DOE/RW-0334P

Office of Civilian Radioactive Waste Management

Physical System Requirements - Overall System

January 1992

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

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DOE/RW-0334P

Office of Civilian Radioactive Waste Management

Physical System Requirements - Overall System

January 1992

U.S. Department of Energy
Office of Civilian Radioactive Waste Management
Washington, D.C. 20585

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OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT
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The Physical System Requirements - Overall System document, in accordance with Document Change Proposal 56 - Interim Approach for the Technical Document Hierarchy, replaces DOE/RW-0264, Waste Management System Requirements (WMSR) document, Vol. I, Revision 1, and DOE/RW-0270P, Waste Management System Description (WMSD), Revision 0, as the highest level technical baseline document for the Waste Acceptance, Store Waste and Transport Waste functions only. Those sections of the Overall System document that apply to MGDS and ESF are nonbinding requirements. WMSR, Volume IV, and applicable portions of the WMSR, Volume I and the WMSD are retained for MGDS and ESF requirements. The Physical System Requirements-Store Waste (DOE/RW-0319) will be effective upon approval of the Physical System Requirements - Overall System", and will replace the Waste Management System Requirements (WMSR), Volume III (DOE/RW-0272P).

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(IF REQUIRED)

DATE: _____

(9) SIGNATURE: _____ PCCB CHAIRMAN

DATE: 1/17/92

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VERIFICATION: _____ DIRECTOR, OQA
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SIGNATURE: _____ PCCB EXECUTIVE SECRETARY

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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.

This approach establishes a framework for integrating the program management efforts with the technical requirements analysis into a single, unified, and consistent program. The functional analysis 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 and each of its elements to fulfill the waste disposal mission; and
- Identify the corresponding requirements leading to the updating of the technical requirements baseline.
- 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 at the overall system level. The Physical System Requirements/Functional Analysis Management Plan, defines the criteria and activities for the preparation, review, and approval of this report.

1.2 Objective

The objective of this document is to establish the top-level functions, requirements, interfaces, and system architecture which will guide the further decomposition of the Manage Waste Disposal functions within each of the four functions: accept waste, transport waste, store waste, and dispose of waste. This document is to be used along with lower level requirements documents as the basis for design. This document is the starting point for the next functional analysis iteration. As such, it is an explicit definition of the problem to be solved rather than a solution.

The complete series of requirements documents will be baselined and utilized by the OCRWM program.

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. 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.

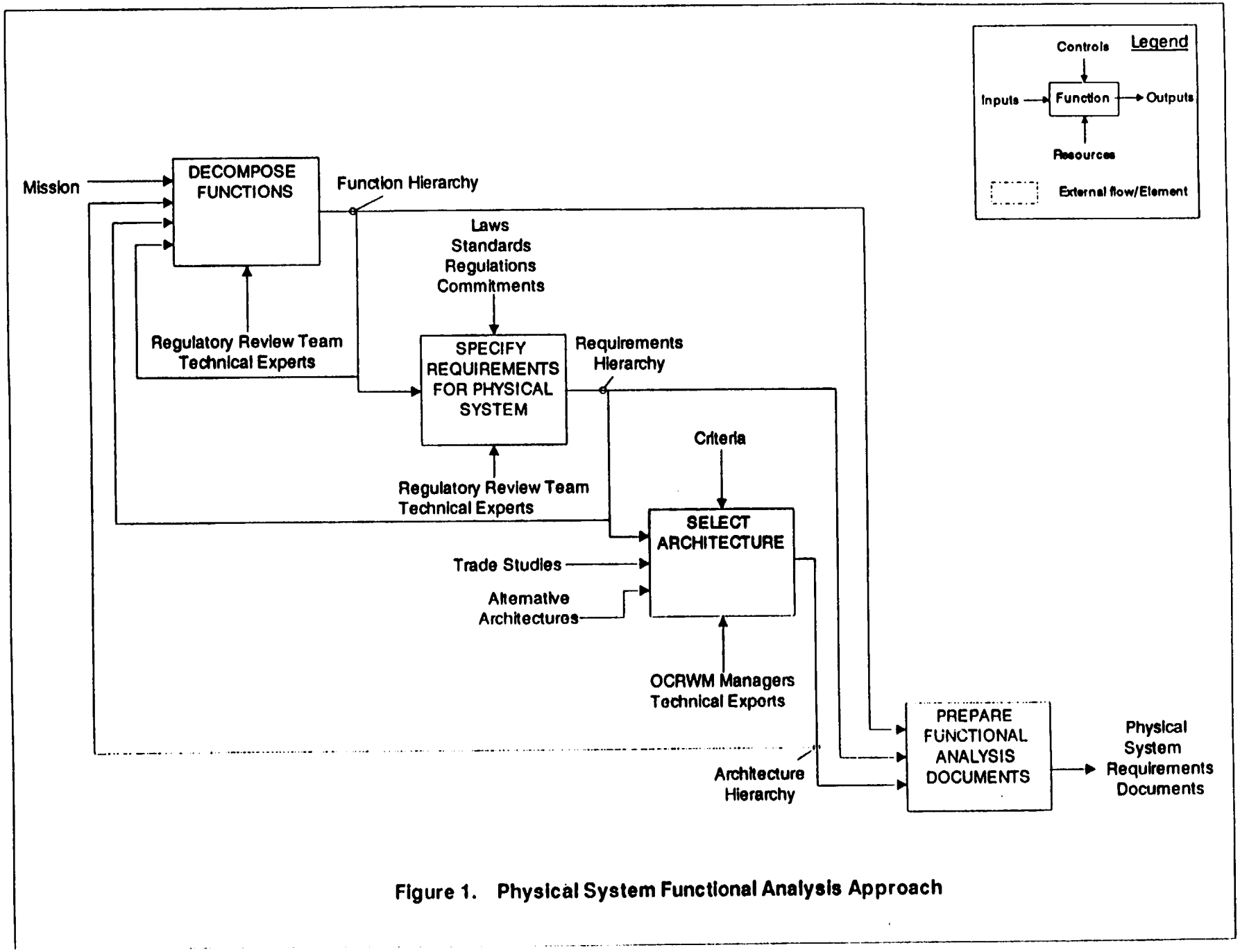


Figure 1. Physical System Functional Analysis Approach

Table 1. Source Documents Containing Requirements at the Overall System Level

Document Identifier	Document Description
NWPA-42 USC 10101 et.seq.	Nuclear Waste Policy Act
29 USC 651 et.seq.	Occupational Safety and Health Act
40 CFR 191	Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes
10 CFR 60	Disposal of High-Level Radioactive Wastes in Geologic Repositories
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 960	General Guidelines for the Recommendation of Sites for Nuclear Waste Repositories
10 CFR 961	Standard Contract for Disposal of Spent Nuclear Fuel and/or High-Level Radioactive Waste
DOE/RW-0035	Monitored Retrievable Storage Submission to Congress
DOE/RW-0235	MRS System Study Summary Report
DOE/RW-0239	The DOE Position on the MRS Facility
DOE/RW-0247	Report to Congress on Reassessment of the CRWM Program
DOE ORDER 5480.11	Radiation Protection for Occupational Workers
MOA between DP and RW	Memorandum of 7/14/86 on Policy for Shipping Defense High-Level Waste (DHLW) to a Civilian Radioactive Waste Repository
Presidential Memo	Memorandum of 4/30/85 on Disposal of Defense Waste in a Commercial Repository

Beginning with the mission statement, the technical experts assigned a set of applicable requirements from those provided by the regulatory review team, and provided an architectural concept. At this point, the mission statement became the parent function which the technical experts decomposed into a set of functions that are both necessary and sufficient to satisfy the parent. Physical system requirements were assigned and architectural concepts provided for each function, establishing the basis for further decomposition. The final step for the overall system level was to decompose the functions to one more level of detail, to better understand the functions at the overall system level.

1.4 Mission

Based upon the Nuclear Waste Policy Act, the mission of the operating waste management system is **to manage and dispose of the nation's spent fuel and high-level radioactive waste in a manner that protects the health and safety of the public and of workers and the quality of the environment.** In order to accomplish this mission, DOE is developing a waste management system which will accept, transport, store, and dispose of spent nuclear fuel and high-level radioactive waste in a geologic repository in a timely manner.

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 satisfaction of the mission. For the Nuclear Waste Management System (NWMS), that phase was determined to be the operating phase. Thus, the time period covered by this functional analysis is from the initial acceptance of spent fuel or high-level radioactive waste through at least 10,000 years following permanent closure, as required by 40 CFR 191.13.

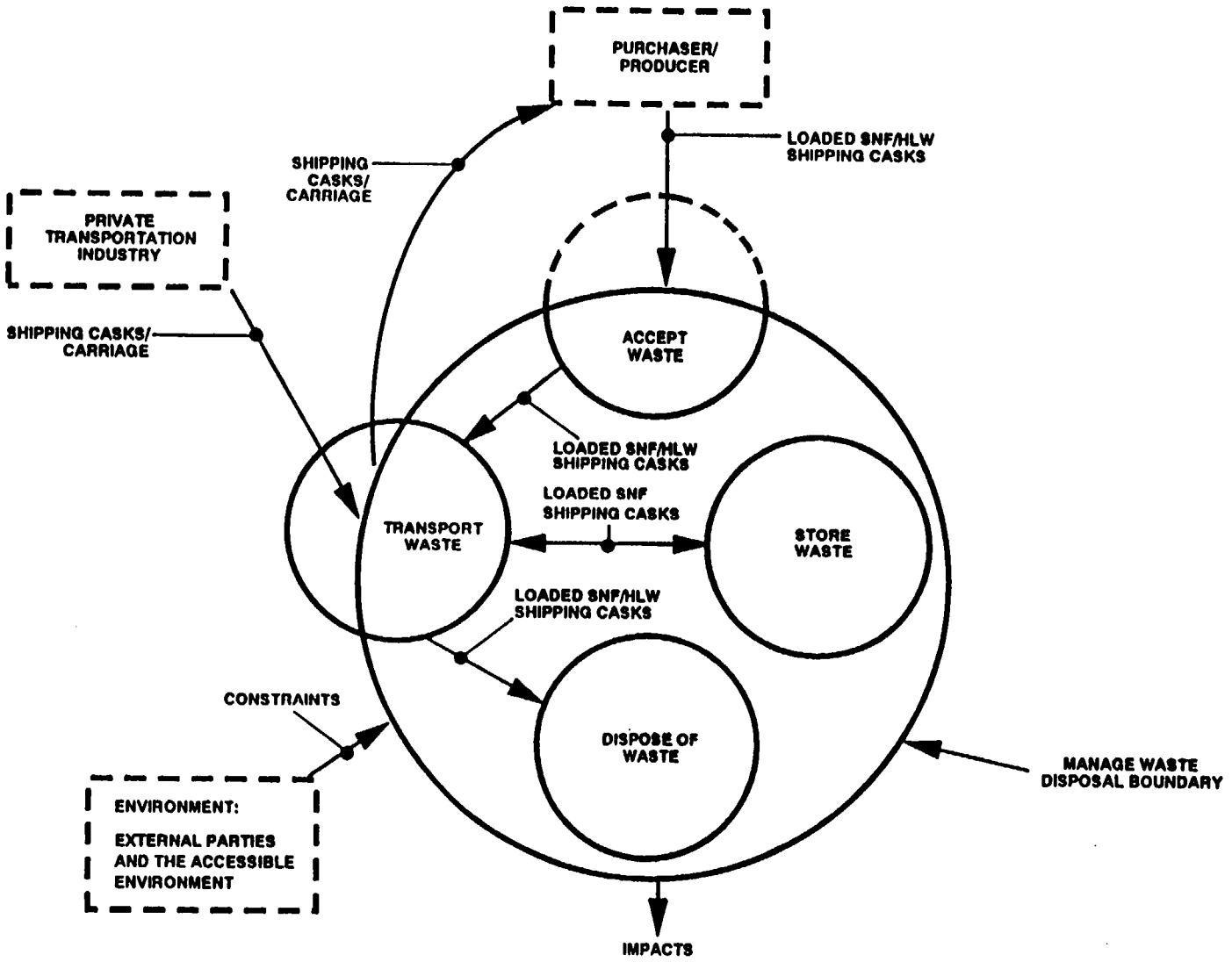
The scope of this document is restricted to a functional analysis at the first (i.e., manage waste disposal) and second (i.e., accept waste, transport waste, store waste, and dispose of waste) levels only. These second level functions become the mission statements in the subsequent "Physical System Requirements" documents which contain considerably more detail.

Figure 2 illustrates the boundaries between the manage waste disposal function and its environment. Two of the subfunctions (accept waste and transport waste) are shown to extend across the overall system boundary, whereas the other two (store waste and dispose of waste) are contained entirely within the overall system boundary. This shows that a primary interface exists between the accept waste function and the purchaser/producer and between the transport waste function and the private transportation industry. There are, of course, 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.

1.5.2 Organization of Document

Section 2.0 of this document contains an explicit description for the first and for each of the second level functions, 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.

Section 3.0 contains individual architectural description tables for each physical system element. These tables present the rationale justifying the need for, or the selection of, a particular architecture and a brief description of the current concept.



SNF: Spent Nuclear Fuel

HLW: High Level Waste

FIGURE 2. MANAGE WASTE DISPOSAL BOUNDARIES

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Section 4.0 contains a more illustrative description of the important functional interfaces that have been identified at the overall system level. This includes interfaces between the second level functions and between each function and the external environment. Two types of diagrams are used to illustrate these functional interfaces: N-square diagrams and functional flow diagrams.

A number of appendices are included in this document. Appendix A is a Data Dictionary containing a glossary of terms that are used throughout the functional analysis effort; Appendix B, a Bibliography of reference documents used in this effort; Appendix C, Decision Documentation, indicates the basis for any DOE/OCRWM decisions that have been made in support of this effort; Appendix D, a list of the Acronyms that are used throughout this document; Appendix E, Interfaces, contains a list of the important inputs and outputs; and Appendix F, which is a reserved section for the Waste Acceptance Schedule. In addition, Supplemental Appendices, which are not intended to be approved and controlled, are included as separate attachments for completeness.

2.0 FUNCTIONS AND REQUIREMENTS

Figure 3 displays the functions to the third level (1.X.Y), deemed necessary to fulfill the "manage waste disposal" mission. Although the focus of this report is through the second level (1.X), to better understand the functions at any level, it is important to at least identify the subfunctions one level below. As indicated, the numbering scheme which uniquely identifies function titles is based on using a 1. at the first level, a 1.X at the second level, a 1.X.Y at the third level, etc. This scheme, which permits traceability between functions and subfunctions, is used throughout the physical system functional analysis.

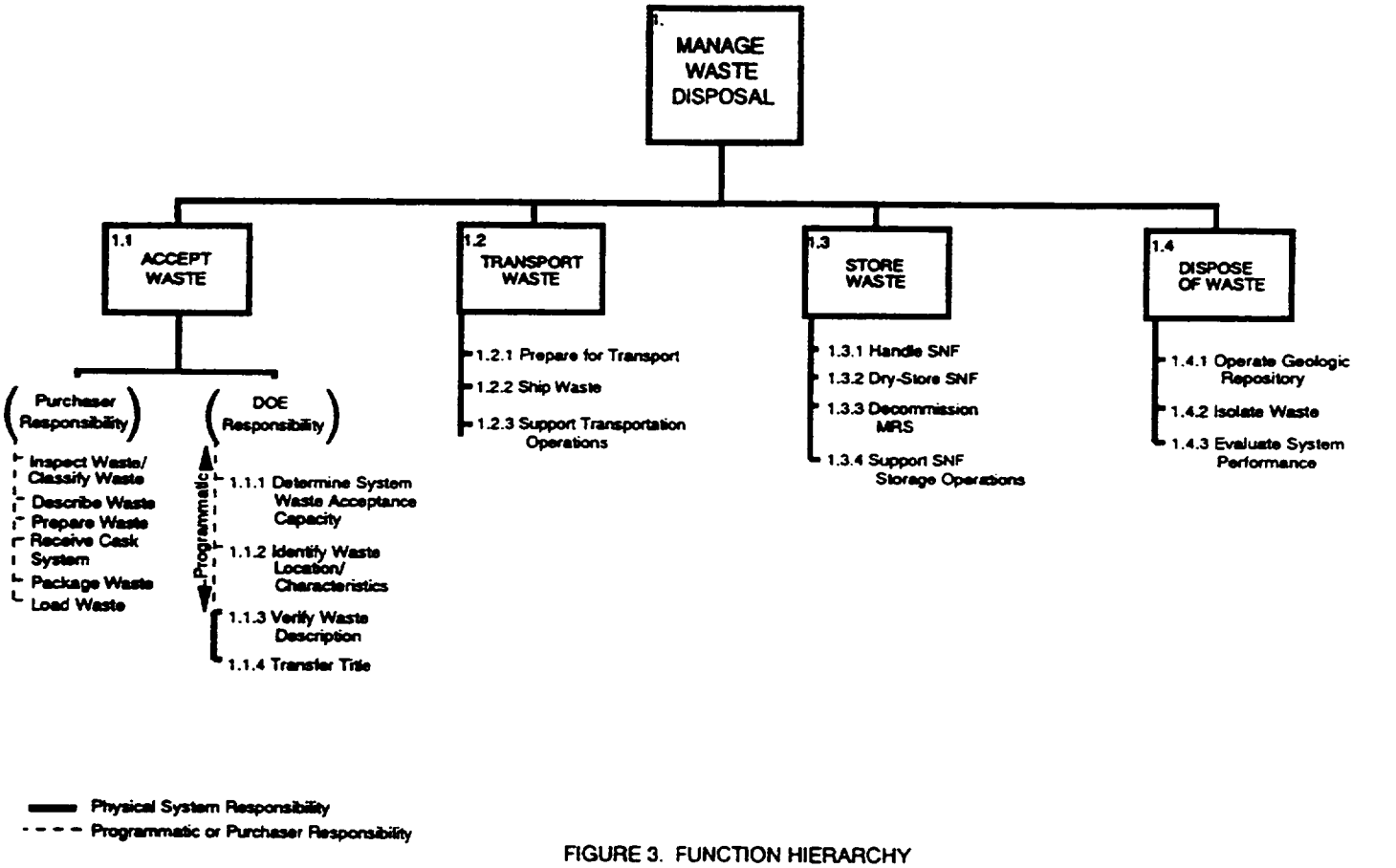

FIGURE 3. FUNCTION HIERARCHY

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Table 1 contains a list of source documents from which the requirements contained in this document were extracted. Although additional source documents have been and will continue to be reviewed, it was determined that the scope and detail contained in the documents referenced in Table 1 are sufficient to specify an initial set of requirements in the overall system functional analysis document. Other

supplementary documents have been identified as potential source documents, which will be reviewed to identify requirements. Any applicable results of these reviews will be incorporated into subsequent revisions to this functional analysis document. This list is not intended to be complete. It will be expanded as more applicable documents are identified.

Tables F1. through F1.4 contain description of the first and each of the second level functions, including an identification of inputs to, and outputs from, each of the functions. A detailed list of such inputs and outputs are provided in Appendix E. Tables F1. through F1.4 also include a compilation of the corresponding requirements that are determined to be appropriate at this level. In general, if a requirement is applicable to all functions at a given level in the hierarchy, it is assigned to their parent function in order to avoid unnecessary repetition. These baseline requirements ensure that flexibility of design is maintained and that evolving technology may be considered.

Requirements could be one of three types: **constraints**, or regulatory requirements, which are imposed on the function by external sources (e.g., Congress, Environmental Protection Agency, Nuclear Regulatory Commission); **performance requirements** which are imposed on the function by DOE/OCRWM; and **interface requirements** which apply to the inputs to, or outputs from, the functions and may be imposed either by external sources or by DOE/OCRWM. The numbering convention used for the identification of requirements in these tables is as follows: for example, 1.3C1: the first constraint (C) assigned to Function 1.3; 1.3P1: the first performance requirement (P) assigned to Function 1.3; and 1.3O3a: the first (a) requirement assigned to output (O) 3 from Function 1.3. Each requirement that has been extracted from a source document has the appropriate reference noted. Others that have not yet been firmly decided are noted as "TBD", or "No requirements specified at this time". Note that any reference to an appendix, a different section number or paragraph number within a particular requirement refers to the appendix, section or paragraph in the source document itself.

OCRWM recognizes that this initial version of the overall system requirements document contains a limited number of performance requirements and no state and local regulatory requirements. Furthermore, many of the interfaces currently have no requirements specified, pending future decisions to be made by OCRWM management on the basis of the results of both prior and future systems studies. Subsequent revisions to Physical System Requirements/Functional Analysis documents will include additional specific requirements as they are identified and resolved. To be included, performance and interface requirements tied to quality affecting activities must be (or have been) developed under a Quality Assurance (QA) program which meets the requirements of 10 CFR 50 Appendix B and NQA-1 and documented under an acceptable decision record format.

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 manage and dispose of the nation's spent fuel and high-level radioactive waste in a manner that protects the health and safety of the public and of workers and the quality of the environment. In order to accomplish this mission, DOE is developing a waste management system which will accept, transport, store, and dispose of spent nuclear fuel and high-level radioactive waste in a geologic repository in a timely manner.

The NWPA 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. [NWPA Sec. 2 (23) and (12)]

IV. Interfaces:

A. Inputs:

1.I1	SNF	**From:** Purchaser
1.I2	CHLW	**From:** Producer
1.I3	DHLW	**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.
[NWPA 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)]

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)]

Table F1.1 Function Description: Accept Waste

I. Function ID Number: 1.1

II. Function Title: Accept Waste

III. Function Definition:

... 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, ... [NWPA Sec. 302 (a)(1)]

The transfer of custody, f.o.b. carrier, of spent nuclear fuel or high-level radioactive waste from Purchaser to DOE at the Purchaser's civilian nuclear power reactor or such other domestic site as may be designated by the Purchaser ... [10 CFR Part 961, Subpart B, Article I, Definitions Para 7]

IV. Interfaces:

A. Inputs:

1.1I1	SNF	**From:**	Purchaser
1.1I2	CHLW	**From:**	Producer
1.1I3	DHLW	**From:**	Producer
1.1I4	Empty Cask/Carriage	**From:**	Function 1.2

B. Outputs:

1.1O1	Loaded SNF Cask/Carriage	**To:**	Function 1.2
1.1O2	Loaded CHLW Cask/Carriage	**To:**	Function 1.2
1.1O3	Loaded DHLW Cask/Carriage	**To:**	Function 1.2

V. Function Requirements:

A. Constraints:

1.1C1 This requirement intentionally left blank.

1.1C2 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 or spent nuclear fuel involved as expeditiously as practicable upon the request of the generator or owner of such waste or spent fuel; ...
[NWPA Sec. 302(a)(5)(A)]

1.1C3 This requirement intentionally left blank.

B. Performance:

1.1P1 ... The services to be provided by DOE under this contract shall begin, after commencement of facility operations, not later than January 31, 1998 and shall continue until such time as all SNF and/or HLW from the civilian nuclear power reactors specified in Appendix A, annexed hereto and made a part hereof, has been disposed of.
[10 CFR 961.11, II]

1.1P2 ... target for spent-fuel acceptance in 1998.
[DOE/RW-0247]

C. Interface:

1.1I1a This requirement intentionally left blank.

1.1I1b The Purchaser shall deliver to DOE and DOE shall, as provided in this contract, accept the SNF ... which is described in accordance with Article VI.A. of this contract, for disposal thereof.

[10 CFR 961.11, V.A.]

1.1I1c Except as otherwise provided in this contract, DOE shall accept hereunder only such SNF ... which meets the General Specifications for such fuel ... as set forth in Appendix E, annexed hereto and made a part hereof.

[10 CFR 961.11, VI.A.1.(a)]

1.1I1d The SNF acceptance rate will be in accordance with Appendix F of this document.
[TBD, pending DOE/OCRWM decision]

1.1I2a This requirement intentionally left blank.

1.1I2b The Purchaser shall deliver to DOE and DOE shall, as provided in this contract, accept the ... HLW which is described in accordance with Article VI.A. of this contract, for disposal thereof.

[10 CFR 961.11, V.A.]

1.1I2c Except as otherwise provided in this contract, DOE shall accept hereunder only such ... HLW which meets the General Specifications for such ... waste as set forth in Appendix E **[10 CFR 961]**, annexed hereto and made a part hereof.

[10 CFR 961.11, VI.A.1.(a)]

1.1I2d The CHLW acceptance rate will be in accordance with Appendix F of this document.
[TBD, pending DOE/OCRWM decision]

1.1I2e The acceptance MOA for HLW from WVDP is TBD.
[TBD, pending DOE/OCRWM decision]

1.1I3 The DHLW acceptance rate will be in accordance with Appendix F of this document.
[TBD, pending DOE/OCRWM decision]

1.1I4 DOE shall arrange for, and provide, a cask(s) and all necessary transportation of the SNF and/or HLW from the Purchaser's site to the DOE facility. Such cask(s) shall be furnished sufficiently in advance to accommodate scheduled deliveries. Such cask(s) shall be suitable for use at the Purchaser's site, meet applicable regulatory requirements, and be accompanied by pertinent information including, but not limited to, the following: (a) written procedures for cask handling and loading, including specifications on Purchaser-furnished canisters for containment of failed fuel; (b) Training for Purchaser's personnel in cask handling and loading, as may be necessary; (c) Technical information, special tools, equipment, lifting trunnions, spare parts and consumables needed to use and perform incidental maintenance on the cask(s); and (d) Sufficient documentation on the equipment supplied by DOE.

[10 CFR 961.11, IV.B.2.]

1.1O1 Requirements at this level to be specified.

1.1O2 Requirements at this level to be specified.

1.1O3 Requirements at this level to be specified.

Table F1.2 Function Description: Transport Waste

I. Function ID Number: 1.2

II. Function Title: Transport Waste

III. Function Definition:

The movement of accepted waste and empty casks from designated delivery sites (according to 10 CFR 961, and MOA between DP and RW) to a DOE NWMS facility and/or between DOE NWMS facilities; and empty casks to designated delivery sites and/or between DOE NWMS facilities.

IV. Interfaces:

A. Inputs:

1.2I1	Loaded SNF Cask/Carriage	**From:**	Functions 1.1/1.3
1.2I2	Loaded CHLW Cask/Carriage	**From:**	Function 1.1
1.2I3	Loaded DHLW Cask/Carriage	**From:**	Function 1.1
1.2I4	Empty Cask/Carriage	**From:**	Functions 1.3/1.4

B. Outputs:

1.2O1	Loaded SNF Cask/Carriage	To:	Functions 1.3/1.4
1.2O2	Loaded CHLW Cask/Carriage	To:	Function 1.4
1.2O3	Loaded DHLW Cask/Carriage	To:	Function 1.4
1.2O4	Empty Cask/Carriage	To:	Functions 1.1/1.3
1.2O5	Federally-Permitted Radiation Exposure	To:	Accessible Environment
1.2O6	Federally-Permitted Release of Radionuclides	To:	Accessible Environment

V. Function Requirements:

A. Constraints:

1.2C1 This requirement intentionally left blank.

1.2C2 No spent nuclear fuel or high-level radioactive waste may be transported by or for the Secretary under subtitle A or under subtitle C except in packages that have been certified for such purpose by the Commission.

[NWPA Sec. 180(a)]

1.2C3 (b) The Secretary shall abide by regulations of the Commission regarding advance notification of State and local governments prior to transportation of spent nuclear fuel or high-level radioactive waste under subtitle A or under subtitle C.

(c) The Secretary shall provide technical assistance and funds to States for training for public safety officials of appropriate units of local government and Indian tribes through whose jurisdiction the Secretary plans to transport spent nuclear fuel or high-level radioactive waste under subtitle A or under subtitle C. Training shall cover procedures required for safe routine transportation of these materials, as well as procedures for dealing with emergency

response situations. The Waste Fund shall be the source of funds for work carried out under this subsection.

[NWPA Sec. 180]

1.2C4 Except as provided in paragraph (c) of this section, a package used for the shipment of fissile material must be so designed and constructed and its contents so limited that it would be subcritical if water were to leak into the containment system or liquid contents were to leak out of the containment system so that, under the following conditions, maximum reactivity of the fissile material would be attained:

(1) The most reactive credible configuration consistent with the chemical and physical form of the material;

(2) Moderation by water to the most reactive credible extent; and

(3) Close reflection by water on all sides.

[10 CFR 71.55(b)]

1.2C5 A licensee subject to this part, who under a general or specific license transports licensed material or delivers licensed material to a carrier for transport, shall comply with the requirements of this Subpart G, with the quality assurance requirements of Subpart H of this part, and with the general provisions of Subpart A of this part.

[10 CFR 71.81]

1.2C6 The shipment will be made in full compliance with applicable Federal regulations and in accord with procedures established by RW for spent fuel and defense waste transfer to a repository. All transportation activities pertaining to defense wastes by RW will be coordinated with DOE's Transportation Management Division to ensure as a minimum that the intent of DOE Orders for transportation safety, security, environmental acceptability, and economy are met.

[MOA between DP and RW, 1986]

B. Performance:

1.2P1 This requirement intentionally left blank.

1.2P2 All shipments from the MRS facility to the repository would be made exclusively by rail in dedicated trains...

[DOE/RW-0239, Sec. 3]

C. Interface:

1.2I1 The SNF transportation rate will be in accordance with Appendix F of this document.

[TBD, pending DOE/OCRWM decision]

1.2I2 The CHLW transportation rate will be in accordance with Appendix F of this document.

[TBD, pending DOE/OCRWM decision]

1.2I3 The DHLW transportation rate will be in accordance with Appendix F of this document.

[TBD, pending DOE/OCRWM decision]

1.2I4 No requirements specified at this time

1.2O1 The SNF transportation rate will be in accordance with Appendix F of this document.
[TBD, pending DOE/OCRWM decision]

1.2O2 The CHLW transportation rate will be in accordance with Appendix F of this document.
[TBD, pending DOE/OCRWM decision]

1.2O3 The DHLW transportation rate will be in accordance with Appendix F of this document.
[TBD, pending DOE/OCRWM decision]

1.2O4 DOE shall arrange for, and provide, a cask(s) and all necessary transportation of the SNF and/or HLW from the Purchaser's site to the DOE facility. Such cask(s) shall be furnished sufficiently in advance to accommodate scheduled deliveries. Such cask(s) shall be suitable for use at the Purchaser's site, meet applicable regulatory requirements, and be accompanied by pertinent information including, but not limited to, the following: (a) written procedures for cask handling and loading, including specifications on Purchaser-furnished canisters for containment of failed fuel; (b) Training for Purchaser's personnel in cask handling and loading, as may be necessary; (c) Technical information, special tools, equipment, lifting trunnions, spare parts and consumables needed to use and perform incidental maintenance on the cask(s); and (d) Sufficient documentation on the equipment supplied by DOE.
[10 CFR 961.11, IV.B.2]

1.2O5 A package must be designed and prepared for shipment so that the radiation level does not exceed 200 millirem per hour at any point on the external surface of the package and the transport index does not exceed 10 (See 71.4 "Definitions"). For a package transported as exclusive use by rail, highway, or water, radiation levels external to the package may exceed those limits, but must not exceed any of the following:

(a) 200 millirem/hour on the accessible external surface of the package unless the following conditions are met, in which case the limit is 1000 millirem per hour:

(1) The shipment is made in a closed transport vehicle;

(2) Provisions are made to secure the package so that its position within the vehicle remains fixed during transportation; and

(3) There are no loading or unloading operations between the beginning and end of the transportation;

(b) 200 millirem/hour at any point on the outer surface of the vehicle, including the upper and lower surfaces, or, in the case of an open vehicle, at any point on the vertical planes projected from the outer edges of the vehicle, on the upper surface of the load, and on the lower external surface of the vehicle;

(c) 10 millirem/hour at any point two meters from the vertical planes represented by the outer lateral surfaces of the vehicle, or, in the case of an open vehicle, at any point two meters from the vertical planes projected from the outer edges of the conveyance; and

(d) Two millirem/hour in any normally occupied positions of the vehicle, except that this provision does not apply to private motor carriers when persons occupying these positions are provided with special health supervision, personnel radiation exposure monitoring devices, and training in accordance with 19.12 of this chapter.
[10 CFR 71.47]

1.2O6 (i)(1) The level of non-fixed (removable) radioactive contamination on the external surfaces of each package offered for shipment is as low as reasonably achievable. The level of non-fixed radioactive contamination may be determined by wiping an area of 300 square centimeters of the surface concerned with an absorbent material, using moderate pressure, and measuring the activity on the wiping material. Sufficient measurements must be taken in the most appropriate locations to yield a representative assessment of the non-fixed contamination levels. Except as provided under paragraph (i)(2) of this section, the amount

of radioactivity measured on any single wiping material when averaged over the surface wiped, must not exceed the limits given in Table V of this part at any time during transport. Other methods of assessment of equal or greater efficiency may be used. When other methods are used, the detection efficiency of the method used must be taken into account and in no case may the non-fixed contamination on the external surfaces of the package exceed ten times the limits listed in Table V.

Table V -- Removable External Radioactive Contamination Wipe Limits

Contaminant	Maximum permissible limits	
	$\mu Ci/cm^2$	dpm/cm^2
Beta-gamma emitting radionuclides; all radionuclides with half-lives less than ten days; natural uranium; natural thorium; uranium-235; uranium-238; thorium-232; thorium-228 and thorium-230 when contained in ores or physical concentrates	10^{-5}	22
All other alpha emitting radionuclides	10^{-6}	2.2

(2) In the case of packages transported as exclusive use shipments by rail or highway only, the non-fixed radioactive contamination at any time during transport must not exceed ten times the levels prescribed in paragraph (i)(1) of this section. The levels at the beginning of transport must not exceed the levels prescribed in paragraph (i)(1) of this section;
[10 CFR 71.87(i)]

Table F1.3 Function Description: Store Waste

I. Function ID Number: 1.3

II. Function Title: Store Waste

III. Function Definition:

"To store spent nuclear fuel, in a manner that protects the health and safety of the public and maintains the quality of the environment, with the intent to recover such fuel for subsequent disposal."

The term storage means retention of ... spent nuclear fuel ... with the intent to recover such waste or fuel for subsequent use, processing or disposal. [NWPA Sec. 2.(25)]

...including meeting needs for packaging and handling of spent nuclear fuel, improving the flexibility of the repository development schedule, and providing temporary storage of spent nuclear fuel accepted for disposal. [NWPA Sec. 143(a)(1)(C)(iv)]

IV. Interfaces:

A. Inputs:

1.3I1	Loaded SNF Cask/Carriage	**From:**	Function 1.2
1.3I2	Empty Cask/Carriage	**From:**	Function 1.2

B. Outputs:

1.3O1	Loaded SNF Cask/Carriage	**To:**	Function 1.2
1.3O2	Empty Cask/Carriage	**To:**	Function 1.2
1.3O3	Federally-Permitted Radiation Exposure	**To:**	Accessible Environment
1.3O4	Federally-Permitted Release of Radionuclides	**To:**	Accessible Environment

V. Function Requirements:

A. Constraints:

1.3C1 ...the construction of one or more monitored retrievable storage facilities for ... spent nuclear fuel. ... (A) to accommodate spent nuclear fuel ... resulting from civilian nuclear activities; (B) to permit continuous monitoring, management, and maintenance of such spent fuel ... for the foreseeable future; (C) to provide for the ready retrieval of such spent fuel ... for further processing or disposal; and (D) to safely store such spent fuel and waste as long as may be necessary by maintaining such facility through appropriate means, including any required replacement of such facility.

[NWPA Sec. 141(b)(1)]

1.3C2 The Secretary is authorized to site, construct, and operate one monitored retrievable storage facility subject to the conditions described in sections 143 through 149.

[NWPA Sec. 142(b)]

1.3C3 the quantity of spent nuclear fuel ... at the site of such facility at any one time may not exceed 10,000 metric tons of heavy metal until a repository under this Act first accepts spent nuclear fuel or solidified high-level radioactive waste; ...

[NWPA Sec. 148(d)(3)]

1.3C4 the quantity of spent nuclear fuel ... at the site of such facility at any one time may not exceed 15,000 metric tons of heavy metal.

[NWPA Sec. 148(d)(4)]

1.3C5 ... The license term for an MRS must not exceed 40 years from the date of issuance...

[10 CFR 72.42(a)]

1.3C6 The quantity of spent nuclear fuel ... at the site of the MRS at any one time may not exceed 10,000 metric tons of heavy metal until a repository authorized under NWPA and Part 60 of this chapter first accepts spent nuclear fuel or solidified high-level radioactive waste; ...

[10 CFR 72.44(g)(3)]

1.3C7 The quantity of spent nuclear fuel ... at the site of the MRS at any one time may not exceed 15,000 metric tons of heavy metal.

[10 CFR 72.44(g)(4)]

1.3C8 (c) If an MRS is located, or is planned to be located, within 50 miles of the first HLW repository, any Commission decision approving the first HLW repository application must limit the quantity of spent fuel or high-level radioactive waste that may be stored. This limitation shall prohibit the storage of a quantity of spent fuel containing in excess of 70,000 metric tons of heavy metal, or a quantity of solidified high-level radioactive waste resulting from the reprocessing of such a quantity of spent fuel, in both the repository and the MRS until such time as a second repository is in operation.

(d) An MRS authorized by section 142(b) of NWPA (101 Stat. 1330-232, 42 U.S.C. 10162(b)) may not be constructed in the State of Nevada. The quantity of spent nuclear fuel or high-level radioactive waste that may be stored at an MRS authorized by section 142(b) of NWPA shall be subject to the limitations in Section 72.44(g) of this part instead of the limitations in paragraph (c) of this section.

[10 CFR 72.96]

1.3C9 (a) For each ... MRS site, a controlled area must be established.

(b) ... The minimum distance from the spent fuel ... handling and storage facilities to the nearest boundary of the controlled area shall be at least 100 meters.

(c) The controlled area may be traversed by a highway, railroad or waterway, so long as appropriate and effective arrangements are made to control traffic and to protect public health and safety.

[10 CFR 72.106]

1.3C10 The MRS must be designed to store ... spent fuel ... . Liquid high-level radioactive wastes may not be received or stored in an MRS. If the MRS is a water-pool type facility, the solidified waste form shall be a durable solid with demonstrable leach resistance.

[10 CFR 72.120(b)]

1.3C11 (a) Design for criticality safety. Spent fuel handling, packaging, transfer, and storage systems must be designed to be maintained subcritical and to ensure that, before a nuclear criticality accident is possible, at least two unlikely, independent, and concurrent or sequential changes have occurred in the conditions essential to nuclear criticality safety. The design of handling, packaging, transfer, and storage systems must include margins of safety for the nuclear criticality parameters that are commensurate with the uncertainties in the data and methods used in calculations and demonstrate safety for the handling, packaging, transfer, and storage conditions and in the nature of the immediate environment under accident conditions.

(b) Methods of criticality control. When practicable the design of an ... MRS must be based on favorable geometry, permanently fixed neutron absorbing materials (poisons), or both. Where solid neutron absorbing materials are used, the design shall provide for positive means to verify their continued efficacy.

[10 CFR 72.124]

1.3C12 Each licensee[2] shall establish, maintain, and execute a quality assurance program satisfying each of the applicable criteria of this subpart, and satisfying any specific provisions which are applicable to the licensee's activities. The licensee shall execute the applicable criteria in a graded approach to an extent that is commensurate with the importance to safety. The quality assurance program must cover the activities identified in Sec. 72.24(n) throughout the life of the licensed activity, from the site selection through decommissioning, prior to termination of the license.

[2] While the term "licensee" is used in these criteria, the requirements are applicable to whatever design, construction, fabrication, assembly, and testing is accomplished with respect to structures, systems, and components prior to the time a license is issued.

[10 CFR 72.140(b)]

1.3C13 No monitored retrievable storage facility developed pursuant to this section may be constructed in any State in which there is located any site approved for site characterization under section 112[42 U.S.C. 10132]. The restriction in the preceding sentence shall only apply until such time as the Secretary decides that such candidate site no longer a candidate site under consideration for development as a repository. Such restriction shall continue to apply to any site selected for construction as a repository.

[NWPA Sec. 141 (g)]

1.3C14 construction of such facility may not begin until the Commission has issued a license for the construction of a repository under section 115(d) [42 U.S.C. 10135(d)]; ...

[NWPA Sec. 148 (d)(1)]

1.3C15 construction of such facility or acceptance of spent nuclear fuel ... shall be prohibited during such time as the repository license is revoked by the Commission or construction of the repository ceases; ...

[NWPA Sec. 148 (d)(2)]

1.3C16 Construction of the MRS may not begin until the Commission has authorized the construction of a repository under section 114(d) of NWPA (96 Stat. 2215, as amended by 101 Stat. 1330-230, 42 U.S.C 10134(d)) and Part 60 of this chapter; ...

[10 CFR 72.44 (g)(1)]

1.3C17 Construction of the MRS or acceptance of spent nuclear fuel ... at the MRS is prohibited during such time as the repository license is revoked by the Commission or construction of the repository ceases; ...

[10 CFR 72.44 (g)(2)]

B. Performance:

1.3P1 This requirement intentionally left blank.

1.3P2 ... and an initiative for establishing integrated monitored retrievable storage (MRS) with a target for spent-fuel acceptance in 1998.

[DOE/RW-0247]

1.3P3 Accept only spent-fuel at the MRS facility.

[DOE/RW-0239]

1.3P4 This requirement intentionally left blank.

1.3P5 Use dry storage as the preferred method of storage at an MRS.

[DOE/RW-0035, DOE/RW-0235]

C. Interface:

1.3I1 The SNF acceptance rate, characteristics and transportation mode to the MRS installation will be in accordance with Appendix F of this document.

[TBD, pending DOE/OCRWM decision]

1.3I2 Requirements at this level to be specified.

1.3O1 Requirements at this level to be specified.

1.3O2 Requirements at this level to be specified.

1.3O3a Management and storage of spent nuclear fuel ... at all facilities regulated by the Commission or by Agreement States shall be conducted in such a manner as to provide reasonable assurance that the combined annual dose equivalent to any member of the public in the general environment resulting from:

(1) Discharges of radioactive material and direct radiation from such management and storage and

(2) all operations covered by Part 190; shall not exceed 25 millirems to the whole body, 75 millirems to the thyroid, and 25 millirems to any other critical organ.

[40 CFR 191.03(a)]

1.3O3b (a) During normal operations and anticipated occurrences, the annual dose equivalent to any real individual who is located beyond the controlled area must not exceed 25 mrem to the whole body, 75 mrem to the thyroid and 25 mrem to any other organ as a result of exposure to:

(1) Planned discharges of radioactive materials, radon and its decay products excepted, to the general environment,

(2) Direct radiation from ... MRS operations, and

(3) Any other radiation from uranium fuel cycle operations within the region.

(b) Operational restrictions must be established to meet as low as is reasonably achievable objectives for radioactive materials in effluents and direct radiation levels associated with ... MRS operations.

(c) Operational limits must be established for radioactive materials in effluents and direct radiation levels associated with ... MRS operations to meet the limits given in paragraph (a) of this section.

[10 CFR 72.104]

1.303c Any individual located on or beyond the nearest boundary of the controlled area shall not receive a dose greater than 5 rem to the whole body or any organ from any design basis accident...

[10 CFR 72.106 (b)]

1.304a Management and storage of spent nuclear fuel ... at all facilities regulated by the Commission or by Agreement States shall be conducted in such a manner as to provide reasonable assurance that the combined annual dose equivalent to any member of the public in the general environment resulting from:

(1) Discharges of radioactive material and direct radiation from such management and storage and

(2) all operations covered by Part 190; shall not exceed 25 millirems to the whole body, 75 millirems to the thyroid, and 25 millirems to any other critical organ.

[40 CFR 191.03(a)]

1.304b Each license authorizing the receipt, handling, and storage of spent fuel ... under this part must include technical specifications that, in addition to stating the limits on the release of radioactive materials for compliance with limits of Part 20 of this chapter and the "as low as is reasonably achievable" objectives for effluents, require that:

(1) Operating procedures for control of effluents be established and followed, and equipment in the radioactive waste treatment systems be maintained and used, to meet the requirements of 72.104;

(2) An environmental monitoring program be established to ensure compliance with the technical specifications for effluents;

[10 CFR 72.44(d)]

1.304c (a) During normal operations and anticipated occurrences, the annual dose equivalent to any real individual who is located beyond the controlled area must not exceed 25 mrem to the whole body, 75 mrem to the thyroid and 25 mrem to any other organ as a result of exposure to:

(1) Planned discharges of radioactive materials, radon and its decay products excepted, to the general environment,

(2) Direct radiation from ... MRS operations, and

(3) Any other radiation from uranium fuel cycle operations within the region.

(b) Operational restrictions must be established to meet as low as is reasonably achievable objectives for radioactive materials in effluents and direct radiation levels associated with ... MRS operations.

(c) Operational limits must be established for radioactive materials in effluents and direct radiation levels associated with ... MRS operations to meet the limits given in paragraph (a) of this section.

[10 CFR 72.104]

1.3O4d Any individual located on or beyond the nearest boundary of the controlled area shall not receive a dose greater than 5 rem to the whole body or any organ from any design basis accident.

[10 CFR 72.106 (b)]

1.3O4e ... MRS must be designed to provide means to limit to levels as low as is reasonably achievable the release of radioactive materials in effluents during normal operations; and control the release of radioactive materials under accident conditions. Analyses must be made to show that releases to the general environment during normal operations and anticipated occurrences will be within the exposure limit given in section 72.104. Analyses of design basis accidents must be made to show that releases to the general environment will be within the exposure limits given in section 72.106. Systems designed to monitor the release of radioactive materials must have means for calibration and testing their operability.

[10 CFR 72.126(d)]

Table F1.4 Function Description: Dispose of Waste

I. Function ID Number: 1.4

II. Function Title: Dispose of Waste

III. Function Definition:

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

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

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

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

IV. Interfaces:

A. Inputs:

1.4I1	Loaded SNF Cask/Carriage	**From:**	1.2
1.4I2	Loaded CHLW Cask/Carriage	**From:**	1.2
1.4I3	Loaded DHLW Cask/Carriage	**From:**	1.2

B. Outputs:

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

V. Function Requirements:

A. Constraints:

1.4C1 ... repositories that will provide a reasonable assurance that the public and the environment will be adequately protected from the hazards posed by high-level radioactive waste and such spent nuclear fuel as may be disposed of in a repository;
[NWPA Sec. 111 (b)(1)]

1.4C2 ... shall prohibit the emplacement in the first repository of a quantity of spent fuel containing in excess of 70,000 metric tons of heavy metal or a quantity of solidified high-level radioactive waste resulting from the reprocessing of such a quantity of spent fuel until such time as a second repository is in operation. In the event that a monitored retrievable storage facility, approved pursuant to subtitle C of this Act, shall be located, or is planned to be located, within 50 miles of the first repository, ... shall prohibit the emplacement of a quantity of spent fuel containing in excess of 70,000 metric tons of heavy metal or a quantity of solidified high-level radioactive waste resulting from the reprocessing of spent fuel in both the repository and monitored retrievable storage facility until such time as a second repository is in operation.
[NWPA Sec. 114(d)]

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]

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)]

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]

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]

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]

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]

1.4O1 No requirements specified at this time

1.4O2 Management and storage of spent nuclear fuel or high-level or transuranic radioactive wastes at all facilities regulated by the Commission or by Agreement States shall be conducted in such a manner as to provide reasonable assurance that the combined annual dose equivalent to any member of the public in the general environment resulting from:

(1) Discharges of radioactive material and direct radiation from such management and storage and

(2) all operations covered by Part 190; shall not exceed 25 millirems to the whole body, 75 millirems to the thyroid, and 25 millirems to any other critical organ.

[40 CFR 191.03(a)]

1.4O3a Management and storage of spent nuclear fuel or high-level or transuranic radioactive wastes at all facilities regulated by the Commission or by Agreement States shall be conducted in such a manner as to provide reasonable assurance that the combined annual dose equivalent to any member of the public in the general environment resulting from:

(1) Discharges of radioactive material and direct radiation from such management and storage and

(2) all operations covered by Part 190; shall not exceed 25 millirems to the whole body, 75 millirems to the thyroid, and 25 millirems to any other critical organ.

[40 CFR 191.03(a)]

1.4O3b (a) Disposal systems for spent nuclear fuel or high level or transuranic radioactive wastes shall be designed to provide a reasonable expectation, based upon performance assessments, that the cumulative releases of radionuclides to the accessible environment for 10,000 years after disposal from all significant processes and events that may affect the disposal system shall:

(1) Have a likelihood of less than one chance in 10 of exceeding the quantities calculated according to Table 1 (Appendix A): and

(2) Have a likelihood of less than one chance in 1,000 of exceeding ten times the quantities calculated according to Table 1 (Appendix A).

[40 CFR 191.13]

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

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

Application of Table 1

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

which is the same as:

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

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.

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.

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).

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:

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

[40 CFR 191.13, Appendix A]

1.4O3c (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)]

3.0 ARCHITECTURE DESCRIPTION

Architecture is defined herein to be that part of the physical system actually built, found, or selected to perform a function subject to its stated requirements. Figure 4 defines the architecture to the second level, which portrays the concepts that comprise a Nuclear Waste Management System. It indicates how DOE/OCRWM plans to satisfy its mission and it defines the basis for the next functional analysis iteration.

Tables A.1 - A.1.4 identify the specific requirements to be satisfied by each architectural concept, a rationale justifying the need for the architecture, and a description of the current concept.

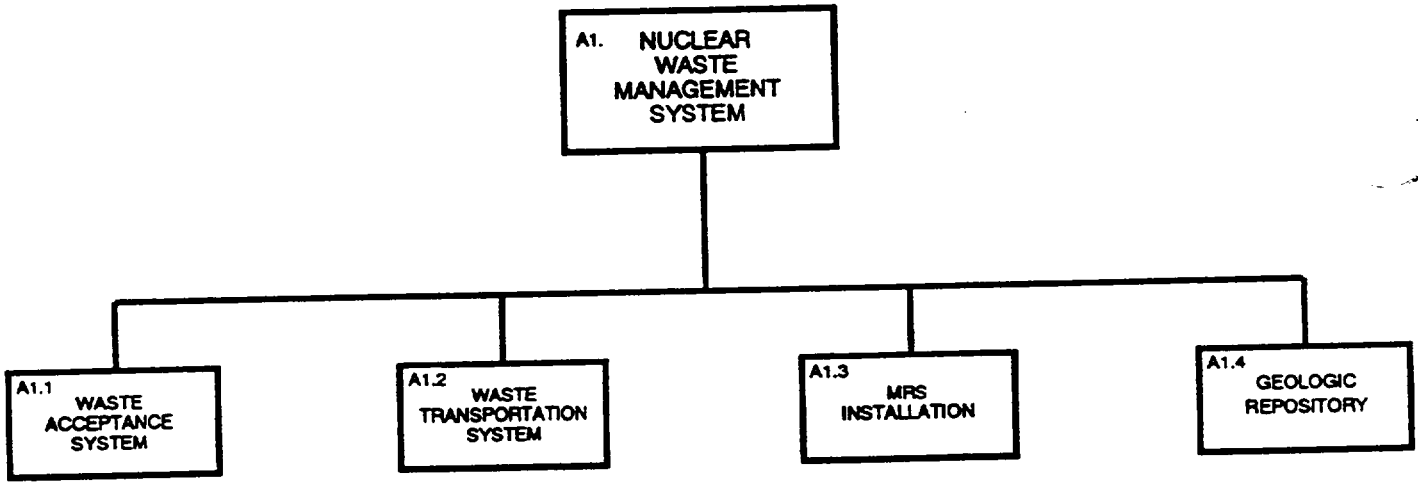

FIGURE 4. PHYSICAL SYSTEM ARCHITECTURE

Table A1. Nuclear Waste Management System

ARCHITECTURE: Nuclear Waste Management System

REQUIREMENTS SATISFIED:

1.C1 - 1.C5; 1.P1; 1.I1 - 1.I3; 1.O1, 1.O2

RATIONALE:

- ... to develop a technically sound integrated waste-management system ...

[DOE/RW-0247, Sec. 5]

DESCRIPTION:

- The Nuclear Waste Management System consists of the composite of the sites, and all facilities, systems, equipment, materials, information, activities, and the personnel required to perform those activities necessary to manage waste disposal.

Table A1.1 Waste Acceptance System

ARCHITECTURE: Waste Acceptance System

REQUIREMENTS SATISFIED:

1.1C1 - 1.1C3; 1.1P1, 1.1P2; 1.1I1 - 1.1I4; 1.1O1 - 1.1O5

RATIONALE:

- ... 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.

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

DESCRIPTION:

- Waste acceptance system will take legal and physical possession of the spent fuel and high level waste from its owners. The waste acceptance system establishes the baseline system interface requirements and determines the quantity, schedule and characteristics of waste to be accepted. The results define the inputs to the Transport Waste, Store Waste, and Dispose of Waste functions. It is the interface between the NWMS and the waste purchasers/producers that allows nuclear waste to enter the system.

Table A1.2 Waste Transportation System

ARCHITECTURE: Waste Transportation System

REQUIREMENTS SATISFIED:

1.2C1 - 1.2C6; 1.2P1, 1.2P2; 1.2I1 - 1.2I4; 1.2O1 - 1.2O6

RATIONALE:

• The Secretary, in providing for the transportation of spent nuclear fuel under this Act, shall utilize by contract private industry to the fullest extent possible in each aspect of such transportation.

[NWPA Sec. 137 (a)(2)]

DESCRIPTION:

• The transportation system will consist of (1) the cask system, which includes transportation casks suitable for use at the purchaser's/producer's sites, vehicular conveyances, tie-downs for securing the casks to transport vehicles, ancillary equipment, and associated handling equipment designed for use in the waste-management system; (2) the transportation support system, which may include a control center, maintenance facilities, and the services and equipment required to support waste transportation; and (3) operating procedures.

Table A1.3 Monitored Retrievable Storage Installation

ARCHITECTURE: Monitored Retrievable Storage Installation

REQUIREMENTS SATISFIED:

1.3C1 - 1.3C17; 1.3P1 - 1.3P5; 1.3I1, 1.3I2; 1.3O1 - 1.3O4

RATIONALE:

• Long-term storage of ... spent nuclear fuel in monitored retrievable storage facilities is an option for providing safe and reliable management of such waste or spent fuel.

[NWPA Sec. 141(a)(1)]

• ...waste acceptance at an MRS site could begin, on a limited basis, as early as January 1998; a full-capability MRS facility (i.e., a facility that would store spent fuel as necessary and stage spent-fuel shipments to the repository for final disposal), as recommended in the DOE's May 1989 statement to the MRS Commission, would be available in the year 2000.

[DOE/RW-0247 Sec. 2.7.2]

• The DOE ... supports the development of an MRS facility as an integral part of the waste-management system because an integrated MRS facility is critical to achieving the goal of early and timely acceptance of spent fuel and because it would allow the DOE to better meet other strategic objectives, such as timely disposal, schedule confidence, and system flexibility.

[DOE/RW-0247, Sec. 4.3]

• The concept preferred by the DOE is an integral MRS facility that is designed to allow development in stages. "Integral" means a facility that is fully integrated into a waste-management system in which all elements and components are optimized as part of a single system. It is an in-line facility that will receive commercial spent fuel, provide a limited amount of storage, provide staging for transportation to the repository, and perform other functions if determined necessary or desirable by future analyses.

[DOE/RW-0239, Sec. 3]

DESCRIPTION:

• "Monitored Retrievable Storage Installation" or "MRS" means a complex designed, constructed, and operated by DOE for the receipt, transfer, handling, packaging, possession, safeguarding, and storage of spent nuclear fuel aged for at least one year ... pending shipment to a HLW repository or other disposal.

[10 CFR 72.3]

Table A1.4 Geologic Repository

ARCHITECTURE: Geologic Repository

REQUIREMENTS SATISFIED:

1.4C1 - 1.4C7; 1.4P1, 1.4P2; 1.4I1 - 1.4I3; 1.4O1 - 1.4O3

RATIONALE:

• To provide for the development of repositories for the disposal of high-level radioactive waste and spent nuclear fuel,...

[NWPA Preamble]

• The DOE is committed to developing a geologic repository for spent fuel and high-level waste...

[DOE/RW-0247, Sec. 3]

DESCRIPTION:

• The term "repository" means any system licensed by the Commission that is intended to be used for, or may be used for, the permanent deep geologic disposal of high-level radioactive waste and spent nuclear fuel, whether or not such system is designed to permit the recovery, for a limited period during initial operation, of any materials placed in such system. Such term includes both surface and subsurface areas at which high-level radioactive waste and spent nuclear fuel handling activities are conducted.

[NWPA Sec. 2(18)]

• "Disposal System" means any combination of engineered and natural barriers that isolate spent nuclear fuel or radioactive waste after disposal.

[40 CFR 191.12(a)]

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.

Figure 5 shows the functional interfaces, both internal and external, at the second level of the function hierarchy. As depicted in the N-Square diagram (Figure 5), 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.

A more visual display of the interfaces is illustrated in the functional flow diagrams (Figures 6 and 7). Functional interfaces enter or exit a box containing a function as either inputs or outputs (see legend on illustration). A detailed list of inputs and outputs are provided in Appendix E. Each interface is automatically tracked through lower level functional flow diagrams, thus assuring both traceability and consistency in logic and material flows. To maintain legibility on these diagrams, inputs and outputs are tracked throughout the series of subordinate functional flow diagrams, but only key inputs/outputs, addressing the most important concepts at a particular function level, are explicitly shown on each diagram. Also, only the important controls and resources are shown at each level.

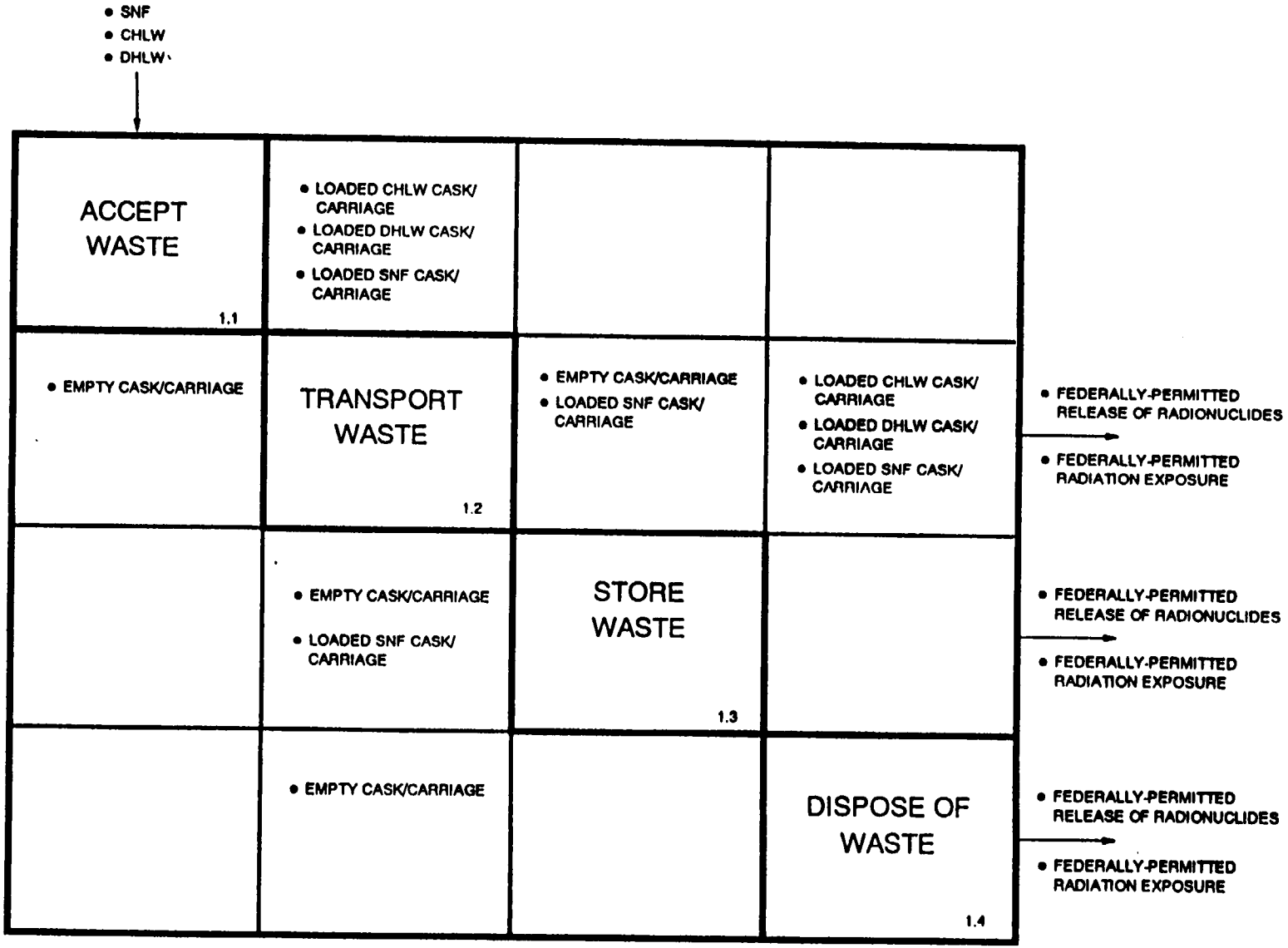

Figure 5. N-Square Chart for Second Level Functions

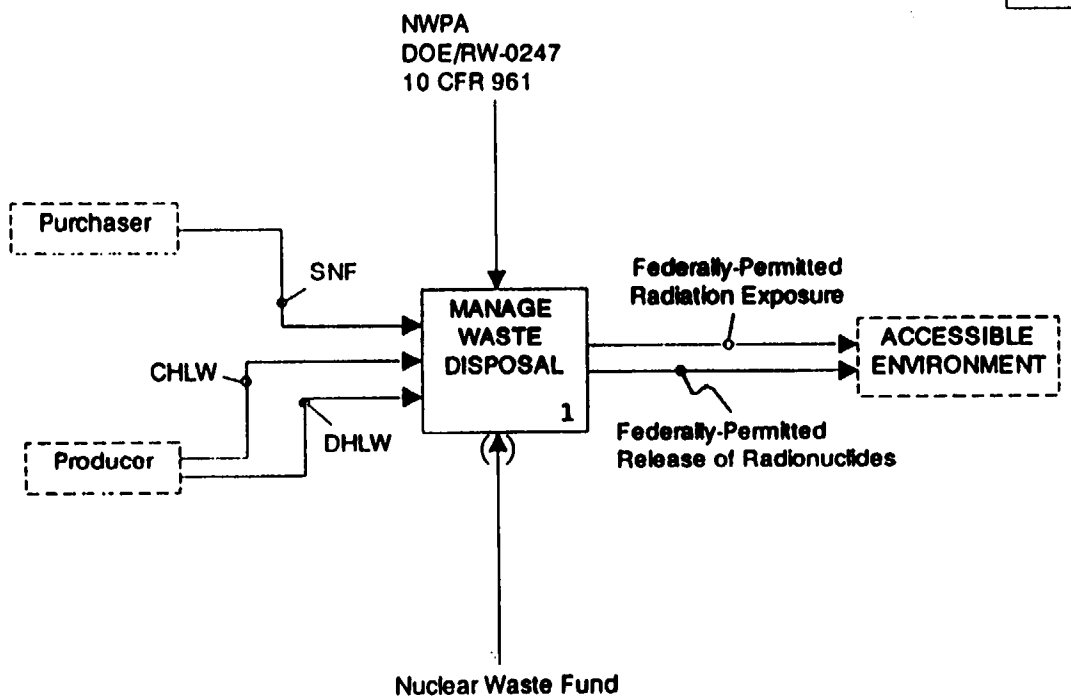

Figure 6. Nuclear Waste Management System Mission

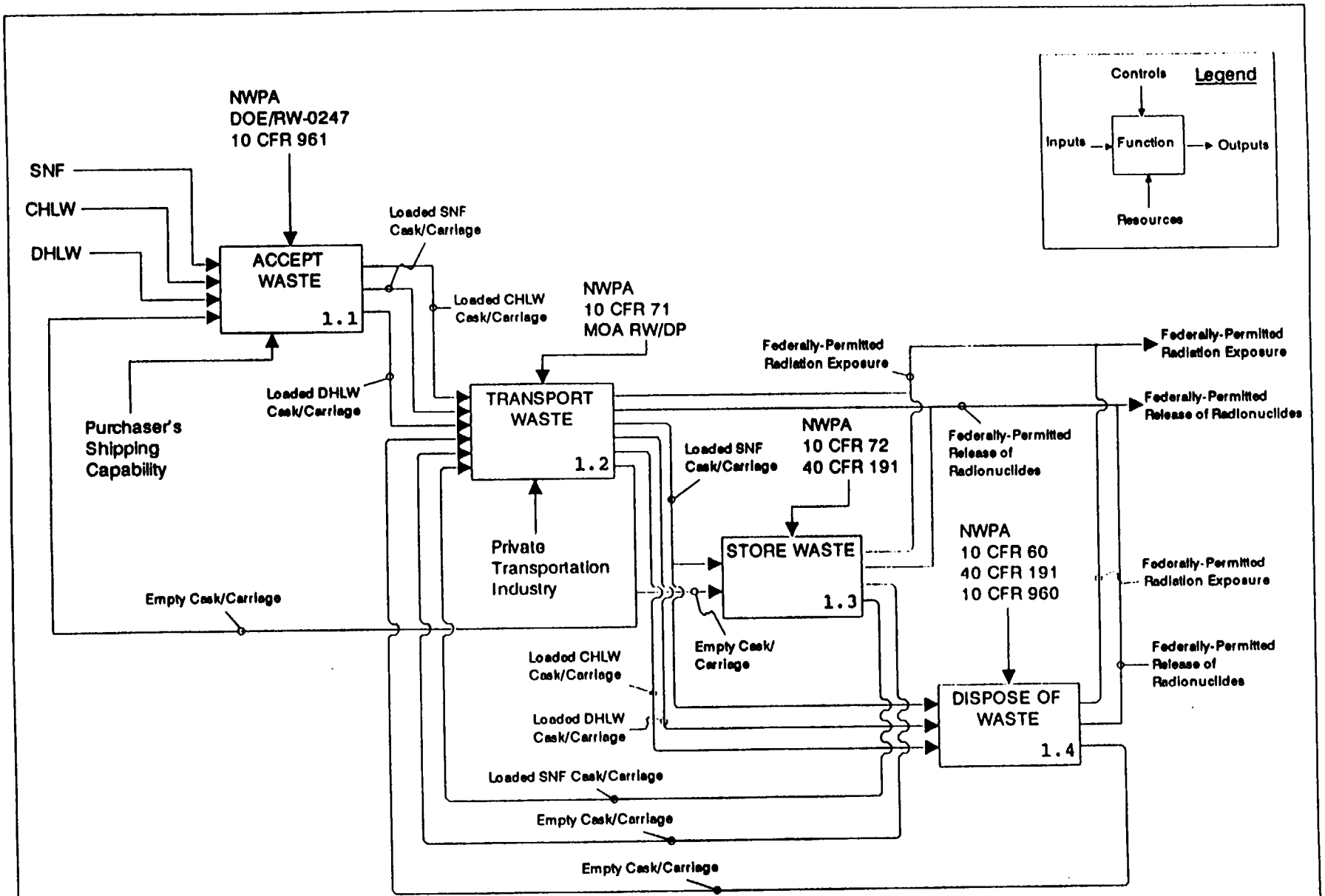

Figure 7. Manage Waste Disposal

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APPENDIX A

GLOSSARY

Accessible Environment - (1) The atmosphere, (2) the land surface, (3) surface water, (4) oceans, and (5) the portion of the lithosphere that is outside the controlled area. [10 CFR 60.2]

Architecture - That part of the physical system actually built, found, or selected to perform a function subject to its stated requirements.

As Low As Reasonably Achievable (ALARA) - As low as is reasonably achievable taking into account the state of technology, and the economics of improvement in relation to -

(1) Benefits to the public health and safety,
(2) Other societal and socioeconomic considerations, and
(3) The utilization of atomic energy in the public interest. [10 CFR 72.3]

Burnup - A measure of nuclear reactor fuel consumption expressed as the amount of energy produced per unit weight of fuel.

Carriage - The vehicle on which the Shipping Cask is transported. (i.e., truck trailer, rail, or barge).

Cask Maintenance Facility - A facility to maintain the cask system. The specific mission of the cask maintenance facility is to provide for the servicing, testing, maintenance, repair, modification, and configuration control of all cask system elements.

Commission - The Nuclear Regulatory Commission or its duly authorized representatives. [10 CFR 60.2; 10 CFR 72.3]

Civilian High-Level Radioactive Waste (CHLW) - The high-level radioactive waste, as defined by NWPA Sec. 2(12), resulting from atomic energy civilian activities.

Consolidation - The operation performed on spent fuel assemblies during which the upper and lower fuel assembly tie plates are removed, the assembly spacer grids and any other assembly structural members are removed, and the fuel tubes are collected and formed into a closely packed bundle in a canister. The nonfuel structural members of the fuel assemblies will be reduced in volume and placed in containers for shipment and disposal.

Constraint - A requirement imposed by the external environment (e.g., NRC), considered to be unchangeable.

Control - See constraint.

Controlled Area - (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)]

Controlled Area - A surface location, to be marked by suitable monuments, extending horizontally no more than 10 kilometers in any direction from the outer boundary of the underground facility, and the underlying subsurface, which area has been committed to use as a geologic repository and from which incompatible activities would be restricted following permanent closure. [10 CFR 60.2]

Controlled Area - That area immediately surrounding an ...MRS for which the licensee exercises authority over its use and within which ...MRS operations are performed. [10 CFR 72.3]

Defense High-Level Radioactive Waste (DHLW) - The high-level radioactive waste, as defined by NWPA Sec. 2(12), resulting from atomic energy defense activities.

Disposal - The isolation of radioactive wastes from the accessible environment [10 CFR 60.2]. Disposal means the emplacement in a repository of high-level radioactive waste, spent nuclear fuel, or other highly radioactive material with no foreseeable intent of recovery, whether or not such emplacement permits the recovery of such waste. [NWPA Sec. 2(9)]

Disposal System - Any combination of engineered and natural barriers that isolate spent nuclear fuel or radioactive waste after disposal. [40 CFR 191.12(a)]

Function - A primary statement of purpose; definition of what a system or subsystem must accomplish to meet the system mission.

Functional Analysis - As the first step in the Systems Engineering process, defines a baseline of functions and function performance requirements which must be met in order to adequately accomplish the operation, support, test, and production requirements of the system. [DSMC 6.1]

Functional Interface - The interaction between functions, as in the flow of material or information between a sequence of activities.

Geologic Repository - The term "repository" means any system licensed by the Commission that is intended to be used for, or may be used for, the permanent deep geologic disposal of high-level radioactive waste and spent nuclear fuel, whether or not such system is designed to permit the recovery, for a limited period during initial operation, of any

materials placed in such system. Such term includes both surface and subsurface areas at which high-level radioactive waste and spent nuclear fuel handling activities are conducted. "Disposal System" means any combination of engineered and natural barriers that isolate spent nuclear fuel or radioactive waste after disposal.

High-level Radioactive Waste (HLW) - (A) The highly radioactive material resulting from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and 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. [NWPA Sec. 2(12)]

High-level Radioactive Waste (HLW) - (1) Irradiated reactor fuel, (2) liquid wastes resulting from the operation of the first cycle solvent extraction system, or equivalent, and the concentrated wastes from subsequent extraction cycles, or equivalent, in a facility for reprocessing irradiated reactor fuel, and (3) solids into which such liquid wastes have been converted. [10 CFR 60.2]

Input - Anything that is acted upon by a function to produce desired outputs. Inputs can be classified as either internal or external. Inputs that originate from outside a particular system are considered to be external. Inputs that are outputs from functions within a particular system are considered to be internal.

Integral MRS facility - A facility that is fully integrated into a waste-management system in which all elements and components are optimized as part of a single system. It is an in-line facility that will receive commercial spent fuel, provide a limited amount of storage, provide staging for transportation to the repository, and perform other functions if determined necessary or desirable by future analyses. [DOE/RW-239]

Interface Requirement - A requirement which applies to the inputs to, or outputs from, the function.

Isolation - Inhibiting the transport of radioactive material so that amounts and concentrations of this material entering the accessible environment will be kept within prescribed limits. [10 CFR 60.2]

Monitored Retrievable Storage Installation (MRS) - A complex designed, constructed, and operated by DOE for the receipt, transfer, handling, packaging, possession, safeguarding, and storage of spent nuclear fuel aged for at least one year and solidified high-level radioactive waste resulting from civilian nuclear activities, pending shipment to a HLW repository or other disposal. [10 CFR 72.3]

Nuclear Waste Management System (NWMS) - Consists of the composite of the sites, and all facilities, systems, equipment, materials, information, activities, and the personnel required to perform those activities necessary to manage waste disposal.

Output - Anything that leaves a function or system.

Performance Requirement - A requirement established by OCRWM.

Physical Interface - The boundary at which physical systems interact, as in a necessary fit between architectures.

Physical System - The Nuclear Waste Management System (NWMS) consisting of the composite of the sites, and all facilities, systems, equipment, materials, information, activities, and the personnel required to perform those activities necessary to manage waste disposal.

Producer - Any generator of high-level radioactive waste resulting from atomic energy activities.

Purchaser - Any person, other than a Federal agency, who is licensed by the Nuclear Regulatory Commission to use a utilization or production facility under the authority of sections 103 or 104 of the Atomic Energy Act of 1954 (42 U.S.C. 2133, 2134) or who has title to spent nuclear fuel or high-level radioactive waste and who has executed a contract with DOE. [10 CFR 961.3]

Region - The geographical area surrounding and including the site, which is large enough to contain all the features related to a phenomenon or to a particular event that could potentially impact the safe or environmentally sound construction, operation, or decommissioning of an independent spent fuel storage or monitored retrievable storage installation. [10 CFR 72.3]

Repository - Any system licensed by the Commission that is intended to be used for, or may be used for, the permanent deep geologic disposal of high-level radioactive waste and spent nuclear fuel, whether or not such system is designed to permit the recovery, for a limited period during initial operation, of any materials placed in such system. Such term includes both surface and subsurface areas at which high-level radioactive waste and spent nuclear fuel handling activities are conducted. [NWPA Sec. 2(18)]

Requirement - A qualitative or quantitative statement of how well a function must be performed. Requirements may be of three types: Performance Requirements, Constraints, and Interface Requirements.

Resource - The people, material, or funds available to support the satisfaction of a function.

Retrieval - The act of intentionally removing radioactive waste from the underground location at which the waste had been previously emplaced for disposal. [10 CFR 60.2] (This definition applies to the Dispose of Waste function).

Shipping Cask - A container for shipping spent nuclear fuel and/or high-level radioactive waste which meets all applicable regulatory requirements.

Site - The real property on which the ...MRS is located [10 CFR 72.3]. The location of the controlled area [10 CFR 60.2].

Spent Nuclear Fuel (SNF) - Fuel that has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated by reprocessing. [NWPA Sec. 2(23); 10 CFR 961.11, I.18] Fuel that has been withdrawn from a nuclear reactor following irradiation, has undergone at least one year's decay since being used as a source of energy in a power reactor, and has not been chemically separated into its constituent elements by reprocessing. Spent fuel includes the special nuclear material, byproduct material, source material, and other radioactive materials associated with fuel assemblies. [10 CFR 72.3]

Storage - Retention of high-level radioactive waste, spent nuclear fuel, or transuranic waste with the intent to recover such waste or fuel for subsequent use, processing, or disposal. [NWPA Sec. 2(25)]

Systems Engineering - The management function which controls the total system development effort for the purpose of achieving an optimum balance of all system elements. It is a process which transforms an operational need into a description of system parameters and integrates those parameters to optimize the overall system effectiveness. [DSMC 1.3] Systems engineering is a sequence of activities and decisions that transforms an identified mission need into a description of system performance parameters and a preferred system configuration. [DOE ORDER 4700.1]

Systems Engineering Process - An iterative process applied throughout the acquisition life cycle. The process itself leads to a well defined, completely documented, and optimally balanced system. It does not produce the actual system itself, but rather, it produces the complete set of documentation, tailored to the needs of the specific program, which fully describes the system to be developed and produced. [DSMC 5.1]

Trade Study - A quantitative or qualitative parametric analysis of alternatives from which comparisons can be made to support the selection of the "better" alternative.

Waste Acceptance System - Waste acceptance system will take legal and physical possession of the spent fuel and high level waste from its owners. The waste acceptance system establishes the baseline system interface requirements and determines the quantity, schedule and characteristics of waste to be accepted. The results define the inputs to the Transport Waste, Store Waste, and Dispose of Waste functions. It is the interface between the NWMS and the waste purchasers/producers that allows nuclear waste to enter the system.

Waste Transportation System - The transportation system will consist of (1) the cask system, which includes transportation casks suitable for use at the purchaser's/producer's sites, vehicular conveyances, tie-downs for securing the casks to transport vehicles, ancillary equipment, and associated handling equipment designed for use in the waste-management system; (2) the transportation support system, which may include a control center, maintenance facilities, and the services and equipment required to support waste transportation; and (3) operating procedures.

APPENDIX B

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APPENDIX C

DECISION DOCUMENTATION

1. The decision to use dry storage as the preferred method of storage at an MRS.

[DOE/RW-0035, DOE/RW-0235]

2. The decision to include an MRS as an element of the Nuclear Waste Management System.

[DOE/RW-0239]

3. The decision to accept only spent-nuclear fuel at the MRS facility.

[DOE/RW-0239]

4. 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]

5. ...and an initiative for establishing integrated monitored retrievable storage (MRS) with a target for spent-fuel acceptance in 1998.

[DOE/RW-0247]

6. ...the start of repository operations is...2010.

[DOE/RW-0247]

APPENDIX D

ACRONYMS

AE	Accessible Environment
ALARA	As Low as Reasonably Achievable
CFR	Code of Federal Regulations
CHLW	Civilian High-Level Radioactive Waste
CRWM	Civilian Radioactive Waste Management
DE	Design Earthquake
DHLW	Defense High-Level Radioactive Waste
DOE	Department of Energy
DP	Office of Defense Programs, Department of Energy
DSMC	Defense Systems Management College
EPA	Environmental Protection Agency
ESF	Exploratory Studies Facility
f.o.b.	Freight on Board
GR	Generic Requirements
HLW	High-Level Radioactive Waste
IAEA	International Atomic Energy Agency
ISFSI	Independent Spent Fuel Storage Installation
MOA	Memorandum of Agreement
MRS	Monitored Retrievable Storage
MSIS	Management Systems Improvement Strategy
MTHM	Metric Tons of Heavy Metal
MTU	Metric Tons of Uranium
MWd	Megawatt Days
NEPA	National Environmental Policy Act
NRC	Nuclear Regulatory Commission
NWMS	Nuclear Waste Management System
NWPA	Nuclear Waste Policy Act
OCRWM	Office of Civilian Radioactive Waste Management
PNL	Pacific Northwest Laboratory
PP	Purchaser and/or Producer
QA	Quality Assurance
RW	Office of Civilian Radioactive Waste Management
SNF	Spent Nuclear Fuel
TBD	To Be Determined
TRU	Transuranic
USC	United States Code
WMSR	Waste Management System Requirements (Document)
WVDP	West Valley Demonstration Project

APPENDIX E

INTERFACES

INTERFACE CONTROL #	FROM	TO	OUTPUT/INPUT TITLE	OUTPUT/INPUT ID#
PP[1]/1.1	Purchaser and/or Producer	Accept Waste	SNF CHLW DHLW	1.111 1.112 1.113
1.1/1.2	Accept Waste	Transport Waste	Loaded SNF Cask/Carriage Loaded CHLW Cask/Carriage Loaded DHLW Cask/Carriage	1.101/1.211 1.102/1.212 1.103/1.213
1.2/1.1	Transport Waste	Accept Waste	Empty Cask/Carriage	1.204/1.114
1.2/1.3	Transport Waste	Store Waste	Loaded SNF Cask/Carriage Empty Cask/Carriage	1.201/1.311 1.204/1.312
1.2/1.4	Transport Waste	Dispose of Waste	Loaded SNF Cask/Carriage Loaded CHLW Cask/Carriage Loaded DHLW Cask/Carriage	1.201/1.411 1.202/1.412 1.203/1.413

[1] PP means Purchaser and/or Producer

INTERFACES (con't)

INTERFACE CONTROL #	FROM	TO	OUTPUT/INPUT TITLE	OUTPUT/INPUT ID#
1.2/AE [2]	Transport Waste	Accessible Environment	Federally-Permitted Radiation Exposure	1.205
			Federally-Permitted Release of Radionuclides	1.206
1.3/1.2	Store Waste	Transport Waste	Loaded SNF Cask/Carriage	1.301/1.211
			Empty Cask/Carriage	1.302/1.214
1.3/AE	Store Waste	Accessible Environment	Federally-Permitted Radiation Exposure	1.303
			Federally-Permitted Release of Radionuclides	1.304
1.4/1.2	Dispose of Waste	Transport Waste	Empty Cask/Carriage	1.401/1.214
1.4/AE	Dispose of Waste	Accessible Environment	Federally-Permitted Radiation Exposure	1.402
			Federally-Permitted Release of Radionuclides	1.403

[2] AE means Accessible Environment

APPENDIX F

WASTE ACCEPTANCE SCHEDULE

	Annual Waste Acceptance Rate			Annual Waste Transportation Rate				Waste Storage Inventory	Waste Disposal Inventory		
				Accept-Store	Accept-Dispose		Store-Dispose				
Year	SNF	CHLW	DHLW	SNF	SNF	CHLW	DHLW	SNF	SNF	CHLW	DHLW
1998									.	.	.
1999									.	.	.
2000									.		
2001									.	.	.
2002									.	.	.
2003									.	.	.
2004									.	.	.
2005									.	.	.
2006									.	.	.
2007									.	.	.
2008									.	.	.
2009									.	.	.
2010									.	.	.
.											
.											
.											

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