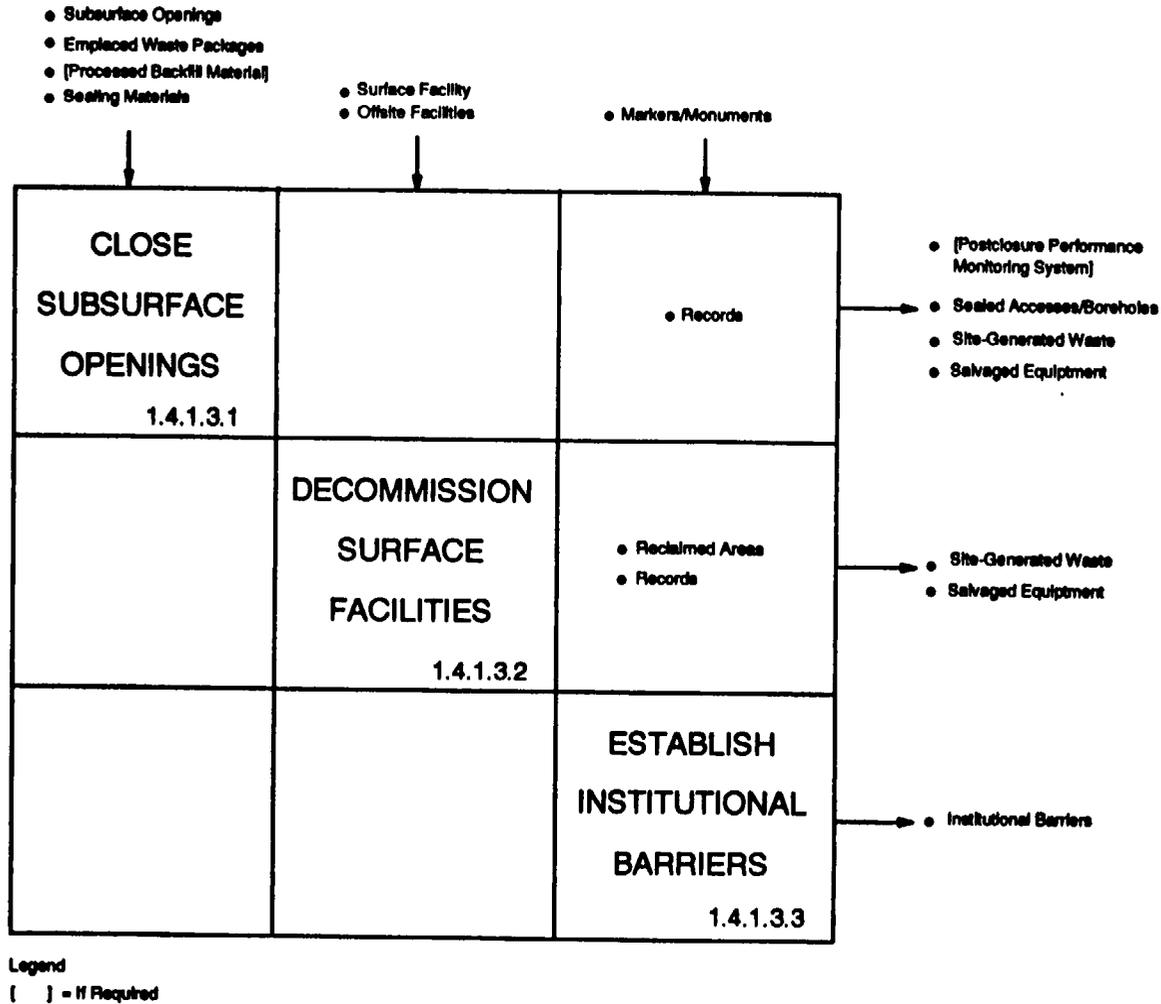


Figure 21. N Square Chart for 1.4.1.3 - Close Geologic Repository

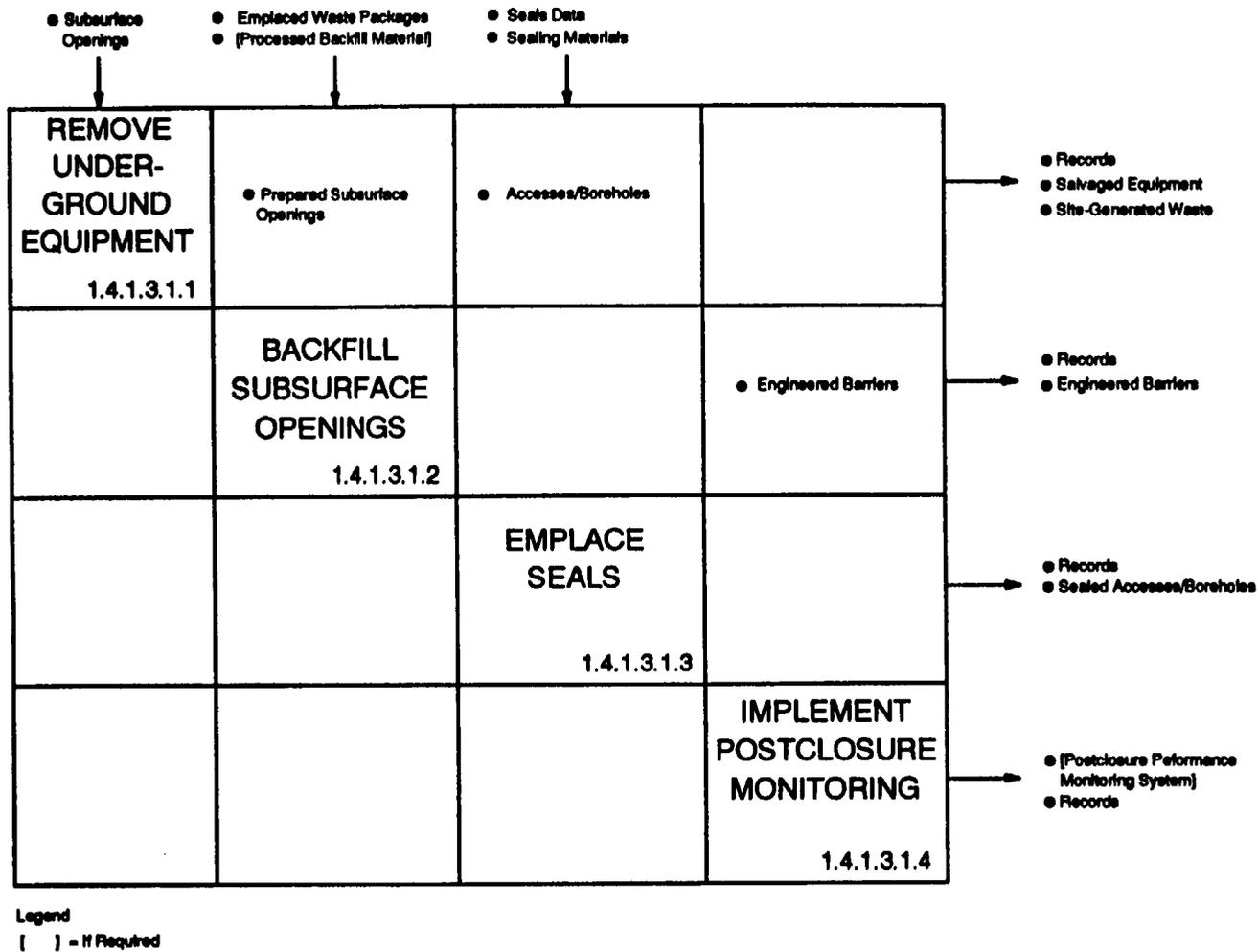


Figure 22. N Square Chart for 1.4.1.3.1-Close Subsurface Openings

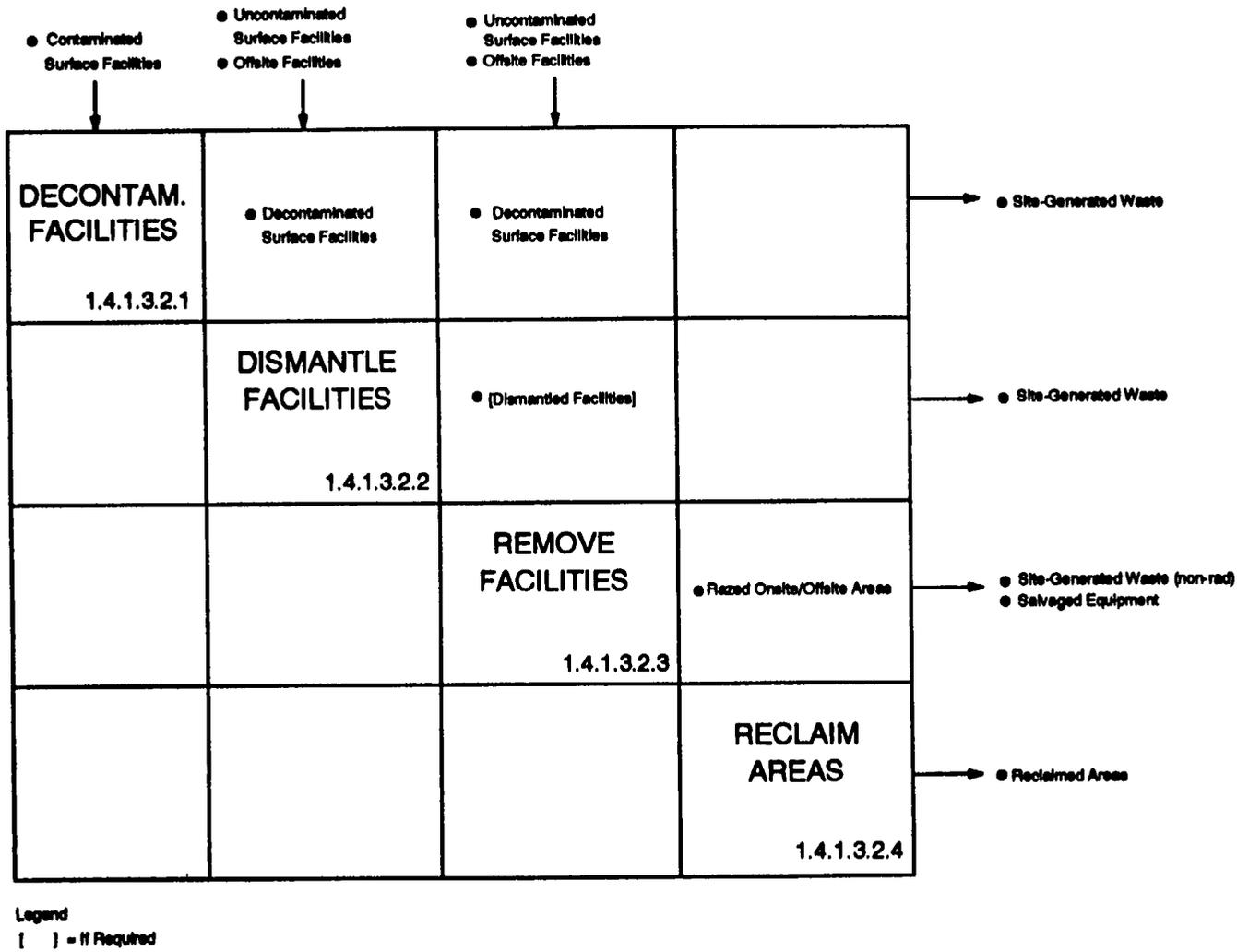


Figure 23. N Square Chart for 1.4.1.3.2 - Decommission Surface Facilities

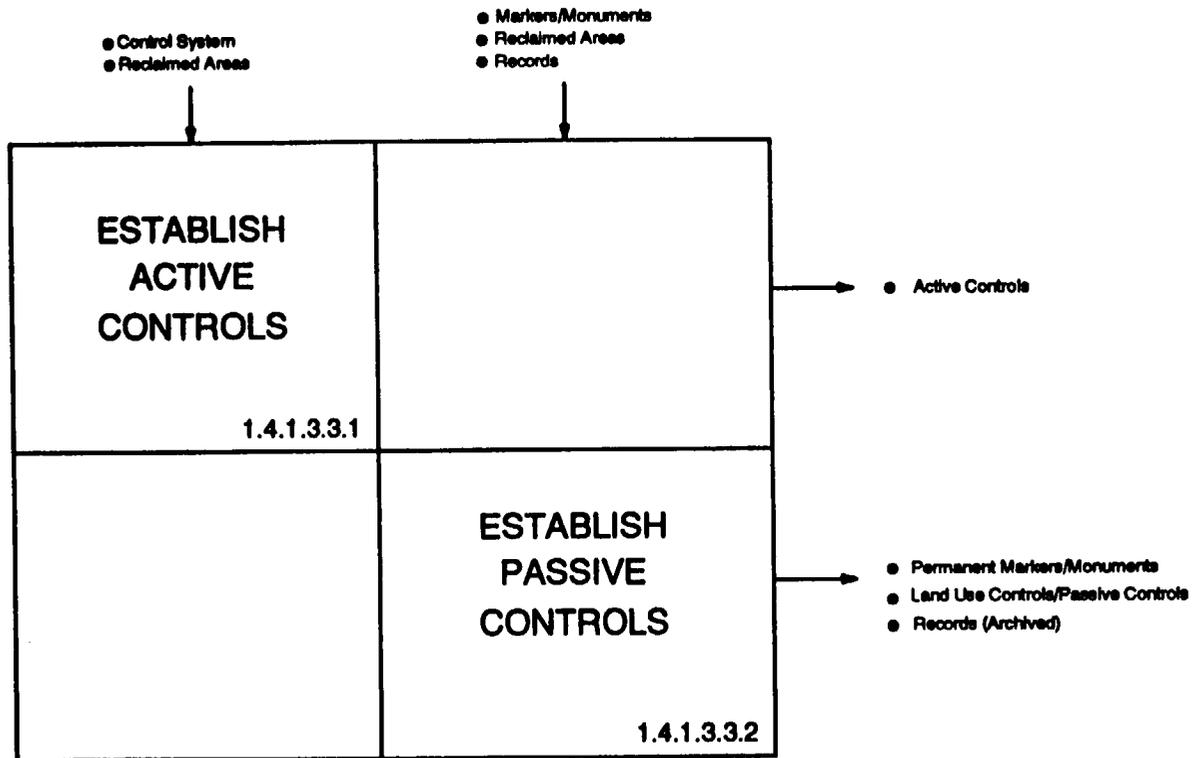


Figure 24. N Square Chart for 1.4.1.3.3 - Establish Institutional Barriers

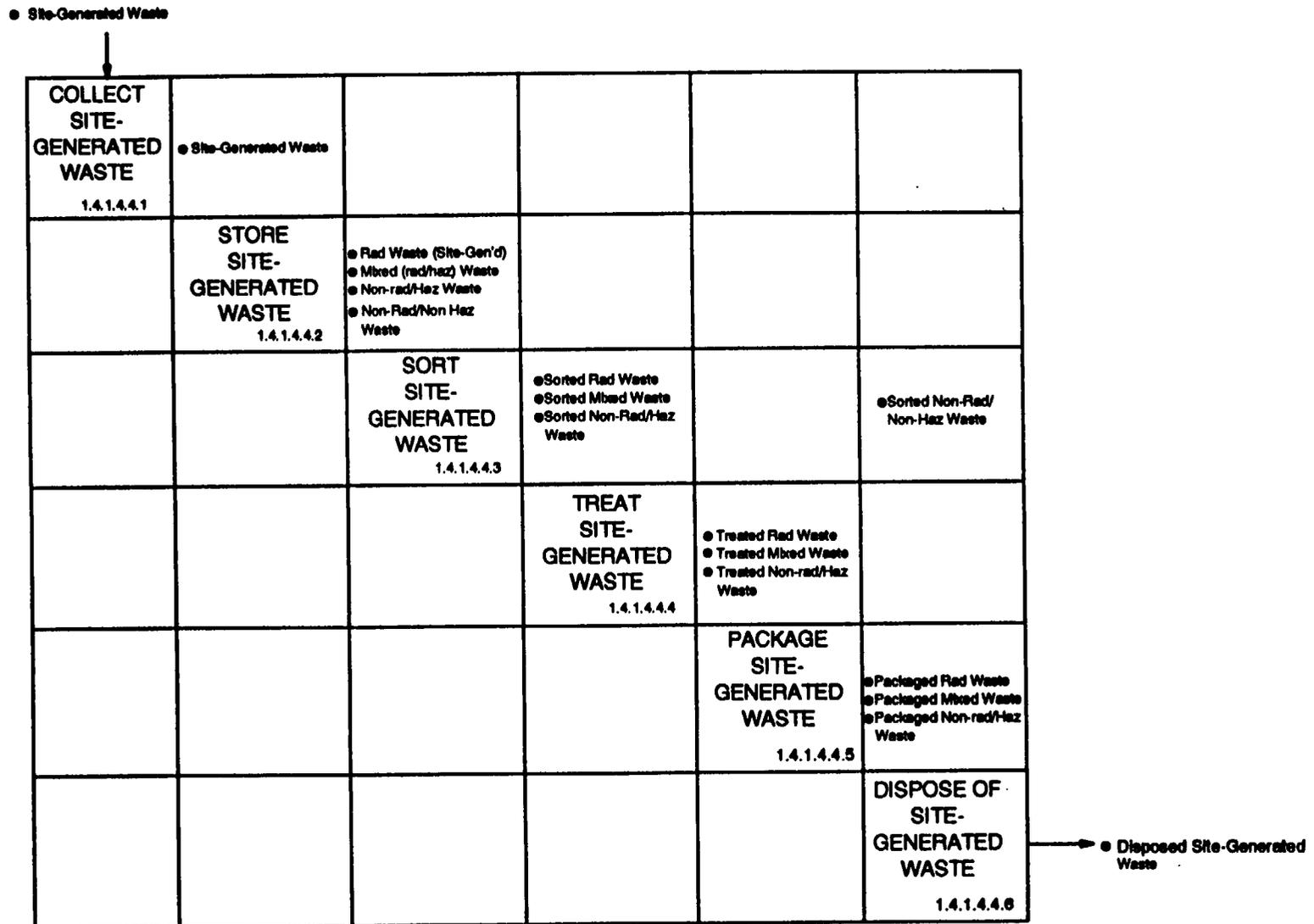


Figure 25. N Square Chart for 1.4.1.4.4 - Process Site-Generated Waste

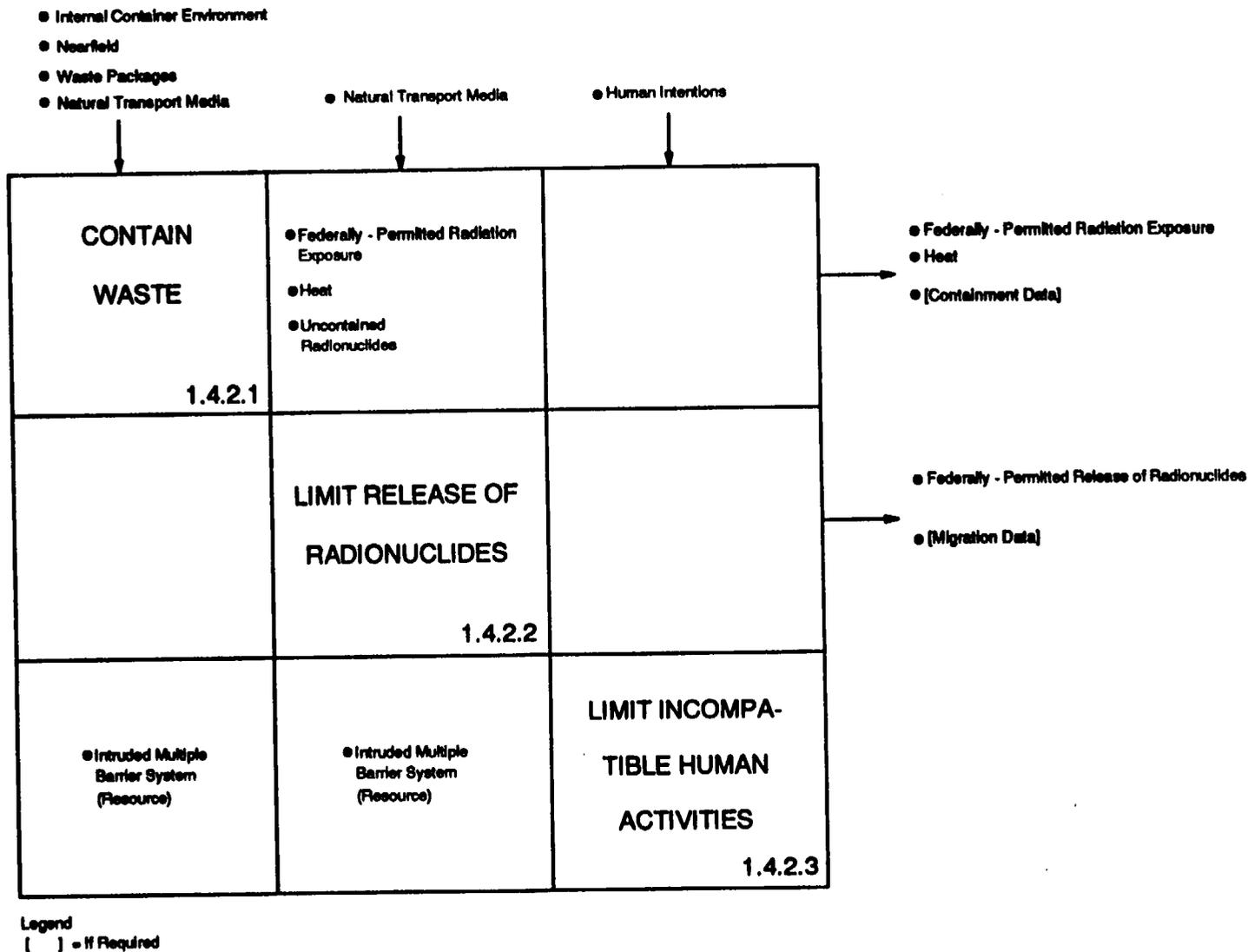
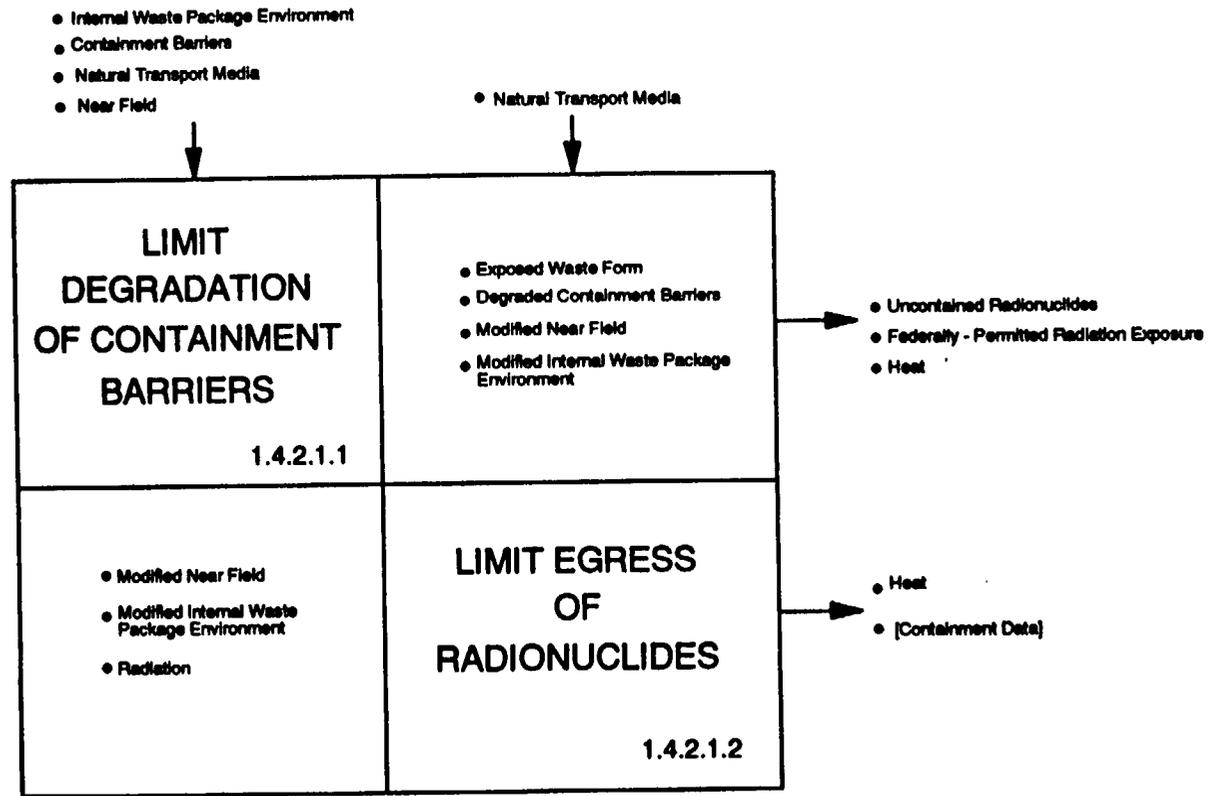


Figure 26. N Square Chart for 1.4.2 - Isolate Waste

nd2rev1 3/26/91



Legend
 [] = If Required

Figure 27. N Square Chart for 1.4.2.1 - Contain Waste

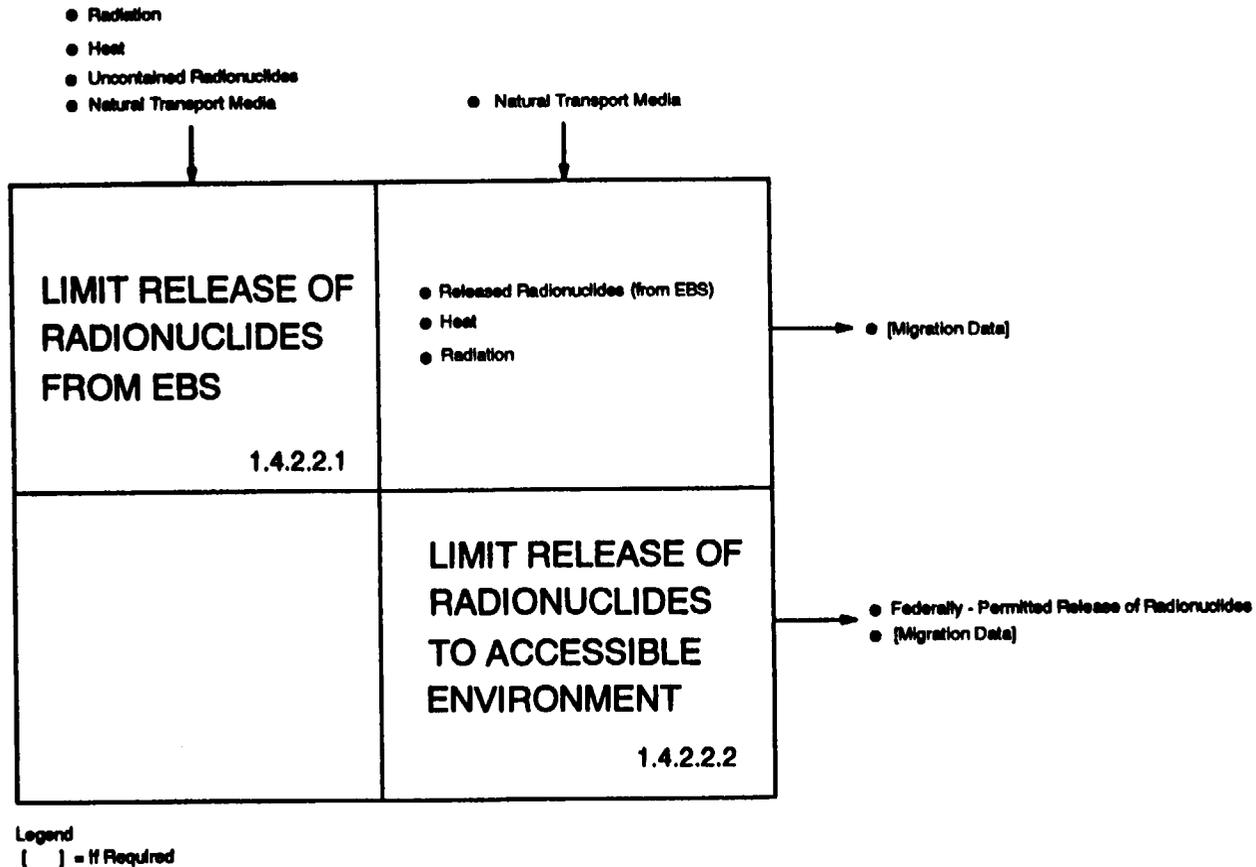


Figure 28. N Square Chart for 1.4.2.2 - Limit Release of Radionuclides

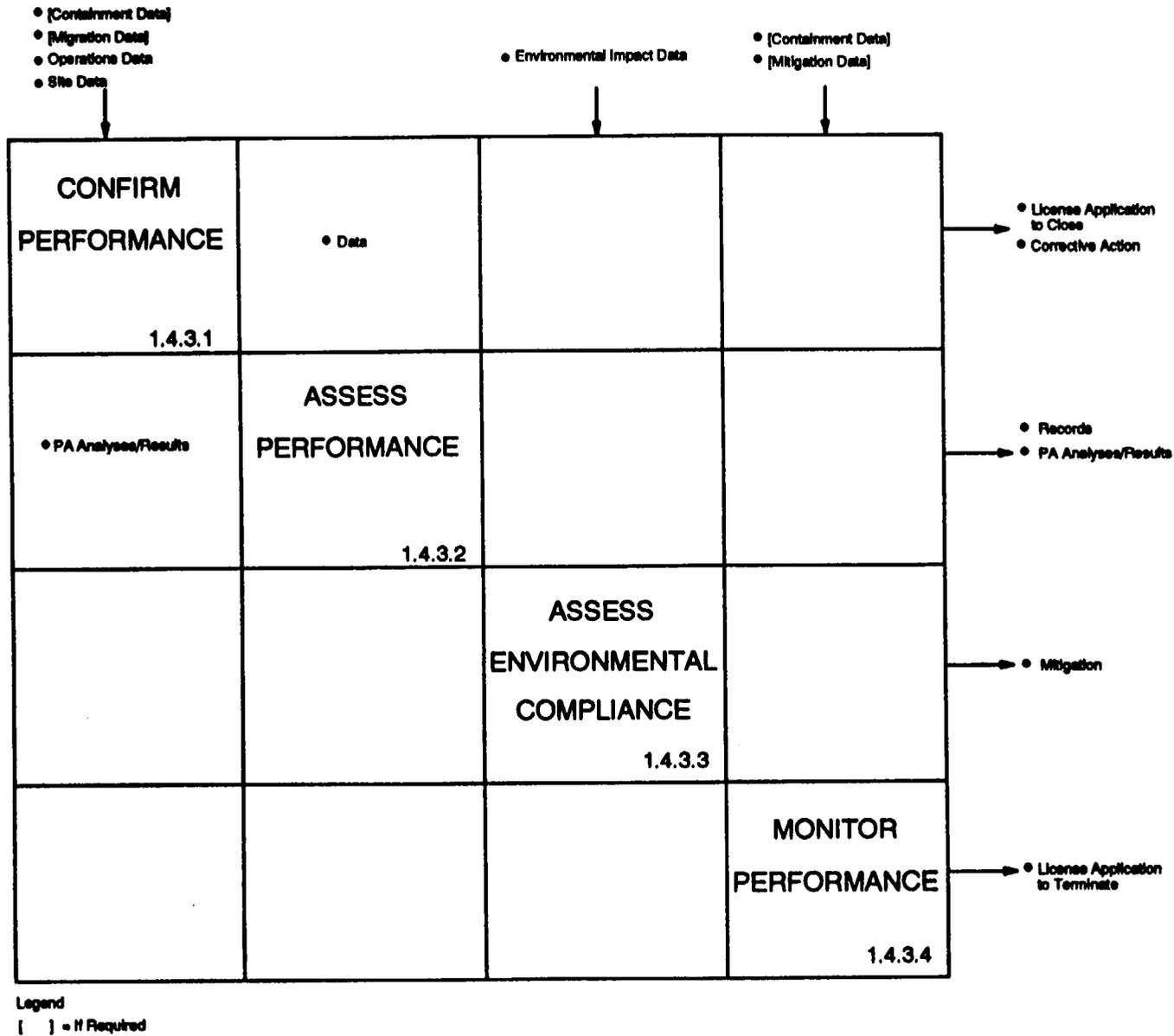


Figure 29. N Square Chart for 1.4.3 - Evaluate System Performance

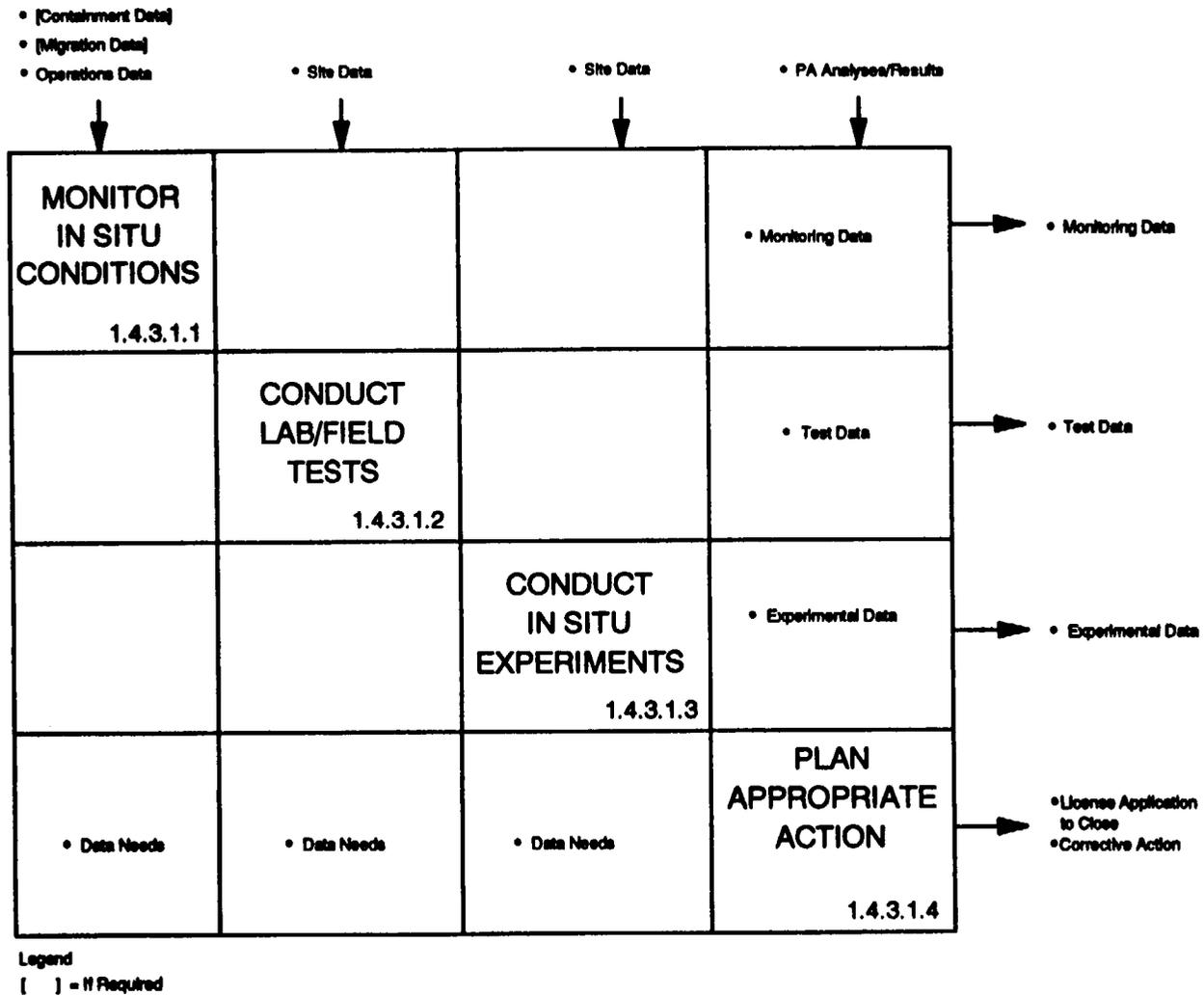


Figure 30. N Square Chart for 1.4.3.1 - Confirm Performance

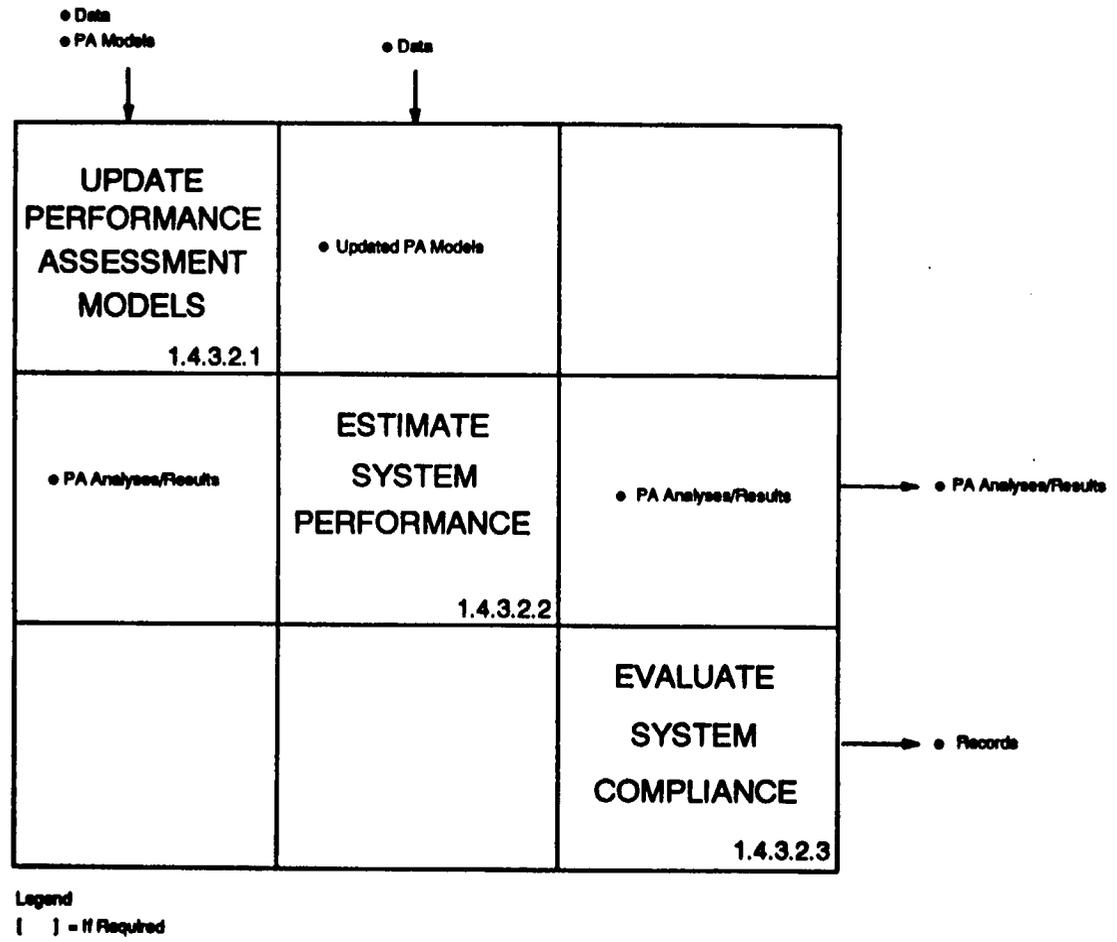


Figure 31. N Square Chart for 1.4.3.2 - Assess Performance

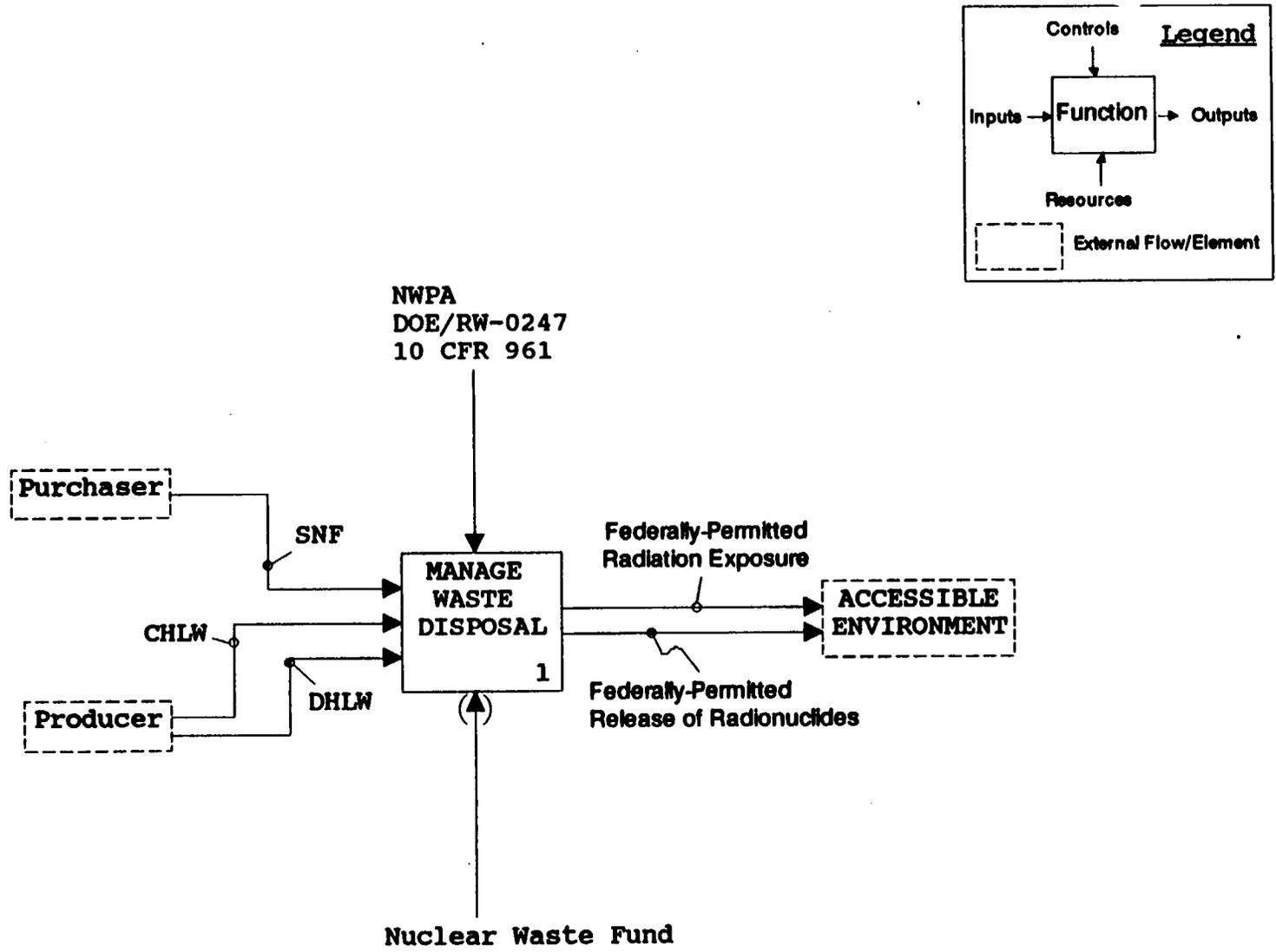
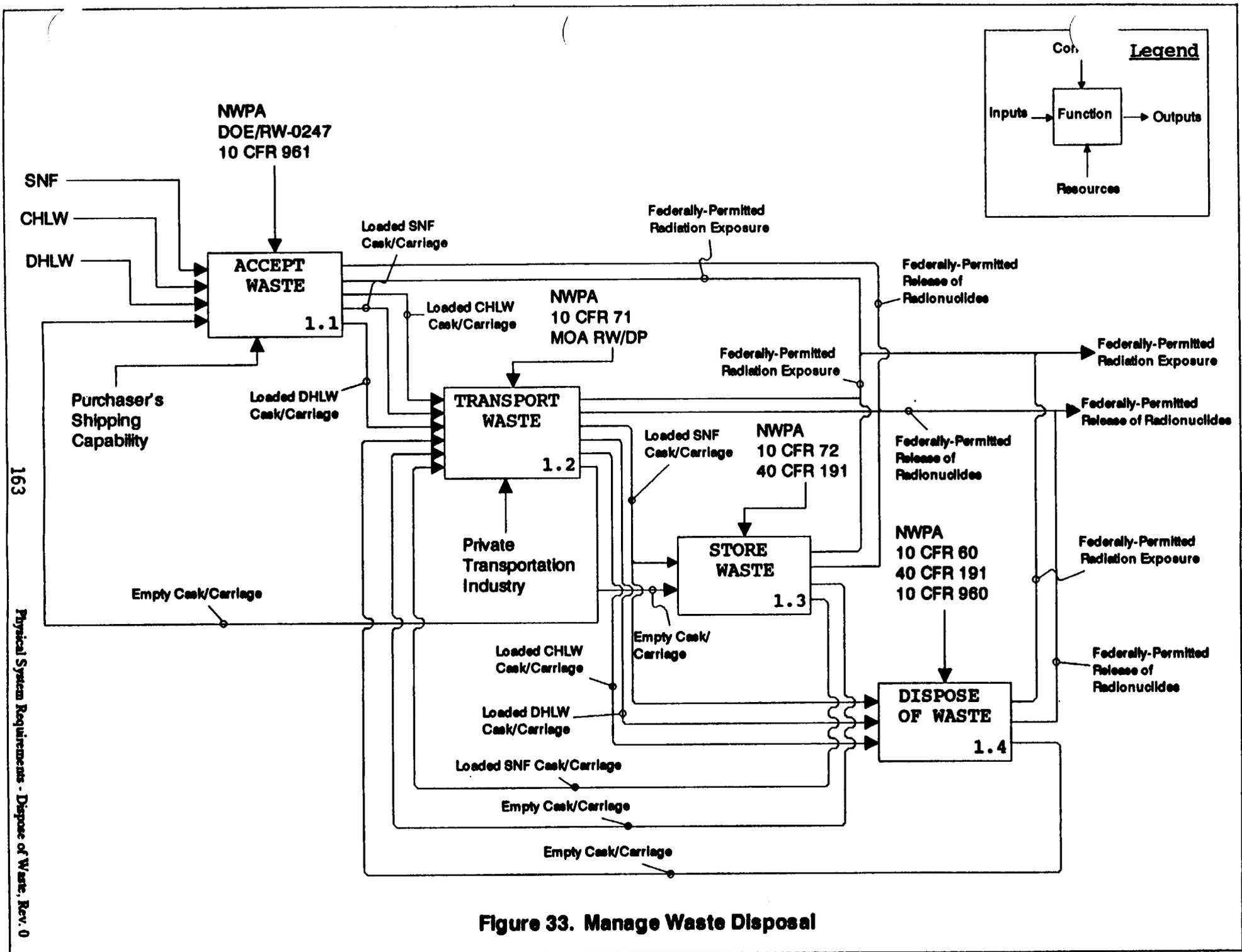


Figure 32. Nuclear Waste Management System Mission



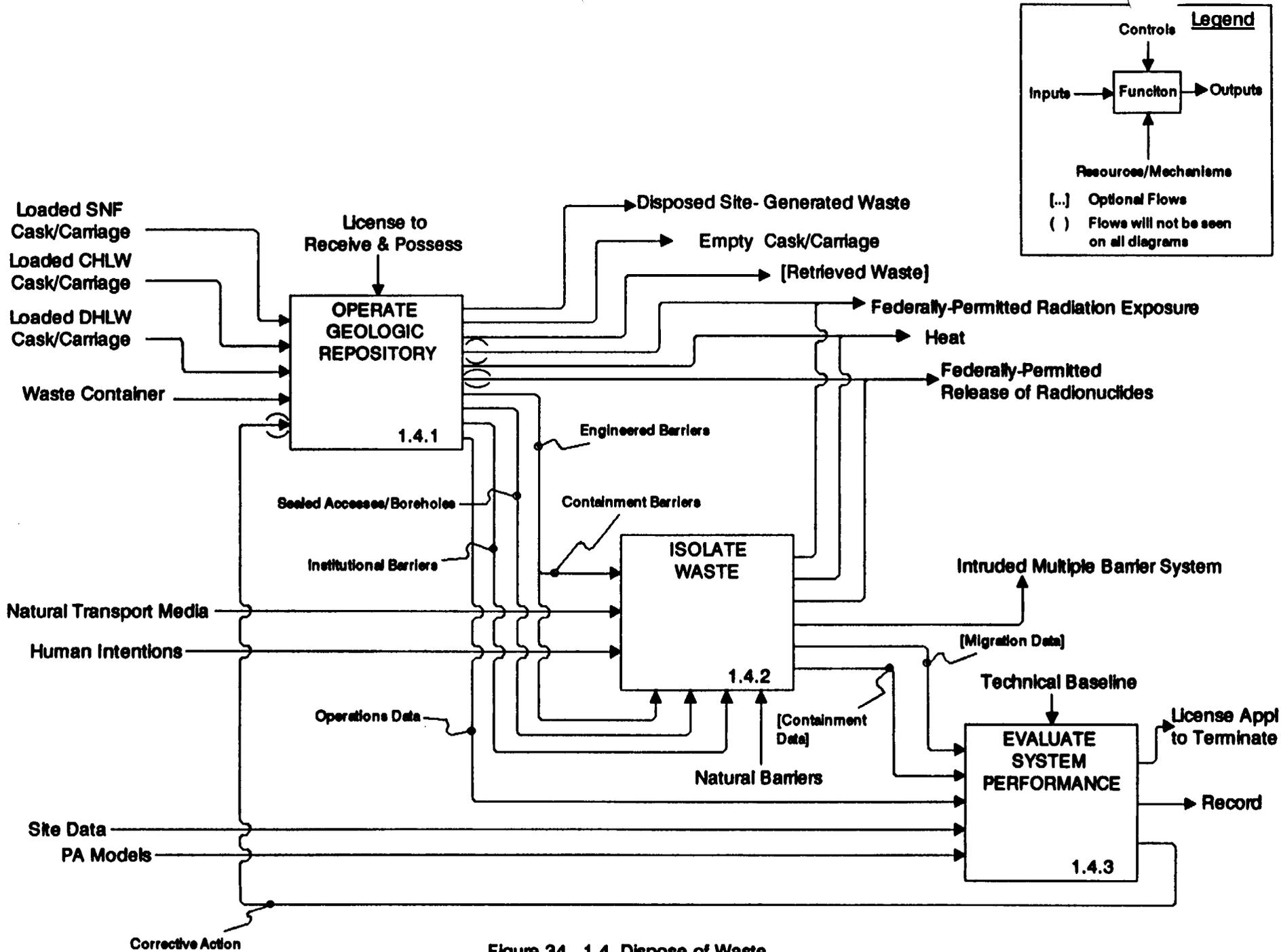


Figure 34. 1.4 Dispose of Waste

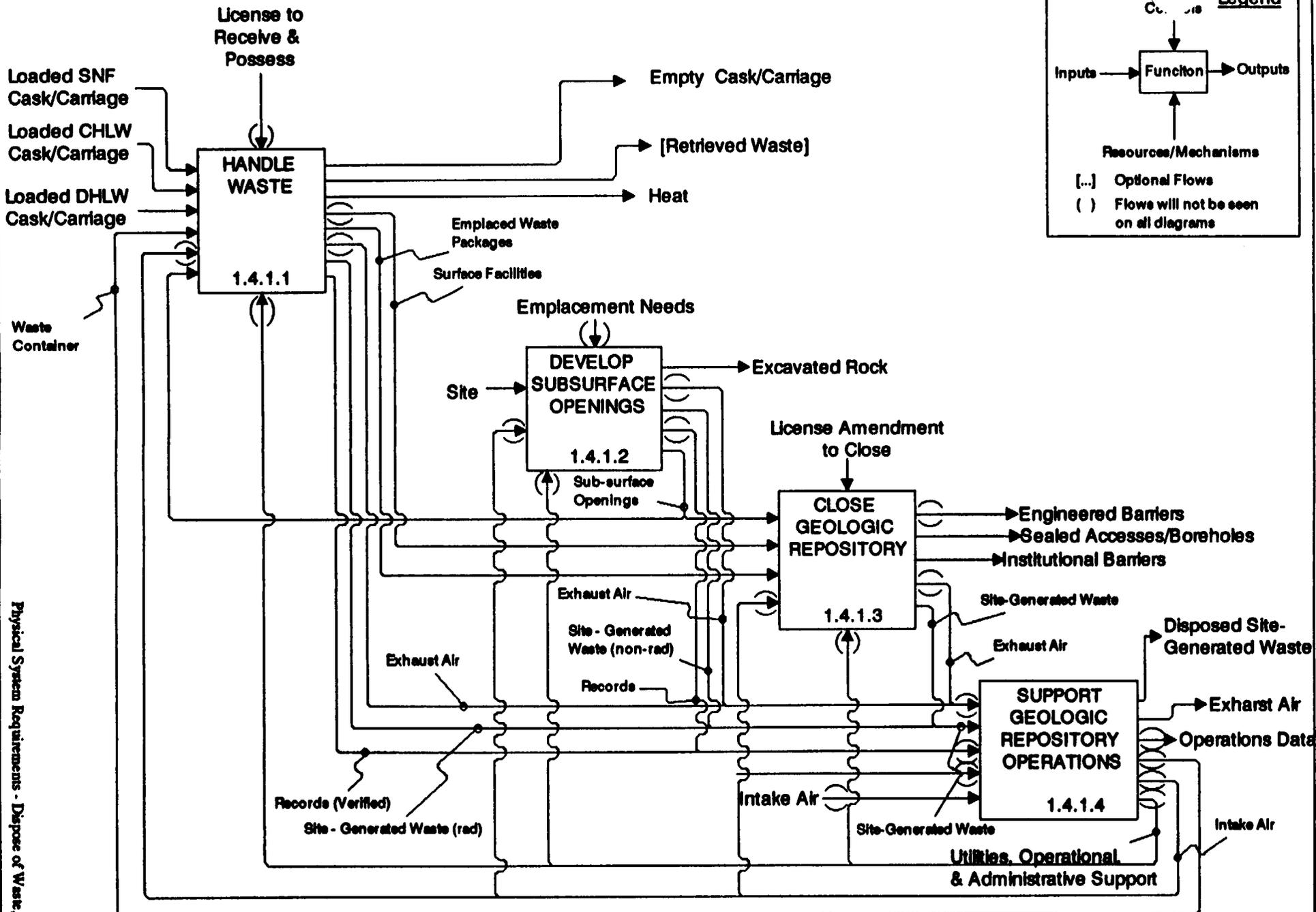


Figure 35. 1.4.1 Operate Geologic Repository

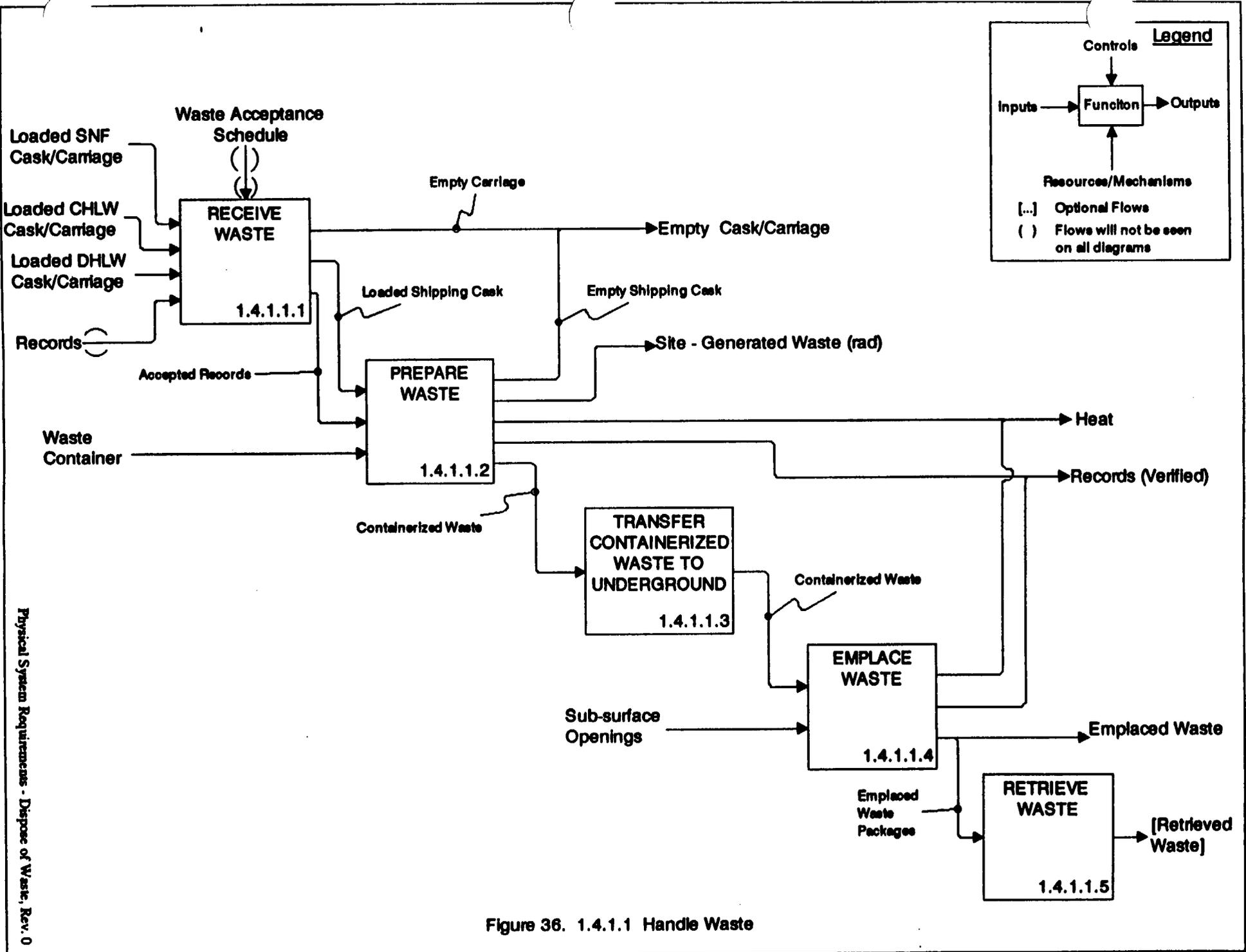


Figure 36. 1.4.1.1 Handle Waste

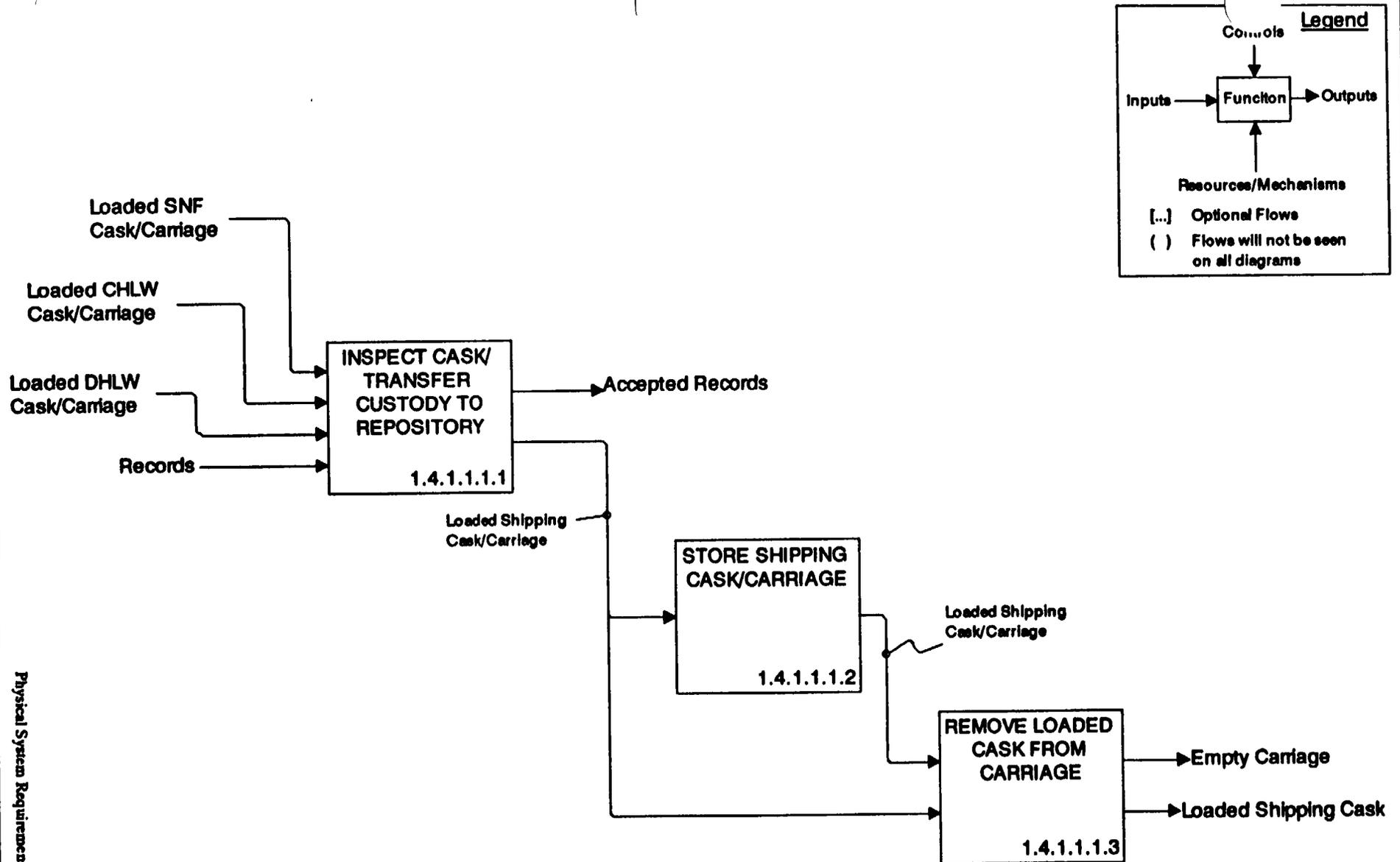


Figure 37. 1.4.1.1.1 Receive Waste

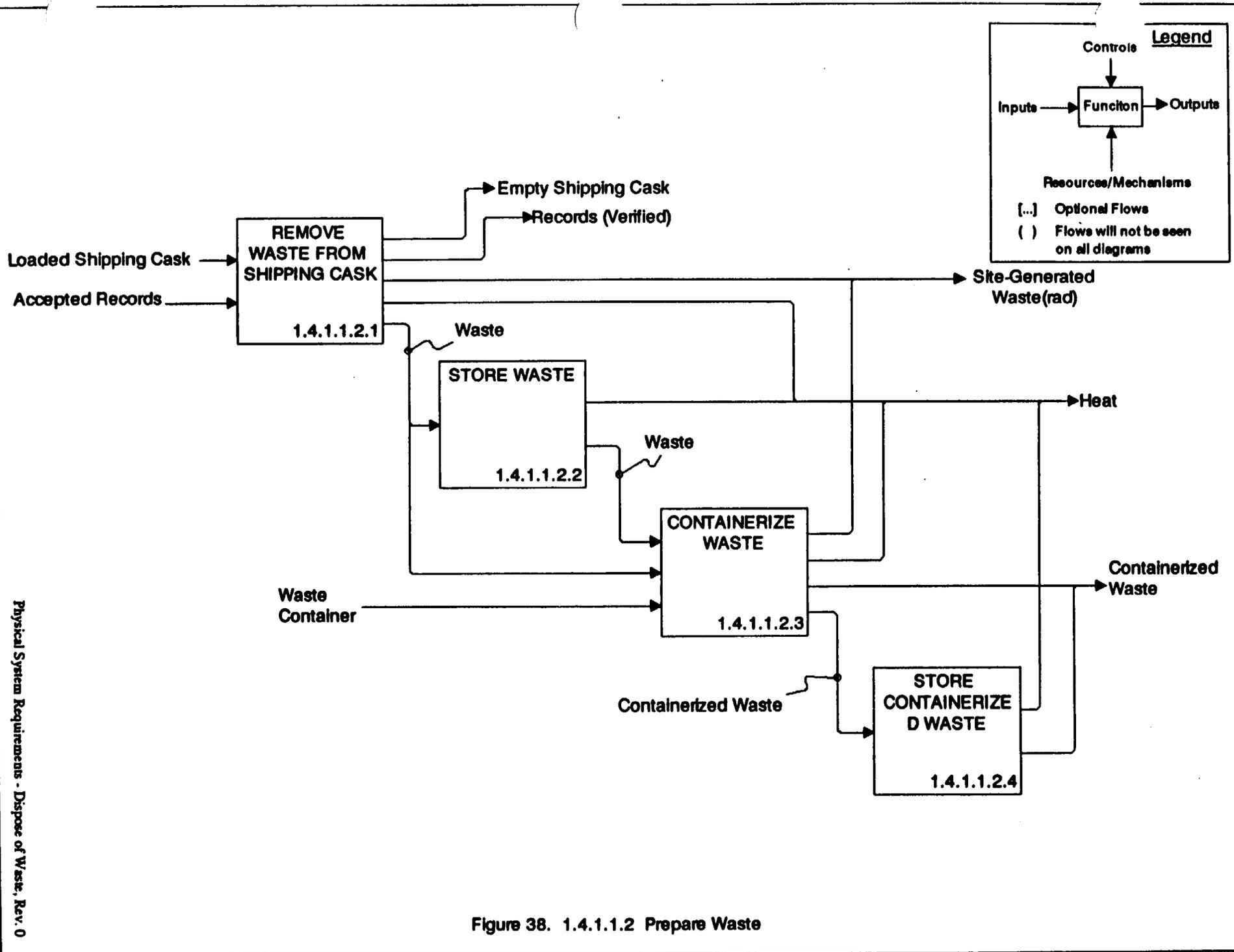


Figure 38. 1.4.1.1.2 Prepare Waste

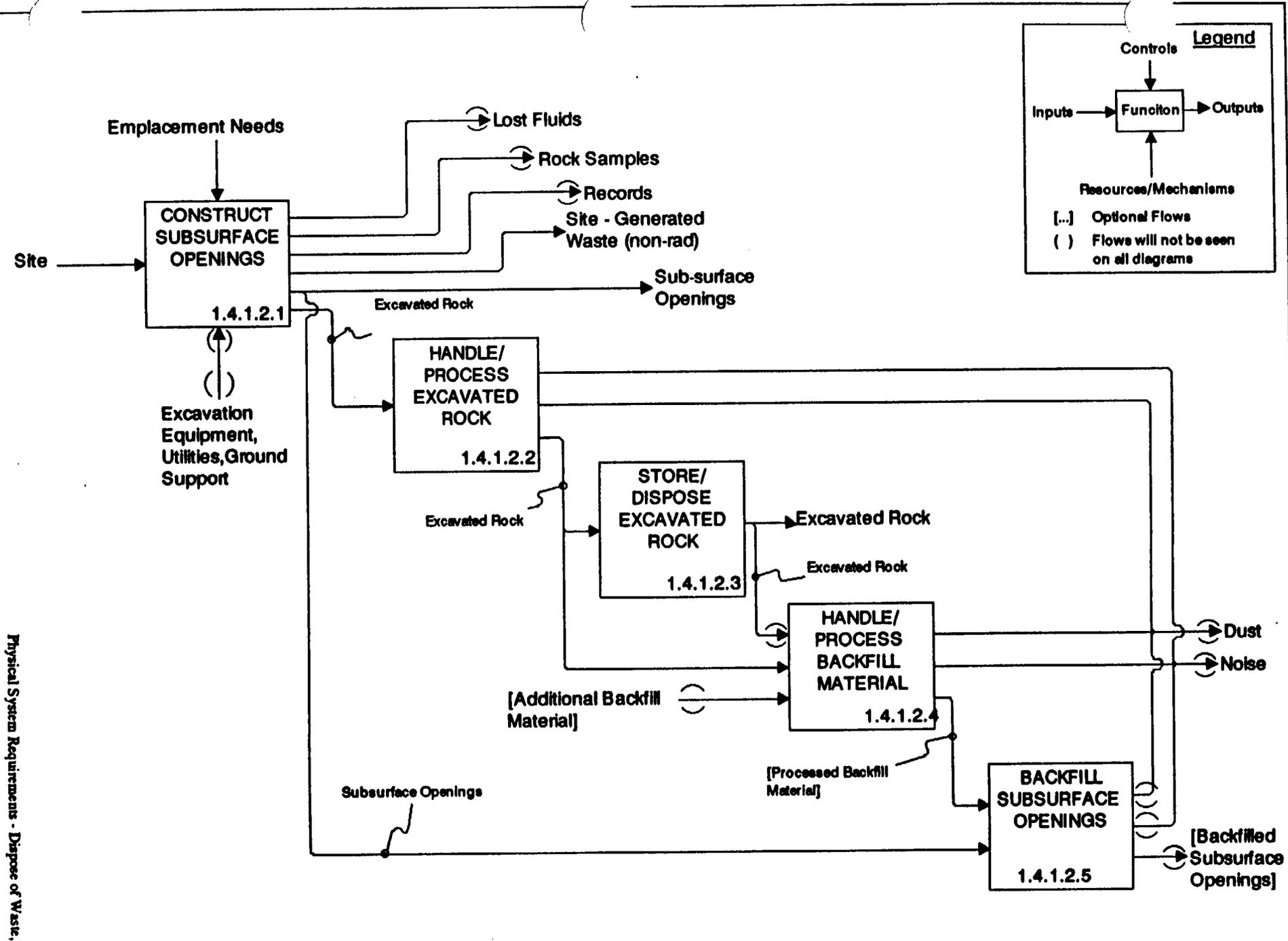


Figure 39. 1.4.1.2 Develop Subsurface Openings

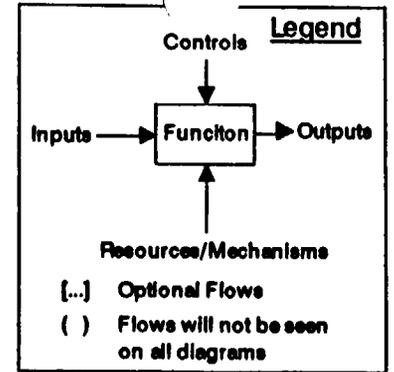
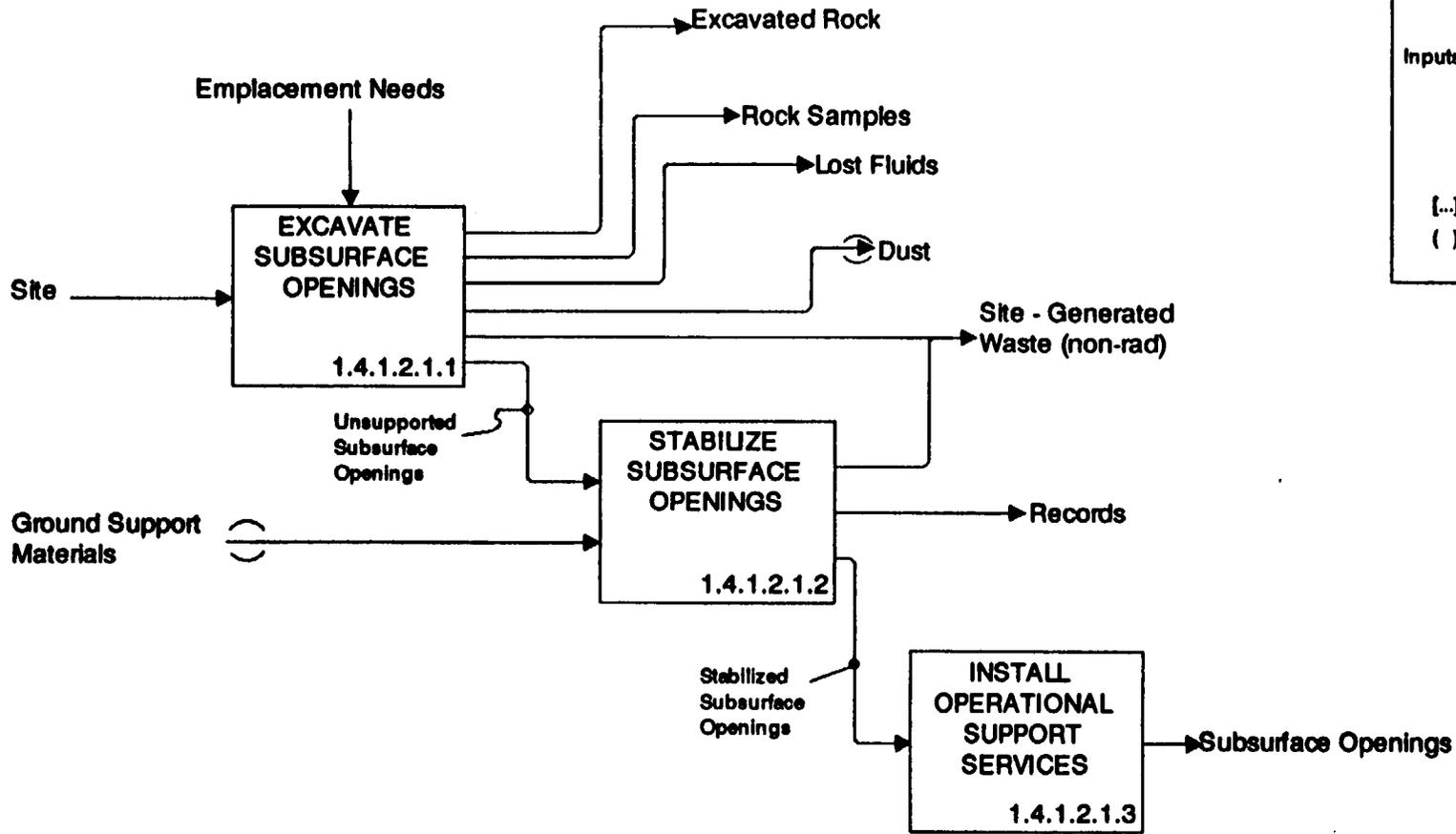
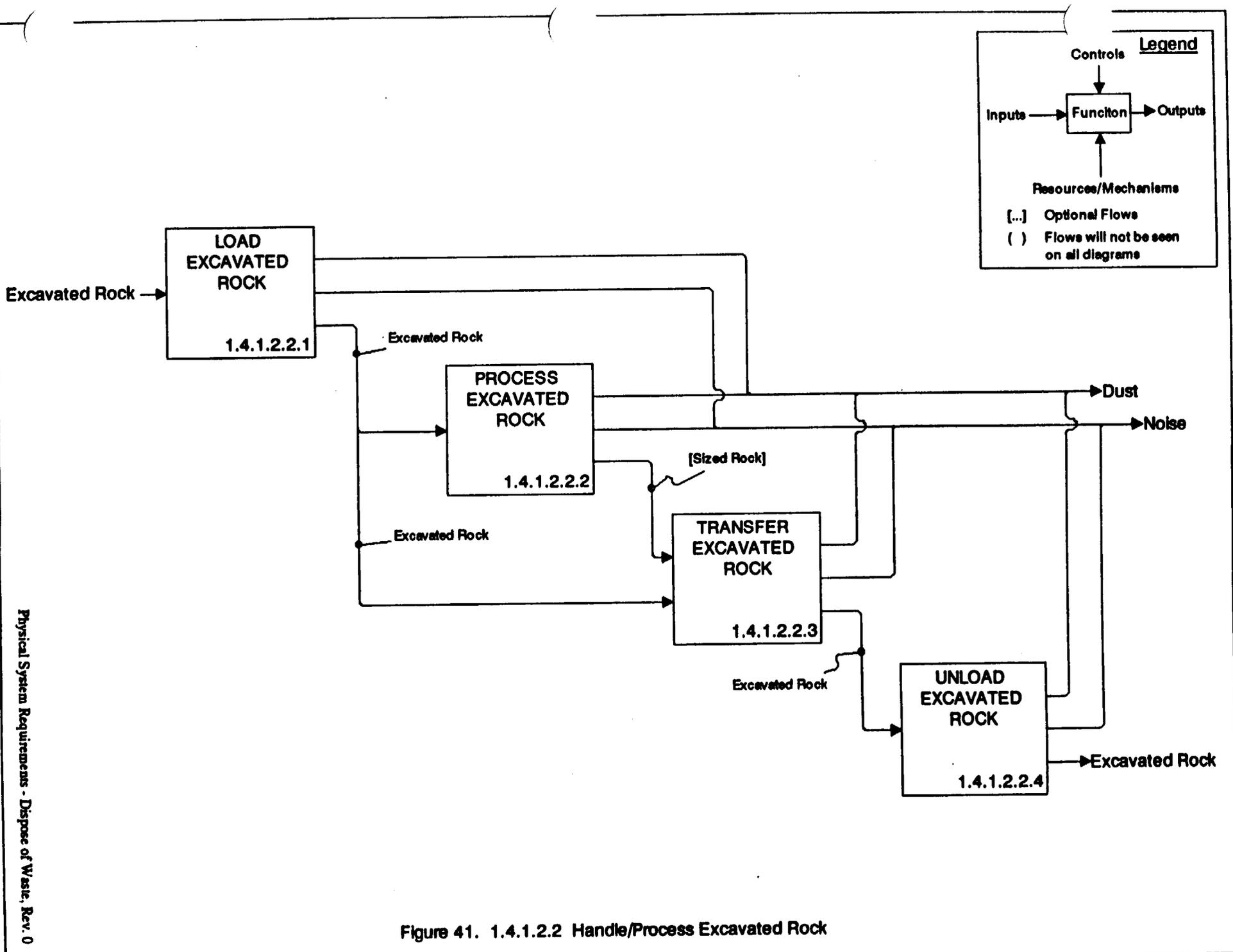


Figure 40. 1.4.1.2.1 Construct Subsurface Openings



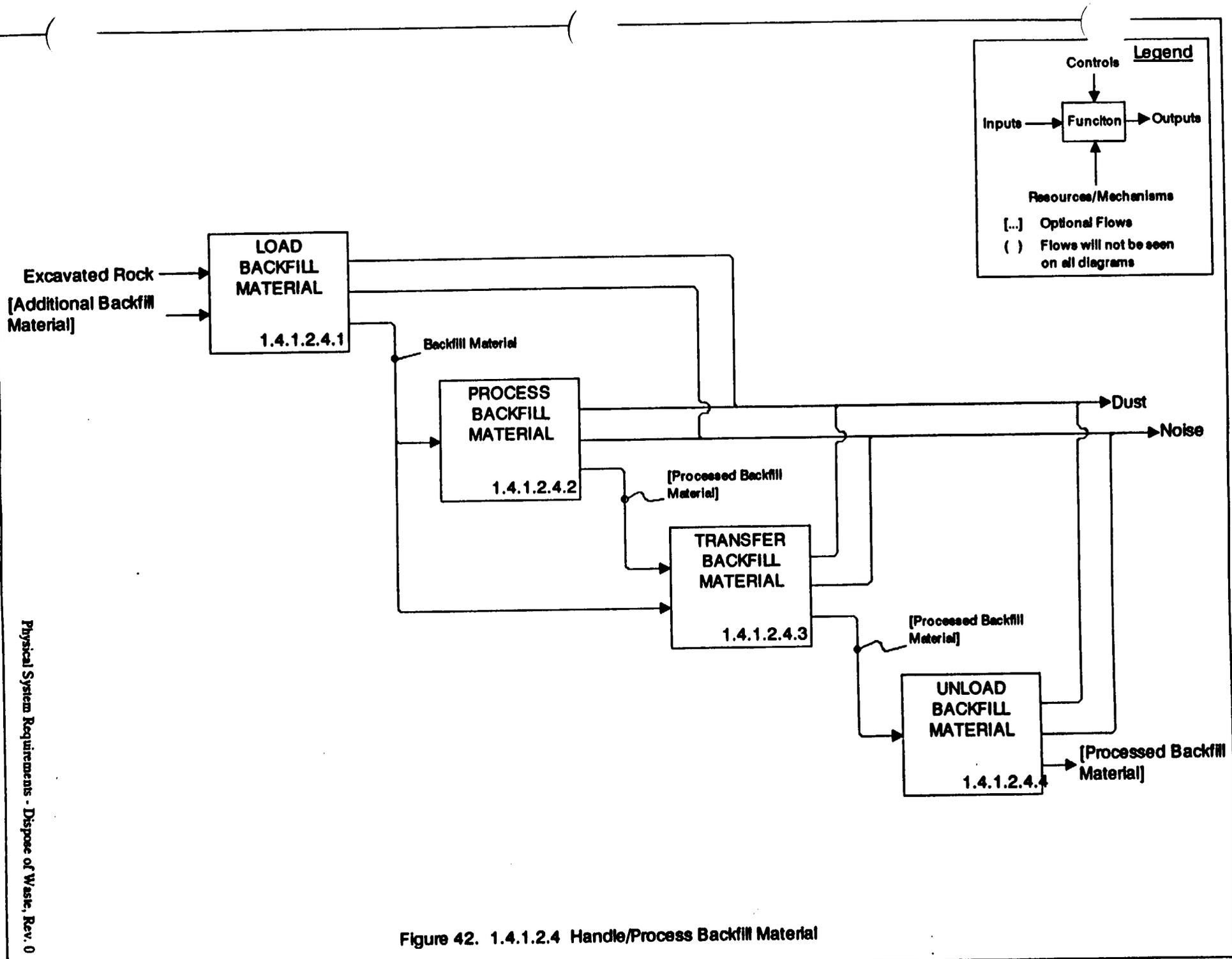


Figure 42. 1.4.1.2.4 Handle/Process Backfill Material

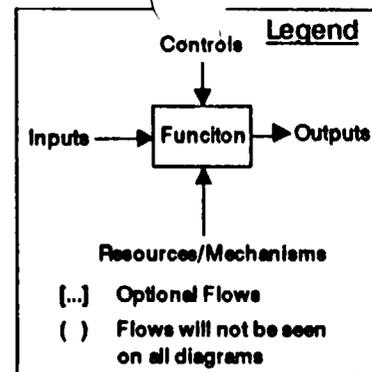
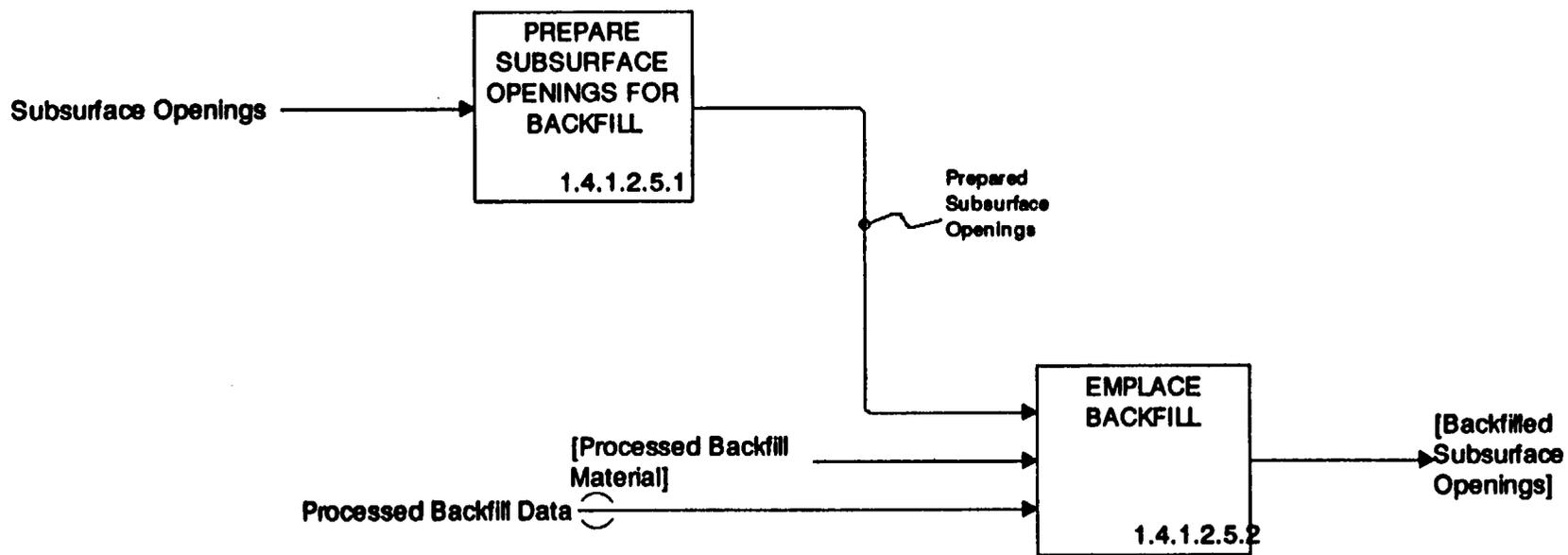


Figure 43. 1.4.1.2.5 Backfill Subsurface Openings

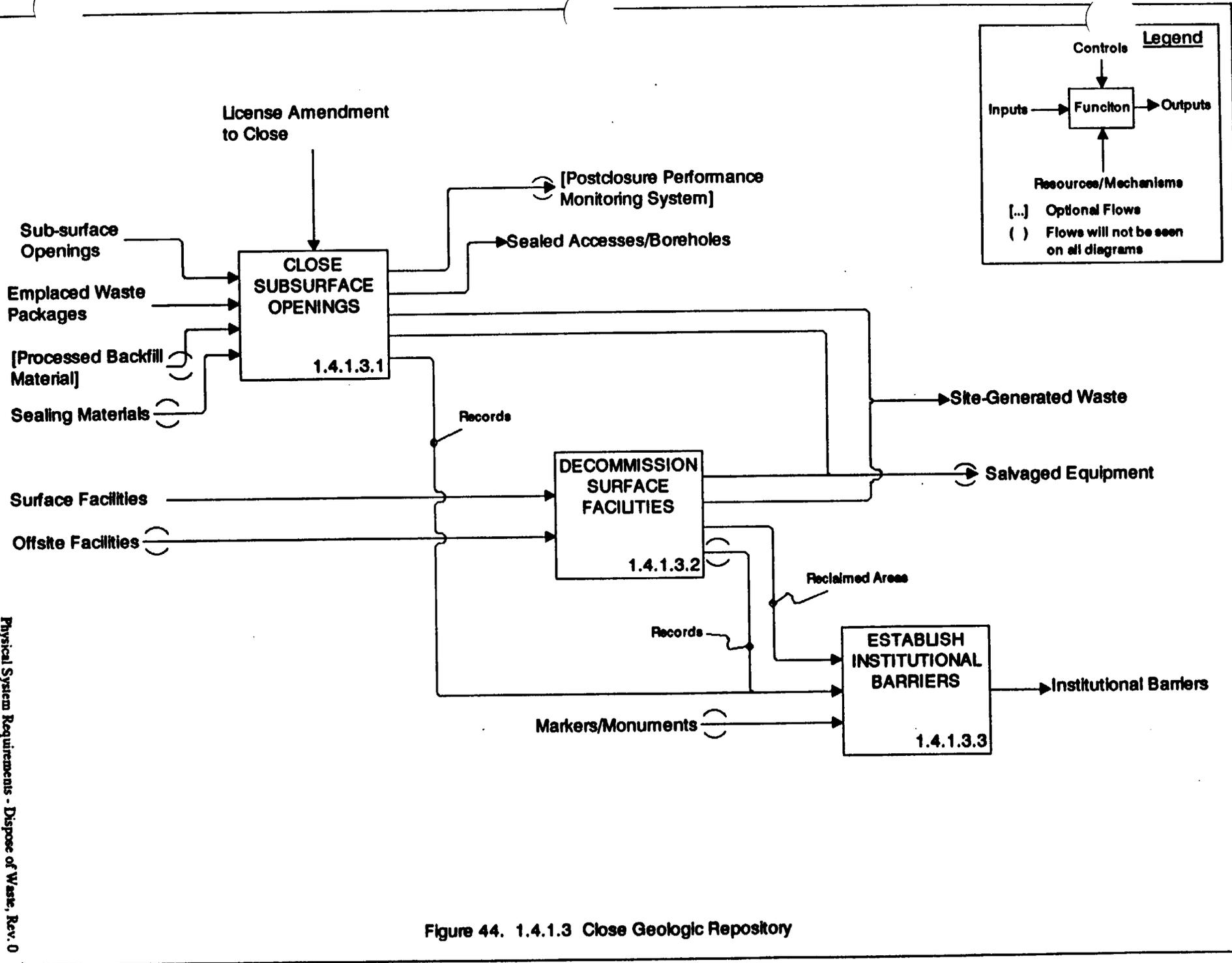


Figure 44. 1.4.1.3 Close Geologic Repository

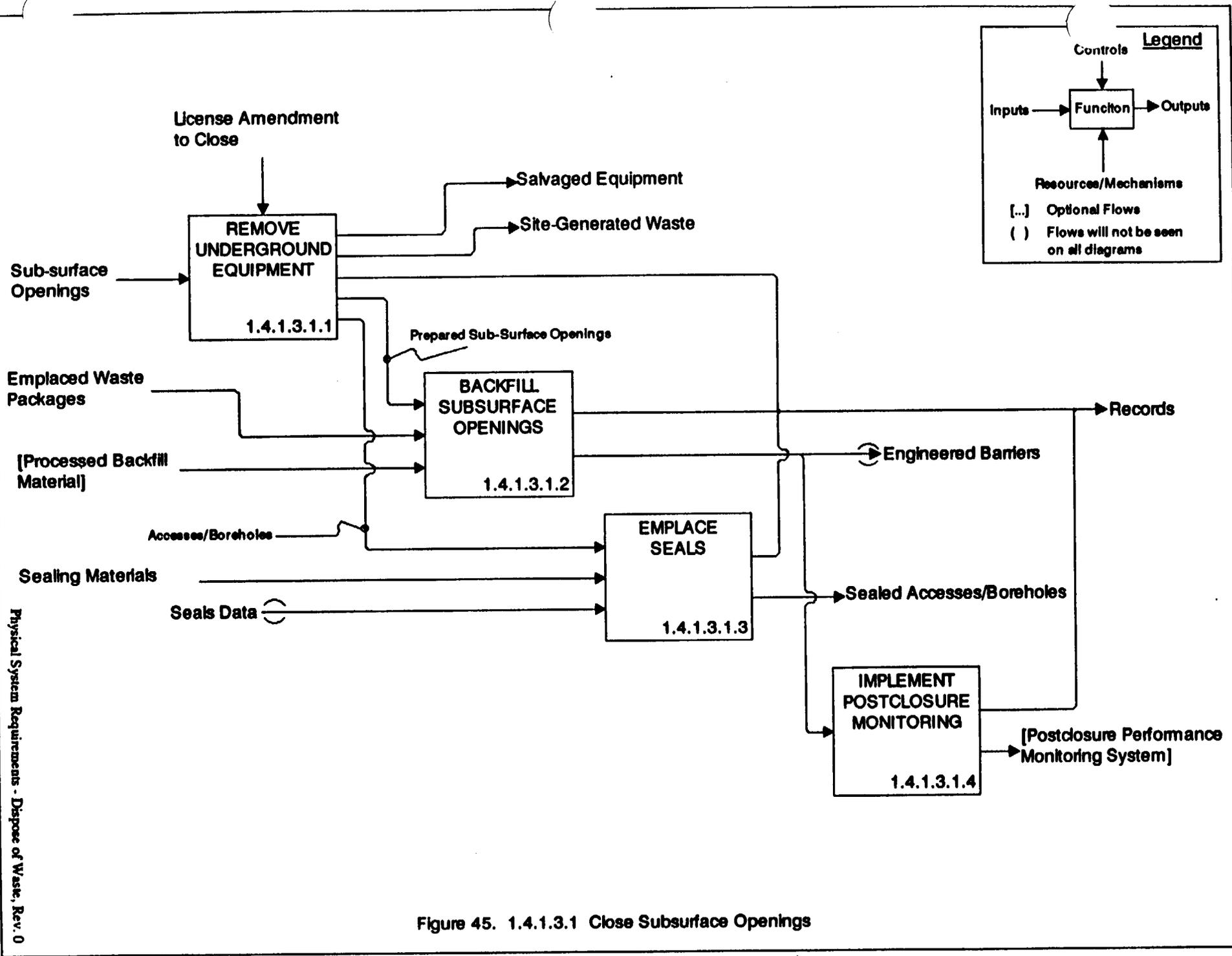


Figure 45. 1.4.1.3.1 Close Subsurface Openings

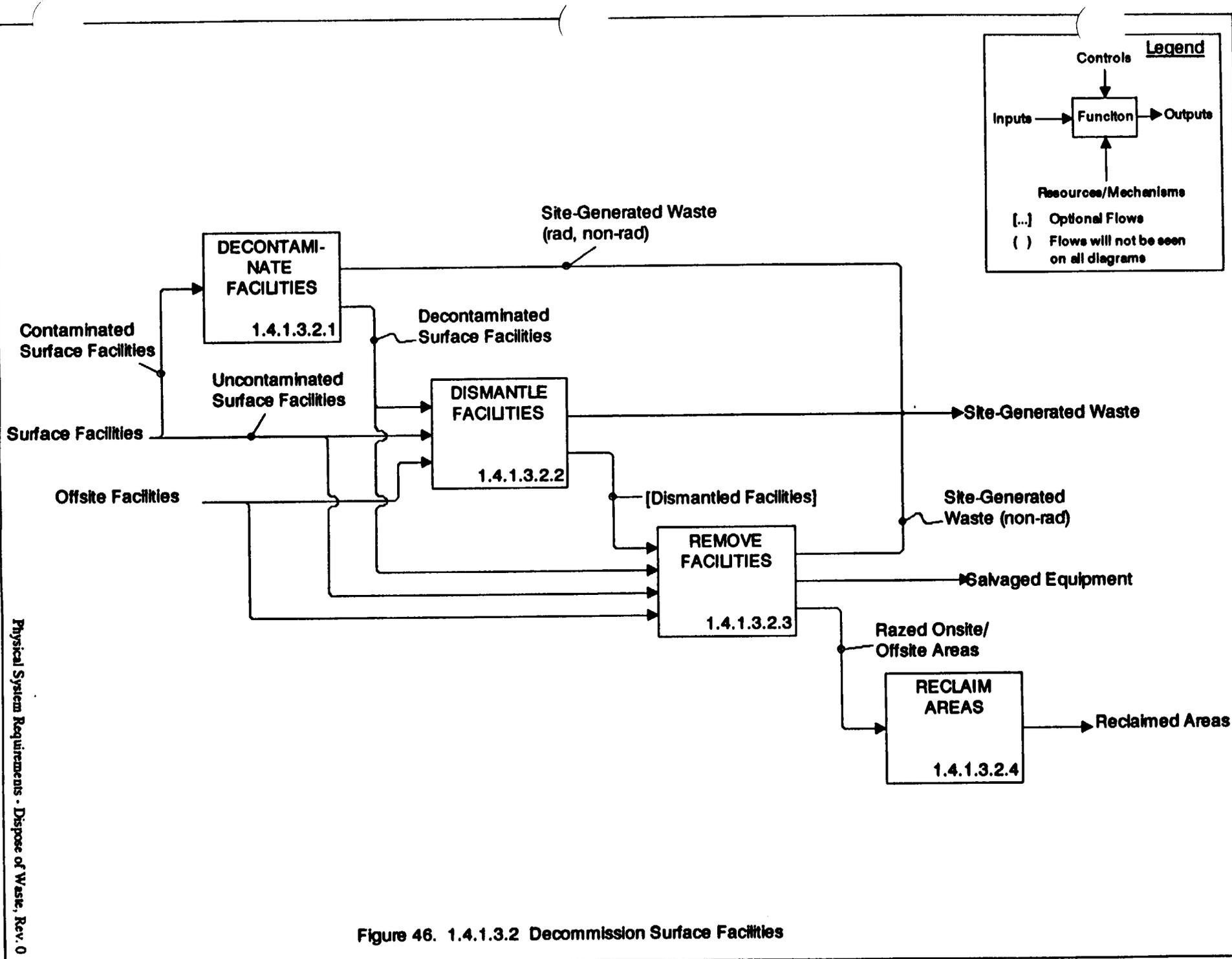


Figure 46. 1.4.1.3.2 Decommission Surface Facilities

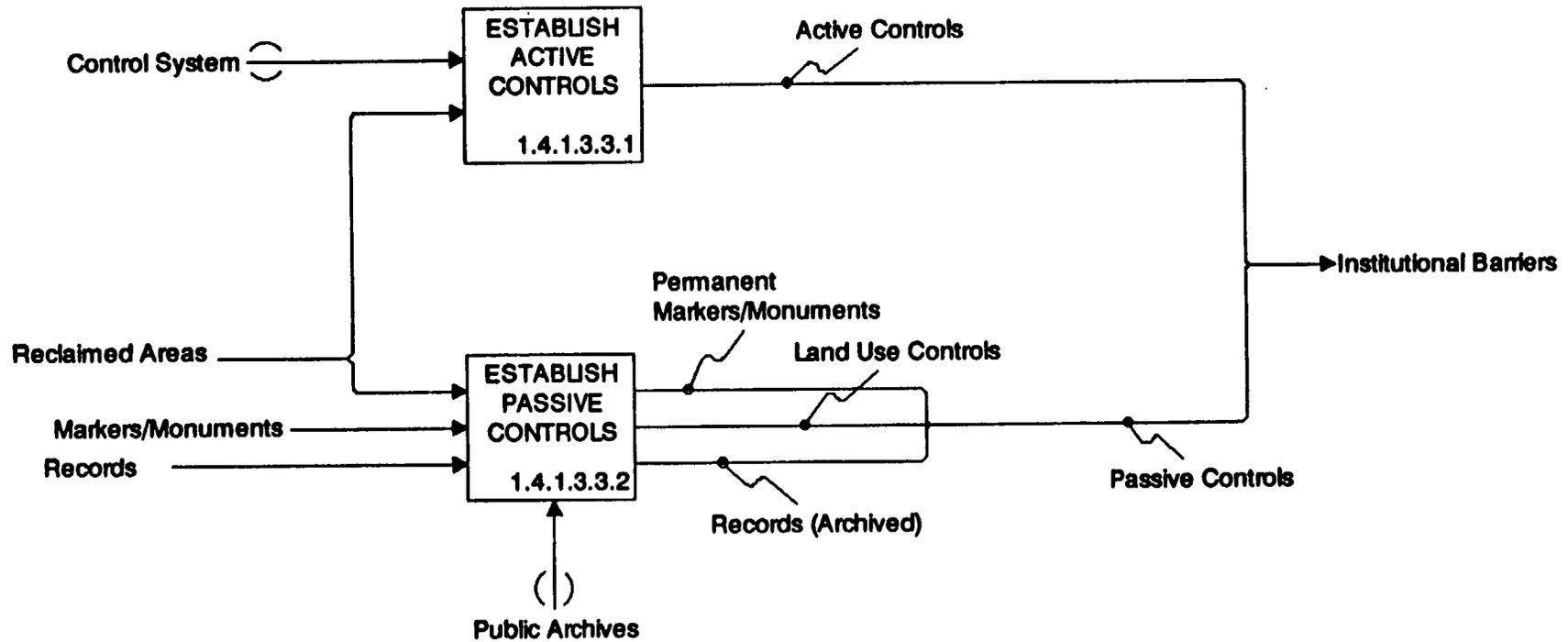
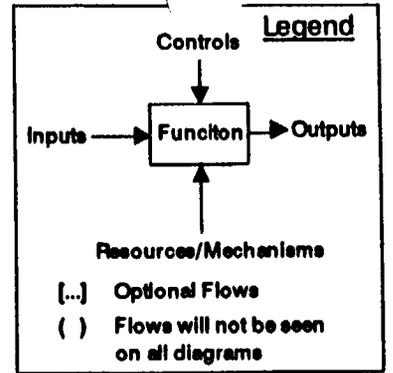


Figure 47. 1.4.1.3.3 Establish Institutional Barriers

Site-Generated Waste

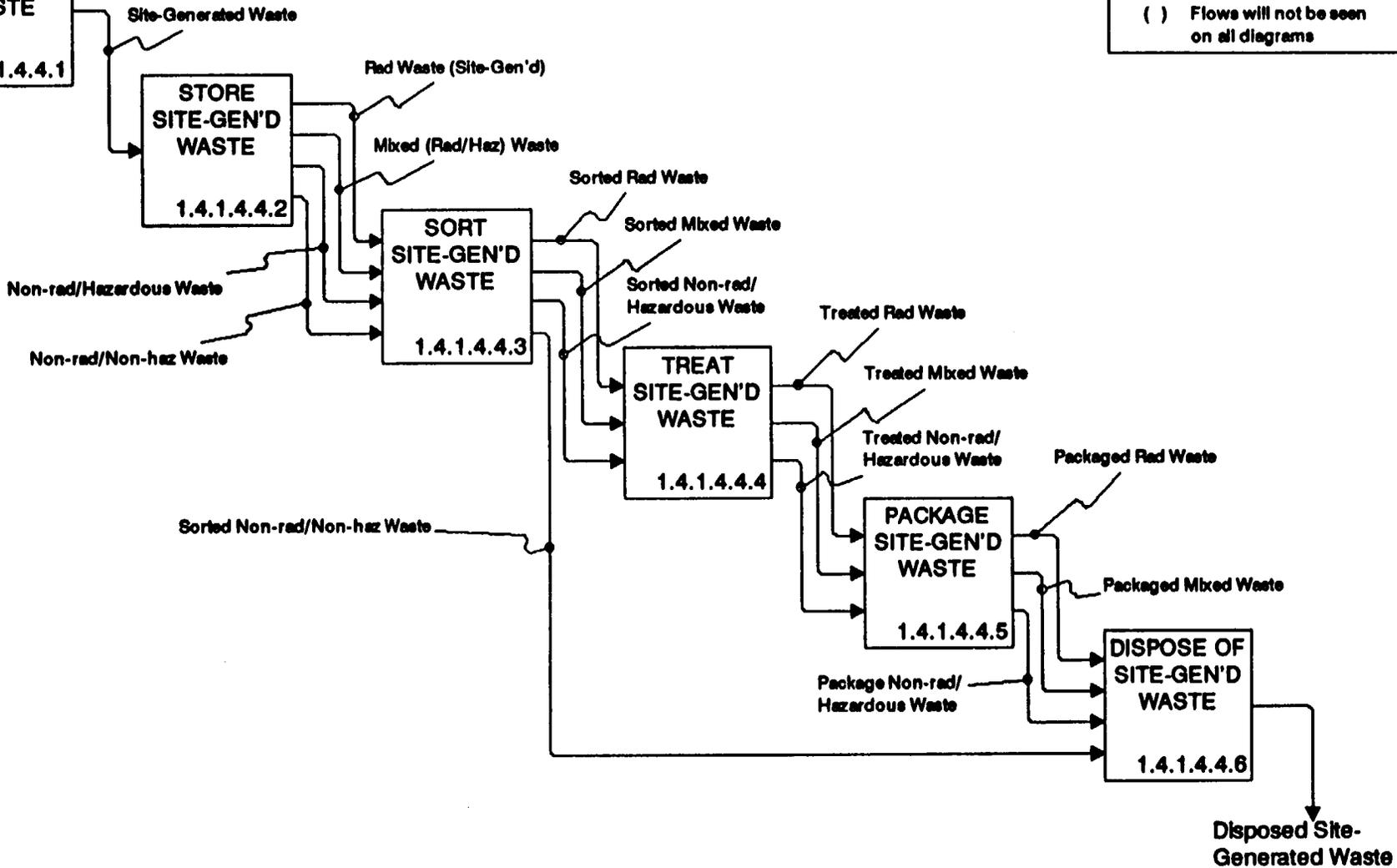
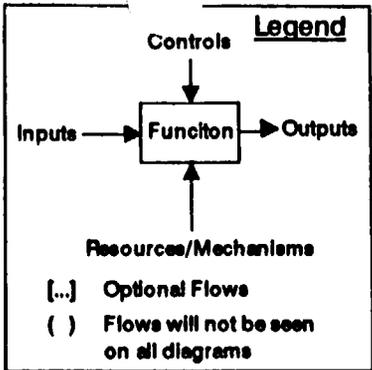


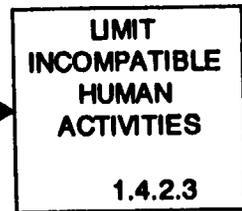
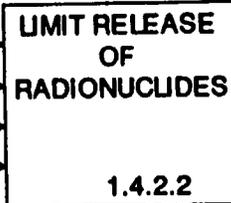
Figure 48. 1.4.1.4.4 Process Site-Generated Waste

Containment Barriers

Near-Field

Internal Waste Package Environment

Natural Transport Media



Engineered Barriers

Natural Barriers

Sealed Accesses/Boreholes

Institutional Barriers

Intruded Multiple Barrier System

[Containment Data]

Heat

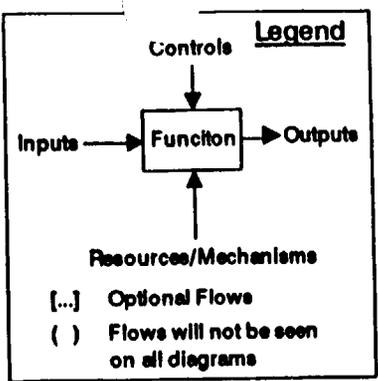
Federally-Permitted Radiation Exposure

Heat

Federally-Permitted Radiation Exposure

Federally-Permitted Release of Radionuclides

[Migration Data]



Physical System Requirements - Dispose of Waste, Rev. 0

Figure 49. 1.4.2 Isolate Waste

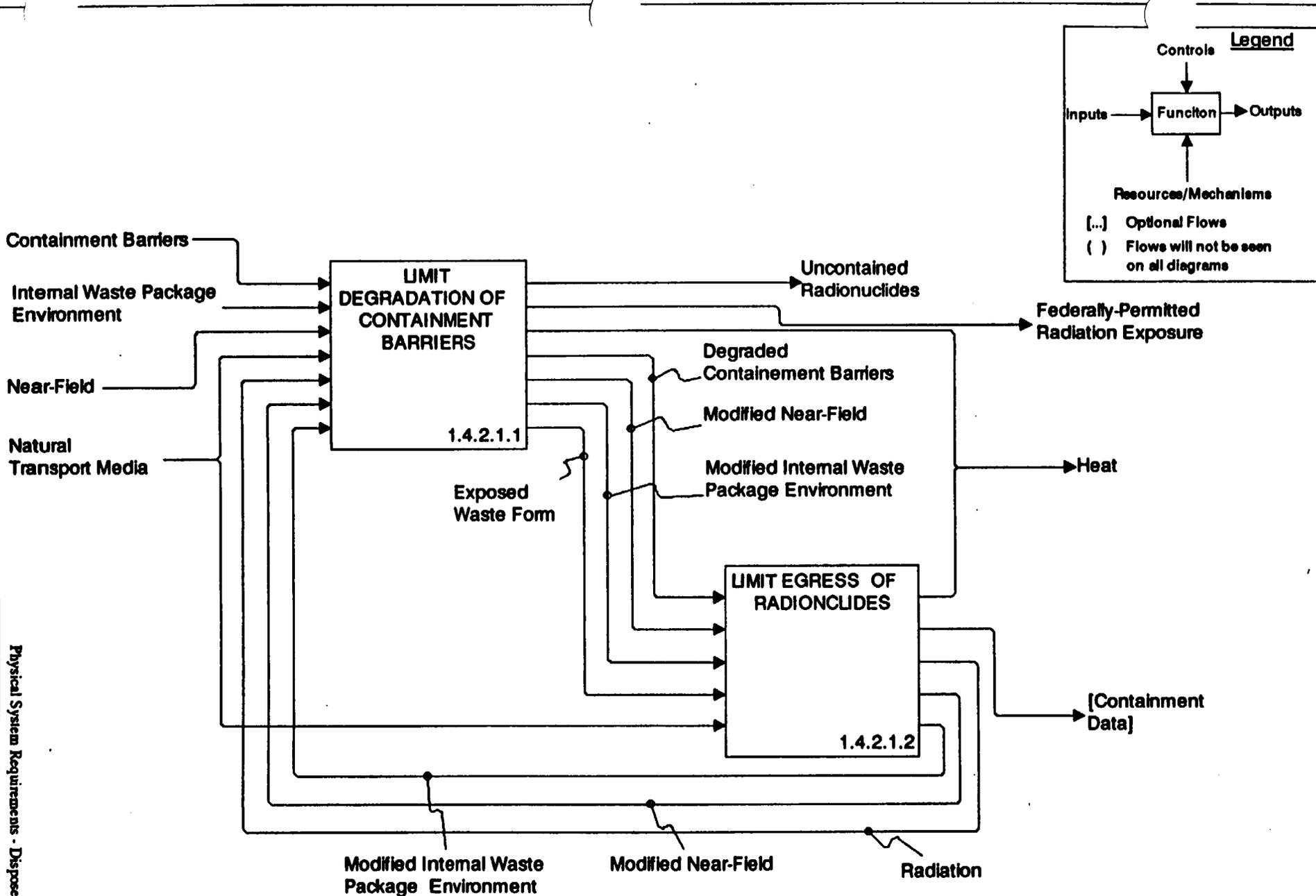


Figure 50. 1.4.2.1 Contain Waste

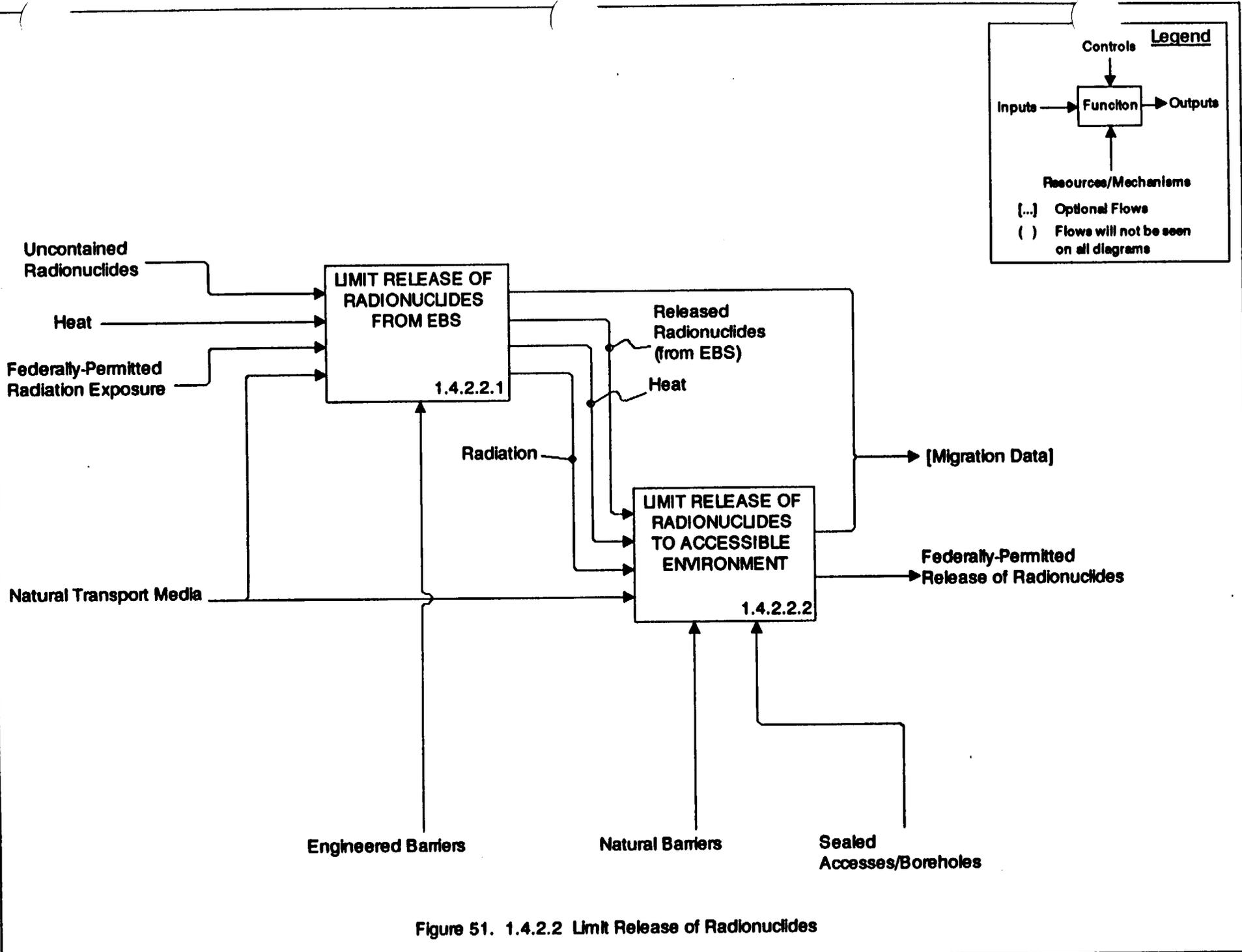


Figure 51. 1.4.2.2 Limit Release of Radionuclides

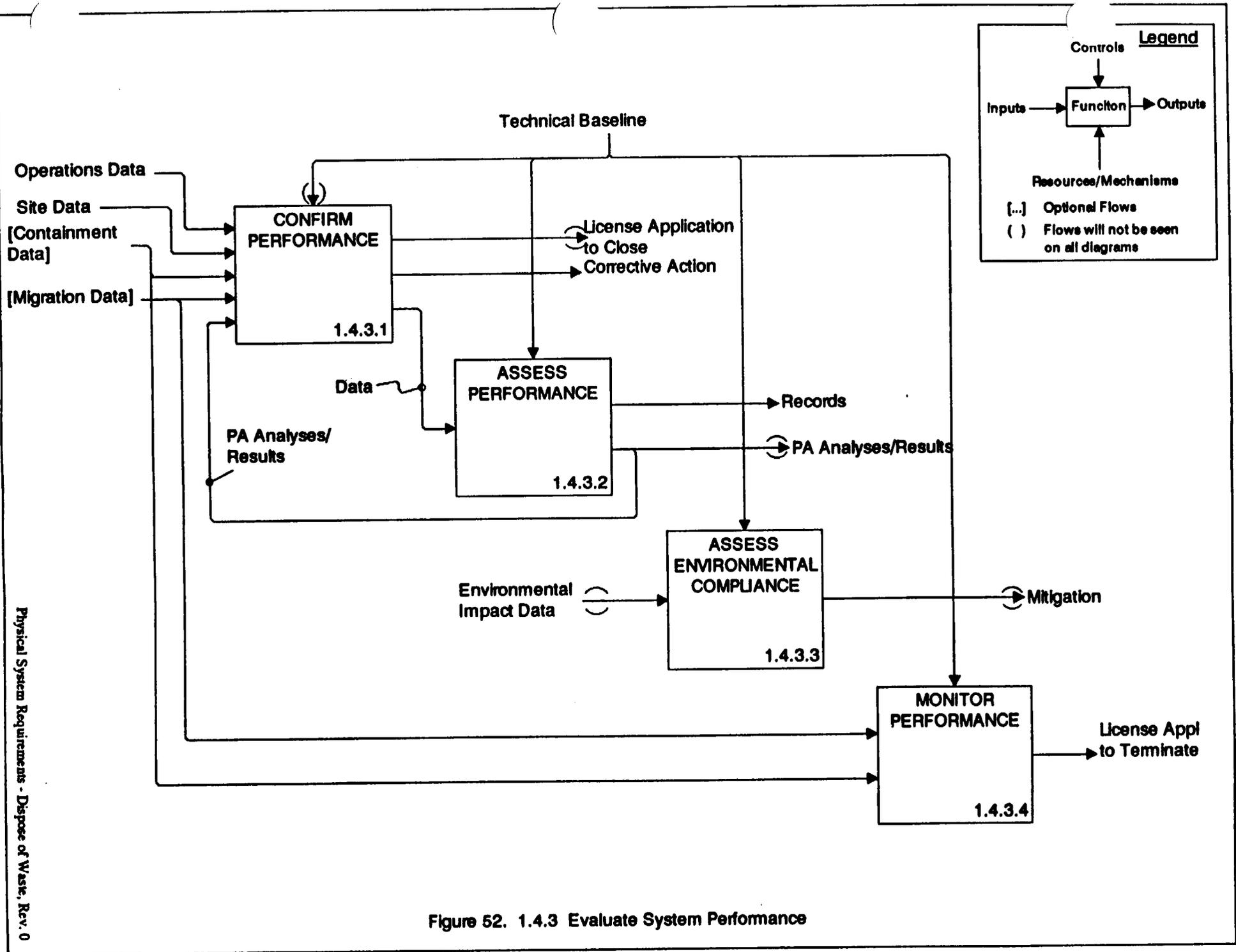


Figure 52. 1.4.3 Evaluate System Performance

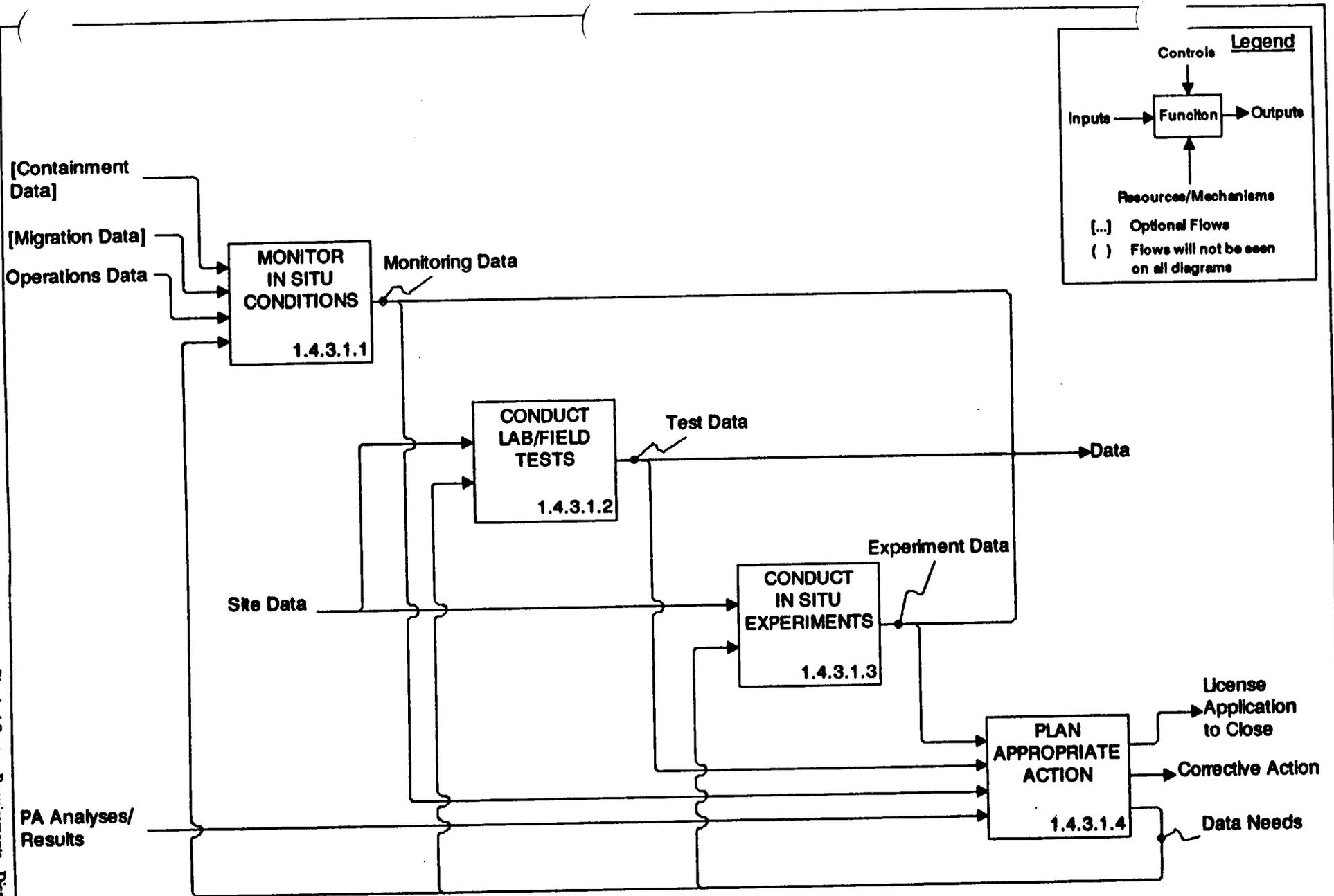


Figure 53. 1.4.3.1 Confirm Performance

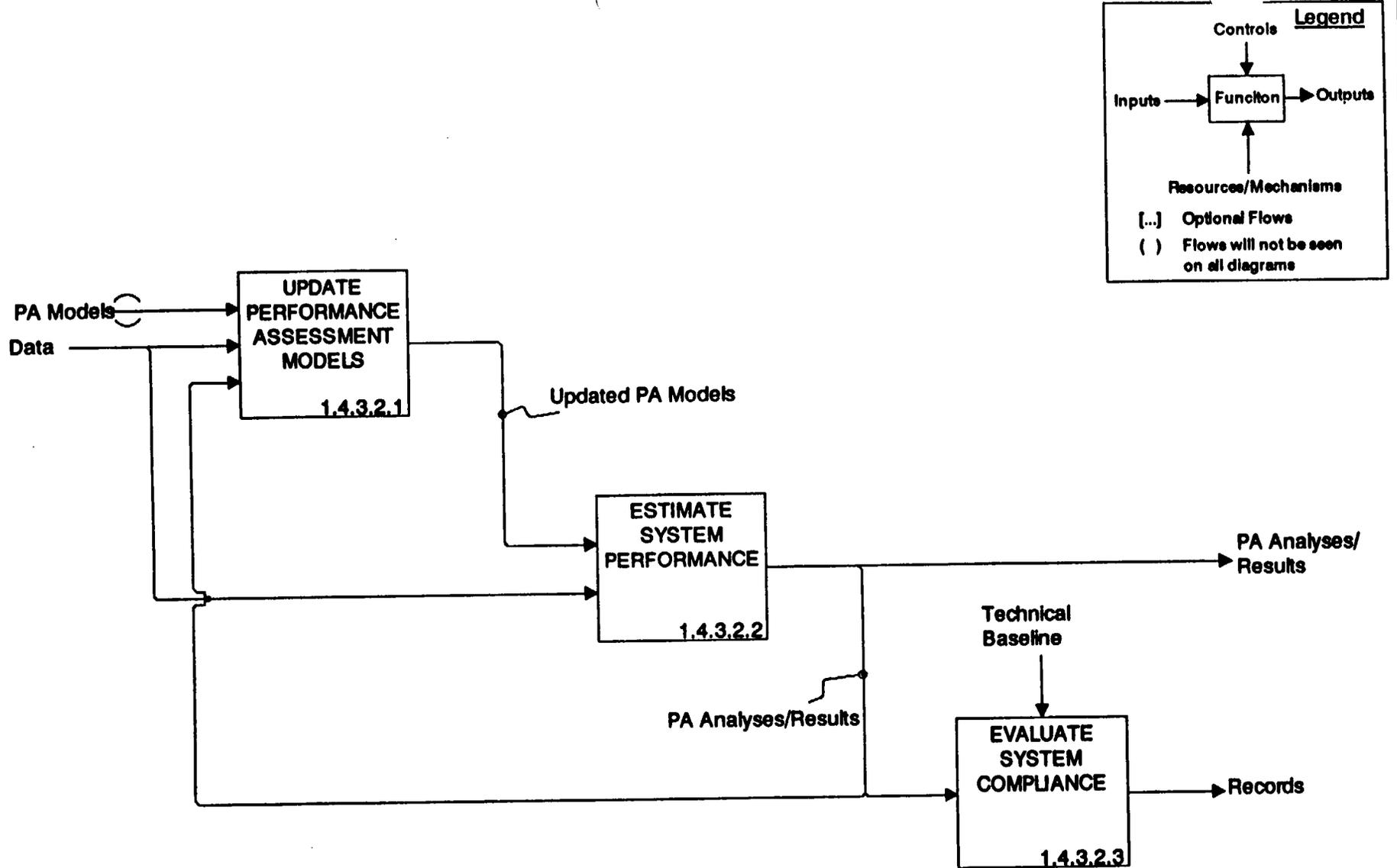


Figure 54. 1.4.3.2 Assess Performance

APPENDICES

1 APPENDIX A

2 GLOSSARY

3 This glossary contains definitions for the various terms used throughout this report and
4 references for those terms that have been previously defined in one or more source
5 documents. Supplemental Appendix S1 contains a listing of those terms that have
6 multiple, inconsistent, definitions.

7 As Low As Reasonably Achievable (ALARA) - As low as is reasonably achievable taking
8 into account the state of technology, and the economics of improvement in relation to-

- 9 (1) Benefits to the public health and safety,
10 (2) Other societal and socioeconomic considerations, and
11 (3) The utilization of atomic energy in the public interest. [10 CFR 72.3]

12 Access Drift - A drift that connects the mains and the perimeter drifts; it delineates the
13 waste emplacement panels and provides access to the waste emplacement drifts. In the
14 vertical waste emplacement configuration, there is also a midpanel access drift that
15 supplies additional ventilation to the more numerous drifts. [DOE/RW-0199, Vol. VIII,
16 Part B, page G-1]

17 Accessible Environment - (1) The atmosphere, (2) the land surface, (3) surface water, (4)
18 oceans, and (5) the portion of the lithosphere that is outside the controlled area.
19 [10 CFR 60.2]

20 Active Institutional Control - (1) controlling access to a disposal site by any means other
21 than passive institutional controls; (2) performing maintenance operations or remedial
22 actions at a site; (3) controlling or cleaning up releases from a site; or (4) monitoring
23 parameters related to disposal system performance. [40 CFR 191.12(f)]

24 Architecture - That part of the physical system actually built, found, or selected to perform
25 a function subject to its stated requirements.

26 Barrier - Any material or structure that prevents or substantially delays movement of water
27 or radionuclides. [10 CFR 60.2, 10 CFR 960.2]

28 - Any material or structure that prevents or substantially delays movement of water or
29 radionuclides toward the accessible environment. For example, a barrier may be a
30 geologic structure, a canister, a waste form with physical and chemical characteristics that
31 significantly decrease the mobility of radionuclides, or a material placed over and around

1 waste, provided that the material or structure substantially delays movement of water or
2 radionuclides. [40 CFR 191.12(d)]

3
4 Borehole - A hole made with a drill, auger, or other tools for exploring strata in search
5 of minerals, supplying water for blasting, emplacing waste, proving the position of old
6 workings or faults, or releasing accumulations of gas or water. Boreholes include core
7 holes, dry-well-monitoring holes, waste-emplacment boreholes, and test holes for
8 geophysical or ground-water characterization. [DOE/RW-0199, Vol. VIII, Part B,
page G-9]

9 Burnup - A measure of nuclear reactor fuel consumption expressed as the amount of
10 energy produced per unit weight of fuel.

11 Candidate Site - An area, within a geohydrologic setting, that is recommended by the
12 Secretary of Energy under Section 112 of the Act (42 USC 10132) for site characterization,
13 approved by the President under Section 112 of the Act (42 USC 10133) for
14 characterization, or undergoing site characterization under Section 113 (42 USC 10133).
15 [10 CFR 960.2]

16 Canister - The metal receptacle with the following purpose: 1) for solidified HLW, its
17 purpose is a pour mold and 2) for spent fuel, it may provide structural support for loos
18 rods or containment of radionuclides.

19 Carriage - The vehicle on which the Shipping Cask is transported (i.e., truck trailer, rail,
or barge).

21 Civilian High-Level Radioactive Waste (CHLW) - The high-level radioactive waste, as
22 defined by NWPA Sec. 2(12), resulting from atomic energy civilian activities.

23 Closure or Permanent Closure - The final backfilling of the remaining open operational
24 areas of the underground facility and boreholes after the termination of waste
25 emplacement, culminating in the sealing of shafts. [10 CFR 960.2]

26 Commission - The Nuclear Regulatory Commission or its duly authorized representatives.
27 [10 CFR 60.2]

28 Consolidation - The operation performed on spent fuel assemblies during which the upper
29 and lower fuel-assembly tie plates are removed, the assembly spacer grids and any other
30 assembly structural members are removed, and the fuel tubes are collected and formed
31 into a closely packed bundle in a canister or container. The nonfuel structural members
32 of the fuel assemblies are reduced in volume and placed in canisters or containers for
33 shipment and disposal. [DOE/RW-0199, Vol. VIII, Part B, page G-18]

1 Constraint - A requirement imposed by the external environment (e.g., NRC).

2 Container - The component of the waste package that is placed around the waste form
3 or the canistered waste form.

4 Containerize - To place the waste form or the canisterized waste in a container for
5 emplacement.

6 Containment - The confinement of radioactive waste within a designated boundary.
7 [10 CFR 60.2, 10 CFR 960.2]

8 Control - See constraint.

9 Controlled Area* - A surface location, to be marked by suitable monuments, extending
10 horizontally no more than 10 kilometers in any direction from the outer boundary of the
11 underground facility, and the underlying subsurface, which area has been committed to
12 use as a geologic repository and from which incompatible activities would be restricted
13 following permanent closure. [10 CFR 60.2]

14 - A surface location, to be marked by suitable monuments, extending horizontally no more
15 than 10 kilometers in any direction from the outer boundary of the underground facility,
16 and the underlying subsurface, which area has been committed to use as a geologic
17 repository and from which incompatible activities would be prohibited before and after
18 permanent closure. [10 CFR 960.2]

19 - (1) A surface location, to be identified by passive institutional controls, that encompasses
20 no more than 100 square kilometers and extends horizontally no more than five kilometers
21 in any direction from the outer boundary of the original location of the radioactive wastes
22 in a disposal system; and (2) the subsurface underlying such a surface location. [40 CFR
23 191.12(g)]

24 Cumulative Releases of Radionuclides - The total number of curies of radionuclides
25 entering the accessible environment in any 10,000-year period, normalized on the basis of
26 radiotoxicity in accordance with 40 CFR Part 191. The peak cumulative release of
27 radionuclides refers to the 10,000-year period during which any such release attains its
28 maximum predicted value. [10 CFR 960.2]

29
30 * Controlled area is defined as 5 km from the outer boundary of the underground
31 facility. The DOE does not use the 10 CFR 60.2 and 10 CFR 960.2 definitions.

1 **Decommissioning** - The permanent removal from service of surface facilities and
2 components necessary for preclosure operations only, after repository closure, in
3 accordance with regulatory requirements and environmental policies. [10 CFR 960.2]

4 **Defense High-Level Radioactive Waste (DHLW)** - The high-level radioactive waste, as
5 defined by NWPA Sec. 2(12), resulting from atomic energy defense activities.

6 **Disposal** - The emplacement in a repository of high-level radioactive waste, spent nuclear
7 fuel, or other highly radioactive material with no foreseeable intent of recovery, whether
8 or not such emplacement permits the recovery of such waste. [NWPA Sect. 2(9)]

9 - Permanent isolation of spent nuclear fuel or radioactive waste from the accessible
10 environment with no intent of recovery, whether or not such isolation permits the recovery
11 of such fuel or waste. For example, disposal of waste in a mined geologic repository
12 occurs when all of the shafts to the repository are backfilled and sealed.
13 [40 CFR 191.02(1)]

14 - The isolation of radioactive wastes from the accessible environment.
15 [10 CFR 60.2]

16 - The emplacement in a repository of high-level radioactive waste, spent nuclear fuel, or
17 other highly radioactive material with no foreseeable intent of recovery, whether or not
18 such emplacement permits the recovery of such waste, and the isolation of such waste
19 from the accessible environment. [10 CFR 960.2]

20 **Disposal Package or Package** - The primary container that holds, and is in contact with,
21 solidified high-level radioactive waste, spent nuclear fuel, or other radioactive materials,
22 and any overpacks that are emplaced at a repository. [NWPA Sect. 2(10)]

23 **Disposal System** - Any combination of engineered and natural barriers that isolate spent
24 nuclear fuel or radioactive waste after disposal. [40 CFR 191.12(a)]

25 **Disturbed Zone** - That portion of the controlled area the physical or chemical properties
26 of which have changed as a result of underground facility construction or as a result of
27 heat generated by the emplaced radioactive wastes such that the resultant change of
28 properties may have a significant effect on the performance of the geologic repository.
29 [10 CFR 60.2]

30 - That portion of the controlled area, excluding shafts, whose physical or chemical
31 properties are predicted to change as a result of underground facility construction or heat
32 generated by the emplaced radioactive waste such that the resultant change of properties
33 could have a significant effect on the performance of the geologic repository. [10 CFR
34 960.2]

1 **Engineered Barrier** - Manmade components of a disposal system designed to prevent the
2 release of radionuclides into the geologic medium involved. Such term includes the high-
3 level radioactive waste form, high-level radioactive waste canisters, and other materials
4 placed over and around such canisters. [NWSA Sect. 2(11)]

5 **Engineered Barrier System** - The waste packages and the underground facility.
6 [10 CFR 60.2]

7 - The manmade components of a disposal system designed to prevent the release of
8 radionuclides from the underground facility or into the geohydrologic setting. Such term
9 includes the radioactive-waste form, radioactive-waste canisters, any other components of
10 the waste package, and barriers used to seal penetrations in and into the underground
11 facility. [10 CFR 960.2]

12 **Facility** - Any structure, system, or component, including engineered barriers, created by
13 the DOE to meet repository-performance of functional objectives. [10 CFR 960.2]

14 **Far Field** - That portion of the host rock surrounding the underground facility within which
15 the thermal effects of the emplaced waste can be analyzed by considering only the areal
16 power density without consideration of the specific geometric characteristics of the
17 underground facility. [DOE/RW-0199, Vol. VIII, Part B, page G-38]

18 **Function** - A primary statement of purpose; definition of what a system or subsystem must
19 accomplish to meet the system mission.

20 **Functional Analysis** - The first step in the Systems Engineering process that defines a
21 baseline of functions and function performance requirements which must be met in order
22 to adequately accomplish the operation, support, test, and production requirements of a
23 system. [DSMC 6.1]

24 **Functional Interface** - The interaction between functions, as in the flow of material or
25 information between a sequence of activities.

26 **Geologic Repository** - A system which is intended to be used for, or may be used for, the
27 disposal of radioactive wastes in excavated geologic media. A geologic repository includes:
28 (1) the geologic repository operations area, and (2) the portion of the geologic setting that
29 provides isolation of the radioactive waste. [10 CFR 60.2]

30 - A system, requiring licensing by the NRC, that is intended to be used, or may be used,
31 for the disposal of radioactive waste in excavated geologic media. A geologic repository
32 includes (1) the geologic repository-operations area and (2) the portion of the geologic
33 setting that provides isolation of the radioactive waste and is located within the controlled
34 area. [10 CFR 960.2]

1 - The Term "repository" means any system licensed by the Commission that is intended
2 to be used for, or may be used for, the permanent deep geologic disposal of high-level
3 radioactive waste and spent nuclear fuel, whether or not such system is designed to permit
4 the recovery, for a limited period during initial operation, of any materials placed in such
5 system. Such term includes both surface and subsurface areas at which high-level
6 radioactive waste and spent nuclear fuel handling activities are conducted. "Disposal
7 System" means any combination of engineered and natural barriers that isolate spent
8 nuclear fuel or radioactive waste after disposal.

9 Geologic Repository Operations Area - A high-level radioactive waste facility that is part
10 of a geologic repository, including both surface and subsurface areas, where waste handling
11 activities are conducted. [10 CFR 60.2]

12 A radioactive-waste facility that is part of the geologic repository, including both surface
13 and subsurface areas and facilities where waste-handling activities are conducted. [10 CFR
14 960.2]

15 Geologic Setting - The geologic, hydrologic, and geochemical systems of the region in
16 which a geologic repository operations area is or may be located. [10 CFR 60.2,
17 10 CFR 960.2]

18 High-level Radioactive Waste - (A) the highly radioactive material resulting from the
19 reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing
20 and any solid material derived from such liquid waste that contains fission products in
21 sufficient concentrations; and (B) other highly radioactive material that the Commission,
22 consistent with existing law, determines by rule requires permanent isolation. [NWSA Sect.
23 2(12)]

24 - (1) Irradiated reactor fuel, (2) liquid wastes resulting from the operation of the first cycle
25 solvent extraction system, or equivalent, and the concentrated wastes from subsequent
26 extraction cycles, or equivalent, in a facility for reprocessing irradiated reactor fuel, and
27 (3) solids into which such liquid wastes have been converted. [10 CFR 60.2]

28 HLW Facility - A facility subject to the licensing and related regulatory authority of the
29 Commission pursuant to Section 202(3) and 202(4) of the Energy Reorganization Act of
30 1974 (88 Stat. 1244). [10 CFR 60.2]

31 Host Rock - The geologic medium in which the waste is emplaced. [10 CFR 60.2]

32 - The geologic medium in which the waste is emplaced, specifically the geologic materials
33 that directly encompass and are in close proximity to the underground facility. [10 CFR
34 960.2]

1 **Important to Safety** - With reference to structures, systems, and components means those
2 engineered structures, systems, and components essential to the prevention or mitigation
3 of an accident that could result in a radiation dose to the whole body, or any organ, of
4 0.5 rem or greater at or beyond the nearest boundary of the unrestricted area at any time
5 until the completion of permanent closure. [10 CFR 60.2]

6 **Input** - Anything that is acted upon by a function to produce desired outputs. Inputs can
7 be classified as either internal or external. Inputs that originate from outside a particular
8 system are considered to be external. Inputs that are outputs from functions within a
9 particular system are considered to be internal.

10 **Interface Requirements** - A requirement which applies to the inputs to, or outputs from,
11 the function.

12 **Isolation** - Inhibiting the transport of radioactive material so that amounts and
13 concentrations of this material entering the accessible environment will be kept within
14 prescribed limits. [10 CFR 60.2]

15 **Management** - Any activity, operation, or process (except for transportation) conducted
16 to prepare spent nuclear fuel or radioactive waste for storage or disposal, or the activities
17 associated with placing such fuel or waste in a disposal system. [40 CFR 191.01(m)]

18 **Multibarrier System** - A system of natural and engineered barriers, operating independently
19 or relatively independently, that acts to contain and isolate the waste. [DOE/RW-0199,
Vol. VIII, Part B, page G-67]

21 **Nuclear Waste Management System** - (NWMS) - Consists of the composite of the sites,
22 and all facilities, systems, equipment, materials, information, activities, and the personnel
23 required to perform those activities necessary to manage waste disposal.

24 **Natural Barrier** - The physical, mechanical, chemical, and hydrologic characteristics of the
25 geologic environment that individually and collectively act to minimize or preclude
26 radionuclide transport. [DOE/RW-0199, Vol. VIII, Part B, page G-67]

27 **Natural System** - A host rock suitable for repository construction and waste emplacement
28 and the surrounding rock formations. Includes natural barriers that provide containment
29 and isolation by limiting radionuclide transport through the geohydrologic environment to
30 the biosphere and provide conditions that will minimize the potential for human
31 interference in the future. [DOE/RW-0199, Vol. VIII, Part B, page G-68]

32 **Natural Transport Media** - This includes the assumed groundwater flux and chemistry; air;
33 etc.

1 Near-field - That portion of the rock surrounding emplaced waste in which analysis of the
2 thermal and thermomechanical effects of the waste must consider the specific geometric
3 characteristics of the underground facility, including borehole size and orientation, standoff
4 distance, drift shape dimensions and spacing, or overall layout of the facility.
5 [DOE/RW-0199, Vol. VIII, Part B, page G-68]

6 Output - Anything that leaves the system or function after it has been acted upon by that
7 function.

8 Passive Institutional Control - (1) Permanent markers placed at a disposal site, (2) public
9 records and archives, (3) government ownership and regulations regarding land or resource
10 use, and (4) other methods of preserving knowledge about the location, design, and
11 contents of a disposal system. [40 CFR 191.12(e)]

12 Performance Assessment - An analyses that: (1) Identifies the processes and events that
13 might affect the disposal system; (2) examines the effects of these processes and events
14 on the performance of the disposal system; and (3) estimates the cumulative releases of
15 radionuclides, considering the associated uncertainties, caused by all significant processes
16 and events. These estimates shall be incorporated into an overall probability distribution
17 of cumulative release to the extent practicable. [40 CFR 191.12(q)]

18 - Any analysis that predicts the behavior of a system or system component under a given
19 set of constant and/or transient conditions. Performance assessments will include estimates
20 of the effects of uncertainties in data and modeling.
21 [10 CFR 960.2]

22 Performance Confirmation - The program of tests, experiments, and analyses which is
23 conducted to evaluate the accuracy and adequacy of the information used to determine
24 with reasonable assurance that the performance objectives for the period after permanent
25 closure will be met. [10 CFR 60.2]

26 Permanent Closure - Includes sealing of shafts. Permanent Closure represents the end of
27 active human intervention with respect to the engineered barrier system.
28 [10 CFR 60.102(d)]

29 - Final backfilling of the underground facility and the sealing of shafts and boreholes. [10
30 CFR 60.2]

31 Physical Interface - The boundary at which physical systems interact, as in a necessary fit
32 between architectures.

1 **Physical System** - The Nuclear Waste Management System (NWMS) consisting of the
2 composite of the sites, and all facilities, systems, equipment, materials, information,
3 activities, and the personnel required to perform those activities necessary to manage waste
disposal.

5 **Postclosure** - The period of time after the closure of the geologic repository.
6 [10 CFR 960.2]

7 **Preclosure** - The period of time before and during the closure of the geologic repository.
8 [10 CFR 960.2]

9 **Producer** - Any generator of high-level radioactive waste resulting from atomic energy
10 activities.

11 **Purchaser** - Any person, other than a Federal agency, who is licensed by the Nuclear
12 Regulatory Commission to use a utilization or production facility under the authority of
13 sections 103 or 104 of the Atomic Energy Act of 1954 (42 USC 2133, 2134) or who has
14 title to spent nuclear fuel or high level radioactive waste and who has executed a contract
15 with DOE. [10 CFR 961.3]

16 **Radioactive-Waste Facility** - A facility subject to the licensing and related regulatory
17 authority of the NRC pursuant to sections 202(3) and 202(4) of the Energy Reorganization
18 Act of 1974 (88 Stat. 1244). [10 CFR 960.2]

19 **Repository** - Any system licensed by the Commission that is intended to be used for, or
20 may be used for, the permanent deep geologic disposal of high-level radioactive waste
21 and spent nuclear fuel, whether or not such system is designed to permit the recovery, for
22 a limited period during initial operation, of any materials placed in such system. Such
23 term includes both surface and subsurface areas at which high-level radioactive waste and
24 spent nuclear fuel handling activities are conducted. [NWPA Sect. 2(18)]

25 **Repository Construction** - All excavation and mining activities associated with the
26 construction of shafts, shaft stations, rooms, and necessary openings in the underground
27 facility, preparatory to radioactive-waste emplacement, as well as the construction of
28 necessary surface facilities, but excluding site characterization activities. [10 CFR 960.2]

29 **Repository Operation** - All of the functions at the site leading to and involving radioactive-
30 waste emplacement in the underground facility, including receiving, transportation,
31 handling, emplacement and, if necessary, retrieval. [10 CFR 960.2]

1 Repository Support Facilities - All permanent facilities constructed in support of site-
2 characterization activities and repository construction, operation, and closure activities,
3 including surface structures, utility lines, roads, railroads, and similar facilities, but excluding
4 the underground facility. [10 CFR 960.2]

5 Requirement - A qualitative or quantitative statement of how well a function must be
6 performed. Requirements may be of three types: Performance Requirements, Constraints,
7 and Interface Requirements.

8 Requirements Allocation - The further decomposition of system level requirements until
9 a level is reached at which a specific hardware item or software routine can fulfill the
10 needed functional/performance requirements. [DSMC 6.4]

11 Resource - The people, material, or funds available to support the satisfaction of a
12 function.

13 Restricted Area - Any area access to which is controlled by the licensee for purposes of
14 protection of individuals from exposure to radiation and radioactive materials. "Restricted
15 area" shall not include any areas used as residential quarters, although a separate room
16 or rooms in a residential building may be set apart as a restricted area. [10 CFR 60.2]

17 - Any area access to which is controlled by the DOE for purposes of protecting individuals
18 from exposure to radiation and radioactive materials before repository closure, but not
including 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 960.2]

21 Retrieval - The act of intentionally removing radioactive waste from the underground
22 location at which the waste had been previously emplaced for disposal. [10 CFR 60.2]

23 - Retrieval - The act of intentionally removing radioactive waste before repository closure
24 from the underground location at which the waste had been previously emplaced for
25 disposal. [10 CFR 960.2]

26 Seal - An engineered component that reduces water flow. [DOE/RW-0199, Vol. VIII,
27 Part B, page G-89]

28 Shipping Cask - A container for shipping spent nuclear fuel and/or high-level radioactive
29 waste which meets all applicable regulatory requirements.
30

1 Site - The location of the controlled area. [10 CFR 60.2]

2 - An area contained within the boundary of a location under the effective control of
3 persons possessing or using spent nuclear fuel or radioactive waste that are involved in any
4 activity, operation, or process covered by this subpart. [40 CFR 191.02(n)]

5 - A potentially acceptable site or a candidate site, as appropriate, until such time as the
6 controlled area has been established, at which time the site and the controlled area are
7 the same. [10 CFR 960.2]

8 Spent Nuclear Fuel - (SNF) - Fuel that has been withdrawn from a nuclear reactor
9 following irradiation, the constituent elements of which have not been separated by
10 reprocessing. [NWSA Sect. 2(23); 10 CFR 961.11, I.18]

11 Storage - Retention of spent nuclear fuel or radioactive wastes with the intent and
12 capability to readily retrieve such fuel or waste for subsequent use, processing, or disposal.
13 [40 CFR 191.02(k)]

14 - Retention of high-level radioactive waste, spent nuclear fuel, or transuranic waste with
15 the intent to recover such waste or fuel for subsequent use, processing, or disposal.
16 [NWSA Sect. 2(25)]

17 Surface Facilities - Repository support facilities within the restricted area. [10 CFR 960.2]

18 System - The geologic setting at the site, the waste package, and the repository, all acting
19 together to contain and isolate the waste. [10 CFR 960.2]

20 System Performance - The complete behavior of a repository system in response to the
21 conditions, processes, and events that may affect it. [10 CFR 960.2]

22 Systems Engineering - The management function which controls the total system
23 development effort for the purpose of achieving an optimum balance of all system
24 elements. It is a process which transforms an operational need into a description of
25 system parameters and integrates those parameters to optimize the overall system
26 effectiveness. [DSMC 1.3]. Systems engineering is a sequence of activities and decisions
27 that transforms an identified mission need into a description of system performance
28 parameters and a preferred system configuration [DOE Order 4700.1]

29 Systems Engineering Process - An iterative process applied throughout the acquisition
30 life cycle. The process itself leads to a well defined, completely documented, and
31 optimally balanced system. It does not produce the actual system itself, but rather, it
32 produces the complete set of documentation, tailored to the needs of a specific program,
33 which fully describes the system to be developed and produced. [DSMC 5.1]

1 Trade Study - A quantitative or qualitative parametric analysis of alternatives from which
2 comparisons can be made to support the selection of the "better" alternative.

Underground Facility - The underground structure, including openings and backfill materials, but excluding shafts, boreholes, and their seals. [10 CFR 60.2]

5 - The underground structure and the rock required for support, including mined openings
6 and backfill materials, but excluding shafts, boreholes, and their seals. [10 CFR 960.2]

7 Unrestricted Area - Any area, access to which is not controlled by the licensee for
8 purposes of protection of individuals from exposure to radiation and radioactive materials,
9 and any area used for residential quarters. [10 CFR 60.2]

10 Waste Form - The radioactive waste materials and any encapsulating or stabilizing matrix.
11 [10 CFR 60.2, 10 CFR 960.2]

12 - The materials comprising the radioactive components of waste and any encapsulating or
13 stabilizing matrix. [40 CFR 191.12(c)]

14 Waste Package - The waste form and any containers, shielding, packing and other
15 absorbent materials immediately surrounding an individual waste container. [10 CFR 60.2]

APPENDIX B

BIBLIOGRAPHY

1. ANSI/ASME NQA-1-1986, Quality Assurance Program Requirements for Nuclear facilities. [NQA-1]
2. 10 CFR 50 (Code of Federal Regulations), Title 50, "Energy," Part 50, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," U.S. Government Printing Office, Washington, D.C. [10 CFR 50]
3. 10 CFR 60 (Code of Federal Regulations), Title 10, "Energy," Part 60, "Disposal of High-Level Radioactive Wastes in Geologic Repositories," U.S. Government printing Office, Washington, D.C. [10 CFR 60]
4. 10 CFR 73 (Code of Federal Regulations), Title 10, "Energy," Part 73, "Physical Protection of Plants and Materials," U.S. Government Printing Office, Washington, D.C. [10 CFR 73]
5. 10 CFR 960 (Code of Federal Regulations), Title 10, "Energy," Part 960, "General Guidelines For The Recommendation of Sites For Nuclear Waste Repositories," U.S. Government Printing Office, Washington, D.C. [10 CFR 960]
6. 10 CFR 961 (Code of Federal Regulations), Title 10, "Energy," Part 961, "Standard Contract for Disposal of Spent Nuclear Fuel and/or High-Level Radioactive Waste," U.S. Government Printing Office, Washington, D.C. [10 CFR 961]
7. 40 CFR 191 (Code of Federal Regulations), Title 40, "Protection of Environment," Part 191, "Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes," U.S. Government Printing Office, Washington, D.C. [40 CFR 191]
8. Defense Systems Management College, "Systems Engineering Management Guide," Technical Management Department, U.S. Government Printing Office, Washington, D.C. [DSMC]
9. DOE (U.S. Department of Energy), "Federal Employee Occupational Safety and Health Program," DOE Order 3790.1A, Washington, D.C. [DOE ORDER 3790.1A]
10. DOE (U.S. Department of Energy), "Project Management System," DOE Order 4700.1, Washington, D.C. [DOE ORDER 4700.1]

- 1 11. DOE (U.S. Department of Energy), "Radiation Protection of the Public and the
2 Environment," DOE Order 5400.5, Washington, D.C. [DOE ORDER 5400.5]
- 3
4 12. DOE (U.S. Department of Energy), "Environment, Safety, and Health Program
5 for Department of Energy Operations," DOE Order 5480.1B, Washington, D.C.
6 [DOE ORDER 5480.1B]
- 7 13. DOE (U.S. Department of Energy), "Radiation Protection for Occupational
8 Workers," DOE Order 5480.11, Washington, D.C. [DOE ORDER 5480.11]
- 9 14. DOE (U.S. Department of Energy), 1989. "General Design Criteria," DOE Order
10 6430.1A, Washington, D.C. [DOE Order 6430.1A]
- 11 15. DOE (U.S. Department of Energy), 1985. Mission Plan for the Civilian Radioactive
12 Waste Management Program, Overview and Current Program Plans, DOE/RW-
13 0005, Volume I, Washington, D.C. [Mission Plan]
- 14 16. DOE (U.S. Department of Energy), 1987. OCRWM Mission Plan Amendment,
15 DOE/RW-0128, Washington, D.C. [Mission Plan Amendment - June 1987]
- 16 17. DOE (U.S. Department of Energy), 1988. Draft 1988 Mission Plan Amendment,
17 DOE/RW-0187, Washington, D.C. [Draft 1988 Mission Plan Amendment - June
1988]
18. DOE (U.S. Department of Energy), 1986. Action Memo, "Establishing Policy for
19 Shipping Defense High-Level Waste to a Civilian Radioactive Waste Repository,"
20 from J.L. Meinhardt, DOE - DP to Assistant Secretary for DP, DP-1 and Director,
21 OCRWM, RW-1, dated June 17, 1986. [MOA between DP and RW]
- 22 19. DOE (U.S. Department of Energy), 1989. Report to Congress on Reassessment
23 of the Civilian Radioactive Waste Management Program, DOE/RW-0247,
24 Washington, D.C. [DOE/RW-0247]
- 25 20. DOE (U.S. Department of Energy), 1987. Characteristics of Spent-fuel, High Level
26 Waste, and Other Radioactive Wastes Which May Require Long-Term Isolation,
27 DOE/RW-0184, Washington, D.C. [DOE/RW-0184]
- 28 21. DOE (U.S. Department of Energy), 1990. "Quality Assurance Administrative
29 Procedures," DOE/RW-0197, Preparation of Technical Documents - QAAP 3.5,
30 Rev. 1, Washington, D.C. [DOE/RW-0197]

- 1 22. DOE (U.S. Department of Energy), 1990. "Quality Assurance Administrative
2 Procedures," DOE/RW-0197, Technical Document Input Control - QAAP 3.6, Rev.
3 0, Washington, D.C. [DOE/RW-0197]
- 4 23. DOE (U.S. Department of Energy), 1990. "Quality Assurance Administrative
5 Procedures," DOE/RW-0197, Interface Control - QAAP 3.7, Rev. 0, Washington,
6 D.C. [DOE/RW-0197]
- 7 24. DOE (U.S. Department of Energy), 1988. "Site Characterization Plan," DOE/RW-
8 0199, Washington, D.C. [DOE/RW-0199]
- 9 25. Federal Water Pollution Control Act, As Amended by the Clean Water Act of
10 1977, 33 USC 1251 et.seq., [33 USC 1251 et.seq.]
- 11 26. "Management Systems Improvement Strategy," (MSIS), Memorandum dated August
12 10, 1990, from John W. Bartlett
- 13 27. Meta Software Corporation, 1989, Design IDEF, Version 1.5, Cambridge, MA
- 14 28. Mine Safety and Health, 33 USC 801 et.seq., [33 USC 801 et.seq.]
- 15 29. NWPA (Nuclear Waste Policy Act), 1983. "Nuclear Waste Policy Act of 1982,"
16 Public Law 97-425, 42 USC 10101 -10226, Washington, D.C. This Act includes
17 Amendments PL 100-203 (Dec 22, 1987) and PL 100-507 (Oct 18, 1988) [NWPA]
- 18 30. OSHA (Occupational Safety and Health Act), 29 USC 651 [29 USC 651 et.seq.]
- 19 31. Physical System Requirements - Overall System, Draft Document, June 20, 1991
20 [Overall System Report]
- 21 32. Presidential Memo, 1985. Memo, "Disposal of Defense Waste in a Commercial
22 Repository," from the President, Ronald Reagan, to the Secretary of Energy, John
23 Herrington, dated April 30, 1985. [Presidential Memo]
- 24 33. SDWA (Safe Drinking Water Act), 42 USC 300f et.seq. October 31, 1988 [42
25 USC 300f et.seq.]
- 26 34. Technical Document Management Plan, "Physical System Requirements/Functional
27 Analysis Management Plan," May 22, 1991

APPENDIX C

DECISION DOCUMENTATION

Specifications of many performance and interface requirements and the selection of particular architectural concepts are the results of DOE decisions. As additional decisions are made and documented, they will be included in the technical baseline and documented in this section.

1. All shipments from the MRS facility to the repository would be made exclusively by rail in dedicated trains, which would minimize the number of shipments to the repository.

[DOE/RW-0239]

2. ...the start of repository operations is...2010.

[DOE/RW-0247]

**APPENDIX D
ACRONYMS**

1		
2		
3	AE	Accessible Environment
4	ALARA	As Low as Reasonably Achievable
	CFR	Code of Federal Regulations
5	CHLW	Civilian High-Level Radioactive Waste
6	CRWM	Civilian Radioactive Waste Management
7	DE	Design Earthquake
8	DHLW	Defense High-Level Radioactive Waste
9	DOE	Department of Energy
10	DP	Office of Defense Programs, Department of Energy
11	DSMC	Defense Systems Management College
12	DWPF	Defense Waste Processing Facility
13	EBS	Engineered Barrier System
14	EPA	Environmental Protection Agency
15	ESF	Exploratory Studies Facility
16	f.o.b.	Freight on Board
17	GR	Generic Requirements
18	HLW	High-Level Radioactive Waste
19	IAEA	International Atomic Energy Agency
20	MOA	Memorandum of Agreement
21	MRS	Monitored Retrievable Storage
22	MSIS	Management System Improvement Strategy
23	MTHM	Metric Tons of Heavy Metal
	MTU	Metric Tons of Uranium
24	MWd	Megawatt Days
25	NBS	Natural Barrier System
26	NEPA	National Environmental Policy Act
27	NRC	Nuclear Regulatory Commission
28	NWMS	Nuclear Waste Management System
29	NWPA	Nuclear Waste Policy Act
30	OCRWM	Office of Civilian Radioactive Waste Management
31	PNL	Pacific Northwest Laboratory
32	PP	Purchaser and/or Producer
33	QA	Quality Assurance
34	RW	Office of Civilian Radioactive Waste Management
35	SNF	Spent Nuclear Fuel
36	TBD	To Be Determined
37	TRU	Transuranic
38	USC	United States Code
39	WAPS	Waste Acceptance Preliminary Specifications
40	WVDP	West Valley Demonstration Project
41		
42		

APPENDIX E

DISPOSE OF WASTE INTERFACES*

INTERFACE CONTROL #	FROM	TO	OUTPUT/INPUT TITLE	OUTPUT/INPUT ID#
1.2/1.4.1	Transport Waste	Operate Geologic Repository	Loaded SNF Cask/Carriage Loaded CHLW Cask/Carriage Loaded DHLW Cask/Carriage	1.2O1 ¹ /1.4.111 1.2O2 ² /1.4.112 1.2O3 ³ /1.4.113
AE ⁴ /1.4.1	Accessible Environment	Operate Geologic Repository	Waste Containers	1.4.114
1.4.1/1.2	Operate Geologic Repository	Transport Waste	Empty Cask/Carriage	1.4.1O2/1.214 ⁵
1.4.1/AE ⁴	Operate Geologic Repository	Accessible Environment	Disposed Site-Generated Waste Heat Radiation Released Radionuclides [Retrieved Waste] ⁶	1.4.1O1 1.4.1O3 1.4.1O4 1.4.1O5 1.4.1O6
1.4.1/1.4.2	Operate Geologic Repository	Isolate Waste	Waste Packages	1.4.1O7/1.4.211
1.4.1/1.4.3	Operate Geologic Repository	Evaluate System Performance	Operations Data	1.4.1O11/1.4.3
AE/1.4.2	Accessible Environment	Isolate Waste	Transport Media	1.4.212
1.4.2/1.4.3	Isolate Waste	Evaluate System Performance	[Migration Data] ⁶ [Containment Data] ⁶	1.4.2O5/1.4.311 1.4.2O6/1.4.312

DISPOSE OF WASTE INTERFACES (cont'd)

INTERFACE CONTROL #	FROM	TO	OUTPUT/INPUT TITLE	OUTPUT/INPUT ID#
1.4.2/AE	Isolate Waste	Accessible Environment	Heat	1.4.2O1
			Human Intrusions	1.4.2O2
			Radiation	1.4.2O3
			Released Radionuclides	1.4.2O4
1.4.3/1.4.1	Evaluate System Performance	Operate Geologic Repository	Corrective Action	1.4.3O3/1.4.1I5
1.4.3/AE	Evaluate System Performance	Accessible Environment	License Amend.to Terminate Records	1.4.3O1 1.4.3O2

- 1. 1.2O1: The output "Loaded SNF Cask/Carriage" from function 1.2 - Transport Waste
- 2. 1.2O2: The output "Loaded CHLW Cask/Carriage" from function 1.2 - Transport Waste
- 3. 1.2O3: The output "Loaded DHLW Cask/Carriage" from function 1.2 - Transport Waste
- 4. Accessible Environment
- 5. 1.2I4: The input "Empty Cask/Carriage" to function 1.2 - Transport Waste
- 6. [] = if required
- Interfaces for functions below the third level are not shown in this appendix

APPENDIX F

APPENDIX F1 WASTE ACCEPTANCE SCHEDULE

Year	<u>Annual Waste Acceptance Rate</u>			<u>Annual Waste Transportation Rate</u>				<u>Waste Storage Inventory</u>	<u>Waste Disposal Inventory</u>			
	SNF	CHLW	DHLW	<u>Accept-Dispose</u>			<u>Store-Dispose</u>	SNF	SNF	CHLW	DHLW	
				SNF	CHLW	DHLW	SNF					
1998										-	-	-
1999										-	-	-
2000										-	-	-
2001										-	-	-
2002										-	-	-
2003										-	-	-
2004										-	-	-
2005										-	-	-
2006										-	-	-
2007										-	-	-
2008										-	-	-
2009										-	-	-
2010										-	-	-
.												
.												
.												

TBD

APPENDIX F2 WASTE CHARACTERISTICS FOR GEOLOGIC REPOSITORY DESIGN

Year	<u>SNF Transported to Repository</u>				<u>SNF Inventory at Repository</u>			
	Age	Burnup	Type	Qty.	Age	Burnup	Type	Qty.
2010								
2011								
2012								
2013								
2014								
2015								
.								
.								
.								

TBD

Note: CHLW characteristics to comply with the Waste Acceptance Preliminary Specifications (WAPS) for West Valley Demonstration Project (WVDP) High-level Waste Form, DOE/RW-0261

DHLW from Defense Waste Processing facility (DWPF) to comply with the WAPS for the DWPF High-level Waste Form, DOE/RW-0260

The dimensional characteristics of the SNF to be received are listed in the DOE/RW-0184, Characteristics of Spent Fuel, High-Level Waste, and Other Radioactive Wastes Which May Require Long-Term Isolation.

APPENDIX F3 WASTE TRANSPORTATION RATES TO GEOLOGIC REPOSITORY BY MODE

Year	<u>SNF/HLW From Purchaser/ Producer</u>		<u>SNF From MRS</u>
	Truck	Rail	Rail
2010			
2011			
2012			
2013			
2014			
2015			
.			
.			
.			

TBD

APPENDIX G

INDENTURED LIST OF DISPOSE OF WASTE FUNCTIONS

2

3 (1. Manage Waste Disposal)

4 1.4 Dispose of Waste

5 1.4.1 Operate Geologic Repository

6 1.4.1.1 Handle Waste

7 1.4.1.1.1 Receive Waste

8 1.4.1.1.1.1 Inspect Cask/Transfer Custody to Repository

9 1.4.1.1.1.2 Store Shipping Cask/Carriage

10 1.4.1.1.1.3 Remove Loaded Cask from Carriage

1.4.1.1.2 Prepare Waste

12 1.4.1.1.2.1 Remove Waste from Shipping Cask

13 1.4.1.1.2.2 Store Waste

14 1.4.1.1.2.3 Containerize Waste

15 1.4.1.1.2.4 Store Containerized Waste

16 1.4.1.1.3 Transfer Containerized Waste to Underground

17 1.4.1.1.4 Emplace Waste

18 1.4.1.1.5 Retrieve Waste

19 1.4.1.2 Develop Subsurface Openings

20 1.4.1.2.1 Construct Subsurface Openings

21 1.4.1.2.1.1 Excavate Subsurface Openings

- 1.4.1.2.1.2 Stabilize Subsurface Openings
- 2 1.4.1.2.1.3 Install Operational Support Services
- 3 1.4.1.2.2 Handle/Process Excavated Rock
- 4 1.4.1.2.2.1 Load Excavated Rock
- 5 1.4.1.2.2.2 Process Excavated Rock
- 6 1.4.1.2.2.3 Transfer Excavated Rock
- 7 1.4.1.2.2.4 Unload Excavated Rock
- 8 1.4.1.2.3 Store/Dispose Excavated Rock
- 9 1.4.1.2.4 Handle/Process Backfill Material
- 10 1.4.1.2.4.1 Load Backfill Material
- 1.4.1.2.4.2 Process Backfill Material
- 12 1.4.1.2.4.3 Transfer Backfill Material
- 13 1.4.1.2.4.4 Unload Backfill Material
- 14 1.4.1.2.5 Backfill Subsurface Openings
- 15 1.4.1.2.5.1 Prepare Subsurface Openings for Backfill
- 16 1.4.1.2.5.2 Emplace Backfill
- 17 1.4.1.3 Close Geologic Repository
- 18 1.4.1.3.1 Close Subsurface Openings
- 19 1.4.1.3.1.1 Remove Underground Equipment
- 20 1.4.1.3.1.2 Backfill Subsurface Openings
- 21 1.4.1.3.1.3 Emplace Seals

1.4.1.3.1.4 Implement Postclosure Monitoring

2 1.4.1.3.2 Decommission Surface Facilities

3 1.4.1.3.2.1 Decontaminate Facilities

4 1.4.1.3.2.2 Dismantle Facilities

5 1.4.1.3.2.3 Remove Facilities

6 1.4.1.3.2.4 Reclaim Areas

7 1.4.1.3.3 Establish Institutional Barriers

8 1.4.1.3.3.1 Establish Active Controls

9 1.4.1.3.3.2 Establish Passive Controls

10 1.4.1.4 Support Geologic Repository Operations

11 1.4.1.4.1 Provide Utility Services

1.4.1.4.1.1 Provide Ventilation (HVAC)

13 1.4.1.4.1.2 Provide Communications

14 1.4.1.4.1.3 Supply/Control Water

15 1.4.1.4.1.4 Provide Power

16 1.4.1.4.1.5 Provide Illumination

17 1.4.1.4.1.6 Provide On-Site Transportation

18 1.4.1.4.2 Provide Protective Services

19 1.4.1.4.2.1 Safeguard Radioactive Material

20 1.4.1.4.2.2 Provide Physical Security

21 1.4.1.4.2.3 Provide Inspection/Testing Services

22 1.4.1.4.2.4 Provide Emergency Medical Treatment

1.4.1.4.2.5 Provide Fire/Explosion Protection

2 1.4.1.4.2.6 Provide Radiological Protection

3 1.4.1.4.2.7 Provide Non-Radiological Protection

4 1.4.1.4.2.8 Provide Environmental Protection

5 1.4.1.4.3 Administer General Support Services

6 1.4.1.4.3.1 Maintain Records

7 1.4.1.4.3.2 Provide Engineering Support

8 1.4.1.4.3.3 Provide for Human Resources

9 1.4.1.4.3.3.1 Provide Training

10 1.4.1.4.3.3.2 Provide Personnel Services

1.4.1.4.3.4 Provide Procurement Services

12 1.4.1.4.3.5 Provide Public Relations

13 1.4.1.4.3.6 Provide Financial Accounting

14 1.4.1.4.4 Process Site Generated Waste

15 1.4.1.4.4.1 Collect Site-Generated Waste

16 1.4.1.4.4.2 Store Site-Generated Waste

17 1.4.1.4.4.3 Sort Site-Generated Waste

18 1.4.1.4.4.4 Treat Site-Generated Waste

19 1.4.1.4.4.5 Package Site-Generated Waste

20 1.4.1.4.4.6 Dispose of Site-Generated Waste

21 1.4.1.4.5 Maintain Operating Facilities

1.4.1.4.5.1 Maintain Operating Equipment

1.4.1.4.5.2 Maintain Buildings

1.4.1.4.5.3 Maintain Utilities

1.4.1.4.5.4 Prepare Shipping Cask for Return to Service

1.4.1.4.6 Administer QA

1.4.2 Isolate Waste

1.4.2.1 Contain Waste

1.4.2.1.1 Limit Degradation of Containment Barriers

1.4.2.1.2 Limit Egress of Radionuclides

1.4.2.2 Limit Release of Radionuclides

1.4.2.2.1 Limit Release of Radionuclides from EBS

1.4.2.2.2 Limit Release of Radionuclides to Accessible Environment

1.4.2.3 Limit Incompatible Human Activities

1.4.2.3.1 Limit Inadvertent Human Activities

1.4.2.3.2 Limit Intentional Human Activities

1.4.3 Evaluate System Performance

1.4.3.1 Confirm Performance

1.4.3.1.1 Monitor In Situ Conditions

1.4.3.1.1.1 Monitor In Situ NBS Conditions

1.4.3.1.1.2 Monitor In Situ Waste Package and Underground Facility Conditions

1.4.3.1.2 Conduct Lab/Field Tests

1.4.3.1.2.1 Test/Map Geologic Setting

2 1.4.3.1.2.2 Test NBS Performance

3 1.4.3.1.2.3 Test Waste Package and Underground Facility
4 Performance

5 1.4.3.1.3 Conduct In Situ Experiments

6 1.4.3.1.3.1 Test In Situ NBS Performance

7 1.4.3.1.3.2 Test In Situ Waste Package and Underground Facility
8 Performance

9 1.4.3.1.4 Plan Appropriate Action

10 1.4.3.2 Assess Performance

11 1.4.3.2.1 Update Performance Assessment Models

12 1.4.3.2.2 Estimate System Performance

1.4.3.2.2.1 Estimate EBS Performance

14 1.4.3.2.2.2 Estimate NBS Performance

15 1.4.3.2.2.3 Estimate Total System Performance

16 1.4.3.2.2.4 Estimate Long-Term-Radiological Environmental
17 Consequences

18 1.4.3.2.3 Evaluate System Compliance

19 1.4.3.2.3.1 Evaluate EBS Compliance

20 1.4.3.2.3.2 Evaluate NBS Compliance

21 1.4.3.2.3.3 Evaluate Total System Compliance

22 1.4.3.3 Assess Environmental Compliance

23 1.4.3.3.1 Collect Environmental Data

1.4.3.3.2 Assess Environmental Impacts

2

1.4.3.3.3 Plan for Mitigation

3

1.4.3.4 Monitor Performance

SUPPLEMENTAL APPENDICES

APPENDIX S1

FINDINGS

The following list of management, technical, and programmatic findings were identified by the technical experts during this functional analysis effort. They should be addressed in order to continue the functional analysis or resolve differences in approaches, architecture, or technical assumptions:

1. What is the desired minimum age and maximum burnup of fuel for routine acceptance? What capabilities should be provided to handle younger and higher burnup fuel?
2. What is the status of the DOE position on retrievability and retrieval for a geologic repository which was part of the GR Document (OGR/B-2), as Appendix D? How should the requirements given in the DOE position be treated? How long? How accessible?
3. Decouple MRS construction from the repository schedule.
4. Where will the cask maintenance facility(ies) be located? MRS? Repository? Elsewhere? How will casks be cleaned and maintained at each facility and whose responsibility will it be?

Will a cask maintenance facility (a facility dedicated to major maintenance operations) be physically located at the Geologic Repository, but operated by the transportation system?

Is the control center for the transportation system to be located at the NWMS and, if so, under what conditions?
5. How long will data be taken to confirm post-closure performance?
6. Will backfilling of drifts occur during operations or during closure operations or will it occur at all?
7. Develop excavation rate during operations phase at the repository. The excavation rate must at least equal the waste emplacement rate.
8. What is the current DOE position on rod consolidation and packaging?
9. Who processes some of the off-normal wastes (i.e., particulates)? the producer? or someone else?
10. Need to determine the applicability of the Federal Mine Safety and Health Act of 1977 (30 USC 801 et.seq.). Need to also review and determine the applicability of the Existing MOU between DOE and the Department of Labor.

11. Parts of the performance confirmation program will be carried out in places beyond the geologic repository operations area (GROA); even though the performance confirmation program, as stated in 10 CFR 60, is confined to the GROA.
12. What is the status of the NRC positions on "substantially complete containment", "anticipated processes and events", and "unanticipated processes and events"? How will DOE accommodate the NRC positions?
13. Which definition for "Controlled Area" should be used - 10 CFR 60 or 10 CFR 960 or 40 CFR 191? [Note: NRC in their proposed rulemaking for 10 CFR 60 (51 FR 22288 published 6-19-1986) has accepted 40 CFR 191 definition.]
14. Definitions for "Disposal" term are different as given in NWPA, 40 CFR 191, 10 CFR 60, and 10 CFR 960. Which definitions should be used?
15. Definitions for "Disturbed Zone" are different in 10 CFR 60 and 10 CFR 960. 10 CFR 960 excludes "shafts" in the controlled area whereas 10 CFR 60 does not make such exclusion. Which definition should be used?
16. Definitions for "Engineered Barrier System" are different in 10 CFR 60 and 10 CFR 960. Which definition should be used?
17. Definitions for "High-level Radioactive Waste" in NWPA and 10 CFR 60 are different. DOE uses the terms spent fuel, HLW, CHLW and DHLW. How should this be treated?
18. Definitions for "Geologic Repository" are different in 10 CFR 60 and 10 CFR 960. Which definition should be used?
19. Definitions for "Host Rock" are different in 10 CFR 60 and 10 CFR 960. Which definition should be used?
20. Definitions for "Performance Assessment" are different in 40 CFR 191 and 10 CFR 960. Which definition should be used?

APPENDIX S2

SYSTEM STUDIES

The following list of recommended studies are needed to further specify certain requirements for the Dispose of Waste functions:

1. Waste retrieval analysis
2. Waste throughput analysis (i.e, quantity/schedule for accept/transport/store/dispose) based on the Characteristics and Integrated Data Base at Oak Ridge National Laboratory, for U.S. Spent Fuel and Radioactive Waste.
3. Post-closure performance confirmation program analysis

APPENDIX S3

SUPPLEMENTAL LIST OF POTENTIAL SOURCE DOCUMENTS

The following documents have been identified as potential sources for additional requirements and will be reviewed in the future or, as identified by an asterisk, contain no applicable physical system requirements at this level.

DOE ORDERS

DOE ORDER 1000.3B	Internal Control Systems
DOE ORDER 1323.1A	Congressional Reports Monitoring System
DOE ORDER 1324.2A	Records Disposition
DOE ORDER 1324.5	Records Management Program
DOE ORDER 1325.1A	Department of Energy Correspondence Manual
DOE ORDER 1340.1A	Management of Public Communications Publications, & Scientific, Technical and Engineering Publications
DOE ORDER 1350.1	Audiovisual and Exhibits Management
DOE ORDER 1540.1	Materials Transportation and Traffic Management
DOE ORDER 1540.2	Hazardous Material Packaging for Transport - Administrative Procedures
DOE ORDER 1540.3	Base Technology for Radioactive Material Transportation Packaging System
DOE ORDER 1600.1	Federal Women's Program
DOE ORDER 1600.2B	Secretary's Commitment to Equal Opportunity
DOE ORDER 1600.3	Policy on Sexual Harassment
DOE ORDER 1600.4	Hispanic Employment Program
DOE ORDER 1600.5	System for Processing Complaints of Discrimination
DOE ORDER 1600.6	Civil Rights Compliance in Federally Assisted Programs
DOE ORDER 1700.1	Freedom of Information Program
DOE ORDER 1800.1A	Privacy Act
DOE ORDER 2100.3	Transfer of Contracts Between Departmental Elements
DOE ORDER 2100.8	Cost Accounting, Cost Recovery, & Interagency Sharing of Data Processing Facilities
DOE ORDER 2200.4	Accounting Overview
DOE ORDER 2200.5	Fund Accounting
DOE ORDER 2200.6	Financial Accounting
DOE ORDER 2200.7	Cost Accounting
DOE ORDER 2200.8A	Accounting Systems, Organizations, and Reporting
DOE ORDER 2200.9A	Miscellaneous Accounting
DOE ORDER 2200.10A	Accounts, Codes, and Illustrative Entries
DOE ORDER 2250.1C	Cost and Schedule Control Systems Criteria
DOE ORDER 3220.1	Management of Contractor Personnel Policies and Programs
DOE ORDER 3220.2	Equal Opportunity in Operating and Onsite Service Contractor Facilities
DOE ORDER 3220.4	Contractor Personnel and Industrial Relations Reports
DOE ORDER 3304.1	Employment of Experts and Consultants
DOE ORDER 3410.1B	Training
DOE ORDER 3410.2A	Upward Mobility Program
DOE ORDER 3550.1A	Pay Administration and Hours of Duty
DOE ORDER 3600.1A	Time and Attendance Reporting

DOE ORDERS (Continued)

DOE ORDER 3630.1B	Leave Administration
DOE ORDER 3710.1A	Labor-Management Relations Program for Federal Employees
DOE ORDER 3750.1	Work Force Discipline
DOE ORDER 3771.1	Grievance Policy and Procedures
DOE ORDER 3790.1A	Federal Employees Occupational Safety and Health Program
DOE ORDER 3792.3	Drug-Free Federal Workplace Testing Implementation Program
DOE ORDER 4010.1	Value Engineering
DOE ORDER 4200.1C	Competition in Contracting
DOE ORDER 4200.3B	Management of Support Services Contract Activity
DOE ORDER 4200.4A	Selection, Appointment, and Termination of Appointment of Contracting Officers
DOE ORDER 4300.1B	Real Property and Site Development Planning
DOE ORDER 4330.4	Real Property Maintenance Management
DOE ORDER 4540.1B	Utility Acquisition and Management
*DOE ORDER 4700.1	Project Management System
DOE ORDER 5000.3	Unusual Occurrence Reporting System
DOE ORDER 5100.4	Internal Review Budget Process
DOE ORDER 5100.12	Budget Execution - Department of Energy Base Table
DOE ORDER 5100.14	Allotment and Approved Funding Program Process
DOE ORDER 5160.1A	Reprogramming, Restructuring, and Appropriations Transfer Procedures
DOE ORDER 5300.1B	Telecommunication
DOE ORDER 5400.1	General Environmental Protection Program
DOE ORDER 5400.3	Hazardous and Radioactive Mixed Waste Program
DOE ORDER 5400.5	Radiation Protection of the Public and the Environment
DOE ORDER 5440.1D	National Environmental Policy Act Compliance Program
DOE ORDER 5480.1B	Environment, Safety, and Health Program for Department of Energy Operations
DOE ORDER 5480.3	Safety Requirements for Packaging and Transportation of Hazardous Materials, Hazardous Substances, & Hazardous Wastes
DOE ORDER 5480.4	Environmental Protection, Safety, and Health Protection Standards
DOE ORDER 5480.5	Safety of Nuclear Facilities
DOE ORDER 5480.7	Fire Protection
DOE ORDER 5480.9	Construction Safety and Health Program
DOE ORDER 5480.10	Contractor Industrial Hygiene Program
DOE ORDER 5480.17	Site Safety Representatives
DOE ORDER 5481.1B	Safety Analysis and Review System
DOE ORDER 5482.1B	Environment, Safety, and Health Appraisal Program
DOE ORDER 5483.1A	Occupational Safety and Health Program for DOE Contractor Employees at Government-Owned Contractor-Operated Facilities
DOE ORDER 5484.1	Environmental Protection, Safety, and Health Protection Information Reporting Requirements
DOE ORDER 5500.1A	Emergency Management System
DOE ORDER 5500.3	Reactor and Nonreactor Nuclear Facility Emergency Planning, Preparedness and Response Program for DOE Operations
DOE ORDER 5500.4	Public Affairs Policy and Planning Requirements for Emergencies
DOE ORDER 5500.7A	Vital Records Protection Program
DOE ORDER 5630.11	Safeguards and Security Program
DOE ORDER 5631.1A	Security Education Program
DOE ORDER 5631.2B	Personnel Security Program
DOE ORDER 5632.1A	Protection Program Operations
DOE ORDER 5632.2A	Physical Protection of Special Nuclear Material and Vital Equipment

DOE ORDERS (Continued)

DOE ORDER 5632.3B	Operations Security
DOE ORDER 5635.1A	Control of Classified Documents and Information
DOE ORDER 5650.2A	Classification of Information
DOE ORDER 5700.2C	Cost Estimating, Analysis, and Standardization
DOE ORDER 5700.5	Policy and Management Procedures for Financial Incentives Programs
DOE ORDER 5700.6B	Quality Assurance
DOE ORDER 5700.7B	Work Authorization System
DOE ORDER 5900.1	Management of Energy Data Services Resources
DOE ORDER 5900.2	Use of the Metric System of Measurement
DOE ORDER 6430.1A	General Design Criteria

OCRWM Documents

DOE/RW-0005	Mission Plan for the Civilian Radioactive Waste Management Program
DOE/RW-0035	Monitored Retrievable Storage Submission to Congress
DOE/RW-0043	Program Management System Manual
DOE/RW-0051	Systems Engineering Management Plan
DOE/RW-0101	OGR Issues Hierarchy for a Mined Geologic Disposal System
DOE/RW-0119	OCRWM Safety Plan
DOE/RW-0128	OCRWM Mission Plan Amendment
DOE/RW-0142	Annotated Outline for Site Characterization Plans
DOE/RW-0147	Annotated Outline for SCP Conceptual Design Report
DOE/RW-0176	Environmental Monitoring and Mitigation Plan
DOE/RW-0187	Draft 1988 Mission Plan Amendment
DOE/RW-0194	OCRWM Records Management Policies and Requirements
DOE/RW-0199	Site Characterization Plan: Yucca Mountain Site, and Development Area, Nevada
DOE/RW-0208	Environmental Monitoring and Mitigation Plan for Site Characterization
DOE/RW-0209	Environmental Regulatory Compliance Plan
DOE/RW-0214	OCRWM Quality Assurance Manual
DOE/RW-0215	OCRWM Quality Program Decision Documents
*DOE/RW-0216	Annual Report to Congress (1989)
DOE/RW-0223	Program Change Control Procedures
DOE/RW-0235	MRS System Study Summary Report
*DOE/RW-0239	The DOE Position on the MRS Facility
DOE/RW-0244	Draft Reclamation Program Plan for Site Characterization
DOE/RW-0245	Program Elements Change Control Procedures
DOE/RW-0253	Program Cost & Schedule Baseline
DOE/RW-0260	Waste Acceptance Preliminary Specifications for the Defense Waste Processing Facility High-Level Waste Form (Revision 1)
DOE/RW-0261	Waste Acceptance Preliminary Specifications for the West Valley Demonstration Project High-Level Waste Form (Revision 1)
DOE/RW-0264	Waste Management System Requirements Document, Volume I: General System Requirements

Laws, Statutes and Regulations

7 CFR 658	Farmland Protection Policy Act
10 CFR 2	Submission and Management of Records and Documents Related to the Licensing of a Geologic Repository for the Disposal of High Level Radioactive Waste/SubPart J to 10 CFR 2)
10 CFR 20	Standards for Protection Against Radiation
10 CFR 21	Reporting of Defects and Noncompliance
10 CFR 30	Rules of General Applicability to Domestic Licensing of Byproduct Material
10 CFR 40	Domestic Licensing of Source Material
10 CFR 50	Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants
*10 CFR 51	Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions
10 CFR 70	Domestic Licensing of Special Nuclear Material
*10 CFR 71	Packaging and Transportation of Radioactive Material
*10 CFR 72	Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste
*10 CFR 75	Safeguards on Nuclear Materials-Implementation of US/IAEA Agreements
10 CFR 100	Reactor Site Criteria
10 CFR 962	Byproduct Material
10 CFR 1022	Compliance with Floodplain/Wetlands Environmental Review Requirements
25 CFR 261	Preservation of Antiquities
29 CFR Chapter XVII	Occupational Health and Safety Administration, Department of Labor (Parts 1900-1999)
30 CFR 31	Diesel Mine Locomotives
30 CFR 36	Mobile Diesel-Powered Transportation Equipment for Gassy Noncoal Mines and Tunnels
30 CFR 57	Safety and Health Standards - Underground Metal and Nonmetal Mines
33 CFR Chapter I	Coast Guard, Department of Transportation (Parts 1 - 199)
33 CFR 320	General Regulatory Policies
33 CFR 321	Permits for Dams and Dikes in Navigable Waters of the United States
33 CFR 322	Permits for Structures or Work in or Affecting Navigable Waters of the United States
33 CFR 323	Permits for Discharges of Dredged or Fill Material into Waters of the United States
33 CFR 324	Permits for Ocean Dumping of Dredged Material
33 CFR 325	Processing of Department of the Army Permits
33 CFR 326	Enforcement
33 CFR 327	Public Hearings
33 CFR 328	Definition of Waters of the United States
33 CFR 329	Definition of Navigable Waters of the United States
33 CFR 330	Nationwide Permits
36 CFR 60	National Register of Historic Places
36 CFR 61	Procedures for Approved State and Local Government Historic Preservation Programs
36 CFR 63	Determinations of Eligibility for Inclusion in the National Register of Historic Places
36 CFR 65	National Historic Landmarks Program
36 CFR 296	Protection of Archaeological Resources: Uniform Regulations
36 CFR 800	Protection of Historic and Cultural Properties
40 CFR 50	National Primary and Secondary Ambient Air Quality Standards
40 CFR 58	Ambient Air Quality Surveillance
40 CFR 60	Standards of Performance for New Stationary Sources

Laws, Statutes and Regulations (Continued)

40 CFR 61	National Emission Standards for Hazardous Air Pollutants
40 CFR 121	State Certification of Activities Requiring a Federal License or Permit
40 CFR 122	EPA Administered Permit Programs: The National Pollutant Discharge Elimination System
40 CFR 124	Procedures for Decisionmaking
40 CFR 125	Criteria and Standards for the National Pollutant Discharge Elimination System
40 CFR 162	Regulations for the Enforcement of the Federal Insecticide, Fungicide and Rodenticide Act
40 CFR 190	Environmental Radiation Protection Standards for Nuclear Power Operations
40 CFR 204	Noise Emission Standards for Construction Equipment
40 CFR 271	Requirements for the Authorization of State Hazardous Waste Programs
40 CFR 272	Approved State Hazardous Waste Management Programs
40 CFR 300	National Oil and Hazardous Substances Pollution Contingency Plan
40 CFR 302	Designation, Reportable Quantities, and Notification
40 CFR 355	Emergency Planning and Notification
40 CFR 1500	Purpose, Policy, and Mandate
40 CFR 1501	NEPA and Agency Planning
40 CFR 1502	Environmental Impact Statement
40 CFR 1503	Commenting
40 CFR 1504	Predecision Referrals to the Council of Proposed Federal Actions Determined to be Environmentally Unsatisfactory
40 CFR 1505	NEPA and Agency Decisionmaking
40 CFR 1506	Other Requirements of NEPA
40 CFR 1507	Agency Compliance
40 CFR 1508	Terminology and Index
41 CFR 109-40	Transportation and Traffic Management
43 CFR 3	Preservation of American Antiquities
46 CFR 148	Carriage of Solid Hazardous Materials in Bulk
49 CFR 179	Specifications for Tank Cars
50 CFR 17	Endangered and Threatened Wildlife and Plants
50 CFR 222	Endangered Fish or Wildlife
50 CFR 225	Federal/State Cooperation in the Conservation of Endangered and Threatened Species
50 CFR 226	Designated Critical Habitat
50 CFR 227	Threatened Fish and Wildlife
50 CFR 402	Interagency Cooperation - Endangered Species Act of 1973, as Amended
50 CFR 424	Listing Endangered and Threatened Species and Designating Critical Habitat
50 CFR 450	General Provisions
50 CFR 451	Application Procedure
50 CFR 452	Consideration of Application by the Secretary
50 CFR 453	Endangered Species Committee

Laws, Statutes and Regulations (Continued)

7 USC 136 et.seq.	Environmental Pesticide Control
15 USC 2601 et seq.	Toxic Substances Control Act
16 USC 1A	National Historic Preservation Act
16 USC 1B	Endangered Species Act
*42 USC 1701 et.seq.	Federal Land Policy and Management Act
42 USC 1996 et.seq.	American Indian Religious Freedom Act
42 USC 2011 et.seq.	Atomic Energy Act
42 USC 4321 et.seq.	National Environmental Policy Act
42 USC 4901 et.seq.	Noise Control Act
42 USC 5801 et.seq.	Energy Reorganization Act
42 USC 6901 et.seq.	Solid Waste Disposal
42 USC 7101 et.seq.	DOE Organization Act
42 USC 7401 et.seq.	Air Pollution Prevention and Control
42 USC 9601 et.seq.	Comprehensive Environmental Response, Compensation and Liability Act
*49 USC 1801 et.seq.	Hazardous Material Transportation Act

NUREGS

NUREG-3.49	Design of an Independent Spent Fuel Storage Installation (Water-Basin Type)
NUREG-3.6	Design of an Independent Spent Fuel Storage Installation (Dry Store)
NUREG-1318	Technical Positions on Items and Activities in the High-Level Waste Geologic Repository Program Subject to Quality Assurance Requirements

EXECUTIVE ORDERS

EXEC ORDER 11514	Protection and Enhancement of Environmental Quality
EXEC ORDER 11593	Protection and Enhancement of Cultural Environment
EXEC ORDER 11988	Floodplain Management
EXEC ORDER 11990	Protection of Wetlands
EXEC ORDER 12088	Federal Compliance with Pollution Control Standards

Administrative Documents

MOU DOE/DOL	Memorandum of Understanding, signed 12/23/86, Between the Department of Energy and the Department of Labor on Mining Safety Activities
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Other DOE Documents

DOE/MA-0154	Acquisition Regulations Handbook: Source Evaluation Board
DOE/DP/0020/1	An Evaluation of Commercial Repository Capacity for the Disposal of DHLW

Other Documents

ANSI/ASME NQA-1-1986 Quality Assurance Program Requirements for Nuclear Facilities

Regulations on Which Nevada State Requirements are Based

29 CFR 1910	Occupational Safety and Health Standards
29 CFR 1926	Safety and Health Regulations for Construction
30 CFR 56	Safety and Health Standards - Surface Metal and Nonmetal Mines
40 CFR 2	Public Information
40 CFR 60	Standards of Performance for New Stationary Sources
40 CFR 61	National Emission Standards for Hazardous Air Pollutants
40 CFR 141	National Primary Drinking Water Regulations
40 CFR 143	National Secondary Drinking Water Regulations
40 CFR 260	Hazardous Waste Management System: General
40 CFR 261	Identification and Listing of Hazardous Waste
40 CFR 262	Standards Applicable to Generators of Hazardous Waste
40 CFR 263	Standards Applicable to Transporters of Hazardous Waste
40 CFR 264	Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 265	Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 266	Standards for the Management of Specific Hazardous Wastes and Specific Types of Hazardous Waste Management Facilities
40 CFR 267	Interim Standards for Owners and Operators of New Hazardous Waste Land Disposal Facilities
40 CFR 268	Land Disposal Restrictions
40 CFR 270	EPA Administered Permit Programs: The Hazardous Waste Permit Program
40 CFR 280	Underground Storage Tanks
49 CFR 171	General Information, Regulations, and Definitions
49 CFR 172	Hazardous Materials Tables and Hazardous Materials Communications Regulations
49 CFR 173	Shippers - General Requirements for Shipments and Packaging
49 CFR 174	Carriage by Rail
49 CFR 176	Carriage by Vessel
49 CFR 177	Carriage by Public Highway
49 CFR 178	Shipping Container Specifications
49 CFR 383	Commercial Driver's License Standards; Requirements and Penalties
49 CFR 387	Minimum Levels of Financial Responsibility for Motor Carriers
49 CFR 390	Federal Motor Carrier Safety Regulations: General
49 CFR 391	Qualifications of Drivers
49 CFR 392	Driving of Motor Vehicles
49 CFR 393	Parts and Accessories Necessary for Safe Operation
49 CFR 394	Notification and Reporting of Accidents
49 CFR 395	Hours of Service of Drivers
49 CFR 396	Inspection, Repair, and Maintenance
49 CFR 397	Transportation of Hazardous Materials; Driving and Parking Rules

Additional Nevada State Regulatory Requirements

NAC 444	Sanitation
NAC 445	Water Controls; Air Pollution
NAC 459	Hazardous Materials
NAC 503	Hunting, Fishing and Trapping; Miscellaneous Protective Measures
NAC 512	Inspection and Safety of Mines
NAC 534	Underground Water and Wells
NAC 618	Occupational Safety and Health

APPENDIX S4

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