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Office of Civilian Radioactive Waste Management

Civilian Radioactive Waste Management System

Waste Acceptance System Requirements Document

Revision 5, ICN 01

Effective Date: 3/10/08

Preparer: S. Gomberg — Date: 3/7/08

Approval: C.A. Kouts, Director, Waste Management Office — Date: 3/7/08

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OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT PROGRAM
BASELINE CHANGE CONTROL BOARD
REVISION/CHANGE RECORD

Document Number: DOE/RW-0351
Document Title: Waste Acceptance System Requirements Document

Rev/DCN Number & Date	BCP Number	Revision/Change Description	Sections Affected
Rev. 00 January 1993	Program Change Dir. No. 67	Initial issue.	All
Rev. 01 March 1994	BCP-00-94-0001	Incorporated the Multi-Purpose Canister (MPC) concept into the CRWMS technical baseline.	All
Rev. 01, DCN 01 May 1995	BCP-00-94-0005	Resolved issues needed for the procurement of the MPC system.	Misc.
Rev. 02 May 1996	BCP-00-94-0005	General revision to incorporate the Program Approach.	All
Rev. 02, DCN 01 June 1996	BCP-00-96-0002	Incorporated MPC Policy Change - The CRWMS will accept and accommodate a variety of cask/canister systems for commercial SNF that are currently available or are being developed. These may be individual spent fuel assemblies or single, dual, or triple purpose cask or canister systems. The existing MPC design, if deployed, will be in accordance with the MPC procurement specification.	Misc.
Rev. 02, DCN 02 December 1996	BCP-00-96-0009	Streamlined Requirements Documents - The Waste Acceptance System Requirements Document (WASRD), Storage SRD, and Transportation SRD are transferred to the Waste Acceptance, Storage, and Transportation (WAST) Project (Level II).	All
Rev. 03 April 1999	BCP-00-99-0001	Transferred acceptance requirements for government-owned nuclear materials from the Civilian Radioactive Waste Management System Requirements Document (CRD) to the WASRD and update changes in Waste Acceptance policy.	All
Rev. 04 March 2002	ATI-2002-003	Moved dimensional values from WASRD to ICD, Vol. 2 (in development). Added Technical Information Needs Section. Revised requirements to be less prescriptive and more performance based. Reorganized requirements by waste stream type.	All
Rev. 5 31 May 2007	PMA-2007-006	• Upgraded from interim change to full revision; • Expanded Purpose and added Scope section; • Deleted paragraph and bullet list related to transportation responsibilities. Removed storage facility portion of Figure 2; • Added list of requirements allocated to Waste Acceptance element by CRD;	Title page 1.1 1.3 3.2

OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT PROGRAM BASELINE CHANGE CONTROL BOARD REVISION/CHANGE RECORD			
Document Number: DOE/RW-0351 **Document Title: Waste Acceptance System Requirements Document**			
Rev/DCN Number & Date	**BCP Number**	**Revision/Change Description**	**Sections Affected**
Rev. 5 31 May 2007, Continued		• Restored requirement that waste be in solid form	4.2.4
		• Added text related to information management of difficult to quantify variables such as particulate and water content	4.2.5
		• Added note redirecting reader to IICD-1;	4.2.7
		• Added new requirement regarding compliance with 10 CFR Part 21;	4.2.11
		• Added new requirement regarding nonconforming materials;	4.2.12
		• Updated criticality requirement (in response to TDL 06-010, dated 03/16/2006);	4.3.8, 4.4.8, & 4.8.11
		• Updated thermal values;	4.3.9, 4.4.8, & 4.8.11.
		• All TBVs used in previous versions of the WASRD have been resolved by the acceptance and approval of various, related design documents. Deleted TBV citations and log;	pg *viii*, and 4.3.8, 4,3,9, 4.4.8, 4.4.9, 4.5.2.B (deleted), 4.5.3.B (deleted), 4.5.13A (deleted), 4.5.15 9deleted), 4.8.6, 4.8.11, 4.8.13, 4.9.6.C (deleted), 4.9.6.D (deleted), & Appendix C (deleted)
		• Revised introductory paragraph;	4.4
		• Incorporated changes requested by NNPP at Apr 2004 conference;	4.4
		• Substituted NNPP Technical Baseline Compliance Document preclosure and post closure language in Section 4.4.8;	4.4.8
		• Deleted requirement 4.4.8.B because it was redundant with requirement 4.4.18;	4.4.8.B (deleted)

OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT PROGRAM BASELINE CHANGE CONTROL BOARD REVISION/CHANGE RECORD			
Document Number: DOE/RW-0351 **Document Title: Waste Acceptance System Requirements Document**			
Rev/ICN Number & Date	**BCP Number**	**Revision/Change Description**	**Sections Affected**
Rev. 5 31 May 2007, Continued		• Deleted subsections 4.5 and 4.6;	4.5 & 4.6
		• Added new requirement regarding Uncanistered DOE SNF of Commercial Origin;	4.7.1
		• Deleted as information is redundant with Transportation System Requirements Document (DOE/RW-0425) requirements and also by agreement with NNPP;	4.9
		• Added descriptive comments regarding relationship between Sec. 4 and 5;	5.0
		• Added information needs regarding probability of release as function of drop height or seismic accelerations	5.2
		• The direct reference to an ICD has been removed. The expectation is that control of information needs for HLW will be controlled by existing program documentation and new documentation that will be included with the shipment. This change satisfies Document Action Request D-33984;	5.4.1
		• Updated Section 7, Projected Initial Acceptance Capacity and Overall Schedule, to match Civilian Radioactive Waste Management System, Rev. 7, system requirements;	7
		• Replaced MPC concept with TADs concept throughout document including Appendix C;	Appendix C
		• Updated App. D, Trace with CRD;	Appendix D
		• Added Section on Units conversion;	Appendix E
Rev. 5, ICN 01 (Date TBD)	**YMP-2008-016**	**Interim Change to reflect BCP No. YMP-2008-016, *Clarify Acceptance and MGR Element Technical Requirements for Free Liquids.* Incorporates a minor clarification in Sec. 4.1 (to reflect handling of commercial SNF at Purchaser facility and at the repository), Sec. 4.4.3 (to reflect the NNPP technical manual), and Sec. 4.3.6 (to require the reporting of information on chemically bound liquids contained in DOE SNF disposable canisters). Revises Sec. 4.4.6 to require that residual free liquids in naval SNF canisters be consistent with the repository safety analysis. Updates outdated references. Revises Appendix E's Cover Page.**	**1.1, 1.2, 1.3, 2, 4.1, 4.3.1, 4.3.6, 4.4.3, 4.4.6, 4.9, 6, 7, 8.1, and E-3**

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Table of Contents

ACRONYMS AND ABBREVIATIONS xiii

1. INTRODUCTION 1

1.1 PURPOSE AND SCOPE 1

1.2 DOCUMENT ORGANIZATION 2

1.3 SYSTEM DEFINITION 4

2. PLANNING CONSIDERATIONS 7

3. REQUIREMENTS ON THE CRWMS 9

3.1 PRIMARY REGULATORY REQUIREMENTS 9

3.2 WASTE ACCEPTANCE ELEMENT PERFORMANCE REQUIREMENTS 9

3.3 CRWMS INTERFACE REQUIREMENTS 10

3.3.1 Waste Acceptance to Monitored Geologic Repository (MGR) Interfaces 10

3.4 CRWMS-WASTE OWNER INTERFACES 10

4. ACCEPTANCE REQUIREMENTS FOR SPENT NUCLEAR FUEL AND HIGH-LEVEL WASTE 11

4.1 REQUIREMENTS FOR COMMERCIAL SPENT NUCLEAR FUEL 13

4.2 GENERAL REQUIREMENTS FOR GOVERNMENT-MANAGED NUCLEAR MATERIALS 14

4.2.1 Compliance with the Nuclear Waste Policy Act 14

4.2.2 Compliance with Hazardous Waste Regulations 15

4.2.3 Determination of Which SNF and HLW Are to be Canistered 15

4.2.4 Waste to Remain in a Solid Form at the Time of Acceptance 16

4.2.5 Pyrophoricity, Combustibility, Explosivity, and Chemical Reactivity 16

4.2.6 Organic Content in Sealed Disposable Canisters 16

4.2.7 Canister Dose Rates 17

4.2.8 Canister Fill Material 17

4.2.9 Tamper-Indicating Seals on Canisters Not Welded 17

4.2.10 Safeguards and Security 18

4.2.11 Compliance with 10 CFR Part 21 18

4.2.12 Nonconforming SNF or HLW 18

4.3 SPECIFIC REQUIREMENTS FOR DOE SPENT NUCLEAR FUEL IN DISPOSABLE CANISTERS 19

4.3.1 DOE SNF Disposable Canister Design and Materials of Construction 19

4.3.2 Capability to Lift DOE SNF Disposable Canisters 20

4.3.3 DOE SNF Disposable Canister Sealing 20

4.3.4 DOE SNF Disposable Canister Labeling 20

4.3.5 DOE SNF Disposable Canister Drop 20

4.3.6 Free Liquid in DOE SNF Disposable Canisters 20

4.3.7 Particulate Content in DOE SNF Disposable Canisters 20

4.3.8 DOE SNF Disposable Canister Criticality Potential 21

4.3.9 Thermal Output Limits for DOE SNF Disposable Canisters 21

4.3.10 Disposable Commercial-Origin EM SNF Canister Thermal Design 21

4.3.11 Fires and Explosions Caused by DOE SNF Disposable Canister Contents 22

4.3.12 Commercial-Origin EM SNF Disposable Canister 22

4.4 SPECIFIC REQUIREMENTS FOR NAVAL SPENT NUCLEAR FUEL 23

4.4.1 Naval SFC Materials of Construction 23

4.4.2 Capability to Lift Naval SFCs 24

4.4.3 Naval SFC Sealing 24

4.4.4 Naval SFC Labeling 24

4.4.5 Naval SFC Drop 24

4.4.6 Free Liquid in Canisters Containing Naval SNF 24

4.4.7 Particulate Content in Naval SFCs 24

4.4.8 Naval SFC Criticality Potential 25

4.4.9 Thermal Output 25

4.4.10 Fires and Explosions Caused by Naval SFC Contents 25

4.4.11 Naval SFC Cleanliness Requirement 25

4.4.12 Naval SNF Post Closure Performance 26

4.5 SPECIFIC REQUIREMENTS FOR DOE SPENT NUCLEAR FUEL OF COMMERCIAL ORIGIN IN DISPOSABLE CANISTERS 27

4.6 SPECIFIC REQUIREMENTS FOR DOE SPENT NUCLEAR FUEL OF COMMERCIAL ORIGIN IN NON-DISPOSABLE CANISTERS 28

4.7 SPECIFIC REQUIREMENTS FOR UNCANISTERED DOE SPENT NUCLEAR FUEL OF COMMERCIAL ORIGIN 29

4.7.1 Uncanistered DOE SNF of Commercial Origin 29

4.8 SPECIFIC REQUIREMENTS FOR HIGH-LEVEL WASTE 30

4.8.1 Durability and Phase Stability of Vitrified HLW 30

4.8.2 HLW Canister Design and Materials of Construction 31

4.8.3 Dimensional Envelope for HLW Canisters 31

4.8.4 Filled HLW Canister Weights 31

4.8.5 Capability to Lift HLW Canisters Vertically with Remote Handling Fixtures 31

4.8.6 HLW Canister Sealing 32

4.8.7 HLW Canister Labeling 32

4.8.8 HLW Canister Drop 32

4.8.9 Free Liquid in Canisters Containing HLW 32

4.8.10 Radionuclide Content in High-Level Waste 32

4.8.11 Criticality Potential in Canisters Containing HLW 32

4.8.12 HLW Canister Surface Contamination 33

4.8.13 Thermal Output in Canisters Containing HLW 33

4.9 TRANSPORTATION CASK SYSTEM INTERFACE 34

5. TECHNICAL INFORMATION NEEDS 35

5.1 COMMERCIAL SNF 35

5.2 DOE SNF 35

5.3 NAVAL SNF 36

5.4 HLW 36

5.4.1 Prior to the Start of Production 36

5.4.2 During Production 37

5.4.3 Prior to Delivery 37

5.4.4 At Delivery 38

6. CONFORMANCE VERIFICATION 39

7. PROJECTED INITIAL ACCEPTANCE CAPACITY AND OVERALL SCHEDULE 41

8. REFERENCES 45

8.1 DOCUMENTS CITED 45

8.2 CODES, STANDARDS, AND REGULATIONS 47

APPENDIX A **A-1**

APPENDIX B **B-1**

APPENDIX C **C-1**

APPENDIX D **D-1**

APPENDIX E **E-1**

LIST OF TABLES

7-1 Descriptions of Wastes to be Sent to Repository 47

7-2 Estimated Schedule for Acceptance of Commercial and Government-Managed Nuclear Materials 48

D-1 Traceability of CRD Requirements in the WASRD D-3

E-1 Units Conversion E-3

LIST OF FIGURES

1 RW Technical Baseline 2

2 CRWMS Waste Function Relationships 5

3 Acceptance Requirements for Spent Nuclear Fuel and High-Level Radioactive Waste 7

ACRONYMS AND ABBREVIATIONS

Acronyms

ASTM	American Society for Testing and Materials
BWR	Boiling Water Reactor
CFR	Code of Federal Regulations
CHLW	Commercial High Level Radioactive Waste
CRD	Civilian Radioactive Waste Management System Requirements Document
CRWMS	Civilian Radioactive Waste Management System
CSNF	Commercial Spent Nuclear Fuel
DOE	U.S. Department of Energy
DPC	Dual-Purpose (Storage and Transport) Canister or Cask
EM	Office of Environmental Management (DOE)
FR	Federal Register
HLW	High-Level Radioactive Waste
IICD	Integrated Interface Control Document
ISF	Interim Storage Facility
LaBS	Lanthanide Borosilicate
M&O	Management and Operating Contractor
MCO	Multi-Canister Overpack
MGR	Monitored Geologic Repository
MOA	Memorandum of Agreement
MOX	Mixed-Oxide
MTHM	Metric Tons Heavy Metal
NNPP	Naval Nuclear Propulsion Program
NRC	U.S. Nuclear Regulatory Commission
NWPA	Nuclear Waste Policy Act of 1982
OCRWM	Office of Civilian Radioactive Waste Management (DOE)
PWR	Pressurized Water Reactor
QA	Quality Assurance

ACRONYMS AND ABBREVIATIONS (Continued)

RCRA	Resource Conservation and Recovery Act
RW	Office of Civilian Radioactive Waste Management (DOE)
SFC	Spent Fuel Canister (used for NNPP shipments)
SNF	Spent Nuclear Fuel
TAD	Transportation, Aging and Disposal
WASRD	Waste Acceptance System Requirements Document
WCP	Waste Form Compliance Plan
WVDP	West Valley Demonstration Project

Abbreviations

BTU/hr	British thermal units per hour
cc	cubic centimeter
cm	centimeter
ft	feet
g	grams
in.	inch(es)
in^3	cubic inch(es)
k_{eff}	effective neutron multiplication factor
kg	kilograms
kW	kilowatts
lb	pounds
m	meters
mm	millimeters
mm^3	cubic millimeters
Pu	plutonium
rem	roentgen equivalent man
SS	stainless steel
Sv	sievert
U	uranium
UO_2	uranium dioxide
W	watts
°C	degrees centigrade
°F	degrees Fahrenheit

1. INTRODUCTION

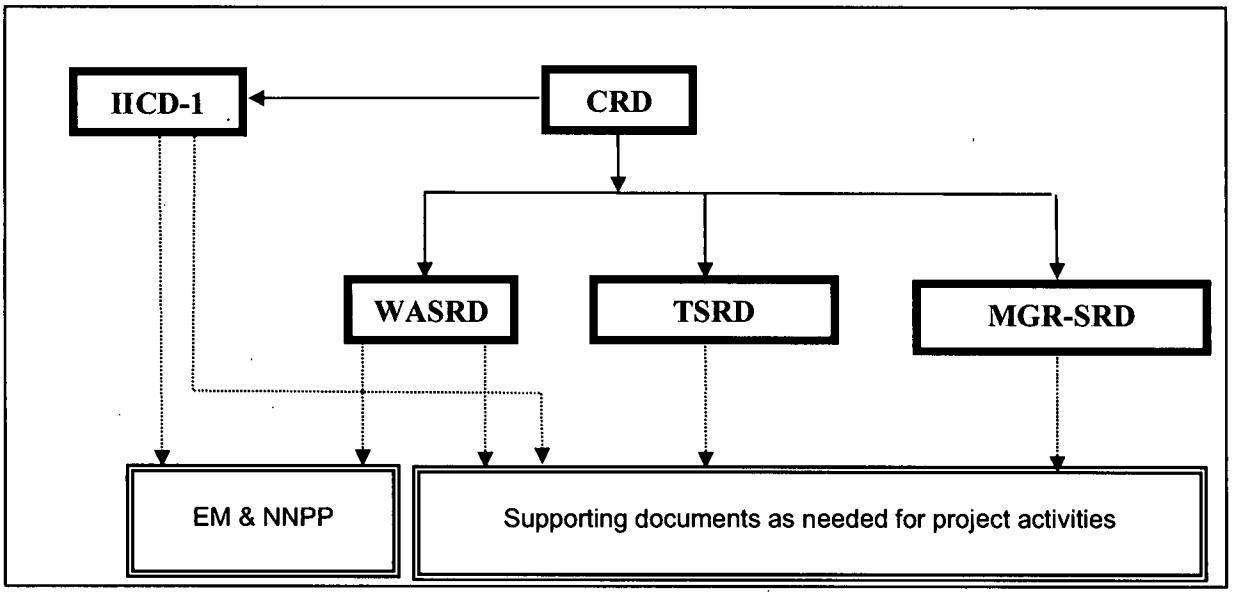
1.1 PURPOSE AND SCOPE

The purpose of this document is to establish waste acceptance technical requirements for the U.S. Department of Energy's (DOE) Civilian Radioactive Waste Management System (CRWMS). These requirements and functions consist of two types: (a) internal CRWMS requirements derived from the Civilian Radioactive Waste Management System Requirements Document (CRD) (DOE 2007a) as illustrated in Figure 1, and (b) acceptance criteria imposed by the CRWMS on spent nuclear fuel (SNF) and high-level waste (HLW) delivered into the CRWMS.

The purpose also includes, in addition to the CRWMS-related requirements that flow down to the Waste Acceptance System Requirements Document (WASRD) from the CRWMS, requirements and functions that, by mutual agreement with external organizations, are described, codified, and regulated by the WASRD. These other functions and requirements include:

- Federal Waste Custodians require their contractors to conform to WASRD requirements;
- The WASRD is the agreed upon reference source of waste acceptance criteria to which Federal Waste Custodians must conform for their wastes to be received by the repository;
- The WASRD is the agreed upon reference source for conformance verification criteria (this effort is in its very earliest stages);
- The WASRD is the reference for the details of Office of Civilian Radioactive Waste Management (RW)/ Office of Environmental Management (EM) agreement on technical information needs to support receipt;
- The WASRD is the official reference for the Integrated Acceptance Schedule (also in its early stages).

The scope of the WASRD is all SNF and HLW bound for the repository.



NOTE: IICD-1 = Integrated Interface Control Document, Volume I, TSRD = Transportation System Requirements Document; MGR-SRD, Monitored Geologic Repository System Requirements Document, EM = DOE Office of Environmental Management, NNPP = Naval Nuclear Propulsion Program

Figure 1. RW Technical Baseline

Figure 1 illustrates the flow of requirements from the top level document (CRD) into lower level documents, in this case level 2 requirements documents. Level 2 documents are intended to expand on Level 1 requirements and provide greater detail so that conformance to them is assured. As with any developing organization and technology, some of the system elements are more developed than others.

1.2 DOCUMENT ORGANIZATION

The WASRD is organized as follows:

Section 1: Introduction. This section presents the system overview including the Waste Acceptance System Element mission and system concept.

Section 2: Planning Considerations. This section will identify planning assumptions that cannot yet be incorporated as requirements. This section is currently reserved and refers to the CRD.

Section 3: Requirements. This section contains requirements on the CRWMS as they relate to the Waste Acceptance element, including performance characteristics and interface requirements.

Section 4: Acceptance Criteria for SNF and HLW. This section contains the requirements that must be met in order for commercial SNF, government-managed SNF (DOE SNF and naval SNF), and HLW to be accepted into the CRWMS. This section also provides an interface to transportation casks. The introduction to Section 4 identifies the criteria applicable to each waste type.

Numeric values from various sources are quoted throughout this section. The sources present some values in English units and others present them in metric units. The measurement unit of each quoted value is presented in the system of the original documentation. That value is followed by a parenthetical expression of the value converted to the other system. Thus, values are presented as # English units (# metric units) or # metric units (# English units). In every case within the measurement system the non-parenthetical value is the preferred and official system.

Section 5: Technical Information Needs. This section identifies additional information required to make design decisions or support further analysis, validation, or modeling, but will not include parameters with quantified ranges or limits that serve as acceptance criteria. This section is incomplete since some of the information to be included is currently under development.

Section 6: Conformance Verification. This section describes the procedures used to ensure that nuclear materials offered for acceptance into the CRWMS meet the relevant requirements for that waste type. Conformance verification is in its nascent stage.

Section 7: Waste Acceptance Delivery Schedule. This section summarizes the draft delivery schedules relative to RW program commitments.

Section 8: References. A list of the references and other documents cited.

Appendix A: Glossary. Definitions of the specialized terms used in this document.

Appendix B: Sample Forward Calculation to Determine Canister Release Dose-Equivalent Source Term. Appendix B has been deleted.

Appendix C: Interfaces for Multi-Element Disposable Canisters. Appendix C is a description of the interface between disposable canisters and the waste package. This Appendix has been deleted in favor of a reference to the *Transportation, Aging and Disposal Canister System Performance Specification* DOE/RW-0585 (DOE 2007e).

Appendix D: Traceability with CRD. This appendix contains a roadmap of CRD specifics into the WASRD.

Appendix E: Units Conversion. Values quoted in the WASRD are presented in both English and metric units as an aid to readers. Appendix E contains the conversion factors used and a discussion of the number of significant figures employed.

The legal or regulatory basis for requirements is documented on Requirements Analysis Sheets in the quality assurance (QA) records package for the WASRD. These sheets provide a statement of the requirement as it appears in the WASRD, an identification of the original source of the requirement, and a rationale for any interpretation of the basic requirement. These records are not included within the WASRD.

Throughout the WASRD, some of the requirement numbers and headings in previous revisions were followed by the word "Deleted." The deletions were made in response to reviewer comments for a variety of reasons, and the rationale for each deletion is included in the Requirements Analysis Sheets. Among the deletions were dimensional and weight limits on loaded canisters, materials of construction, and maximum dose rates. These items are considered to be characteristics of the waste form (canister plus contents) design and will be controlled in the Integrated Interface Control Documents (IICDs). These decisions were reached with the mutual consent of the impacted organization. In this revision, those "deleted" sections have been removed and the remaining sections renumbered accordingly.

1.3 SYSTEM DEFINITION

The CRD (DOE 2007a) defines the Waste Acceptance element as a part of the Civilian Radioactive Waste Management System (see Section 3.3 of CRD, DOE 2007a). The Waste Acceptance element refers to the following CRWMS activities and requirements:

- Establishing waste acceptance and waste form requirements;
- Scheduling and queuing;
- Support and verification of all aspects of the CRWMS readiness to accept waste;
- Acceptance of title to waste and associated documentation;
- Control and accounting for the inventory of SNF and HLW once in the CRWMS, and until such time that this function is transferred to the Monitored Geologic Repository (MGR) along with the associated documentation.

The Waste Acceptance function includes all interactions with Purchasers (commercial utilities and SNF storage sites) and Federal Waste Custodians (government-managed facilities for SNF and HLW) including: transportation interfaces prior to cask arrival; planning activities within the CRWMS covering the collection and dissemination of inventory data; scheduling and queuing for acceptance; verification of data prior to acceptance into the CRWMS; contractual/legal issues associated with waste acceptance; and transport including safeguards and security issues until all SNF and HLW are removed from transport casks at the MGR.

Figure 2 illustrates the key functional relationships between the Waste Acceptance function, the Purchasers/Producers/Federal Waste Custodians, and other CRWMS functions, as follows:

- Purchasers and Federal Waste Custodians are responsible for:
  - Characterizing and packaging SNF and HLW for shipment to the CRWMS;
  - Preparing documentation needed to verify compliance with CRWMS waste acceptance criteria.
- The CRWMS, through the Waste Acceptance function, is responsible for verifying compliance with waste acceptance criteria (certain activities may be delegated to Purchasers and Federal Waste Custodians).

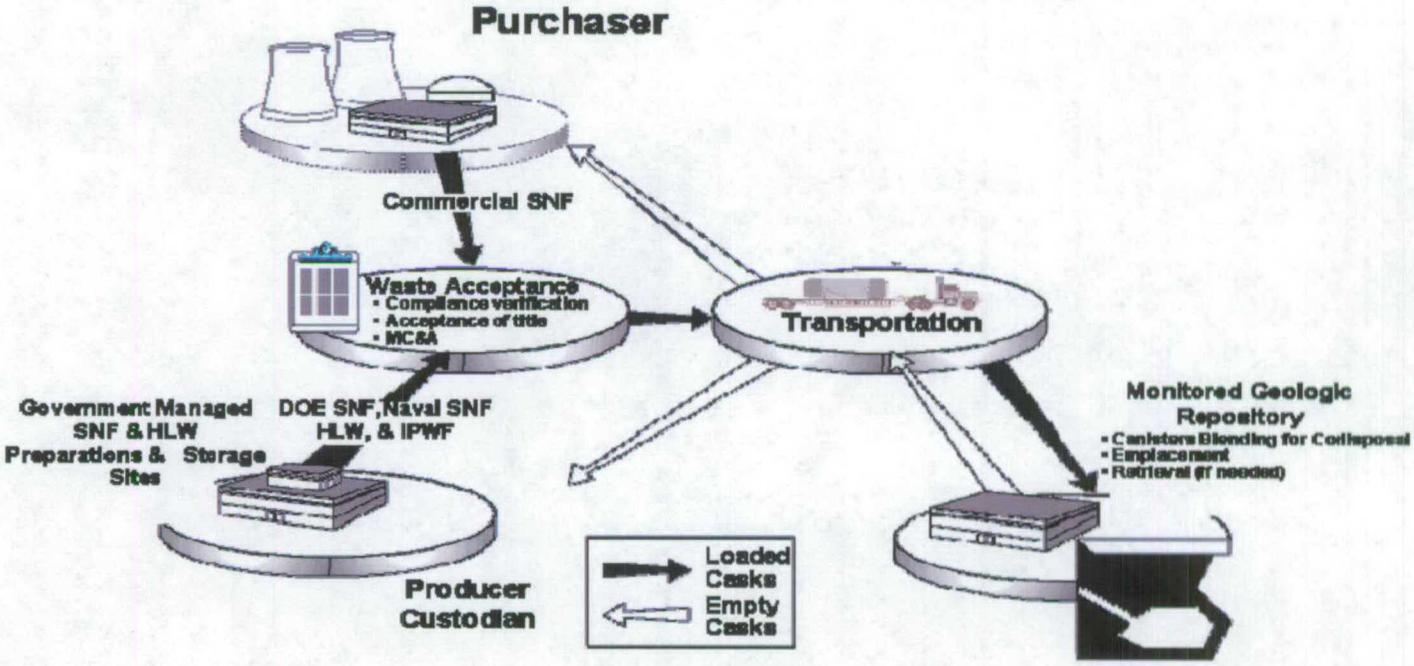


Figure 2. CRWMS Waste Function Relationships

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2. Planning Considerations

See Sections 3.2 and 3.3 of the CRD (DOE 2007a). This section is reserved for an expanded discussion of planning considerations applicable to the Waste Acceptance system.

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3. REQUIREMENTS ON THE CRWMS

3.1 PRIMARY REGULATORY REQUIREMENTS

This section identifies the primary requirements on the CRWMS as established by the federal laws and regulations that define them.

The Waste Acceptance element shall comply with the applicable provisions of 42USC10101 et seq "The Nuclear Waste Policy Act of 1982" as amended.

The Waste Acceptance element shall comply with the applicable provisions of 10 CFR (Code of Federal Regulations) Part 20, "Standards for Protection Against Radiation."

The Waste Acceptance element shall comply with the applicable provisions of 10 CFR Part 63, "Disposal of High-Level Radioactive Wastes in a Geologic Repository at Yucca Mountain, Nevada."

The Waste Acceptance element shall comply with the applicable provisions of 10 CFR Part 71, "Packaging and Transportation of Radioactive Material."

The Waste Acceptance element shall comply with the applicable provisions of 10 CFR Part 73, "Physical Protection of Plants and Materials."

The Waste Acceptance element shall comply with the applicable provisions of 10 CFR Part 75, "Safeguards on Nuclear Materials-Implementation of U.S./IAEA (International Atomic Energy Agency) Agreement."

The Waste Acceptance element shall accept nuclear waste in accordance with 10 CFR Part 961, "Standard Contract for Disposal of Spent Nuclear Fuel and/or High-Level Radioactive Waste."

The Waste Acceptance element shall comply with the applicable provisions of 29 CFR Part 1910, "Occupational Safety and Health Standards."

The Waste Acceptance element shall comply with the applicable provisions of 10 CFR Part 21, "Reporting of Defects and Noncompliance."

3.2 WASTE ACCEPTANCE ELEMENT PERFORMANCE REQUIREMENTS

This section contains the requirements allocated to the Waste Acceptance Element by the CRD.

A. The Waste Acceptance Element shall collect necessary information in support of CRWMS activities. The type of data required includes, but is not limited to, the following:

   1. Contracts and Fees Information - Purchaser Contracts; Custodian and Producer Agreements and changes thereto; records of fee payments;

   2. Planning and Scheduling Information - Delivery Commitment Schedules, Delivery

Commitment Schedule Exchanges, Final Delivery Schedules, Integrated Acceptance Schedule, Purchaser and Custodian SNF data, campaign schedules, acceptance, transportation, delivery, storage, and emplacement schedules, current projections of the full inventory of SNF and HLW expected to require disposal;

3. Operations Support Information - Characterization data for Purchaser and Custodian SNF and Producer HLW. This data shall be sufficient to satisfy the range of requirements on SNF and HLW, such as loading, verification of cask loading, safeguards verification, and requirements of 10 CFR 63.21(c)(4);

4. Safeguards and Security Information - Nuclear Material Transaction reports (10 CFR Part 74.15(a)), Nuclear Material Balance reports (10 CFR Part 75.35(a)), and other information specifically agreed to (e.g., verification forms).

B. Waste Acceptance shall validate title and/or transfer of responsibility and custody documentation from the Purchasers/Producers/Federal Waste Custodians.

C. Acceptance of West Valley Demonstration Project (WVDP) Commercial High-Level Radioactive Waste (CHLW), presently owned by the New York State Energy Research and Development Authority, is contingent upon the New York State Energy Research and Development Authority executing an acceptance and disposal contract, and paying a fee as required under the Nuclear Waste Policy Act (NWPA 1982).

3.3 CRWMS INTERFACE REQUIREMENTS

3.3.1 Waste Acceptance to Monitored Geologic Repository (MGR) Interfaces

This interface is described partially in DOE/RW-0511, *Integrated Interface Control Document, Volume 1* (DOE 2007b). This section is reserved for an expanded discussion of additional interface requirements between Waste Acceptance or Transportation and the MGR, as they are developed.

3.4 CRWMS-WASTE OWNER INTERFACES

The functions of the Waste Acceptance element are performed by the Office of Civilian Radioactive Waste Management (OCRWM) Waste Management Office. These include responsibility for all interfaces between OCRWM and Purchasers and Federal Waste Custodians. Interfaces with Purchasers are those defined in the Standard Contract (10 CFR Part 961). Programmatic interfaces with DOE-EM are those defined in the RW/EM MOA (DOE 2007a). Programmatic interfaces with the NNPP are those defined in the RW/NNPP MOA (Bowman, F.L. and Itkin, I. 2000).

4. ACCEPTANCE REQUIREMENTS FOR SPENT NUCLEAR FUEL AND HIGH LEVEL RADIOACTIVE WASTE

This section contains requirements that must be met before acceptance into the CRWMS for: (1) commercial SNF, (2) government-managed SNF, and (3) HLW plus all associated packaging (Figure 3). In the case of commercial SNF and its associated packaging, the Standard Contract (10 CFR Part 961) remains the sole source of acceptance criteria. The requirements in this section are organized by waste type, as follows:

- Section 4.1 - Requirements for Commercial Spent Nuclear Fuel;
- Section 4.2 - General Requirements for Government-Managed Nuclear Materials;
- Section 4.3 - Specific Requirements for DOE Spent Nuclear Fuel in Disposable Canisters;
- Section 4.4 - Specific Requirements for Naval Spent Nuclear Fuel;
- Section 4.5 - Specific Requirements for DOE Spent Nuclear Fuel of Commercial Origin in Disposable Canisters. Deleted;
- Section 4.6 - Specific Requirements for DOE Spent Nuclear Fuel of Commercial Origin in Non-disposable Canisters [often termed dual-purpose canisters or DPCs]. Deleted;
- Section 4.7 - Specific Requirements for Uncanistered DOE Spent Nuclear Fuel of Commercial Origin;
- Section 4.8 - Specific Requirements for High-Level Waste;
- Section 4.9 - Transport Casks System Interface. Deleted.

Criteria are provided for commercial SNF and government-managed nuclear materials. Acceptance criteria for government-managed nuclear material are organized by both waste type and packaging configuration. The government-managed nuclear materials criteria are subdivided into those for DOE-managed SNF in disposable canisters, uncanistered DOE SNF of commercial origin, naval SNF, and HLW. Packaging options for all government-managed nuclear materials except DOE SNF of commercial origin are limited to disposable canisters. Section 4.2.3 defines which DOE SNF of commercial origin must be loaded into disposable canisters. All DOE SNF of commercial origin not addressed in Section 4.2.3 can be delivered to the CRWMS either as uncanistered assemblies, or in disposable canisters (either those designed for commercial SNF or those designed for DOE-managed SNF).

Applicability of these sections to a given waste type is as follows:

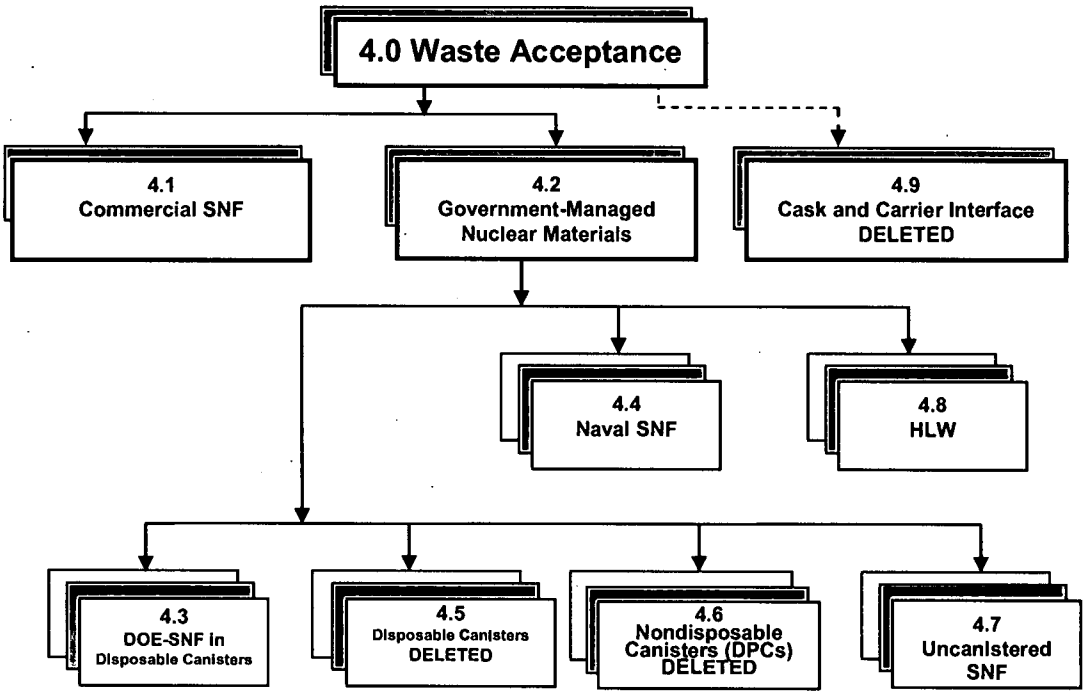


Figure 3. Acceptance Requirements for Spent Nuclear Fuel and High-Level Radioactive Waste

Commercial SNF - Section 4.1 (Requirements for Commercial SNF). Requirements that address commercial SNF are covered simply by a reference to the Standard Contract (10 CFR Part 961).

High-Level Waste - Section 4.2 (General Requirements for Government-Managed Nuclear Materials) and Section 4.8 (Specific Requirements for DOE-HLW).

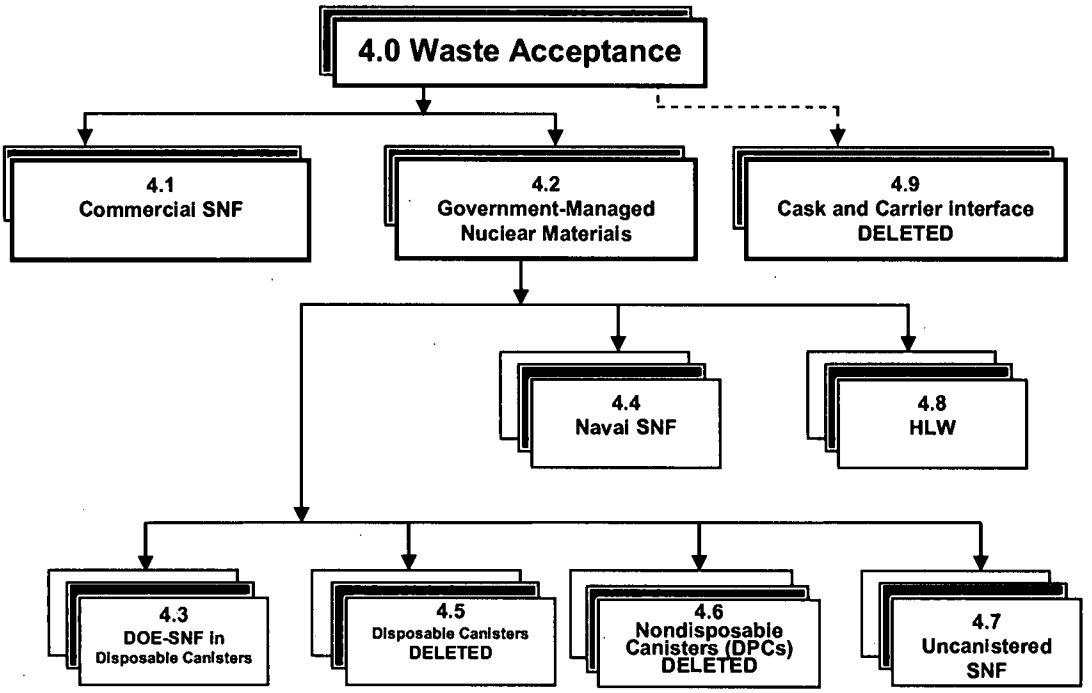
Canistered DOE SNF - Section 4.2 (General Requirements for Government-Managed Nuclear Materials) and Section 4.3 (Specific Requirements for DOE SNF in Disposable Canisters.

Naval SNF - Section 4.2 (General Requirements for Government-Managed Nuclear Materials) and Section 4.4 (Specific Requirements for Naval SNF).

Uncanistered DOE SNF of Commercial Origin - Section 4.2 (General Requirements for Government-Managed Nuclear Materials) and Section 4.7 (Specific Requirements for Uncanistered DOE SNF of Commercial Origin).

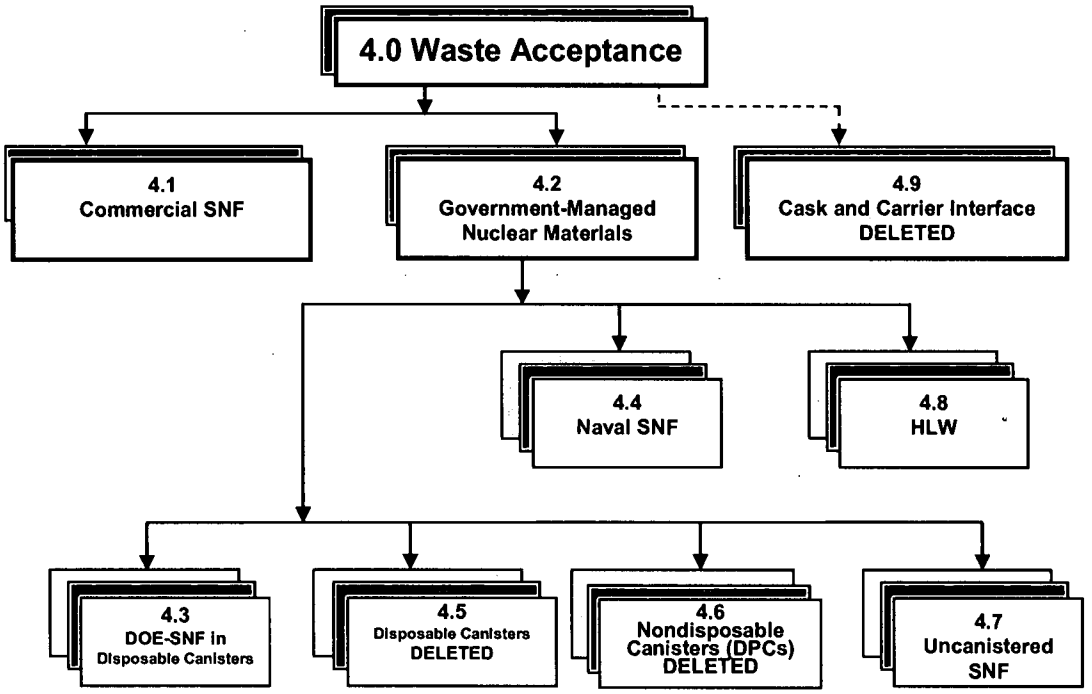
Transport Casks and Associated Carrier Systems - Section 4.9 (Transport Cask System Interface). All subsections have been deleted).

4.1 REQUIREMENTS FOR COMMERCIAL SPENT NUCLEAR FUEL



Commercial SNF shall meet the requirements specified in 10 CFR Part 961, as modified by individual Purchaser contracts. Commercial SNF may include both uranium oxide (UO_2) SNF and mixed-oxide (MOX) SNF from commercial power reactors and SNF from privately owned commercial research reactors. Most **of the** commercial SNF will be loaded into Transportation, Aging and Disposal (TAD) canisters **at the Purchaser facilities** for shipment **to the repository. Commercial Boiling Water Reactor and Pressurized Water Reactor SNF not planned for shipment to the repository in TAD canisters will be loaded into TAD canisters at the geologic repository operations area.**

4.2 GENERAL REQUIREMENTS FOR GOVERNMENT-MANAGED NUCLEAR MATERIALS



The requirements of this section apply to all government managed nuclear materials to be accepted into the CRWMS for disposal, including DOE SNF (DOE-generated SNF, foreign research reactor fuel, and domestic research reactor fuel), DOE SNF of commercial origin, naval SNF, commercial HLW, vitrified plutonium waste form, and defense HLW.

4.2.1 Compliance with the Nuclear Waste Policy Act

Materials accepted into the CRWMS for disposal in the geologic repository shall be SNF or HLW[1] as those terms are defined in the Nuclear Waste Policy Act of 1982, as amended (NWPA 1982).

A. SNF is fuel that has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated by reprocessing.

B. HLW is (a) the highly radioactive material resulting from the reprocessing of SNF, 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

[1] HLW – the highly radioactive material defined in Section (2)(12) of the NWPA. HLW does not include the radioactive waste resulting from the reprocessing of spent nuclear fuel as defined in Section 3116 of the Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005 (PL108-375, October 28, 2004).

radioactive material that the Commission, consistent with existing law, determines by rule requires permanent isolation.

4.2.2 Compliance with Hazardous Waste Regulations

The CRWMS shall only accept HLW and/or SNF that is not subject to regulation as hazardous waste under the Resource Conservation and Recovery Act (RCRA 1976) Subtitle C for disposal in the first geologic repository licensed by NRC under the NWPA. Prior to acceptance for disposal, Federal Waste Custodians must determine and document that RCRA-regulated wastes are not present, and develop appropriate data to assure relevant state and/or U.S. Environmental Protection Agency (EPA) RCRA requirements are addressed.

4.2.3 Determination of Which SNF and HLW Are to be Canistered

A. DOE SNF
All DOE SNF, including foreign research reactor fuel and some domestic research reactor[2] fuel, except as noted in Section 4.2.3.D, shall be placed in a sealed disposable canister compatible with all applicable requirements in WASRD, Section 4.3, before acceptance into the CRWMS. These canisters may contain one or more assemblies, but must be compliant with other WASRD requirements (e.g., criticality control) if the canister contains multiple assemblies.

B. All naval SNF shall be placed in sealed disposable canisters designed specifically for naval SNF (see Section 4.4 for additional requirements on the loaded canister) before acceptance into the CRWMS.

C. All vitrified HLW shall be placed in sealed disposable canisters designed specifically for vitrified HLW (see Section 4.8 for additional requirements on the loaded canister) before acceptance into the CRWMS.

D. DOE SNF of Commercial Origin
DOE SNF of commercial origin having handling features interchangeable with either Boiling-Water Reactor (BWR) or Pressurized-Water Reactor (PWR) fuel assemblies and known to have no defects may be handled in the same manner as commercial SNF as specified in 10 CFR Part 961 (see Section 4.7). All DOE SNF of commercial origin that (a) cannot be shown to have handling interfaces functionally interchangeable with those of an intact assembly from either a commercial BWR or PWR, or (b) has known or suspected defects (to either structural components or to cladding beyond hairline cracks or pinhole leaks), such that the SNF requires isolation or special handling, shall be placed in a disposable canister before acceptance into the CRWMS. The provisions of 10 CFR Part 961 should be followed if there are no defects. Requirements relating to DOE SNF of commercial origin to be loaded bare into a transportation cask are in Section 4.7.

[2] SNF from commercial research reactors will enter the MGR via the Standard Contract (10 CFR Part 961).

E. DOE SNF Debris of Commercial Origin
Prior to acceptance into the CRWMS, DOE-SNF debris of commercial origin (including individual fuel rods, pieces of a fuel rod, or any mixture of SNF and non-fuel material) shall be placed in a canister designed for DOE-generated SNF, as defined in Section 4.3.

F. Non-Fuel Components Associated with DOE SNF of Commercial Origin
Non-fuel no longer physically inserted into a fuel assembly shall be placed into any of the various disposable canisters acceptable to the CRWMS.

4.2.4 Waste to Remain in a Solid Form at the Time of Acceptance

The HLW and/or SNF shall be in solid form and placed in sealed canisters at the time of acceptance. A limited amount of bare SNF may be accepted by RW in accordance with the EM/RW MOA.

4.2.5 Pyrophoricity, Combustibility, Explosivity, and Chemical Reactivity

Pyrophoricity, combustibility, explosivity, and chemical reactivity waste form requirements are listed in sections 5.2, 5.3, and 5.4.1.B(9) as applicable.

At this time, there is no numeric limit on the amount of pyrophorics, combustible, explosive, or chemically reactive materials allowed in Government Managed Nuclear Materials. However, RW must ensure, through information and data provided by the Federal Waste Custodians of HLW and SNF that the waste form does not cause the repository or transportation system to fail to meet the applicable NRC performance-based requirements or any conditions of an operating license or certificate of compliance.

Section 5 *Technical Information Needs* establishes certain reporting requirements which shall be required in accordance with the EM and NNPP Memoranda of Agreement (DOE 2007a, Bowman 2000). This information will allow RW the opportunity to consider the impact of its presence and to develop an action plan, if necessary, jointly with the Federal Waste Custodian.

4.2.6 Organic Content in Sealed Disposable Canisters

General organic waste form limit requirements are listed in sections 5.4.1.B(4) and 5.4.3.C. Specific organic borosilicate glass waste form limits are determined and listed in the individual facility Waste Form Compliance Plans (WCPs).

At this time, there is no numeric limit on the amount of organic materials allowed in Government Managed Nuclear Materials. However, RW must ensure, through information and data provided by the Federal Waste Custodians of HLW and SNF that the waste form does not

cause the repository or transportation system to fail to meet the applicable NRC performance-based requirements or any conditions of an operating license or certificate of compliance.

Section 5 *Technical Information Needs* establishes certain information items to be submitted in accordance with the EM and NNPP Memoranda of Agreement (DOE 2007a, Bowman 2000). This information will allow RW the opportunity to consider the impact of its presence and to develop an action plan, if necessary, jointly with the Federal Waste Custodian.

4.2.7 Canister Dose Rates

Deleted. Canister dose rate limits are presented in the *Integrated Interface Control Document, Volume 1* (DOE 2007b).

4.2.8 Canister Fill Material

Canister contents shall be limited to SNF (including associated non-fuel components) or HLW and canister components needed to comply with acceptance requirements or to provide other necessary functions, which include storage, transportation, and disposal. Such components may be included for the purpose of storage, transportation, or disposal as long as they do not adversely affect the ability of the SNF or HLW to meet post-closure repository performance regulatory standards.

4.2.9 Tamper-Indicating Seals on Canisters Not Welded

A. **All DOE HLW Canisters** that contain Special Nuclear Material greater than low strategic significance, as defined in 10 CFR 73.2, and that are not sealed, consistent with 10 CFR 74.55(a)(2) and NRC guidance in NUREG-1280, Rev.1, must have an intact, properly installed tamper-indicating device. Welding is an acceptable seal in the context of the requirement. This requirement derives from 10 CFR 63.78, which requires that DOE shall implement a program of material control and accounting that is the same as that specified in 10 CFR 72.72, 72.74, 72.76, and 72.78. If tamper indicating devices are employed, they must include the functional features outlined in the NRC's Regulatory Guide 5.15, Tamper-indicating Seals for the Protection and Control of Special Nuclear Material.

B. **All DOE SNF Canisters** that contain Special Nuclear Material and are not sealed, consistent with 10 CFR 74.55(a)(2), and NRC guidance in NUREG-1280, Rev.1, must have an intact, properly installed tamper-indicating device. Welding is an acceptable seal in the context of the requirement. This requirement derives from 10 CFR 63.78, which requires that DOE shall implement a program of material control and accounting that is the same as that specified in 10 CFR 72.72, 72.74, 72.76, and 72.78. If tamper indicating devices are employed, they must include the functional features outlined in the NRC's Regulatory Guide 5.15, Tamper-indicating Seals for the Protection and Control of Special Nuclear Material.

4.2.10 Safeguards and Security

RW is in the process of developing its licensing strategy for implementing safeguards and security at a monitored geologic repository. After finalization and adoption of the strategy, the resulting safeguards and security requirements will be incorporated into the WASRD.

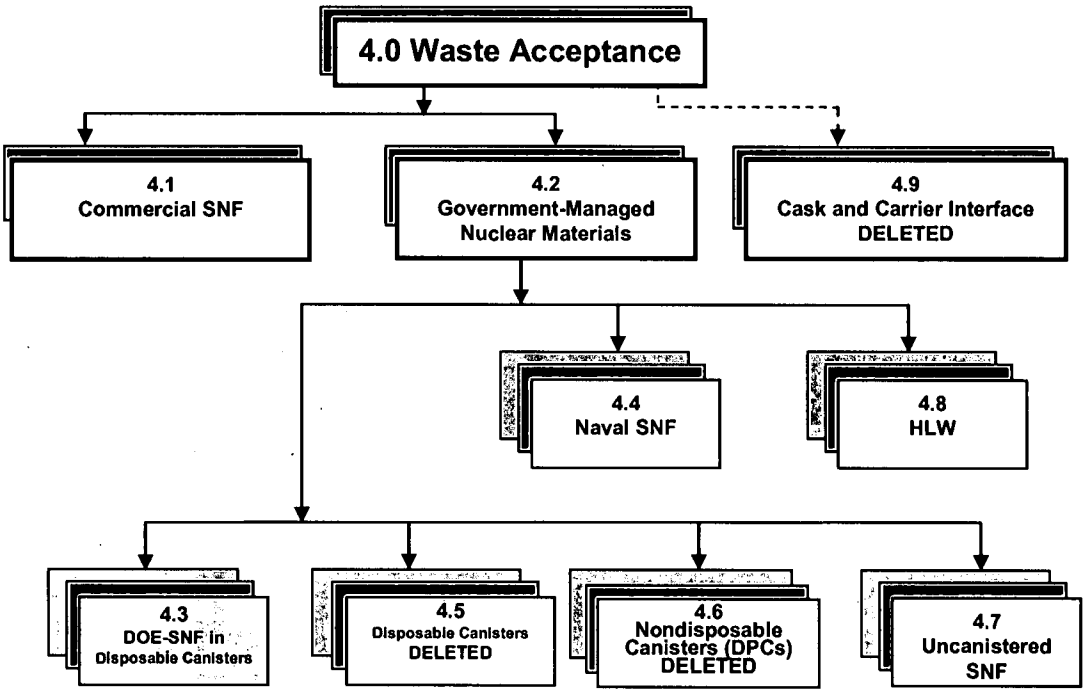
4.2.11 Compliance with 10 CFR Part 21

Federal Waste Custodians, their principal contractors, and the National Spent Nuclear Fuel program shall comply with applicable provisions of 10 CFR Part 21 for reporting defects or non-conformances of any supplied basic component. RW shall evaluate the impact of the defect or non-conformance on the performance of systems, structures, and components and, if necessary, provide formal reporting to NRC under the requirements of 10 CFR Part 21.

4.2.12 Nonconforming SNF or HLW

All SNF and HLW transferred to OCRWM shall meet the requirements of this document. The disposition of nonconforming SNF or HLW shall be by a mutually agreed upon action plan as described in either the EM (DOE 2007a) or NNPP (Bowman 2000) Memorandum of Agreement. In accordance with these Memoranda of Agreement, such action plan will be prepared and agreed upon prior to the disposition of the SNF or HLW. For the purposes of classification, nonconforming SNF or HLW is that which fails to meet any of the requirements listed herein or that fails to perform its stated function during loading, transporting, handling, storing, or disposal.

4.3 SPECIFIC REQUIREMENTS FOR DOE SPENT NUCLEAR FUEL IN DISPOSABLE CANISTERS



This section provides a set of requirements specific for DOE SNF in disposable canisters. These requirements are in addition to the requirements specified in Section 4.2 which are requirements that apply to all government managed nuclear materials. DOE SNF is described as spent nuclear fuel that is managed by DOE, has been withdrawn from a reactor following irradiation, and whose constituent elements have not been separated by reprocessing. Government Managed Nuclear Materials in this category include, but are not limited to, production reactor SNF, both foreign and domestic research reactor SNF, and some SNF from commercial power reactors (commercial origin EM SNF).

4.3.1 DOE SNF Disposable Canister Design and Materials of Construction

A. DOE SNF canisters and internals shall be designed, fabricated, and used under the Quality Assurance Requirements and Description (DOE 2007d) or a program accepted by OCRWM on a case basis.

B. Materials of construction of the DOE SNF canisters and their internals shall be selected to be compatible with the waste disposal package materials and with the contained SNF. Canister materials shall not corrode or otherwise chemically attack the waste package from the inside, and they shall not increase rates of degradation of contained SNF or mobilize radionuclides for transport subsequent to waste package breach.

4.3.2 Capability to Lift DOE SNF Disposable Canisters

DOE SNF canisters shall be designed to support their own weight and that of their contents for multiple vertical lifts and horizontal translations while suspended from above via their lifting features.

4.3.3 DOE SNF Disposable Canister Sealing

Canisters shall be backfilled with an inert gas, sealed, and leak tested. Canister gas leak rates shall be less than $1x10^{-4}$ ref-cc/sec (6.10×10^{-6} in^3/sec.)[1].

4.3.4 DOE SNF Disposable Canister Labeling

Canisters shall have a legible, unique identifier that is permanently attached to the canister and is traceable to the permanent records of the canister and its contents.

4.3.5 DOE SNF Disposable Canister Drop

The DOE SNF Standard Canister and the DOE Multi-Canister Overpack shall be capable of withstanding a flat bottom drop from a height of 23 feet and a drop in any orientation from a height of 2 feet (individually - not both in sequence) onto an essentially unyielding surface without release of radionuclides.

4.3.6 Free Liquid in DOE SNF Disposable Canisters

At this time, there is no numeric limit on the amount of free liquid allowed in DOE SNF canisters. However, RW must ensure, through information and data provided by Federal Waste Custodians of SNF that the waste form **(including residual free water)** does not cause the repository or transportation system to fail to meet the applicable NRC performance-based requirements or any conditions of an operating license or certificate of compliance. **This may be accomplished by use of a process that is appropriate for the particular canistered waste form and results in similar residual water content to that described in NUREG-1567, "Standard Review Plan for Spent Fuel Dry Storage Facilities," March 2000.**

Section 5 *Technical Information Needs* establishes certain reporting requirements which shall be required in accordance with the MOA (DOE 2007c). This information will allow RW the opportunity to consider the impact of the presence of free **and chemically bound water** and to develop an action plan, if necessary, jointly with the Federal Waste Custodian.

[1] Please see Appendix E for conversion factors used and notes on significant figures quoted.

4.3.7 Particulate Content in DOE SNF Disposable Canisters

At this time, there is no numeric limit on the amount of particulates allowed in DOE SNF canisters. However, RW must ensure, through information and data provided by the Federal Waste Custodians of SNF that the waste form does not cause the repository or transportation

system to fail to meet the applicable NRC performance-based requirements or any conditions of an operating license or certificate of compliance.

Section 5 *Technical Information Needs* establishes certain reporting requirements which shall be required in accordance with the MOA (DOE 2007a). This information will allow RW the opportunity to consider the impact of the presence of particulates and to develop an action plan, if necessary, jointly with the Federal Waste Custodian.

4.3.8 DOE SNF Disposable Canister Criticality Potential

A. DOE SNF Preclosure Criticality:
The DOE SNF canister design, in conjunction with the facility systems, structures, and components, shall provide the basis for ensuring subcriticality at the time of delivery to the geologic repository and during all subsequent handling operations, including all event sequences that are important for criticality and have at least one chance in 10,000 of occurring before permanent closure. To provide assurance of subcriticality, the methodology will account for the biases and uncertainties in both the calculations and experimental data used in the development of the effective neutron multiplication factor (k_{eff}), and will also include a technically justified administrative margin (Δkm) following the guidance in Fuel Cycle Safety & Safeguards-Interim Staff Guidance-10.

B. DOE SNF Postclosure Criticality:
The methodology described in the Disposal Criticality Analysis Methodology Topical Report (YMP 2003) shall be used to demonstrate that the total probability of criticality for all DOE SNF canisters shall not cause the total probability of criticality for all waste forms to exceed one chance in 10,000 over the first 10,000 years after permanent closure of the repository.

4.3.9 Thermal Output Limits for DOE SNF Disposable Canisters

DOE SNF canisters shall have a thermal output at the time of acceptance into the CRWMS less than 1,970 W (6720 BTU/hr) (Arenaz 2006).

4.3.10 Disposable Commercial-Origin EM SNF Canister Thermal Design

Cladding temperature for DOE SNF of commercial origin placed in disposable multi-element canisters shall not exceed:

A. 350°C (662 °F) for zirconium alloy-clad assemblies
B. 400°C (752 °F) for stainless steel-clad assemblies.

4.3.11 Fires and Explosions Caused by DOE SNF Disposable Canister Contents

Factors such as pyrophoricity, explosivity, combustibility, chemical reactivity, gas generation, thermal effects, particulate concentrations, internal corrosion of the canister and the contained material, and any other relevant factors, shall be prevented or mitigated prior to acceptance into the CRWMS such that the canister and its contents shall not cause a fire or explosion at the receiving facility during normal handling operations and following a canister drop.

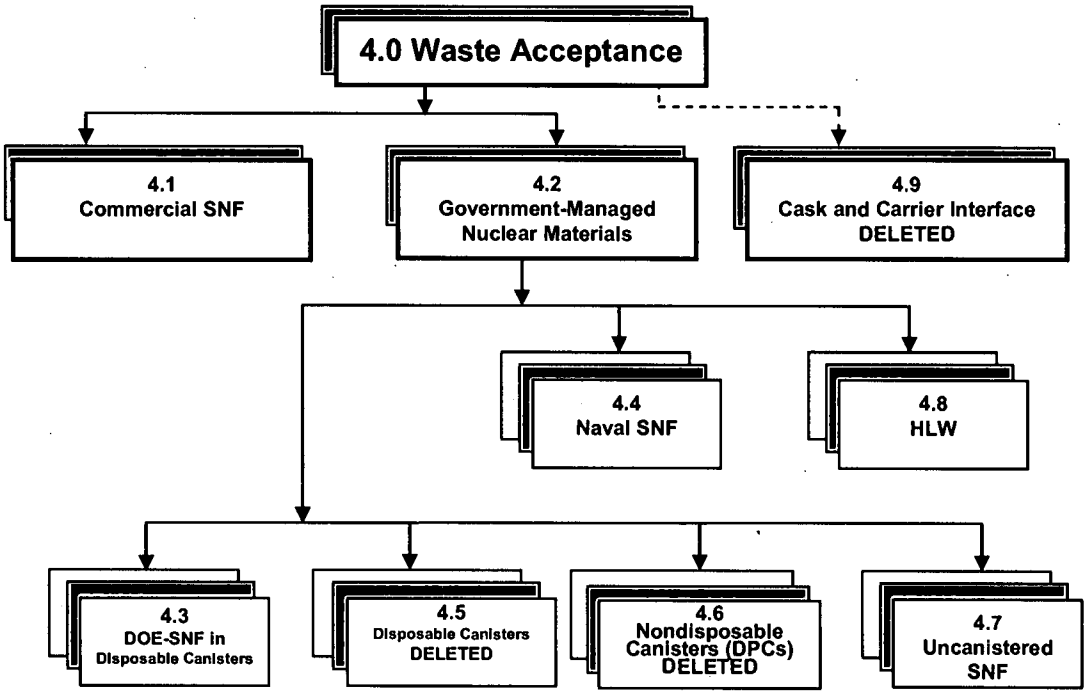
4.3.12 Commercial-Origin EM SNF Disposable Canister

A. Categorization of Contents
   1. DOE SNF of commercial origin delivered in a disposable canister and for which fees **have** been paid shall be classified using Appendix E of 10 CFR Part 961.

   2. DOE SNF of commercial origin delivered in a disposable canister and for which fees have **not** been paid shall be classified as either conforming or nonconforming using Section VII.A of the MOA (DOE 2007a).

B. Where special handling is required for any disposable canister containing DOE SNF of commercial origin, Federal Waste Custodians shall provide handling procedures to the MGR for approval in advance of shipment.

4.4 SPECIFIC REQUIREMENTS FOR NAVAL SPENT NUCLEAR FUEL



This section covers additional acceptance criteria (beyond those in Section 4.2) for all naval SNF including fines, bits and pieces that EM stores at the Idaho Nuclear Technology and Engineering Center on behalf of the Navy as the disposition of this material has not yet been determined. This material will continue to be owned by the Navy.

4.4.1 Naval Spent Fuel Canister (SFC) Materials of Construction

A. The SFC and internal structures shall be designed and fabricated under the NNPP Quality Assurance (QA) Program. DOE-RW has reviewed and found the NNPP QA Program to be acceptable for work conducted by, or under the direction of, the NNPP in support of DOE-RW acceptance of naval SNF (Bowman and Itkin 2000).

B. Materials of construction of the naval SFC and internal structures shall be selected to be compatible (i.e., they do not adversely affect the ability of naval SNF to meet post-closure repository performance regulatory standards) with the waste package materials and with the contained naval SNF. Naval SFC materials shall not corrode or otherwise chemically attack the waste package from the inside, and they shall not increase rates of degradation of contained naval SNF or mobilize radionuclides for transport subsequent to waste package breach.

4.4.2 Capability to Lift Naval SFCs

Naval SFCs shall be designed to support their own weight and that of their contents for multiple vertical lifts and horizontal translations while suspended from above via their lifting features.

4.4.3 Naval SFC Sealing

Naval SFCs shall be backfilled with an inert gas, sealed, and leak tested. Naval SFCs gas leak rates shall be less than **or equal to** $1x10^{-4}$ ref-cc/sec (6.10×10^{-6} in^3/sec.).

4.4.4 Naval SFC Labeling

Naval SFCs shall have a legible, unique identifier that is permanently attached to the naval SFC and is traceable to the permanent records of the naval SFC and its contents.

4.4.5 Naval SFC Drop

Naval SFCs containing naval SNF should be designed to interface with the geologic repository operations area so that when subjected to Category 2 event sequences no individual located on, or beyond, any point of the boundary of the site, will receive the more limiting of a Total Effective Dose Equivalent of 0.05 Sv (5 rem), or the sum of the deep dose equivalent to any individual organ or tissue (other than the lens of the eye) of 0.5 Sv (50 rem). The lens dose equivalent shall not exceed 0.15 Sv (15 rem), and the shallow dose equivalent to skin shall not exceed 0.5 Sv (50 rem).

4.4.6 Free Liquid in Canisters Containing Naval SNF

The residual free liquid in a naval SFC shall be consistent with the repository safety analysis. This condition may be accomplished by use of a process for de-watering equivalent to that described in NUREG-1567, "*Standard Review Plan for Spent Fuel Dry Storage Facilities*," March 2000. Accomplishment of de-watering in accordance with a process consistent with NUREG-1567 provides assurance of consistency with the repository safety analysis for water in the naval SNF canister. Further, RW must ensure, through information and data provided by the NNPP, that the waste form does not cause the repository or transportation system to fail to meet the applicable NRC performance-based requirements or any conditions of an operating license or certificate of compliance.

Section 5 Technical Information Needs establishes certain reporting requirements which shall be required in accordance with the MOA (Bowman, **F.L. and Itkin, I.** 2000). This information will allow RW the opportunity to consider the impact of the presence of free liquids and to develop an action plan, if necessary, jointly with the Naval Nuclear Propulsion Program.

4.4.7 Particulate Content in Naval SFCs

At this time, there is no numeric limit on the amount of particulates allowed in naval SFCs. However, RW must ensure, through information and data provided by the Naval Nuclear Propulsion Program, that the waste form does not cause the repository or transportation system

to fail to meet the applicable NRC performance-based requirements or any conditions of an operating license or certificate of compliance.

Section 5 Technical Information Needs establishes certain reporting requirements which shall be required in accordance with the MOA (Bowman 2000). This information will allow RW the opportunity to consider the impact of its presence and to develop an action plan, if necessary, jointly with the Naval Nuclear Propulsion Program.

4.4.8 Naval SFC Criticality Potential

A. Preclosure (NNPP 2006, 10 CFR Part 63)
The calculated effective neutron multiplication factor (k_{eff}), at time of delivery to the geologic repository and during all subsequent handling operations shall be shown to be subcritical for all event sequences that are important to criticality and have at least one chance in 10,000 of occurring before permanent closure. To provide assurance of subcriticality, the methodology will account for the biases and uncertainties in both the calculations and experimental data used in development of k_{eff}, and will also include a 5% margin (Δkm) to ensure subcriticality.

B. Postclosure (NNPP 2006)
NNPP shall demonstrate that the total probability of criticality for all naval waste forms shall not cause the total probability of criticality for all waste forms to exceed one chance in 10,000 over the first 10,000 years after permanent closure of the repository.

4.4.9 Thermal Output

Naval SFCs shall have a thermal output less than 11.8 kW (4.03 X 10^4 BTU/hr) (NNPP 2006) at the time of acceptance into the CRWMS.

4.4.10 Fires and Explosions Caused by Naval SFC Contents

Factors such as pyrophoricity, explosivity, combustibility, chemical reactivity, gas generation, thermal effects, particulate concentrations, internal corrosion of the canister and the contained material, and any other relevant factors, shall be prevented or mitigated prior to acceptance into the CRWMS such that the canister and its contents shall not cause a fire or explosion at the receiving facility during normal handling operations and following Category 1 or Category 2 Event Sequences.

4.4.11 Naval SFC Cleanliness Requirement

Naval SNF shall be packaged in naval SFCs under "shop clean" conditions (see Appendix A, *Glossary*). In addition, the exterior surfaces of the naval SFCs shall be maintained in a radiologically clean condition.

4.4.12 Naval SNF Post Closure Performance

NNPP shall provide source terms and/or technical discussion that demonstrate that radionuclide releases or dose to the reasonably maximally exposed individual from naval waste packages are represented by radionuclide releases or dose to the reasonably maximally exposed individual from commercial waste packages in terms of postclosure performance (contribution to the public dose). The current Yucca Mountain Project strategy is to model naval SNF waste packages with an equivalent number of commercial SNF waste packages in the Total System Performance Assessment.

4.5 SPECIFIC REQUIREMENTS FOR DOE SPENT NUCLEAR FUEL OF COMMERCIAL ORIGIN IN DISPOSABLE CANISTERS

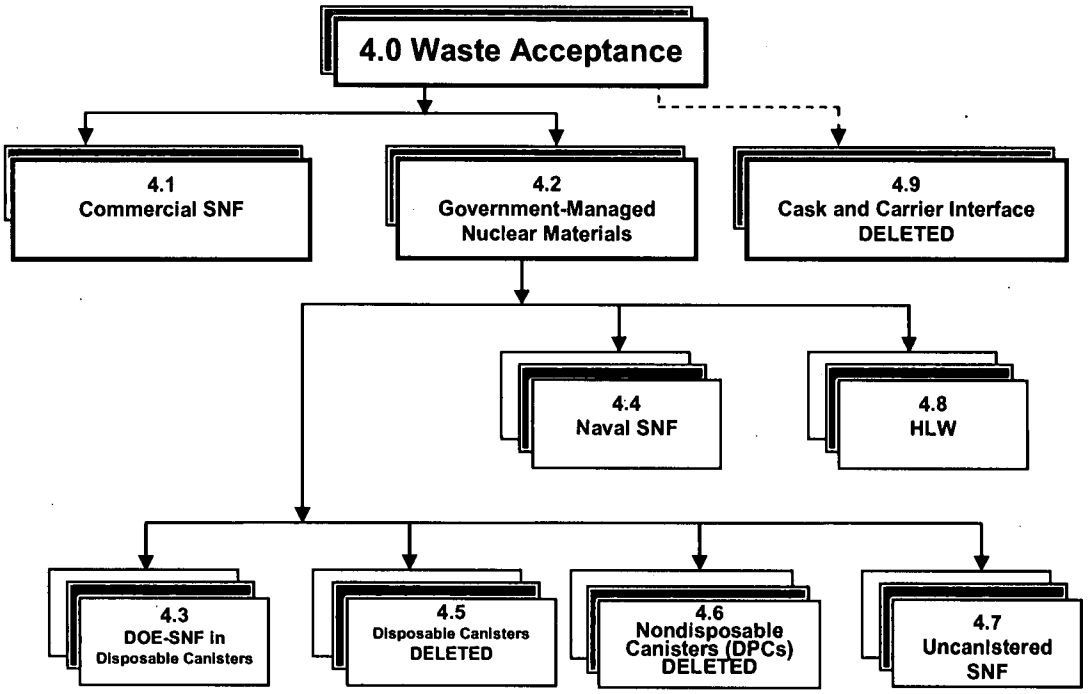
This section has been deleted from the WASRD because it essentially duplicated Section 4.3. Those requirements that are unique have been incorporated into Section 4.3. They are:

- The thermal output requirement was added to subsection 4.3.**9**;
- The thermal design requirement was moved to subsection 4.3.1**0**;
- The categorization of contents was moved to subsection 4.3.1**2**.

4.6 SPECIFIC REQUIREMENTS FOR DOE SPENT NUCLEAR FUEL OF COMMERCIAL ORIGIN IN NON-DISPOSABLE CANISTERS

This section has been deleted. Government Managed Nuclear Materials are not expected to enter the CRWMS in non-disposable canisters. Also, the requirements in this section merely duplicated requirements found in other sections.

4.7 SPECIFIC REQUIREMENTS FOR UNCANISTERED DOE SPENT NUCLEAR FUEL OF COMMERCIAL ORIGIN



This section covers acceptance criteria, beyond those in Section 4.2, that collectively represent the complete set of acceptance criteria for uncanistered DOE SNF of commercial origin. To be a candidate for acceptance into the CRWMS as bare assemblies in a cask, the assembly must fall under any category defined in "Determination of Which SNF and HLW Are to Be Canistered" (see Section 4.2.3, Items D).

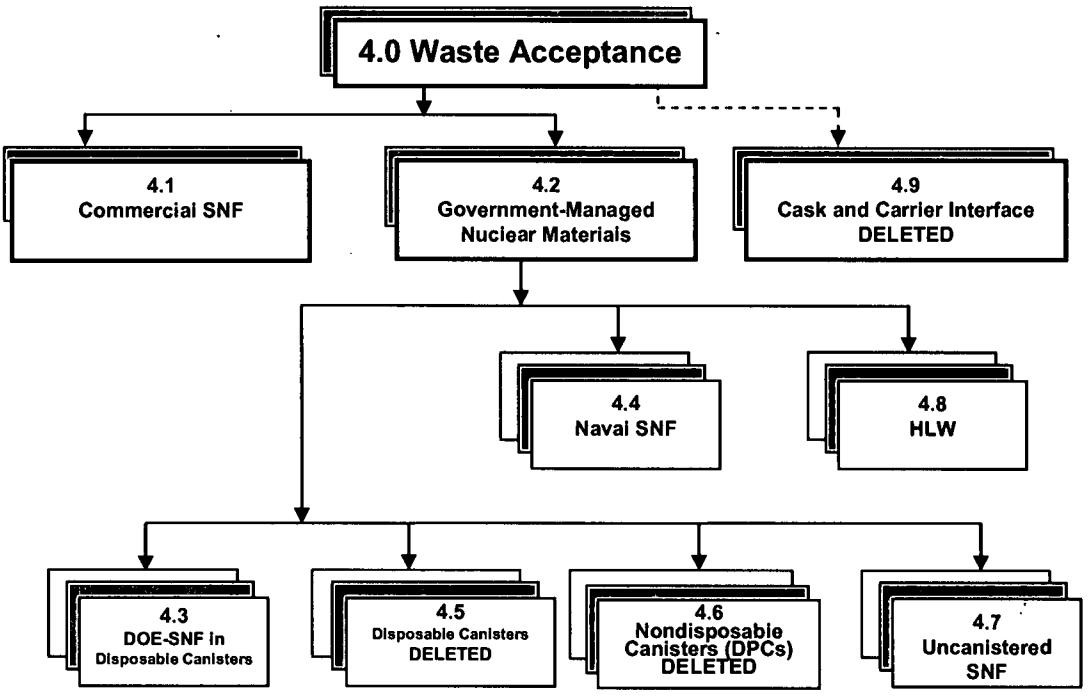
4.7.1 Uncanistered DOE SNF of Commercial Origin

A. Categorization of Contents
   1. DOE SNF of commercial origin delivered bare and for which fees **have** been paid shall be classified using Appendix E of 10 CFR Part 961.

   2. DOE SNF of commercial origin delivered bare and for which fees have **not** been paid shall be classified as either conforming or nonconforming using Section VII.A of the MOA (DOE 2007a).

B. Where special handling is required for any DOE SNF delivered bare, Federal Waste Custodians shall provide handling procedures to the MGR for approval in advance of shipment.

4.8 SPECIFIC REQUIREMENTS FOR HIGH-LEVEL WASTE



This section covers additional acceptance criteria for defense HLW, vitrified plutonium waste form, and commercial HLW in addition to those in Section 4.2 that collectively represent the acceptance criteria for canistered vitrified HLW. At this time, the composition of the vitrified plutonium waste form is not finalized. Once the final composition is determined, additional requirements will be added to this section, as necessary, specific to the vitrified plutonium waste form.

4.8.1 Durability and Phase Stability of Vitrified HLW

A. The standard vitrified HLW form shall be borosilicate glass sealed inside an austenitic stainless steel canister(s) with a concentric neck and lifting flange.

B. Product Consistency

1. The Producer shall demonstrate control of waste form production by comparing production samples or process control information, separately or in combination to the Environmental Assessment benchmark glass (Jantzen 1993) using the Product Consistency Test (ASTM C1285-97) or equivalent.

2. For acceptance, the mean concentrations of lithium, sodium, and boron in the leachate, after normalization for the concentrations in the glass, shall be less than those of the benchmark glass.

4.8.2 HLW Canister Design and Materials of Construction

The HLW canister materials shall preclude chemical, electrochemical, or other reactions (such as internal corrosion) of the canister or waste package such that there will be no adverse effect on normal handling, transportation, storage, emplacement, containment, isolation, or on performance under abnormal occurrences such as a canister drop accident and premature failure in the repository.

4.8.3 Dimensional Envelope for HLW Canisters

At time of delivery, the canistered HLW form shall stand upright without support on a flat horizontal surface and fit without forcing into a right-circular, cylindrical cavity (64 cm [25 in] diameter and 3.01 m [9.88 ft] length or alternatively 64 cm [25 in] diameter and 4.51 m [14.8 ft] length). HLW canister dimensions are found in the Integrated Interface Control Document, Volume 1 (DOE 2007b).

4.8.4 Filled HLW Canister Weights

The weight of filled HLW canister shall not exceed 9,260 pounds (4,200 kg).

4.8.5 Capability to Lift HLW Canisters Vertically with Remote Handling Fixtures

For canisters of HLW accepted into the CRWMS:

A. The Producer shall provide a grapple design suitable for use in loading or unloading a transportation cask with a standard 3.0 m [9.9 ft] HLW canister or a standard 4.5 m [15 ft] canister;

B. The grapple, when attached to the hoist and engaged with the flange, shall be capable of moving the canistered waste form in the vertical direction;

C. The grapple shall be capable of being remotely engaged with and remotely disengaged from the HLW canister flange;

D. The grapple shall be capable of being engaged or disengaged while remaining within the projected diameter of the waste form canister;

E. The grapple shall include safety features that prevent inadvertent release of a suspended canistered waste form.

4.8.6 HLW Canister Sealing

Canisters shall be sealed and leak tight. Canister gas leak rates shall be less than $1x10^{-4}$ ref-cc/sec (6.10×10^{-6} in^3/sec.) (DOE 1996).

4.8.7 HLW Canister Labeling

Canisters shall have a legible, unique identifier that is permanently attached to the canister and is traceable to the permanent records of the canister and its contents.

4.8.8 HLW Canister Drop

The HLW canisters shall be capable of withstanding a drop of 7 meters (23.0 ft) onto a flat, essentially unyielding surface without breaching or dispersing radionuclides.

4.8.9 Free Liquid in Canisters Containing HLW

Sealed HLW canisters shall contain no residual water beyond that condensing from water vapor inside the canister as it cools.

4.8.10 Radionuclide Content in High-Level Waste

Radionuclide estimate waste form requirements are listed in sections 5.4.1.B(2), 5.4.3.C and the NRC Form 741.

4.8.11 Criticality Potential in Canisters Containing HLW

A. Preclosure Criticality:

For acceptance, HLW producers shall provide qualified data to ensure RW can demonstrate preclosure safety requirements relating to criticality, as described below. Specific technical information needs are identified in Section 5.4.1.B(10).

To meet 10 CFR Part 63 preclosure safety requirements, it must be demonstrated that the HLW and its canister, in conjunction with the facility systems, structures, and components, shall provide the basis for ensuring subcriticality at the time of delivery to the geologic repository and during all subsequent handling operations, including all event sequences that are important for criticality and have at least one chance in 10,000 of occurring before permanent closure. To provide assurance of subcriticality, the methodology will account for the biases and uncertainties in both the calculations and experimental data used in the development of the effective neutron

multiplication factor (k_{eff}), and will also include a technically justified administrative margin (Δkm) following the guidance in Fuel Cycle Safety & Safeguards-Interim Staff Guidance-10.

B. Post Closure Criticality:

For acceptance, HLW producers shall provide qualified data to ensure RW can demonstrate postclosure safety requirements relating to criticality, as described below. Specific technical information needs are identified in Section 5.4.1.B(10). Postclosure criticality analyses are based on performance of the co-disposal waste package configurations consisting of both DOE SNF and HLW canisters.

The methodology described in the Disposal Criticality Analysis Methodology Topical Report (YMP/TR-004Q) shall be used to meet 10 CFR Part 63 postclosure criticality requirements to demonstrate that the total probability of criticality for all HLW canisters shall not cause the total probability of criticality for all waste forms to exceed one chance in 10,000 over the first 10,000 years after permanent closure of the repository.

4.8.12 HLW Canister Surface Contamination

The Producer shall inspect the canistered waste form and remove visible waste glass from the exterior surface of the canister prior to shipment.

4.8.13 Thermal Output in Canisters Containing HLW

Total heat generation rate for canisters containing HLW shall not exceed 1500 watts (5120 BTU/hr) per canister (Arenaz 2006) at the year of shipment.

4.9 TRANSPORTATION CASK SYSTEM INTERFACE

This section has been deleted. Transportation requirements formerly in this section are in the *Transportation System Requirements Document*, DOE/RW-0425 **(DOE 2007f)**. Interface requirements formerly in this section are in the *Integrated Interface Control Document*, DOE/RW-0511 (DOE 2007**b**).

5. TECHNICAL INFORMATION NEEDS

In general, this information describes the physical characteristics of the waste and associated packaging to allow the CRWMS to safely transport, handle and dispose of it. These information needs are included in this revision of the WASRD to provide guidance to owners and generators of SNF and HLW for their consideration as to what information must be supplied and its timing.

These information needs are not requirements since, for many of them, a quantitative limit cannot be established nor can a measurement be made once the canister is closed. However, the records packages (e.g. production records) associated with each DOE SNF, naval SNF, or HLW canister should provide insight as to whether any condition or characteristic specified in Section 4.0 cannot be met or could affect compliance with CRMWS acceptance requirements. Should any records package indicate the possibility of such an occurrence, then the waste custodian should notify RW. RW then initiates an analysis of the condition and develops an action plan jointly with the waste custodian that permits the safe transport, handling, and disposal of the waste form. This is the difference between Section 4 and 5: Section 4 contains requirements, those things that Federal Waste Custodians must do; Section 5 requests information that is necessary to perform an analysis of the waste form to judge its impact on the repository.

A future revision of the WASRD will have a better definition and description of the technical information needs. Therefore, the information needs presented here should be considered preliminary and subject to change in subsequent revisions of the WASRD.

5.1 COMMERCIAL SNF

For commercial SNF shipped from commercial entities under contract with the Department of Energy, the information needs are specified in the "Standard Contract for Disposal of Spent Nuclear Fuel and/or High-Level Radioactive Waste" (10 CFR Part 961).

5.2 DOE SNF

A. For DOE SNF the technical information needs are identified in the report "OCRWM Technical Information Needs for DOE Spent Nuclear Fuel" (CRWMS M&O 2000).

B. The unreliability (i.e. probability of release) as a function of drop height up to 23 feet shall be developed for the DOE standard SNF canister and the DOE Multi-Canister Overpack.

C. The probability of failure as a function of seismic accelerations (i.e. fragility curves) shall also be determined using the seismic hazard curve for the Yucca Mountain site with associated input ground motion and structural response.

5.3 NAVAL SNF

For naval SNF, the technical information needs are identified in the document Scope of the Geologic Disposal Technical Information Package for Naval SNF Canisters, Revision 2 S5G Only, (NNPP 2006) and Section V.A of the 2000 Memorandum of Agreement between NNPP and RW (Bowman and Itkin 2000). Similar technical information is required for other naval fuels.

5.4 HLW

This section presents the technical information needs concerning High Level Waste.

5.4.1 Prior to the Start of Production

A. Prior to the start of production of canistered waste forms, the waste producer shall provide all of the documentation (current revision, either as hard copy or as electronic media) required under the Memorandum of Agreement (DOE 2007a). This shall include the EM Waste Acceptance Product Specifications, WCP, Waste Form Qualification Report, and any supporting documentation required by these documents.

B. Information provided shall include the following:

(1) The chemical composition and crystalline phase projections for the vitrified HLW. Information on the chemical composition shall include identification of the oxides of elements present in concentrations greater than 0.5 percent by weight (of glass) and an estimate of the uncertainty of these concentrations for vitrified HLW.

(2) Estimates of the total facility inventory and individual canister inventory of radionuclides (in Curies) that have half-lives longer than 10 years and that are or will be present in concentrations greater than 0.05 percent of the total radioactive inventory. The estimates shall be indexed to the years 2010 and 3110. The Producer shall also report the estimate of the uncertainty in the radionuclide inventories.

(3) The Time-Temperature-Transformation diagrams for the vitrified HLW and identification of temperature limits (if any) necessary to preserve the properties of the vitrified HLW.

(4) Identification of the method to be used to ensure consistency of production batches, and any other information necessary to establish post-closure performance of the waste forms (e.g. identification of organic compounds that may be present and estimated quantities).

(5) Canister material.

(6) Canister dimensions (at the time of acceptance).

(7) Canister lifting and handling arrangements.

(8) Canister labeling conventions.

(9) Information required to assess the canister drop performance during preclosure and to assess repository postclosure performance including information regarding particulates, pyrophorics, combustibles, explosives, or other relevant factors that all may come into play in a Category II event sequence. This is likely to be a detailed list much of which has not yet been determined. This information need will be developed more fully in a future revision of the WASRD.

(10) Information required to assess canister criticality, both pre- and postclosure. This list of information includes, but is not limited to, the following general categories: quantities (number of canisters, amount/canister), waste form dimensions (goes to geometry and concentration of fissile material), quantities of fissile materials present by isotope, materials of construction of canisters and any internal components (goes to influences on chemistry during the postclosure period) and waste form degradation and dissolution characteristics (postclosure geometry and criticality). Information supplied in each category is expected to be as specific as possible. This list will be amplified as new issues arise.

(11) Estimated maximum gamma and neutron dose rates at the canister surface.

(12) Projected distribution of canister thermal outputs, including the maximum.

(13) Method used to assign individual canister Metric Ton Heavy Metal (MTHM) content for accounting against the repository 70,000 MTHM capacity limit as specified in Section 114d of the Nuclear Waste Policy Act of 1982 (as amended).

5.4.2 During Production

Waste producers shall report annually on the production of HLW waste forms, projections of remaining production, and any production trends which may influence the properties of canistered waste forms relative to the information provided in response to 5.4.1. Annual reports shall also identify non-conforming waste forms and the status of actions to address the non-conforming condition(s).

5.4.3 Prior to Delivery

Prior to delivery, waste producers shall provide all relevant production and storage records of canistered waste forms to be delivered, including any documentation of actions required to

address non-conforming conditions. Included in the documentation to be provided is the following:

A. Identification (Label information) of the specific waste form(s) to be delivered.

B. Certification of compliance with WASRD requirements and that all actions required resolving non-conforming conditions have been completed. Completed and approved HLW Production Records in conjunction with relevant shipping and storage records may be used as proof of compliance certification.

C. Production Records and Storage and Shipping Records for individual canistered waste forms to be delivered. These Records along with required information in the WCP and Waste Form Qualification Report shall address product composition, product consistency, radionuclide inventory, sub-criticality, thermal output, gamma and neutron dose rates, post-production temperature history, presence of organic materials (compounds and amounts) and parameters important to canister drop performance.

D. Metric Ton Heavy Metal (MTHM) assignment for each individual canister to be delivered.

5.4.4 At Delivery

A. At the time of delivery, waste producers shall provide a completed DOE/NRC Form-741, Nuclear Material Transaction Reports, traceable to the labels of individual canisters to be shipped. Waste producers shall also certify that canisters loaded into shipping casks are in compliance with the cask Certificate of Compliance.

B. EM shall provide, at the time of acceptance, signed documentation that verifies that each accepted waste form conforms to CRWMS acceptance criteria. EM shall transfer to the authorized RW representative the original or copy (either Hard Copy or Electronic Media) of the completed records package, for acceptance. Such documentation could include HLW Shipping and Storage Records and HLW Production Records.

6. CONFORMANCE VERIFICATION

The CRD (DOE 2007a) provides a working definition: an explanation of how the requirements allocated to that element (in this case, Waste Acceptance) have been satisfied. In addition, the method selected to show conformance verification should be consistent with the principles of *Project Management for the Acquisition of Capital Assets* DOE M 413.3-1 (DOE 2003). These principles include the use of results oriented performance objectives and measurable performance indicators. These objectives and indicators will be built around and sensitive to the technical information supplied by the Federal Waste Custodians and the civilian reactor operators.

The development of conformance verification methods is in its very earliest stages. However, both the MOA with EM (DOE 2007c) and the MOA with NNPP (Bowman, **F.L. and Itkin, I.** 2000) provide some insight into the scope of conformance verification. RW will perform conformance verification on all incoming SNF and HLW. This includes commercial SNF which will be judged by the terms and conditions of the Standard Contract (10 CFR Part 961). DOE-managed SNF and HLW will have to conform to the requirements of the WASRD along with requirements of the *Spent Nuclear Fuel Verification Plan* (DOE 1997). Action plans for the disposition of nonconforming materials will be developed and implemented. All transfers of SNF or HLW from EM to RW must be reported on DOE/NRC Form 741. NNPP will submit an unclassified Form 741. These steps form a preliminary framework of conformance verification. Detail will be added as the Waste Acceptance element of the CRWMS matures.

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7. PROJECTED INITIAL ACCEPTANCE CAPACITY AND OVERALL SCHEDULE

Table 7-1 provides an initial projection of the schedule for accepting Government Managed Nuclear Materials and commercial SNF. The estimated schedule shown for commercial SNF reflects the planning basis documented in Table 1 of the Civilian Radioactive Waste Management System Requirements Document (DOE 2007**a**, Section 3.2.1.D).

The NWPA requires that the NRC "...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 a time as a second repository is in operation." DOE plans to co-emplace DOE wastes and commercial SNF in a manner that ensures that repository thermal goals are met. When the emplacement limit is reached, emplacement will stop until a second repository is in operation or appropriate changes to the NWPA are enacted.

Table 7-1 identifies the total projected quantities of the various waste types expected to require geologic disposal and current plans for their acceptance by the CRWMS. The schedule is based on the following:

- Government-managed nuclear waste will be accepted by the CRWMS as early as Year 1 of operations.
- The 1995 EM plan (Lytle 1995; Dreyfus 1995) to include DOE SNF and naval SNF among the early DOE wastes to be delivered to the CRWMS.
- The December 1996 plan (62 FR 1095) by the Department of Navy (and DOE as cooperating agency) to use a naval canister system for loading, storing, transporting, and possibly disposing of naval SNF.
- The DOE plan (DOE 1999, page S.2) to immobilize approximately 13 metric tons of the surplus-weapons plutonium considered unsuitable for use in MOX fuel.
- The court-ordered agreement between DOE, the U.S. Navy, and the State of Idaho to remove the entire inventory of DOE SNF and naval SNF out of Idaho by January 1, 2035 (Public Service 1995) and that naval SNF shall be among the early shipments to the repository (paragraph D.1.e of the court order).
- Final receipt rates for naval SNF are to be negotiated to be consistent with the Memorandum of Agreement between RW and NNPP (Bowman , F.L. and Itkin, I. 2000).

The rates in this schedule are targets only and do not create any binding legal obligation on the Department of Energy.

Table 7.1: Descriptions of Wastes to be Sent to Repository

Waste Type	Inventory	Description of Waste Form
CSNF	**63,000 MTHM**	Approx. 221,000 BWR and PWR assemblies from commercial nuclear power generation, to be received at Yucca Mountain as Transport-Aging-Disposal canisters, dual-purpose canisters, or uncanistered, intact SNF assemblies. Approx. 1,700 MOX assemblies from conversion of 34 MT of surplus plutonium are included, but may require further testing/characterization. Also includes some commercial-origin DOE SNF for which fees have already been paid.
CHLW		275 canisters of vitrified HLW resulting from the commercial reprocessing of 640 MTHM of SNF. The HLW is owned by New York State and stored at the West Valley Demonstration Project. This HLW is characteristically identical to the HLW at Savannah River. There is currently no acceptance agreement between DOE and New York for this HLW.
DOE HLW	**4,667 MTHM**	Up to 9,334 canisters, either 10- or 15-foot long from reprocessing activities at Hanford, Savannah River, and Idaho National Laboratory. The reference HLW is a vitrified borosilicate glass with a range of waste loadings. (DOE uses a conversion of 0.5 MTHM per canister of DOE HLW to establish the basis to meet the NWPA statutory limit.) Only qualitative information is available to addresses approximately 870 canisters of a vitrified plutonium waste form (not part of the 4,667 MTHM inventory unless qualified for disposal) pending selection of the final waste form composition. The reference vitrified plutonium waste form includes a 10-foot canister of HLW containing up to 28 small cans containing lanthanide borosilicate (LaBS) glass incorporating the approximately 13 MT of surplus plutonium. An additional 100 canisters of HLW glass would also be generated due to the displacement of HLW from Pu.
DOE SNF	**2,333 MTHM**	Spent nuclear fuel from various non-commercial sources, such as weapons production, research and testing, and naval nuclear propulsion. DOE SNF is divided into 34 analytical groups based on fuel properties, cladding integrity, enrichment, etc. DOE SNF would be placed into disposable canisters at its current storage sites in Savannah River, Hanford, and Idaho National Laboratory. The canisters could be either a standardized canister (10-foot x 18", 10-foot x 24", 15-foot x 18", or 15-foot x 24"), multicanister overpacks, or naval spent fuel canisters (long or short). It is estimated that a range of 2,500 to 5,000 canisters will be produced. EM's current estimate is for approximately 3,500 canisters.

The inventories and allocation are consistent with CRWMS technical requirements baseline documents (e.g. CRWMS Requirements Document, MGR System Requirements Document, and Waste Acceptance System Requirements Document). Note that EM and RW agreed, for planning purposes, on a split of 1/3 of the 10% allocation of defense inventory to be for DOE SNF and 2/3 to be for HLW. This split can be readjusted upon joint agreement between EM and RW.

Table 7.2: Estimated Schedule for Acceptance of Commercial and Government-Managed Nuclear Materials

Year of Operation	CSNF & CHLW (MTHM)	Canisters		
		Naval SNF	DOE SNF	Defense High-Level Radioactive Waste
1	400	3	66	193
2 thru 4	3,800 Minimum total for period	15 Minimum total for period	257 Minimum total for period	1,143 Minimum total for period
5 and after	3,000/year	15/year*	179/year	763/year

* Naval Nuclear Propulsion Program activities can prepare up to 24 naval SNF canisters annually for shipment to the MGR. For CRWMS design purposes, this value should be used for maximum receipt rates of naval SNF canisters.

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APPENDIX A

GLOSSARY

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GLOSSARY

Acceptance is the transfer of responsibility, custody, and physical possession of SNF or HLW from EM to RW at EM's facility.

Atomic Energy Defense Activity is any activity of the Secretary of Energy performed in whole or in part in carrying out any of the following functions:

A. Naval reactors development
B. Weapons activities including defense inertial confinement fusion
C. Verification and control technology
D. Defense nuclear materials production
E. Defense nuclear waste and materials by-products management
F. Defense nuclear materials security and safeguards and security investigations
G. Defense research and development.

Borosilicate Waste Glass is glass typically containing approximately 20 to 40 wt. percent waste oxides, 40 to 65 wt. percent silica, 5 to 10 wt. percent boron oxide, and 10 to 20 wt. percent alkali oxides, plus other oxide constituents.

Canister is the structure surrounding the waste form (e.g., HLW immobilized in borosilicate glass) that facilitates handling, storage, transportation, and/or disposal. A canister is a metal receptacle with the following purposes: (1) for solidified HLW, its purpose is a pour mold and (2) for SNF, it may provide structural support for intact SNF, loose rods, non-fuel components, or containment of radionuclides.

Carrier refers to a cargo-carrying vehicle used for transportation of cargo; sometimes called a transporter. The carrier or transporter is required to meet federal and state transportation requirements but is not included under the NRC's transportation system certification program. It includes semi-trailers and railcars needed to make the loaded cargo-carrying vehicle transport-ready.

Cask is a container for shipping or storing spent nuclear fuel and/or canistered high-level waste. Casks must meet all applicable regulatory requirements and be built to a design certified by the NRC. The following types of casks are utilized by the CRWMS:

- Single-Purpose Casks - These transportation casks are primarily intended for transporting uncanistered, standard and nonstandard SNF from Purchaser/Custodian sites to a CRWMS site.

- Canister Casks - These transportation casks are for transporting canisters (TAD or DPC) containing SNF from Purchaser/Custodian sites to CRWMS sites and between CRWMS sites.

- Transportable Storage Casks - These transportation casks are for storing uncanistered SNF at Purchaser sites, transporting SNF from Purchaser sites to CRWMS facilities, and possible storage of SNF at CRWMS facility.

- HLW Casks - These transportation casks are for transporting commercial and defense HLW from Producer sites to the MGR.

- Specialty Casks - These transportation casks are for transporting nonstandard SNF, and/or fuel related hardware, and/or failed fuel from Purchaser/Custodian sites to the MGR.

Cask Subsystem is defined under Transportation Cask Subsystem in this Glossary.

Civilian Radioactive Waste Management System (CRWMS) is the composite of sites, facilities, systems, equipment, materials, information, activities, and personnel required to perform those activities necessary to manage SNF and HLW disposal.

Commercial High-Level Radioactive Waste (Commercial HLW) is the high-level radioactive waste, as defined by NWPA 42 United States Code (U.S.C.) 10101(12), resulting from reprocessing SNF in a commercial facility.

Commercial Spent Nuclear Fuel is SNF resulting from operation of commercial nuclear reactors that is covered by a Standard Contract (10 CFR Part 961) at the time of acceptance. Commercial SNF includes nonfuel components as discussed in Appendix E of 10 CFR Part 961.

Contract is the agreement set forth in 10 CFR Part 961.11 and any duly executed amendment or modification thereto.

Custodian means any government agency that possesses SNF that is a candidate for disposal in the CRWMS.

Defense High-Level Radioactive Waste (Defense HLW) is the high-level radioactive waste, as defined by NWPA 42 U.S.C. 10101(12), resulting from reprocessing SNF in a defense facility.

Disposable Canister means any container into which SNF or HLW are placed such that these materials are contained during subsequent handling, and the combined canister and waste can be emplaced in the repository or inserted into a disposal container without repackaging the canister contents.

Disposal Container is the component of the waste package that envelopes the waste form or the canistered waste form in order to provide structural support, criticality control, and an environmental barrier once emplaced in the repository. It includes the container barriers or shells, spacing structures or baskets, shielding integral to the container, packing contained within the container, and other absorbent materials designed

to be placed internal to the container or immediately surrounding the container shell (i.e., attached to the outer surface of the container). Different disposal containers are designed to contain SNF and HLW, but all exist only until loaded and the outer lid weld is complete and accepted (then the resulting assembly is called a "waste package"). The disposal container does not include the waste form or the encasing containers or canisters.

Disposal means the emplacement of radioactive waste in a geologic repository with the intent of leaving it there permanently (10 CFR Part 63).

DOE-Generated Spent Nuclear Fuel is SNF generated at a DOE installation.

DOE Spent Nuclear Fuel is SNF that is managed by DOE, and has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated by reprocessing. DOE SNF includes, but is not limited to, production reactor SNF, research reactor SNF, naval SNF, and some SNF from commercial power reactors (commercial-origin EM SNF).

DOE Spent Nuclear Fuel of Commercial Origin is SNF managed by EM that previously was irradiated at civilian facilities and for which fees have been, or will be, paid under a standard contract with RW.

Dual-Purpose Canister (DPC) - refers to a sealed, metallic container maintaining multiple SNF assemblies in a dry, inert environment and overpacked separately and uniquely for storage and transportation.

Federal Waste Custodian is the DOE field office site organization responsible for the management of SNF and HLW under the oversight of the Office of Environmental Management and SNF under the oversight of the Naval Nuclear Propulsion Program. For purposes of the WASRD, the Naval Nuclear Propulsion Program is the Federal Waste Custodian responsible for the management of naval SNF.

Function is a primary statement of purpose; it defines what a system or subsystem must accomplish to meet the system mission.

Government-Managed Nuclear Materials consist of both SNF (e.g., DOE SNF and naval SNF) and HLW (e.g. defense) that are in the custody of and will be accepted from a government agency.

Grapple means a device, usually part of a hoisting mechanism that clamps an object to be moved.

High-Level Radioactive Waste (HLW) means (1) the highly radioactive material resulting from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid material derived from such liquid waste that contains fission products in sufficient concentration; and (2) other highly radioactive

material that the Commission, consistent with existing law, determines by rule requires permanent isolation (Nuclear Waste Policy Act of 1982, as amended).*

Interface Requirement means a requirement that applies to the inputs to, or outputs from, the function; or the physical connection or dependence between architectural items.

Monitored Geologic Repository (MGR) means a system that is intended to be used for, or may be used for, the disposal of radioactive wastes in excavated geologic media. A geologic repository includes the engineered barrier system and the portion of the geologic setting that provides isolation of the radioactive waste.

Multicanister Overpack (MCO) means the stainless steel cylinder that is top loaded into the MCO Cask cavity. Note that different basket designs are used in the MCO depending on the material being loaded by the fuel retrieval system.

Non-disposable Canister means a canister suitable for storage or transport but not suitable for disposal. Radioactive waste in a non-disposable canister must be repackaged prior to disposal.

Package means the packaging together with its radioactive contents as presented for transport.

Packaging means the assembly of components necessary to ensure compliance with the packaging requirements of 10 CFR Part 71. It may consist of one or more receptacles, absorbent materials, spacing structures, thermal insulation, radiation shielding, and devices for cooling or absorbing mechanical shocks. The vehicle, tie-down system, and auxiliary equipment may be designated as part of the packaging.

Producer is any generator of HLW resulting from atomic energy defense activities or any producer of vitrified commercial HLW who has executed an acceptance and disposal contract. For purposes of this document, the WVDP, which has commercial HLW, will be considered a "Producer" only when an acceptance and disposal contract is executed.

Product Consistency Test is an ASTM-approved (ASTM C1285-97), crushed glass leachability test procedure used for measuring the concentration of chemical species released from a crushed glass to a test solution. The Product Consistency Test is not a measure of the glass composition itself.

Production Record is the documentation, provided by the Producer, that describes an actual canistered waste form.

Purchaser means any person, other than a Federal agency, who is licensed by the Nuclear Regulatory Commission to use a utilization or production facility under the

* From the DOE/EM standpoint, HLW does not include the radioactive waste resulting from the reprocessing of spent nuclear fuel as defined in Section 3116 of the Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005 (PL108-375, October 28, 2004).

authority of sections 103 and 104 of the Atomic Energy Act of 1954 (AEA 1954) or who has title to spent nuclear fuel or high level radioactive waste and who has executed a contract with DOE.

Pyrophoric Material is any material capable of igniting spontaneously under anticipated temperature, chemical, and/or physical/mechanical conditions specific to waste storage, transportation and/or handling.

ref-cc/sec means the volume of 1 cm^3 of dry air per second at a pressure of 1 atmosphere, absolute, (760 mm Hg) and 25 °C. See reference ANSI N14.5-1997.

Requirement means those statements that describe a characteristic or constraint that must be met for a system, product, or process to be acceptable.

Shipment means the movement of the properly prepared (loaded, unloaded, or empty) cask from one site to another and all associated regulatory activities.

Shop Clean Conditions means that all accessible surfaces shall be visibly free of flux, grease, oil, dust, dirt, loose particles, or other foreign material to the extent necessary to prevent interference with system operation. Some light rust, scale, oxide or other adherent films are acceptable.

Single-Element-Sized Canister is disposable canister that is dimensionally interchangeable with BWR or PWR assemblies and has handling interfaces dimensionally and structurally interchangeable with one or more of these assemblies. Canisters can either have screened ends that allow water to circulate through the canister or can be sealed.

Spent Nuclear Fuel (SNF) is fuel that has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated by reprocessing (Nuclear Waste Policy Act of 1982, as amended).

System Element is one of the three major configuration items that are required to accomplish the functions of the CRWMS. The three system elements are Waste Acceptance, Transportation, and MGR. This differs from the "project" that may be initiated by DOE to manage and control development of one or more system elements (e.g., Yucca Mountain Site Operations Office).

Technical Baseline is a configuration identification document, or set of such documents, that is formally designated and approved at a specific time. Within the CRWMS, technical baseline is composed of, and evolves through, the functional and technical requirements baseline that is presented in the CRD, the design requirements baseline, the final design baseline, and the as-built baseline.

Transportation, Aging and Disposal (TAD) Canister is a multifunctional canister for commercial SNF assemblies which will accommodate transportation by DOE and aging

(to reduce thermal output from SNF over time) at a suitable facility in NRC certified casks. The canister will be placed in a waste package for disposal in an NRC licensed repository.

Transportation Cask is a container for shipping SNF and/or HLW that meets all applicable regulatory requirements.

Transportation Cask System is a cask and associated components such as impact limiters, tie-down devices and personnel barriers, tools, and ancillary equipment necessary to ensure compliance with the package requirements of 10 CFR Part 71.

Transporter is a cargo-carrying vehicle used for transportation of cargo. It includes semi-trailers, rail cars, intermodal transportation skids and equipment such as tie-down components, personnel barriers, etc., needed to make the loaded cargo-carrying vehicle transport-ready.

Upper subcritical limit is the maximum allowed value of k_{eff} (including uncertainty in k_{eff}), under both normal and credible abnormal conditions, including allowance for the bias, the bias uncertainty, and a minimum margin of subcriticality.

Vitrified Plutonium Waste Form is a vitrification technology utilizing a lanthanide borosilicate (LaBS) glass for dispositioning excess weapons-useable plutonium that is not suitable for processing into MOX fuel. The LaBS glass formulation is capable of immobilizing approximately 10 wt % Pu. The final waste form utilizes the can-in-canister technology, which involves placing small cans of the vitrified plutonium waste form into a high level waste (HLW) glass canister fitted with a rack to hold the cans and then filling the canister with HLW glass. The completed assembly containing the plutonium glass and the HLW glass would be referred to as the Vitrified Plutonium Waste Form. SOURCE: WSC-TR-2005-00125 Rev. 0, 2005.

Waste Acceptance is the system element that manages the Accept Waste function that includes acceptance of SNF and HLW into the CRWMS from the Purchaser/ Custodian/Producer of such waste.

Waste Form means the radioactive waste materials and any encapsulating or stabilizing matrix (10 CFR Part 63).

Waste Owner is used as a collective term that includes the Purchaser (Standard Contract holder) for commercial SNF and the Federal Waste Custodian of government-owned SNF and/or HLW.

Waste Package means the waste form and any containers, shielding, packing, and other absorbent material immediately surrounding the individual Waste container (10 CFR Part 63).

APPENDIX B

SAMPLE FORWARD CALCULATION TO DETERMINE CANISTER SOURCE TERM

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APPENDIX C

INTERFACE FOR MULTI-PURPOSE CANISTERS (MPC)

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APPENDIX D

TRACEABILITY WITH CRD

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Table D.1. Traceability of CRD Requirements in the WASRD

CRD Requirement, Rev. 7		WASRD Rev. 5	
Requirement	**Subject**	**Corresponding WASRD Requirement**	**Title/Subject In WASRD**
3.1.1	Policy Driven Requirements		
3.1.1.A	Scope of Baseline; Use of LP-PMC-009-OCRWM	The applicability and implementability of this CRD requirement will be fully assessed in future WASRD revisions.	
3.1.1.B	Consistency with CRD	The applicability and implementability of this CRD requirement will be fully assessed in future WASRD revisions.	
3.1.1.C	Adherence to DOE Order 413.3-Change 1	The applicability and implementability of this CRD requirement will be fully assessed in future WASRD revisions.	
3.1.1.D	Adherence to Change Control and Configuration Control Board Procedures	The applicability and implementability of this CRD requirement will be fully assessed in future WASRD revisions.	
3.1.1.E	Compliance with "Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (IAEA 1997)	The applicability and implementability of this CRD requirement will be fully assessed in future WASRD revisions.	
3.1.1.F	Utilize proven commercial technology to the maximum extent practical	The applicability and implementability of this CRD requirement will be fully assessed in future WASRD revisions.	
3.1.1.G	Conduct independent cost estimating reviews prior to a major critical decision milestone	The applicability and implementability of this CRD requirement will be fully assessed in future WASRD revisions.	
3.1.1.H	Conduct independent cost estimating reviews		
3.1.1.I	Evaluation of need for Second Repository		
3.1.1.J	Develop system start-up plan		
3.1.2	Statutory or Regulatory Driven Requirements	3.1	Primary Regulatory Requirements
3.1.2.A	Comply with applicable NWPA provisions	4.2.1	Compliance with the Nuclear Waste Policy Act
3.1.2.B	Comply with applicable 10 CFR Part 20 provisions	The applicability and implementability of this CRD requirement will be fully assessed in future WASRD revisions.	
3.1.2.C	Comply with applicable 10 CFR Part 961 provisions	The applicability and implementability of this CRD requirement will be fully assessed in future WASRD revisions.	
3.1.2.D	Comply with applicable RW/EM MOA and RW/NNPP MOA provisions	The applicability and implementability of this CRD requirement will be fully assessed in future WASRD revisions.	
3.1.2.E	Comply with applicable 29 CFR Part 1910 and 29 CFR Part 1926 provisions	The applicability and implementability of this CRD requirement will be fully assessed in future WASRD revisions.	

CRD Requirement, Rev. 7		WASRD Rev. 5	
Requirement	**Subject**	**Corresponding WASRD Requirement**	**Title/Subject In WASRD**
3.1.2.F	Comply with applicable 10 CFR Part 75 provisions	The applicability and implementability of this CRD requirement will be fully assessed in future WASRD revisions.	
3.1.2.G	Ensure physical protection of SNF and HLW	The applicability and implementability of this CRD requirement will be fully assessed in future WASRD revisions.	
3.2.1	Overall System Performance	N/A	
3.2.1.A	Designed to accept, transport and dispose of C-SNF, vitrified Defense High-Level Radioactive Waste, and vitrified C-HLW	4	Acceptance Requirements FOR Spent Nuclear Fuel AND High-Level Waste
3.2.1.B	System operating conditions and receipt rates	7	Projected Initial Acceptance Capacity and Overall Schedule
3.2.1.D	Maximum, authorized inventory	7	Projected Initial Acceptance Capacity and Overall Schedule
3.2.1.F	Accommodate a range of storage and transportation technologies	4	Acceptance Requirements FOR Spent Nuclear Fuel AND High-Level Waste
3.2.1.I	RW responsible for design, NRC certification, and fabrication of transportation casks for use by EM.	1.3	System Definition
3.3	Waste Acceptance Element Requirements	3.2	Waste Acceptance Element Performance Requirements
3.3.A	Collect necessary information in support of CRWMS activities	The applicability and implementability of this CRD requirement will be fully assessed in future WASRD revisions.	
3.3.B	Validate title and custody documentation	The applicability and implementability of this CRD requirement will be fully assessed in future WASRD revisions.	
3.3.C	Accept no WVDP C-HLW without executing an acceptance and disposal contract	The applicability and implementability of this CRD requirement will be fully assessed in future WASRD revisions.	

APPENDIX E

UNITS CONVERSION

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APPENDIX E: UNITS CONVERSION

Numeric values are quoted throughout the WASRD. These values are taken from a variety of sources and the units of measurement are not systematic in the sense that they are not presented as all English units or all metric units (*Le Système International d'Unités*). The presentation format used in the WASRD is to present the value with its units are given in the original source material followed parenthetically by the value converted to the other system with appropriate units. This appendix presents both the conversion factors used and some considerations on the use of significant figures.

E.1 Conversion Factors

The following conversion factors were used. They were obtained from the source quoted below and rounded to an equal or greater number of significant figures as the value to be converted using standard procedures with one exception. Therefore, the conversion factor is not the limit on accuracy in the calculation.

Table E-1. Conversion Factors

To Convert		multiply by
from	to	
pounds (lb)	kilograms (kg)	0.4535924
inches (in)	millimeters (mm)	25.4
cubic inches (in^3)	cubic millimeters (mm^3)	16387.064
watts (w)	British thermal units per hour (BTU/hr)	3.41518
feet (ft)	meter (m)	0.3048
degrees centigrade (°C)	degrees Fahrenheit (°F)	F = 1.8*C + 32

Source: ASME B&PV Code, Section III, Division 1, Non-Mandatory Appendix AA, *Guidance for the Use of U.S. Customary and SI Units in the ASME Boiler and Pressure Vessel Code*

E.2 Significant Figures

Converted values were rounded to the same number of significant figures as the original quoted value as suggested in the reference supporting the preceding table. In the cases where only two significant figures are given in the source, only two significant figures are used in the converted value. In such a case, it may appear as though there is a significant arithmetic error in the conversion. However, if only two significant figures are given in the source, one must assume that is the extent of known or desired accuracy. The authors have no license or reason to expand the number of significant figures to something greater than that given in the source.

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For further information, contact:

U.S. Department of Energy
Yucca Mountain Site
Characterization Office
P.O. Box 30307
North Las Vegas, Nevada
89036-0307

Or call:

1-800-967-3477