DOE/RW-0351 **QA:**QA

Office of Civilian Radioactive Waste Management

Civilian Radioactive Waste Management System

Waste Acceptance System Requirements Document

Revision 4

January 2002

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

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This document contains Civilian Radioactive Waste Management System Waste Acceptance Criteria for spent nuclear fuel and high-level radioactive waste. These criteria are based on the best available data and repository designs as of publication. These designs remain preliminary. Additional data must be collected and factored into the design, and the entire repository licensing process must be completed before these criteria can be considered final. As the design and licensing process evolves, the Office of Civilian Radioactive Waste Management may revise these criteria if required.

This document may be affected by technical product input information that requires confirmation. Any changes to the document that may occur as a result of completing the confirmation activities will be reflected in subsequent revisions. The status of the input information quality may be confirmed by review of the Document Input Reference System database.

DOE/RW-0351
QA: QA

Civilian Radioactive Waste Management System

Waste Acceptance System Requirements Document

Revision 4

January 2002

Prepared by:

U.S. Department of Energy
Office of Civilian Radioactive Waste Management
1000 Independence Avenue, S.W.
Washington, DC 20585

Having completed the technical review under procedure AP-2.14Q and management review and approval of ATI-2002-003 by Level II Change Control Board, the Waste Acceptance System Requirements Document, Revision 4 is approved for release.

Jeffery Williams, Acting Director
Office of Acceptance, Transportation
and Integration

2/01/2002
Date

M&O ID:702-295-7522 JAN 30'02 8:37 No.001 P.02

OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT QA: QA
BASELINE CHANGE PROPOSAL Page: 4 of 17

BCP No.:	Level:	Title:
ATI-2002-003	2	Issue and Baseline Waste Acceptance System Reqs. Doc. Rev 04

Level 3 Expedited Disposition

21a. SME Concur: ☐ Yes ☐ No
Print Name: Signature: Date:

21b. SME Concur: ☐ Yes ☐ No
Print Name: Signature: Date:

21c. SME Concur: ☐ Yes ☐ No
Print Name: Signature: Date:

Disposition

22a.	Approve	Endorse	Reject	Conditions/ implementation instructions (see Block 22b.)	Name/Signature	Date
Level 3 Disposition Authority		✓			RF Don Pearman	1/31/02
Level 2 Chairperson	✓				Jeffrey R. Williams	2/1/02
Level 1 Chairperson						

22b. Conditions/Implementing Instructions:
RW-40:
(1) Within 30 working days of disposition of this BCP, RW-40 shall publish the WASRD, Rev. 04
(2) Incorporate into the Integrated ICD relevant portions of this BCP identified as belonging in the Integrated ICD.
(3) Incorporate into a later revision of the WASRD relevant portions of this BCP pertaining to Waste Acceptance.
EM: Update trace of requirements, as needed.
NR-1: Update trace of requirements, as needed.
NA-26: Update trace of requirements, as needed.

☐ See Continuation Page

Closeout

23.	Closed	N/A		Initials	Date
Level 3			Level 3 CCB Secretary		
Level 2			Level 2 CCB Secretary		
Level 1			Level 1 CCB Secretary		

AP-PMC-007.1 Rev. 12/13/2000

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**	**Pages Affected**
Rev. 00 Jan. 1993	Program Change Directive No. 67	Initial issue.	All
Rev. 01 March 1994	BCP-00-94-0001	Incorporates the Multi-Purpose Canister (MPC) concept into the CRWMS technical baseline.	All
Rev. 01, DCN 01 May 1995	BCP-00-94-0005	Resolves 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	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	Streamline of 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	Transfer 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

TBV/TBD Log

Number	Section Number	Projected Resolution Date	Brief Description
TBV-5011	4.3.12 4.4.13.A 4.5.13.A 4.8.12	2002	Effective neutron multiplication factor (k_{eff}) for determining criticality potential for DOE SNF and HLW and naval SNF canisters at time of acceptance into the CRWMS.
TBV-5012	4.3.14 4.4.15 4.5.15 4.8.14	2003	Thermal output for disposable canisters (DOE SNF, naval SNF, commercial single-element-sized and multi-element canisters, and HLW) and uncanistered assemblies.
TBV-5013	4.5.2.B.2	2002	Canister dimensional envelop for disposable commercial origin DOE SNF multi-element canisters.
TBV-5014	4.5.3.A.1 4.5.3.B	2005	Weight limits for commercial-origin SNF disposable and non-disposable canisters.
TBV-5015	4.9.6.C 4.9.6.D	2005	Transport cask and combined cask/carrier weight limits.
TBV-5002	Appendix C	2002	Selection of fill gas, fill temperature, and fill pressure for multipurpose canisters
TBV-5003	Appendix C	2002	Allowable waste package surface temperatures at various times after burial
TBV-5047	4.8.6	2008	HLW Canister Leak Rate

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ACRONYMS AND ABBREVIATIONS

Acronyms

AAR	Association of American Railroads
ASTM	American Society for Testing and Materials
BWR	Boiling-Water Reactor
CDE	Committed Dose Equivalent
CFR	Code of Federal Regulations
CRD	CRWMS Requirements Document
CRWMS	Civilian Radioactive Waste Management System
DBE	Design Basis Event
DDE	Deep Dose Equivalent
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
ICD	Interface Control Document
INEEL	Idaho National Environmental Engineering Laboratory
IPWF	Immobilized Plutonium Waste Form
ISF	Interim Storage Facility
M&O	Management and Operating Contractor
MC & A	Material Control and Accounting
MCO	Multi-Canister Overpack
MGR	Monitored Geologic Repository
MOA	Memorandum of Agreement
MOX	Mixed-Oxide
MPC	Multi-Purpose Canister
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)
ORP	The EM Office of River Protection

ACRONYMS AND ABBREVIATIONS (Continued)

PWR	Pressurized-Water Reactor
QA	Quality Assurance
QARD	Quality Assurance Requirements and Description
RAS	Requirements Analysis Sheets
RCRA	Resource Conservation and Recovery Act
RW	Office of Civilian Radioactive Waste Management (DOE)
SNF	spent nuclear fuel
SRS	DOE Savannah River Site
TBD	to be determined
TBV	to be verified
TEDE	Total Effective Dose Equivalent
WASRD	Waste Acceptance System Requirements Document
WAPS	EM Waste Acceptance Product Specifications
WCP	Wasteform Compliance Plan
WQR	Wasteform Qualification Report
WVDP	West Valley Demonstration Project
YMSCO	Yucca Mountain Site Characterization Office

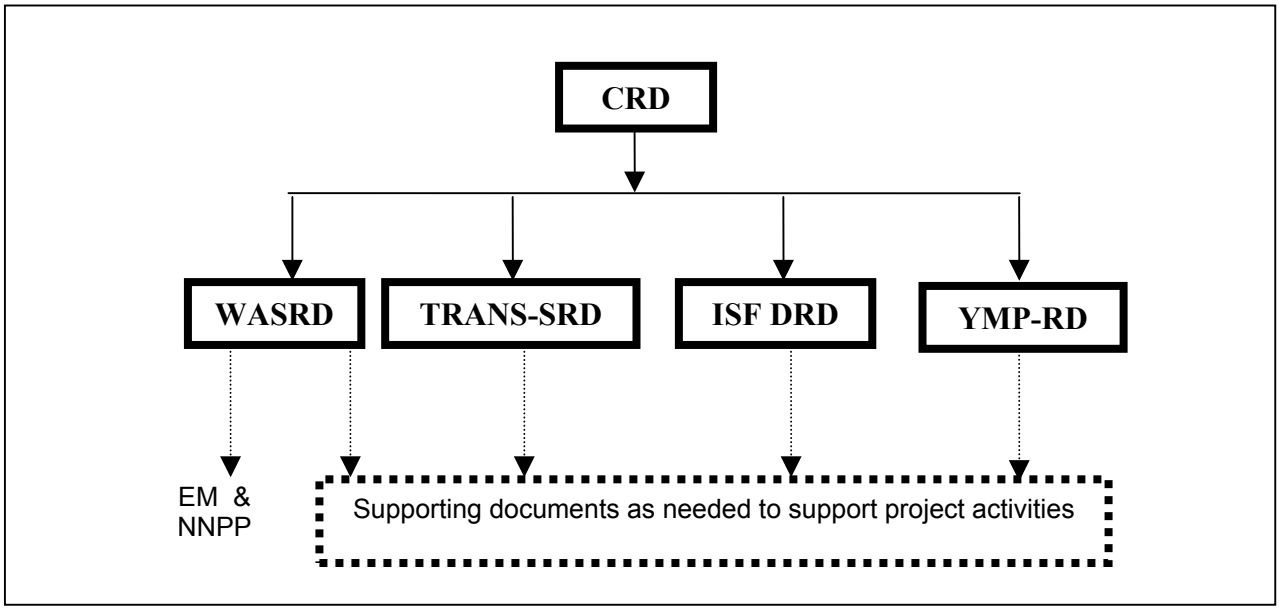
Abbreviations

°C	degrees Centigrade
cm	centimeter
g	grams
g	gravities
in.	inch(es)
k_{eff}	effective neutron multiplication factor
kg	kilograms
kW	kilowatts
m	meters
Pu	plutonium
rem	roentgen equivalent man
SS	stainless steel
Sv	sievert
U	uranium
UO_2	uranium dioxide
W	watts

1. INTRODUCTION

1.1. PURPOSE

This document establishes waste acceptance technical requirements for the U.S. Department of Energy's (DOE) Civilian Radioactive Waste Management System (CRWMS). These requirements consist of two types: (a) internal CRWMS requirements derived from the Civilian Radioactive Waste Management System Requirements Document (CRD) (DOE 2000a) 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



NOTE: Trans SRD = Transportation System Requirements Document; ISF DRD = Interim Storage Facility Design Requirements Document; YMP-RD = Yucca Mountain Project Requirements Document, EM = DOE Office of Environmental Management, NNPP = Naval Nuclear Propulsion Program

Figure 1. RW Technical Baseline

1.2. DOCUMENT ORGANIZATION

The Waste Acceptance System Requirements Document (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 can not 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 (including Immobilized Plutonium Waste Form, IPWF) 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.

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 has been deleted.

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. A description of the interface between disposable canisters and the waste package.

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

The legal or regulatory basis for requirements is documented on requirements analysis sheets (RAS) 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 are 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 RAS. 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 (ICDs).

1.3. SYSTEM DEFINITION

The CRD (DOE 2000a) includes the Waste Acceptance function as part of the larger Waste Acceptance and Transportation element (see Section 3.3 of CRD). The Waste Acceptance function refers to the following CRWMS activities and 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 waste once in the CRWMS, and until such time that this function is transferred to the Monitored Geologic Repository (MGR) along with the waste and associated documentation.

The Waste Acceptance function includes all interactions with Purchasers (commercial utilities and SNF storage sites) and Producers/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 waste inventory data; scheduling and queuing of waste 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 wastes are removed from transport casks at the MGR.

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

- Purchasers/Producers/Custodians are responsible for:
  - characterizing and packaging waste 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/Producers/Custodians).

- Waste transport responsibilities differ according to waste ownership:
  - All transportation activities associated with commercial SNF (including DOE SNF of commercial origin), commercial HLW, and defense HLW are the responsibility of the CRWMS.
  - DOE-EM is responsible for design, NRC certification, and fabrication of the transportation systems for DOE SNF (excluding DOE SNF of commercial origin), however the CRWMS will transport the loaded casks.
  - the CRWMS is responsible for design, NRC certification, and fabrication of the transportation cask systems for HLW.
  - NNPP is responsible for all transportation activities associated with naval SNF.

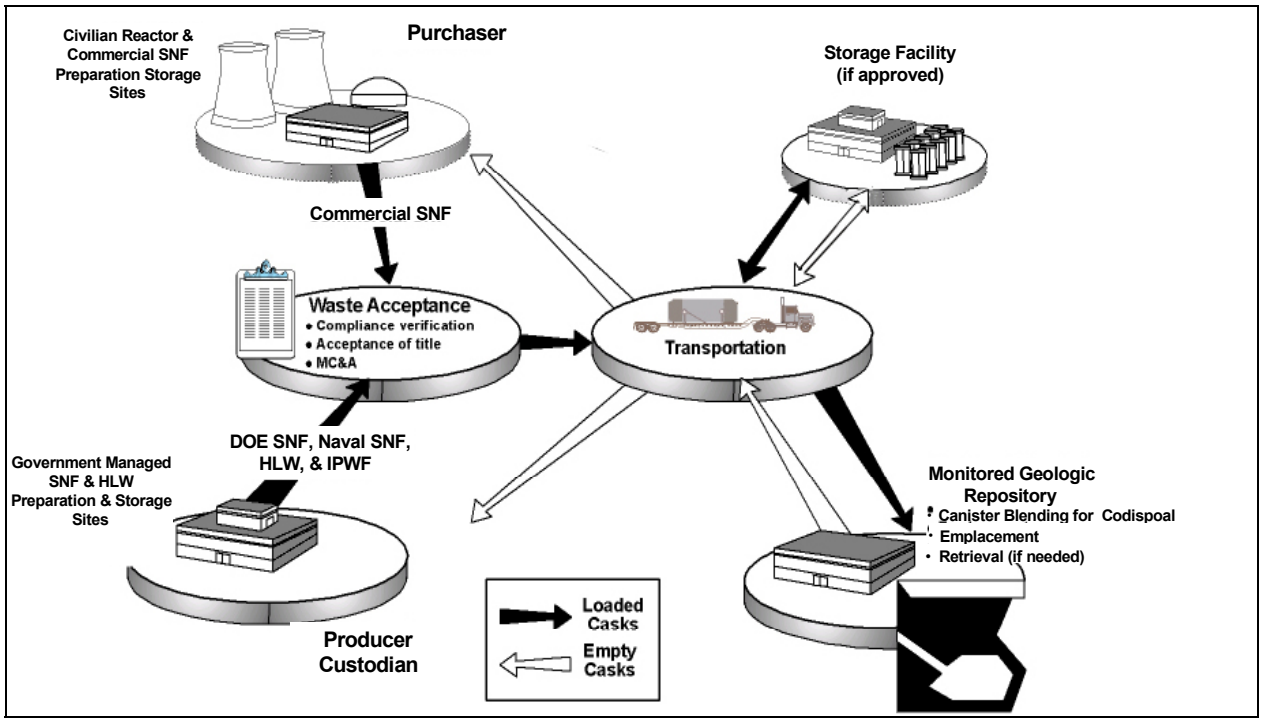


Figure 2. CRWMS Waste Function Relationships

2. PLANNING CONSIDERATIONS

See Section 2.4 of the CRD (DOE 2000a). This section is reserved for an expanded discussion of planning considerations applicable to the Waste Acceptance system.

3. REQUIREMENTS ON THE CRWMS

3.1. PRIMARY REGULATORY REQUIREMENTS

This section identifies the primary requirements of 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 Part 20, "Standards for Protection Against Radiation."

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 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 Department of Transportation regulations as documented in Title 49 of the Code of Federal Regulations.

3.2. WASTE ACCEPTANCE ELEMENT PERFORMANCE REQUIREMENTS

Reserved.

3.3. TRANSPORTATION ELEMENT PERFORMANCE REQUIREMENTS

Reserved.

3.4. CRWMS INTERFACE REQUIREMENTS

3.4.1. Waste Acceptance to Monitored Geologic Repository (MGR) Interfaces

See Section 3.6.5.1 of the CRD (DOE 2000a). This section is reserved for an expanded discussion of additional interface requirements between Waste Acceptance or Transportation and the MGR, as they are developed.

3.4.2. Waste Acceptance to Interim Storage Facility (if authorized) Interfaces

See Section 3.6.5.2 of the CRD (DOE 2000a). In the event that current law is revised to allow interim storage prior to repository construction authorization, this section will cover additional interface requirements between Waste Acceptance or Transportation and the Centralized Interim Storage Facility, as they are developed.

3.5. CRWMS-WASTE OWNER INTERFACES

The Waste Acceptance function, in the form of OCRWM's Office of Acceptance, Transportation, and Integration is responsible for all interfaces between the Office of Civilian Radioactive Waste Management [DOE] (OCRWM) and Purchasers (commercial SNF) and Producer/Custodians (government-managed nuclear materials). Interfaces with Purchasers are those defined in the Standard Contract. Programmatic interfaces with DOE-EM are those defined in the RW/EM MOA (Owendoff and Barrett 1999). 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 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 (including immobilized plutonium) 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 Spent Nuclear Fuel and High-Level Waste
- Section 4.3 - Specific Requirements for DOE-Managed Spent Nuclear Fuel
- 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
- Section 4.6 - Specific Requirements for DOE Spent Nuclear Fuel of Commercial Origin in Non-disposable Canisters [often termed dual-purpose canisters or DPCs]
- Section 4.7 - Specific Requirements for Uncanistered DOE Spent Nuclear Fuel of Commercial Origin
- Section 4.8 - Specific Requirements for High-Level Waste (including Immobilized Plutonium)
- Section 4.9 - Transport Casks System Interface.

Acceptance criteria for government-managed nuclear material are organized by both waste type and packaging configuration. Criteria are provided for SNF, HLW, and the cask/carrier systems to be used to transport either SNF or HLW. A cask/carrier interface section is included because the cask is considered part of the waste packaging. The SNF criteria are further subdivided into those for DOE-managed SNF, naval SNF, and DOE SNF of commercial origin. 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, in non-disposable canisters (including disposable single-element canisters inside the non-disposable canister), 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:

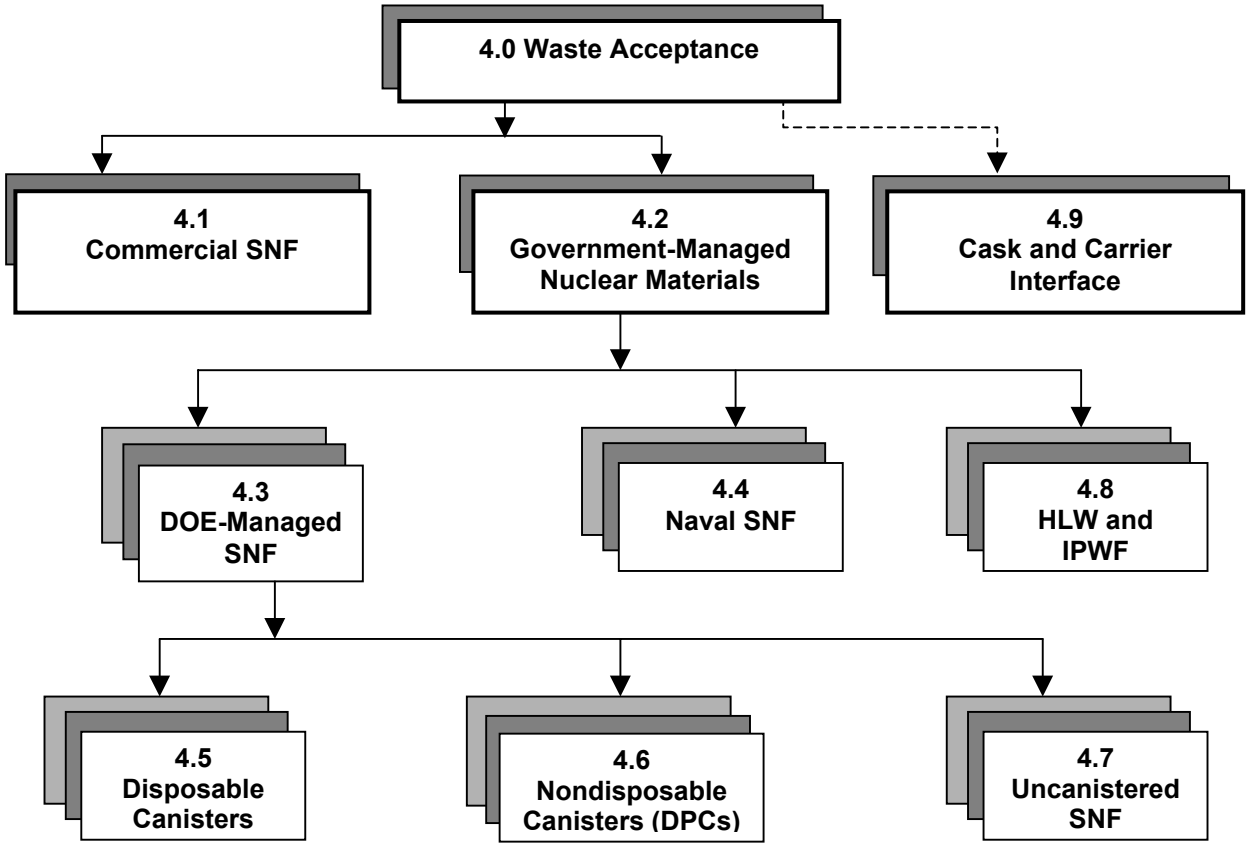


Figure 3. Acceptance Requirements for Spent Nuclear Fuel and High-Level Radioactive Waste (which includes IPWF)

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 SNF and HLW) and Section 4.8 (Specific Requirements for DOE-HLW)

DOE-Managed SNF - Section 4.2 (General Requirements for Government-managed SNF and HLW) and Section 4.3 (Specific Requirements for DOE-Managed SNF)

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

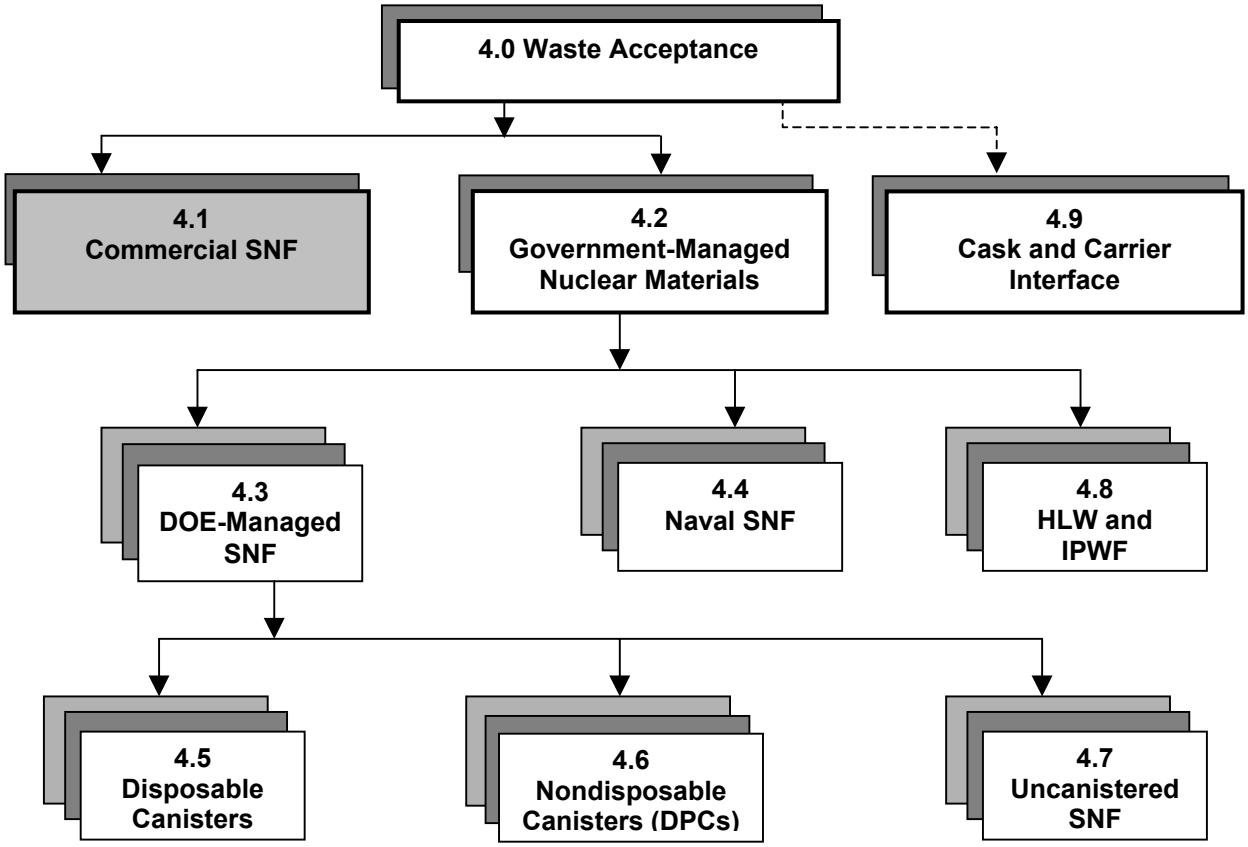
DOE SNF of Commercial Origin

A. Uncanistered - Section 4.2 (General Requirements for Government-Managed SNF and HLW) and Section 4.7 (Specific Requirements for Uncanistered DOE SNF of Commercial Origin)
B. Packaged in Non-disposable Canisters - Section 4.2 (General Requirements for Government-Managed SNF and HLW) and Section 4.6 (Specific Requirements for DOE SNF of Commercial Origin in Non-disposable Canister)
C. Packaged in Disposable Canisters - Section 4.2 (General Requirements for Government-Managed SNF and HLW) and Section 4.5 (Specific Requirements for DOE SNF of Commercial Origin in Disposable Canister).

Transport Casks and Associated Carrier Systems - Section 4.9 (Transport Cask System Interface).

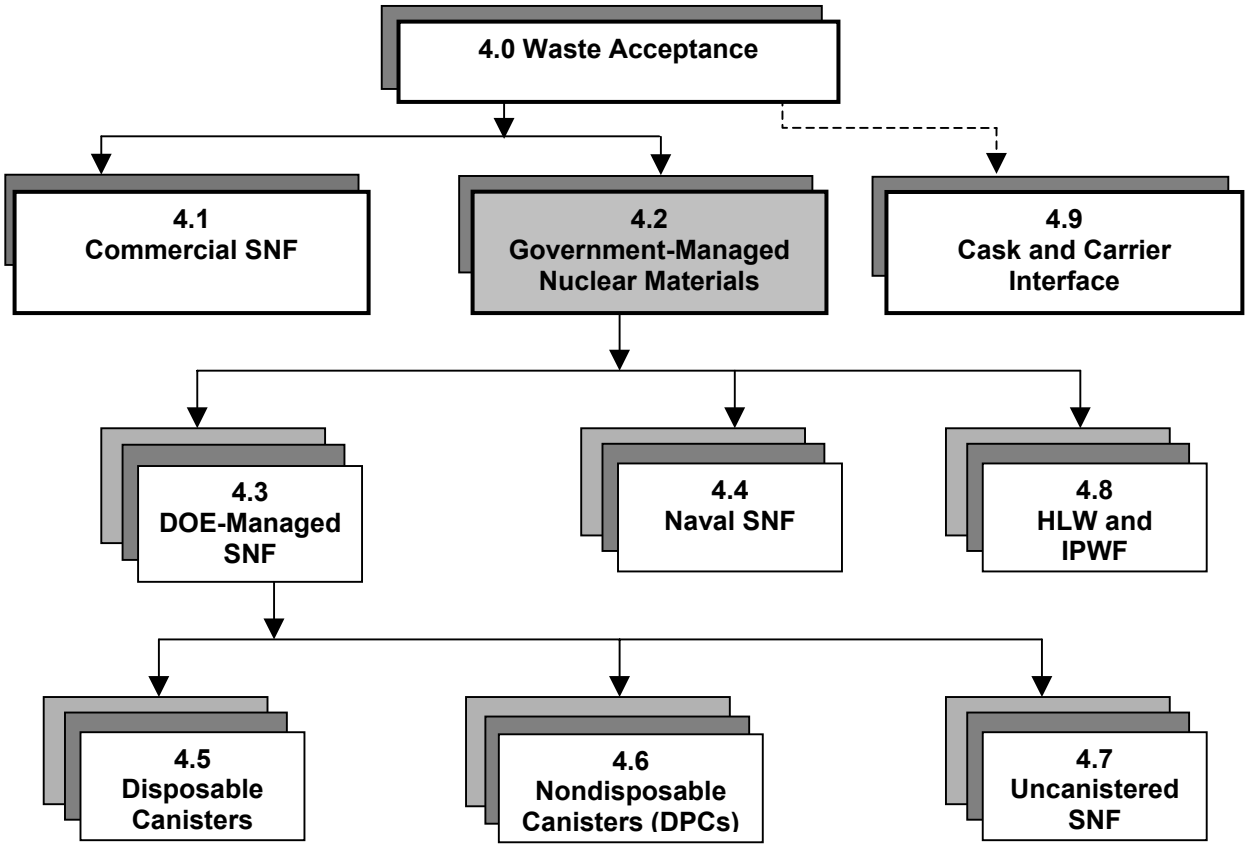
Requirements listed in Sections 4.1 through 4.9 are in addition to those imposed by the U.S. Nuclear Regulatory Commission (NRC) in accordance with 10 CFR Parts 71 through 75 relative to storage and transport of SNF or HLW.

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 (e.g. those owned by General Atomic, Aerotest, Dow, or General Electric) [the latter are expected to include both low-enriched uranium and highly enriched uranium currently covered by these contracts].

4.2. GENERAL REQUIREMENTS FOR GOVERNMENT-MANAGED SPENT NUCLEAR FUEL AND HIGH-LEVEL WASTE



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

4.2.1. Compliance with the Nuclear Waste Policy Act

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

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

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) Subtitle C for disposal in the first geologic repository licensed by NRC under the NWPA. Prior to acceptance for disposal, Producers/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-Managed SNF

1. All DOE-generated SNF, foreign research reactor fuel, and defense research reactor fuel except those assemblies that can be handled interchangeably with commercial boiling-water reactor (BWR)/pressurized-water reactor (PWR) assemblies, 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.

2. All DOE-generated SNF, foreign research reactor fuel, or defense research reactor fuel that can be handled interchangeably with commercial BWR/PWR assemblies may be delivered to the CRWMS either uncanistered, in non-disposable canisters (see Section 4.6 for additional requirements), or in a sealed disposable canister compatible with all applicable requirements in WASRD Section 4.3.

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 BWR or PWR fuel assemblies and known to have no defects shall be handled in the same manner as commercial SNF as specified in 10 CFR Part 961. 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.

E. Acceptable disposable canisters for DOE SNF of commercial origin must be compliant with other WASRD requirements and are limited to the following:

1. Single-element-sized canisters (with screened ends) consistent with those currently in use at commercial power reactors

2. Single-element-sized canisters with sealed ends

3. Sealed multi-element commercial SNF canisters (one per disposal canister basis for canister release dose-equivalent source term criteria)

4. The same sealed canisters (excluding multi-canister overpack [MCO]) designed for DOE-generated SNF at that site. These canisters can contain one or more assemblies.

F. 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 either a single-element-sized disposable canister, as defined in Section 4.5, or a canister designed for DOE-generated SNF, as defined in Section 4.3.

G. Non-Fuel Components Associated with DOE SNF of Commercial Origin

Non-fuel components no longer physically inserted into an assembly shall be placed into any of the various disposable canisters listed in Section 4.5.2 prior to acceptance into the CRWMS.

4.2.4. Waste to Remain in a Solid Form Over Anticipated Repository Conditions

Deleted.

4.2.5. Pyrophoricity, Combustibility, Explosivity, and Chemical Reactivity

Deleted.

4.2.6. Organic Content in Sealed Disposable Canisters

Deleted.

4.2.7. Cladding Condition (not applicable to HLW)

Deleted.

4.2.8. Canister Dose Rates
Deleted.

4.2.9. Canister Internal Pressure (sealed canisters only)
Deleted.

4.2.10. Physical Condition of Canisters at Time of Acceptance into the CRWMS (not applicable to uncanistered assemblies)
Deleted.

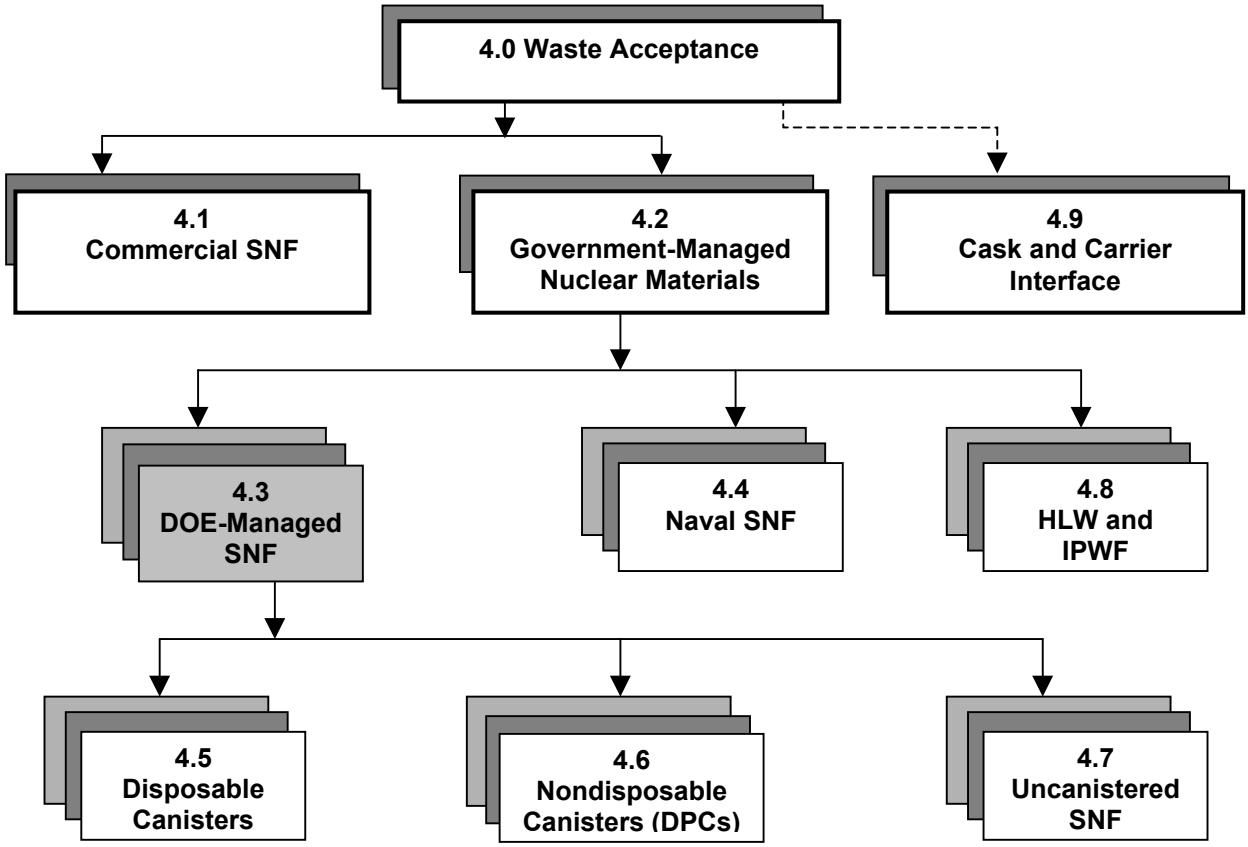
4.2.11. Canister Fill Material
Canister contents shall be limited to SNF (including associated non-fuel components) or HLW and canister components needed to comply with acceptance requirements or to provide other necessary functions, which include storage, transport, and disposal. Such components may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

4.2.12. Tamper - Indicating Seals on Canisters Not Welded
A **All DOE HLW Canisters** that contain special nuclear material (SNM) 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 SNM 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.

4.2.13. 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.

4.3. SPECIFIC REQUIREMENTS FOR DOE-MANAGED SPENT NUCLEAR FUEL



This section covers additional requirements beyond those in Section 4.2 for all DOE-managed SNF. DOE-managed SNF includes nuclear materials generated at DOE installations, foreign research-reactor fuels, and defense research-reactor fuels. It does not include naval SNF (see Section 4.4) or UO_2 zirconium or SS clad SNF from a commercial power reactor (see Sections 4.5 through 4.7) unless these SNF are placed in a disposable canister designed for DOE-managed SNF. Unlike DOE SNF of commercial origin, where loaded canisters are distinguished as single-element or multi-element, canisters of DOE-managed SNF covered in this section can contain as many "assemblies" as appropriate. However, the loaded canister must comply with all applicable requirements in WASRD Sections 4.2 and 4.3.

4.3.1. DOE SNF Canister Design and Materials of Construction

A. DOE SNF canisters and internals shall be designed and fabricated under the QARD (DOE 2000b) or a program approved 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. DOE SNF Canister Dimensional Envelope

Deleted.

4.3.3. DOE SNF Canister Weight

Deleted.

4.3.4. Capability to Lift DOE SNF 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.

4.3.5. DOE SNF 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.

4.3.6. DOE SNF 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.

4.3.7. DOE SNF Canister Drop

A. At the time of acceptance into the CRWMS, disposable multi-element canisters shall be capable of sustaining 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 releasing radioactivity exceeding limits shown in Table 4-1 (BSC 2001).

Table 4-1. DOE SNF Canister Release Source Term Criteria

Canister Type	Canister Release Dose-Equivalent Source Term Rem/Canister	
	Effective [$TEDE_{canister}$]	Max Organ [$(CDE+DDE)_{canister}$]
DOE SNF 18 in. diameter canister	1.15E+08	1.15E+09
DOE SNF 24 in. diameter canister	1.38E+08	1.38E+09
MCO	1.73E+08	1.73E+09

B. 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 to the extent necessary to ensure that limits of Table 4-1 are satisfied.

4.3.8. Free Liquid in DOE SNF Canisters

Deleted.

4.3.9. Particulate Content in DOE SNF Canisters

Deleted.

4.3.10. Radionuclide Content in DOE SNF Canisters

Deleted.

4.3.11. Total Fissile Material in DOE SNF Canisters

Deleted.

4.3.12. DOE SNF Canister Criticality Potential

A. Preclosure

The calculated effective multiplication factor (k_{eff}) at the time of delivery to the CRWMS shall be shown to not exceed 0.95 (TBV-5011) unless at least two unlikely, independent, and concurrent or sequential changes have occurred in the conditions essential to nuclear criticality safety. The calculated k_{eff} must be sufficiently below unity to show at least a 5 percent margin (TBV-5011), after allowance for the bias and the uncertainty in the experiments used to validate the method of calculation.

B. Postclosure

The methodology defined in the Disposal Criticality Analysis Methodology Topical Report (CRWMS M&O 2000e) shall be used to demonstrate acceptable criticality control for canisters and the waste packages in which they are disposed.

4.3.13. Sealed DOE SNF Canister Surface Contamination

Deleted.

4.3.14. Thermal Output Limits for DOE SNF Canisters

DOE SNF canisters shall have a thermal output at the time of acceptance into the CRWMS less than 1,970 W (TBV-5012).

4.3.15. Thermal Design for DOE SNF Canisters

Deleted.

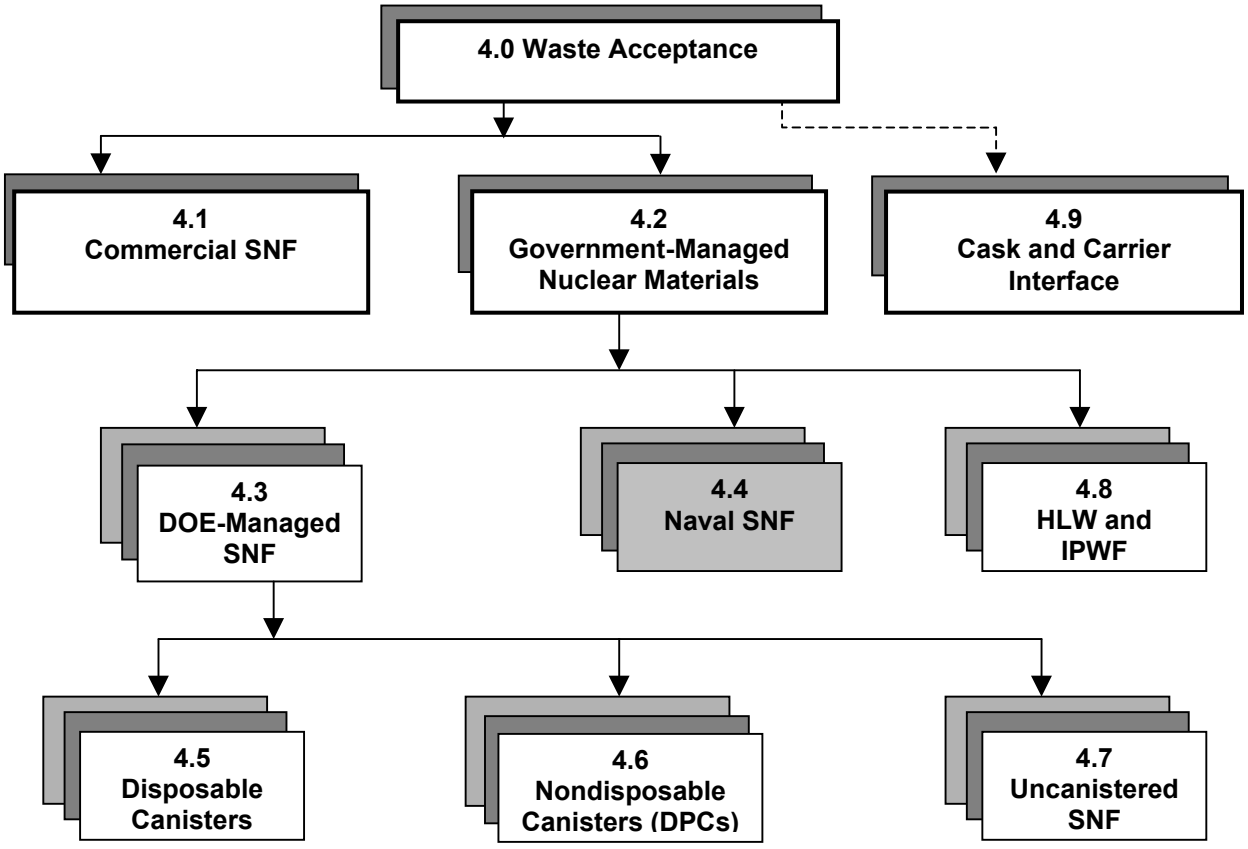
4.3.16. Tamper-Indicating Devices on DOE SNF Canisters Not Sealed

Deleted.

4.3.17. Fires and Explosions Caused by DOE SNF 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.

4.4. SPECIFIC REQUIREMENTS FOR NAVAL SPENT NUCLEAR FUEL



This section covers additional acceptance criteria (beyond those in Sections 4.2) for all naval SNF.

4.4.1. Naval SNF Canister Materials of Construction

A. Naval SNF canisters and internals shall be designed and fabricated under the QARD (DOE 2000b) or a program approved by OCRWM on a case basis.

B. Materials of construction of the naval SNF canisters and their internals 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 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.

4.4.2. Naval SNF Canister Dimensional Envelope

Deleted.

4.4.3. Naval SNF Canister Weight

Deleted.

4.4.4. Capability to Lift Naval SNF Canisters

Naval 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.

4.4.5. Naval SNF 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.

4.4.6. Naval SNF 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.

4.4.7. Naval SNF Canister Internal Structural Integrity

Deleted.

4.4.8. Naval SNF Canister Drop

A. Canisters containing naval SNF should be designed to interface with the geologic repository operations area so that when subjected to Category 2 design basis events no individual located on, or beyond, any point of the boundary of the site, will receive the more limiting of a TEDE 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).

B. 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 to the extent necessary to ensure that these limits are satisfied.

4.4.9. Free Liquid in Canisters Containing Naval SNF

Deleted.

4.4.10. Particulate Content in Naval SNF Canisters

Deleted.

4.4.11. Radionuclide Content in Naval SNF Canisters
Deleted.

4.4.12. Total Fissile Material in Naval SNF Canisters
Deleted.

4.4.13. Naval SNF Canister Criticality Potential
A. Preclosure
The calculated effective multiplication factor (k_{eff}) at the time of delivery to the CRWMS shall be shown to not exceed 0.95 (TBV-5011) unless at least two unlikely, independent, and concurrent or sequential changes have occurred in the conditions essential to nuclear criticality safety. The calculated k_{eff} must be sufficiently below unity to show at least a 5 percent margin (TBV-5011), after allowance for the bias and the uncertainty in the experiments used to validate the method of calculation.

B. Postclosure
The methodology defined in the NNPP addendum (Mowbray 1999) to the Disposal Criticality Analysis Methodology Topical Report (CRWMS M&O 2000e) shall be used to demonstrate acceptable criticality control for canisters and the waste packages in which they are disposed.

4.4.14. Sealed Naval SNF Canister Surface Contamination
Deleted.

4.4.15. Thermal Output
Naval SNF canisters shall have a thermal output less than 11.8 kW (TBV-5012) at the time of acceptance into the CRWMS.

4.4.16. Thermal Design for Canisters Containing Naval SNF
Deleted.

4.4.17. Tamper - Indicating Devices on Naval SNF Canisters Not Welded
Deleted.

4.4.18. Fires and Explosions Caused by Naval SNF 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 credible accident.

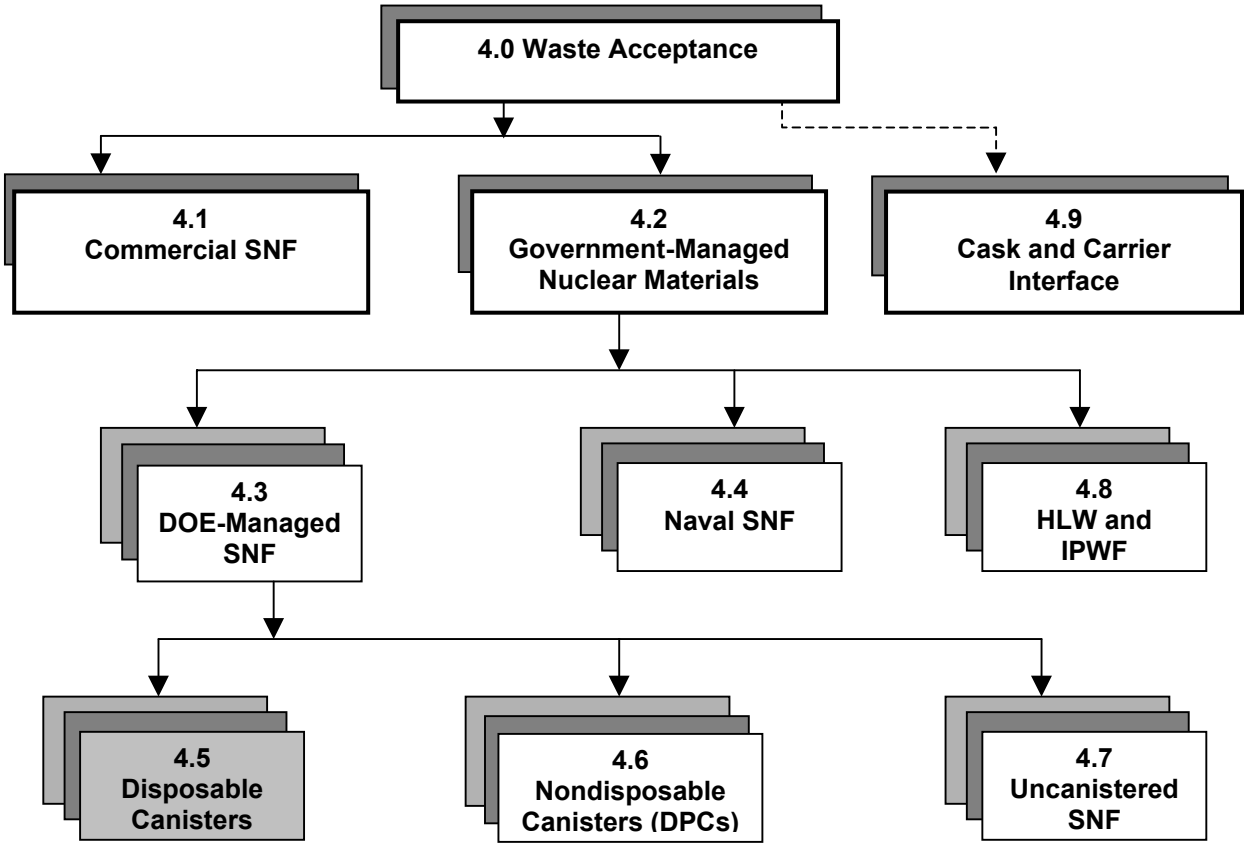
4.4.19. Naval SNF Canister Cleanliness Requirement

Naval SNF shall be packaged in canisters under "shop clean" conditions (see Appendix A, Glossary).

4.4.20. Naval SNF Post Closure Performance

The release rate of radionuclides from a failed package of naval SNF shall not have an effect on post-closure repository performance that is greater than from a package containing an equivalent amount (on an MTHM basis) of zirconium-clad commercial SNF.

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



This section covers additional acceptance requirements (beyond those in Section 4.2) for all DOE SNF of commercial origin (low enrichment, UO_2 matrix, zirconium or SS cladding) loaded into disposable canisters (either single-element-sized or multi-element canisters) similar to those used or contemplated for use in the nuclear power industry. Disposable canisters shall be designed and fabricated in compliance with the applicable provisions of 10 CFR Part 71, "Packaging and Transportation of Radioactive Material" and 10 CFR Part 72, "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste."

4.5.1. Commercial-Origin DOE SNF Disposable-Canister Design and Materials of Construction

Canisters used for the disposal of commercial origin DOE SNF shall be designed and fabricated under the QARD (DOE 2000b) or a program approved by OCRWM on a case basis.

A. The single-element-sized canister shall have lifting features and handling characteristics similar to those of any uncanistered BWR/PWR assemblies to be shipped to the CRWMS with it.

B. The multi-element canister and any associated internals shall:
   1. utilize materials of construction 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.
   2. ensure that all relevant acceptance requirements of this WASRD are satisfied.

4.5.2. Disposable Commercial-Origin DOE SNF Canister Dimensional Envelope

A. Single-Element-Sized Canisters
   1. Single-element-sized canisters containing DOE SNF of commercial origin shall have external dimensions (including handling fixtures or handling-fixture interfaces) with a cross-sectional width (square or rectangular canister) or diameter (round canister) not greater than 4.25 inches and an overall length not greater than 81.5 inches.

   2. The canister shall have maximum external dimensions, excluding removable lifting fixtures, such that it is capable of fitting, without forcing, (when lowered vertically) into a three-dimensional square rectangular cavity with a cross-sectional width of 9.00 inches by 9.00 inches and a length of 201.6 inches.

B. Multi-Element Canisters

   Multi-element canisters loaded with DOE SNF of commercial origin shall:

   1. have the capability to stand upright without support on a flat horizontal surface

   2. have maximum external dimensions, excluding removable lifting fixtures, such that they are capable of fitting, without forcing, (when lowered vertically) into a right cylindrical cavity with a diameter of 68 inches and a length of 213 inches [both dimensions TBV (TBV-5013)].

4.5.3. Disposable Commercial-Origin DOE SNF Canister Weight

A. Single-Element-Sized Canisters

   1. Loaded single-element-sized canisters shall have a maximum weight of 4000 pounds (TBV-5014)

   2. Removable canister-handling fixtures shall not be considered when calculating canister weight

B. Multi-Element Canisters

Loaded and sealed disposable multi-element canisters (e.g., MPCs) shall have a maximum weight of 87,750 pounds (TBV-5014).

4.5.4. Capability to Lift Commercial-Origin DOE SNF Disposable Canisters

The multi-element disposable 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.

4.5.5. Disposable Commercial-Origin DOE SNF Canister Sealing

A. 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.

B. There are no sealing requirements for single-element-sized canisters with screened ends

4.5.6. Disposable Commercial-Origin DOE SNF 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.

4.5.7. Disposable Commercial-Origin DOE SNF Canister Internal Structural Integrity

Deleted.

4.5.8. Disposable Commercial-Origin DOE SNF Canister Drop

A. At the time of acceptance into the CRWMS, disposable multi-element canisters shall be capable of sustaining a flat bottom drop from a height of 23 feet or a drop in any orientation from a height of 2 feet onto an essentially unyielding surface without releasing radioactivity exceeding limits shown in Table 4.2 (BSC 2001). For the flat bottom drop this criterion can be met by limiting canister impact loads through design of the cask-canister system and the disposal container-canister system.

Table 4-2. Disposable Commercial-Origin DOE SNF Canister Release Source Term

Canister Type	Canister Release Dose-Equivalent Source Term Rem/Canister	
	Effective [$TEDE_{canister}$]	Max Organ [$(CDE+DDE)_{canister}$]
Multi-element – Disposable*	6.92E+08	6.92E+09

* assumes one large canister per shipping cask/disposal container

B. 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 to the extent necessary to ensure that limits of Table 4-2 are satisfied.

4.5.9. Free Liquid in Sealed Disposable Commercial-Origin DOE SNF Canisters

Deleted.

4.5.10. Particulate Content in Disposable Commercial-Origin DOE SNF Canisters

Deleted.

4.5.11. Radionuclide Content in Disposable Commercial-Origin DOE SNF Canisters

Deleted.

4.5.12. Total Fissile Material in Disposable Commercial-Origin DOE SNF Canisters

Deleted.

4.5.13. Disposable Commercial-Origin DOE SNF Canister Criticality Potential

A. Preclosure

The calculated effective multiplication factor (k_{eff}) at the time of delivery to the CRWMS shall be shown to not exceed 0.95 (TBV-5011) unless at least two unlikely, independent, and concurrent or sequential changes have occurred in the conditions essential to nuclear criticality safety. The calculated k_{eff} must be sufficiently below unity to show at least a 5 percent margin (TBV-5011), after allowance for the bias and the uncertainty in the experiments used to validate the method of calculation.

B. Postclosure

The methodology defined in the Disposal Criticality Analysis Methodology Topical Report (CRWMS M&O 2000e) shall be used to demonstrate acceptable criticality control for canisters and the waste packages in which they are disposed.

4.5.14. Sealed Disposable Commercial-Origin DOE SNF Canister Surface Contamination

Deleted.

4.5.15. Disposable Commercial-Origin DOE SNF Canister Thermal Output

No disposable multi-element commercial-origin DOE SNF canister shall have a thermal output in excess of 11.8 kW (TBV-5012) at the time of acceptance into the CRWMS.

4.5.16. Disposable Commercial-Origin DOE SNF Canister Thermal Design

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

1. 350°C for zircaloy-clad assemblies
2. 400°C for stainless steel-clad assemblies.

B. Compliance with the above requirement shall be shown to be achievable over 1,000 years. Refer to Appendix C for information on the interface between multi-element disposable canisters, their disposal containers, and the emplacement environment.

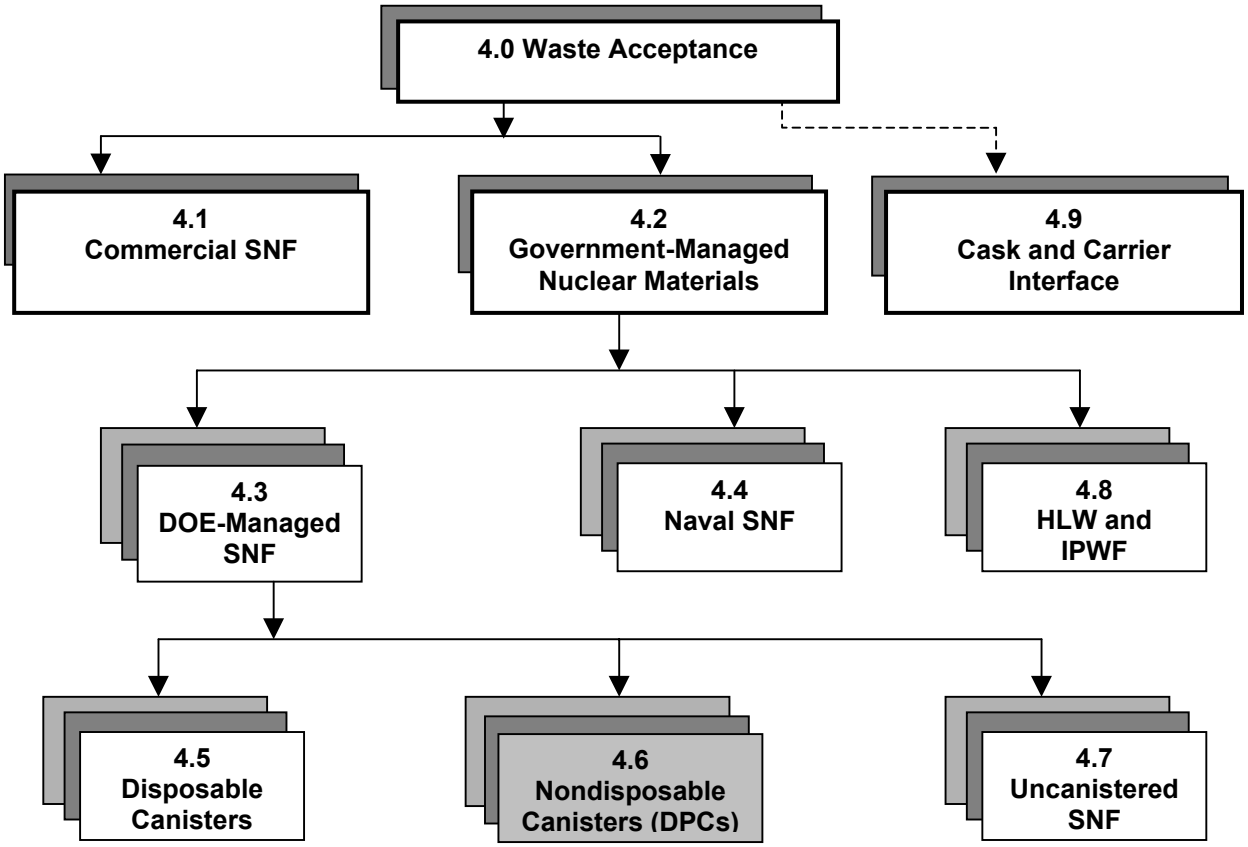
4.5.17. Intact Tamper-Indicating Devices on Disposable Canisters Containing DOE SNF of Commercial Origin

Deleted.

4.5.18. Fires and Explosions Caused by the Contents of Disposable Canisters Containing DOE SNF of Commercial Origin

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.

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



This section covers additional acceptance criteria, beyond those covered in Section 4.2, that collectively represent the acceptance criteria for non-disposable canisters containing DOE SNF of commercial origin. Included under the category of non-disposable canisters are dual-purpose storage-transport canisters (DPCs). In addition to the requirements in Section 4.6, the contents of the non-disposable canister must be compliant with the applicable requirements for the given waste form once it is removed from the non-disposable canister. (Refer to Section 4.5 for requirements if the DOE SNF of commercial origin is in a single-element-size canister).

4.6.1. Non-disposable Canister Contents

A. Classification of Contents

1. DOE SNF of commercial origin in non-disposable canisters for which fees **have** been paid shall be classified using Appendix E of 10 CFR Part 961.
2. DOE SNF of commercial origin in non-disposable canisters for which fees have **not** been paid shall be classified using the RW/EM MOA (Owendoff and Barrett 1999).

B. Where special handling is required for any of the contents of non-disposable canisters, custodians shall provide handling procedures to the MGR for approval in advance of shipment.

4.6.2. Non-disposable Canister Dimensions

Deleted.

4.6.3. Non-disposable Canister Weights

Deleted.

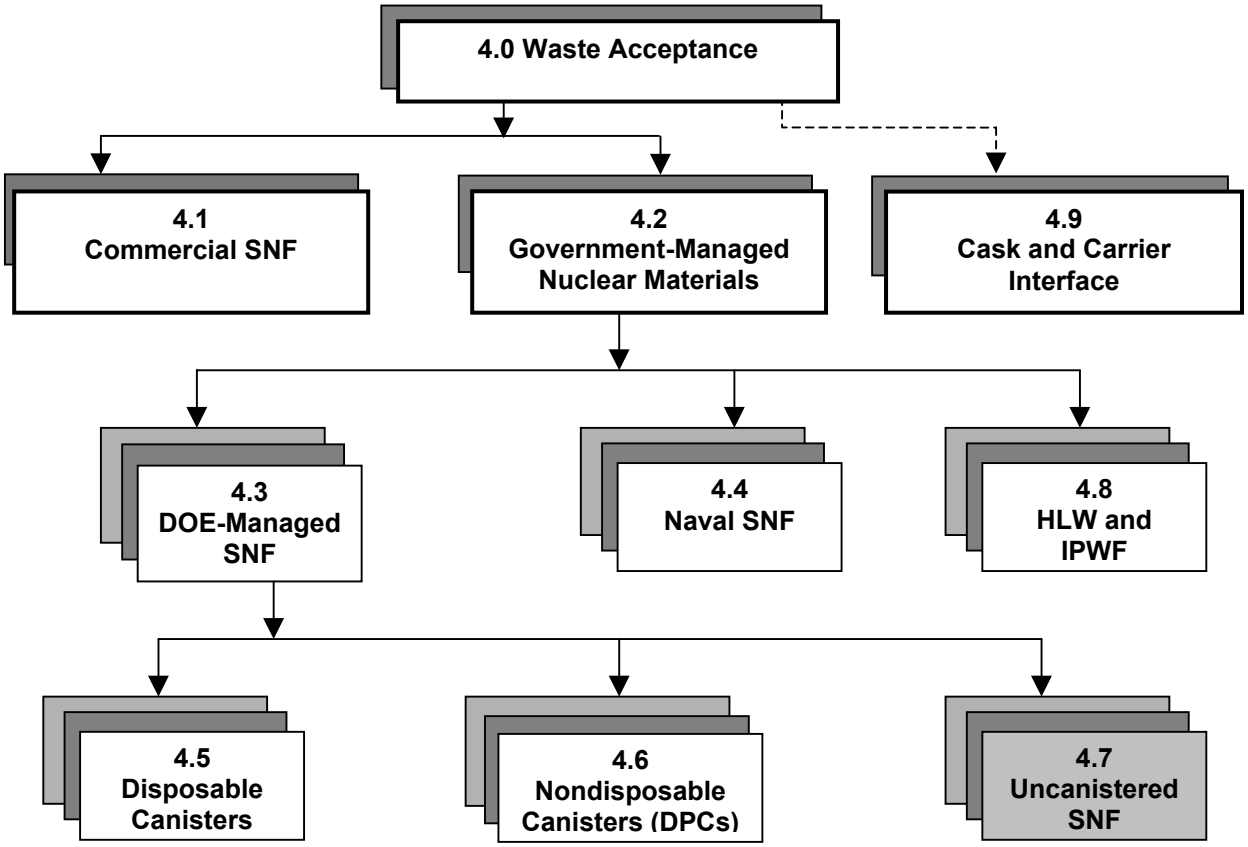
4.6.4. Capability to Lift Non-disposable Canisters Vertically

Non-disposable 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.

4.6.5. Non-disposable Canister Labeling

Deleted.

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 not fall under any category defined in "Determination of Which SNF and HLW Are to Be Canistered" (see Section 4.2.3, Items A-F) and not have been previously designated as "Failed Fuel" per 10 CFR Part 961.11, Appendix E, Item B.6.

4.7.1. Assembly Dimensions

Deleted.

4.7.2. Assembly Weight

Deleted.

4.7.3. Permanent Markings on Assemblies

Deleted.

4.7.4. Capability to Lift Assembly Vertically

Deleted.

4.7.5. Assembly Radionuclide Inventory

Deleted.

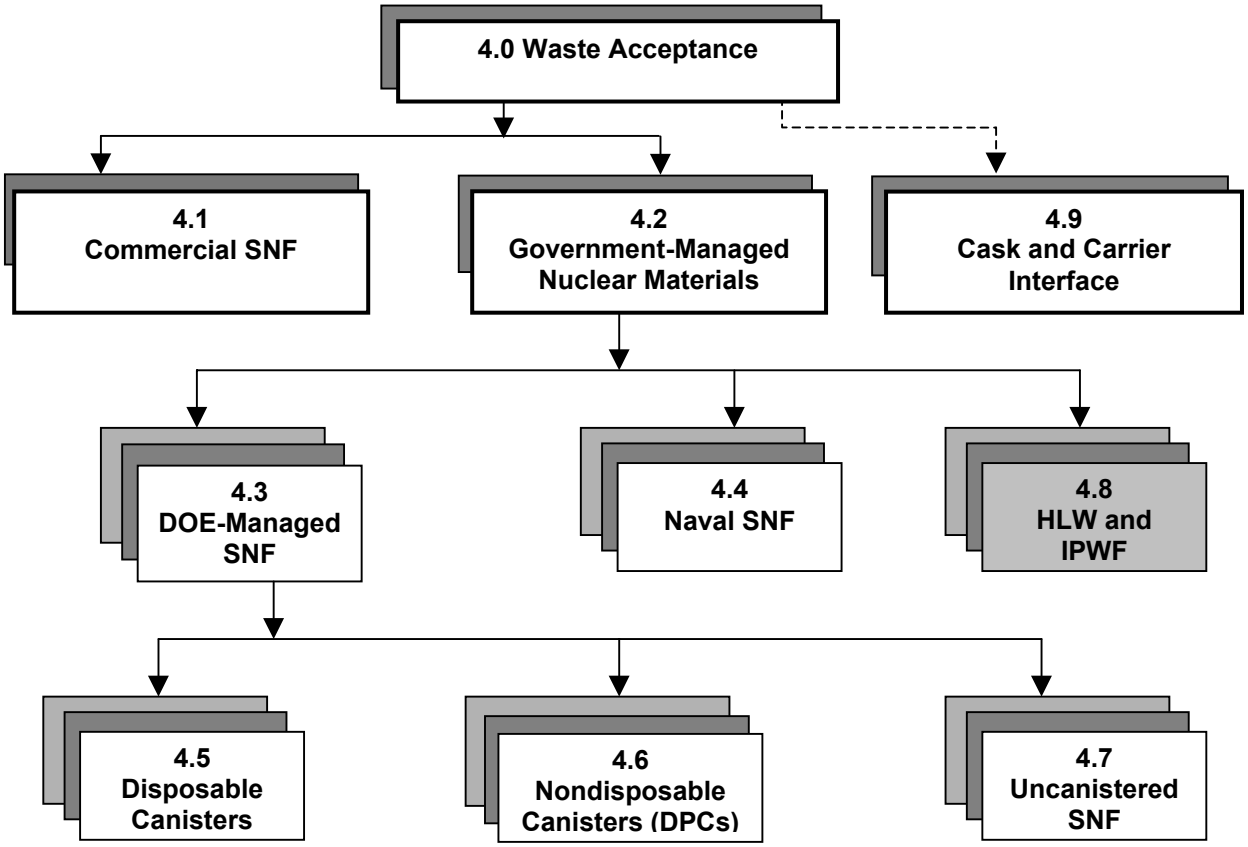
4.7.6. Assembly Total Fissile Material

Deleted.

4.7.7. Assembly Thermal Output

Deleted.

4.8. SPECIFIC REQUIREMENTS FOR HIGH-LEVEL WASTE (INCLUDING IMMOBILIZED PLUTONIUM)



This section covers additional acceptance criteria for defense HLW and commercial HLW in addition to those in Section 4.2 that collectively represent the acceptance criteria for canistered vitrified HLW. It also addresses Immobilized Plutonium Waste Form (IPWF). In general, requirements that apply to HLW also apply to IPWF; exceptions are noted as they occur. EM shall convey IPWF repository waste acceptance requirements, established by RW, to the Office of Defense Nuclear Nonproliferation, as deemed necessary. Organizational responsibilities for IPWF Quality Assurance and other waste acceptance functions are to be established in a Memorandum of Agreement.

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 using the Product Consistency Test 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, or isolation, or on 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 HLW form shall stand upright without support on a flat horizontal surface and fit without forcing into a right-circular, cylindrical cavity (64 cm diameter and 3.01 m length or alternatively 64 cm diameter and 4.51 m length).

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 3.0m HLW canister or a standard 4.5m 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 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. (TBV-5047).

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 onto a flat, essentially unyielding surface without breaching or dispersing radionuclides.

4.8.9. Volume of Vitrified HLW in a Canister

Requirement deleted.

4.8.10. 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.

4.8.11. Radionuclide Content in High-Level Waste

Deleted.

4.8.12. Criticality Potential in Canisters Containing HLW

The calculated k_{eff} for individual canisters at time of acceptance into the CRWMS shall be shown to be 0.95 (TBV-5011) or less under credible water-moderated conditions most likely to cause criticality, after allowance for bias in calculation methods and uncertainty in the empirical data.

4.8.13. 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.

4.8.14. Thermal Output in Canisters Containing HLW

Total heat generation rate for canisters containing HLW or HLW and IPWF shall not exceed 2540 watts per canister (TBV-5012) at the year of shipment.

4.8.15. Additional Requirements For Immobilized Plutonium Waste Form

The standard IPWF shall be a can-in-canister, i.e., ceramic disks inside of SS cylindrical cans (plutonium cans) that are arrayed within the HLW canister by magazines, support assemblies/hardware.

4.8.16. IPWF Canister Drop

A. At the time of receipt into the CRWMS, canisters containing IPWF shall be capable of sustaining 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 releasing radioactivity exceeding limits shown in Table 4-3 (BSC 2001). For the flat bottom drop this criterion can be met by limiting canister impact loads through design.

Table 4-3. IPWF Canister Release Source Term Criteria

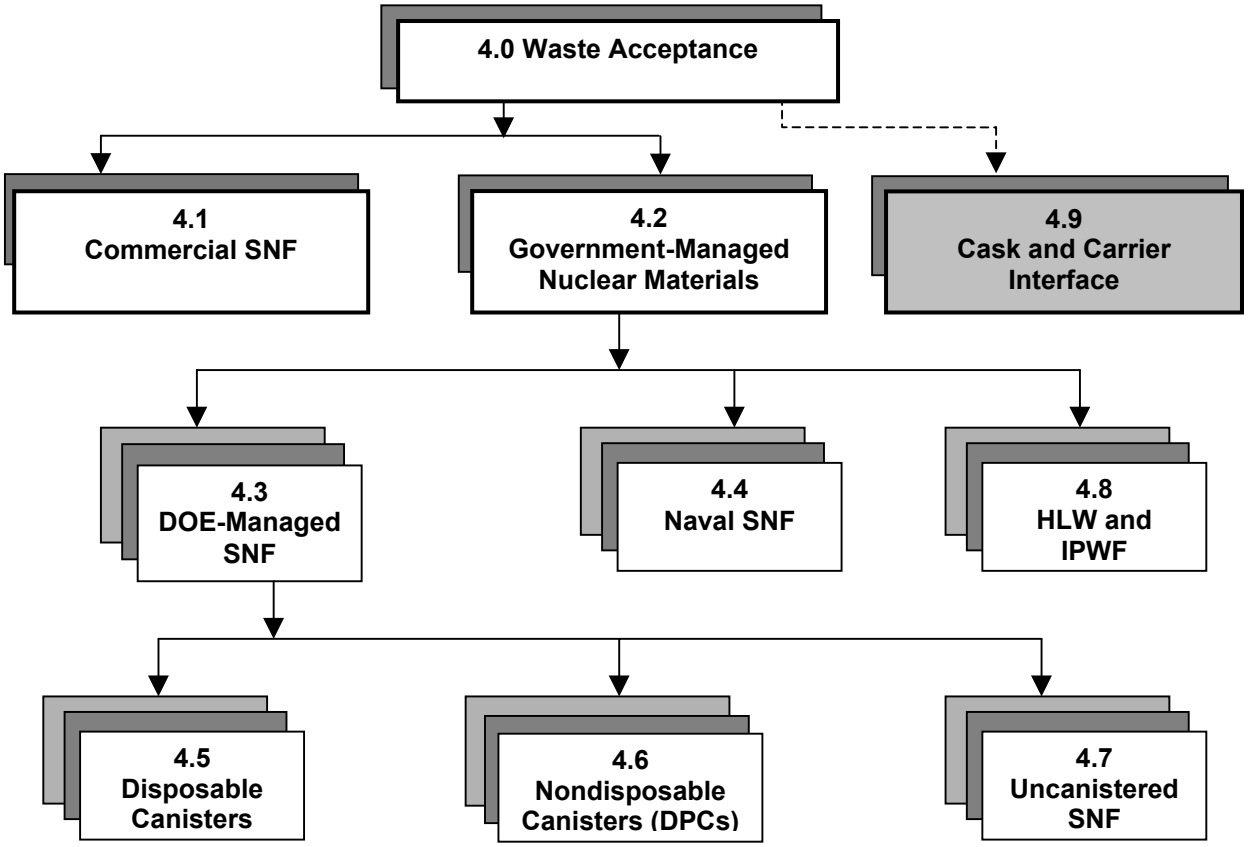
Canister Type	Canister Release Dose-Equivalent Source Term Rem/Canister	
	Effective [$TEDE_{canister}$]	Max Organ [$(CDE+DDE)_{canister}$]
IPWF	1.38E+08	1.38E+09

B. 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 to the extent necessary to ensure that limits of Table 4 - 3 are satisfied.

4.8.17. Immobilized Plutonium Waste Form Criticality Potential

Requirement deleted. See Section 4.8.12.

4.9. TRANSPORTATION CASK SYSTEM INTERFACE



CRWMS will receive and transport all SNF and HLW (including IPWF). The Navy has agreed to be responsible for the transportation of naval SNF (Bowman, F.L. & Itkin, I. 2000). Transportation cask systems are the means by which SNF and HLW are received into and transported by the CRWMS and delivered to the MGR. Transportation casks having a current Certificate of Compliance issued by the NRC in accordance with 10 CFR Part 71 are considered acceptable for use in the CRWMS. This section provides guidance for casks and associated carrier systems not yet docketed or licensed by the NRC. Shippers of SNF or HLW shall comply with the applicable provisions of DOT regulations as documented in Title 49 of the Code of Federal Regulations.

4.9.1. Cask Unique Identifier

Deleted.

4.9.2. Intact Tamper-Indicating Seals

Strategic special nuclear material, as defined in 10 CFR Part 73.2, shall be shipped in containers that have an intact, properly installed tamper-indicating seal that is NRC-approved in accordance with NRC Material Control and Accounting requirements in 10 CFR Part 70.51 and meet the guidance in 10 CFR Part 73.26 and NRC Regulatory Guide, 5.15, Tamper-indicating Seals for the Protection and Control of Special Nuclear Material. The containers also shall be locked if they are not in another locked container or transport. The outermost container or transport shall be protected by tamper indicating seals.

4.9.3. Transport Cask Dimensions

Casks received at the CRWMS shall have dimensions that do not exceed the following:

A. Rail casks

1. With impact limiters attached: 340 inches long by 144 inches diameter
2. With impact limiters removed, but with trunnions attached: 234 inches long by 108 inches diameter (at the trunnions)
3. If the trunnions are removable, the maximum diameter of the cask body: 100 inches

B. Truck casks

1. With impact limiters attached: 245 inches long by 96 inches diameter
2. With impact limiters removed: 200 inches long by 48 inches diameter (at the trunnions).

4.9.4. Transport Cask Package Weight

The maximum hook weight for any lift of the loaded rail cask shall not exceed 200 tons.

4.9.5. Combined Cask/Carrier Dimensions

A. Rail cask/carriers with dimensions greater than Plate F dimensions (AAR, 1992) may require special handling by the CRWMS.

B. Heavy Haul: Truck and tractor shall have maximum dimensions of:

1. 220 feet in length
2. 144 inches in width
3. 162 inches in height.

4.9.6. Combined Cask/Carrier Weight

A. Railroad Shipment

1. Railroad shipments managed by CRWMS will be made under the Association of American Railroads standard of unrestricted interchange. The transportation cask system including impact limiters, tie-downs, and other related transportation equipment shall be compatible with AAR Plate F dimensions (AAR 1992).

2. The combined railcar/cask carrier (gross railcar, cask, skid, and impact limiters) to be accepted into the CRWMS shall not exceed 65,750 pounds gross weight per axle (e.g., 263,000 pounds gross weight for a 4-axle railcar, 394,500 pounds for a 6-axle railcar, or 526,000 pounds for an 8-axle railcar).

3. The maximum combined railcar/cask carrier weight for shipments of naval SNF shall not exceed 630,000 pounds.

B. Truck Shipment

1. Legal-Weight Truck: The combined legal-weight truck/cask carrier shall not exceed a tandem axle gross weight of 34,000 pounds (TBV-5015) and an overall gross weight of 80,000 pounds.

2. Heavy Haul: The combined heavy-haul truck/cask carrier shall not exceed a tandem axle gross weight of 40,560 pounds (TBV-5015) and an overall gross weight of 502,125 pounds.

4.9.7. Capability to Lift Casks Vertically

Deleted.

4.9.8. Combined Cask/Carrier Turning Radius

Deleted.

4.9.9. Vent/Sampling/Drain Ports for Transport Casks

Deleted.

4.9.10. Total Transport Cask Dose Commitment

Deleted.

4.9.11. Cask Surface Contamination

Deleted.

4.9.12. Cask Internal Pressure

Deleted.

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. 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 SNF shipped by commercial power generators, the technical information needs are identified in "Standard Contract for Disposal of Spent Nuclear Fuel and/or High-Level Radioactive Waste" (10 CFR Part 961).

5.2. DOE SNF

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

5.3. NAVAL SNF

For SNF shipped by NNPP, the technical information needs are identified in "Scope of Geological Disposal Technical Information Package for Naval SNF Canisters." (Mowbray, 2001) and in Section V.A of the 2000 Memorandum of Agreement between NNPP and RW (Bowman and Itkin 2000).

5.4. HLW AND IPWF

This section presents the technical information needs concerning High Level Waste, including Immobilized Plutonium Waste Forms.

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) required under the Memorandum of Agreement (Owendoff and Barrett, 1999). This shall include the WAPS, WCP, WQR, and any supporting documentation required by these documents.

B. Information provided shall include the following which shall be controlled in ICD's:

(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 including information regarding particulates, pyrophorics, combustibles, explosives, etc. that all may come into play in a DBE II event. 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 post closure. 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.
(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 to resolve non-conforming conditions have been completed.
C. Production and storage records for individual canistered waste forms to be delivered. These shall include information required by WCP's and WQR's, including that relative to 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

At the time of delivery, waste producers shall provide a completed DOE/NRC Form-741, "Instructions for Completing Nuclear Material Transaction Reports and Concise Note Forms," 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.

6. CONFORMANCE VERIFICATION

This entire section has been deleted.

7. PROJECTED INITIAL ACCEPTANCE CAPACITY AND OVERALL SCHEDULE

Table 7-1 provides an initial projection of the schedule for accepting government-managed and commercial nuclear waste. 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 2000a, Section 3.2.1.B).

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 2010.

- The 1995 EM plan (DOE Lytle, J.E. 1995; Dreyfus, D.A. 1995a) 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 1999c, page S.2) to immobilize at least 17 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 Co. of Colorado v. Batt) and that naval SNF shall be among the early shipments to the repository.

- 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. Estimated Schedule for Acceptance of Commercial and Government-Managed Nuclear Materials[i]

Waste Type	Government-Managed Nuclear Materials				Commercial SNF[b]
	DOE SNF[a]		HLW		
Total Projected Quantities (planning purposes only)	2,500 MTHM[c]		Estimated 22,170 canisters[d,l]		Estimated 83,800 MTHM[e]
	DOE SNF (~3,900 Canisters)	**NAVAL SNF** (~300 Canisters)	**DOE HLW** (~21,500)	**Immobilized Plutonium[f]** (~670 Canisters[g])	
	2010-End of Emplacement	**2010-2014**	**2010-End of Emplacement**	**2010-2014**	**2010-End of Emplacement**
Projected Acceptance Schedule	• Receipt of government-managed SNF starting in 2010 • Receipt of entire DOE inventory from Idaho National Engineering and Environmental Laboratory (INEEL) by 2035 • Annual receipt quantities are to be negotiated by RW and EM consistent with the Memorandum of Agreement (Owendoff 1998)	Acceptance of naval SNF is planned to start in 2010 at the following annual receipt rates: • 3 canisters in 2010 • 3 canister in 2011 • 6 canisters in 2012 • 6 canisters in 2013 • 12 canisters in 2014	•Receipt of HLW starting in 2010 •Annual receipt quantities are to be negotiated by RW and EM consistent with the Memorandum of Agreement (Owendoff 1998)	Immobilized Plutonium is to be accepted starting in 2010 at an estimated rate of 60 canisters per year[j]	Accept Commercial SNF at the following estimated annual rates (MTHM/year): • 400 in 2010 • 600 in 2011 • 1,200 in 2012 • 2,000 in 2013 • 3,000 in 2014 through the end of emplacement[h]
		2015 - 2035		**2015 - Completion**	
		Acceptance quantities for naval SNF will be established between EM and the Navy to ensure removal of naval SNF from Idaho before 2035		Receipt rates have not been finalized, but continuation of an average receipt rate of 60 canisters per year would result in the acceptance of the entire inventory by 2020, and the fulfillment of non-proliferation project objectives[j,m] for surplus weapons plutonium disposition.	

NOTES: [a] Inventory includes foreign research reactor fuel returned to the United States.
[b] The commercial SNF inventory assumes no new reactor construction, license renewals or early shutdowns. The final inventory of commercial SNF requiring disposal is highly uncertain, and could be substantially higher or lower depending on industry developments.
[c] Includes 65 MTHM naval SNF.
[d] Includes the HLW inventory from the WVDP commercial facility.
[e] This total includes Mixed Oxide (MOX) SNF derived from 33 MTHM of surplus plutonium [CRWMS Requirements Document (DOE 2000a)].
[f] Immobilized plutonium is surplus weapons-usable plutonium immobilized and placed in a canister with vitrified HLW for disposal.
[g] This total assumes a plutonium content per canister of 28 kg. Furthermore, the production of this number of IPWF canisters would require the fabrication of about 100 additional canisters since the associated IPWF cans, magazines, and internal canister framework are projected to displace up to 15 percent (by volume) of HLW glass.
[h] In later years, annual receipts may be reduced to match annual utility discharges.
[i] It should be noted that acceptance rates are targets only and do not create any binding obligation upon the D.O.E.

SOURCES: [i] DOE 2000a, Section 3.2.1.C.
[j] DOE 1999c, page S.2.
[k] DOE 2000a, Section 8.1
[l] This estimate results from the following site-specific HLW canister totals: 5,978 canisters for SRS [Picha, K.G., Jr. 1998b (attachment, summary table)]; 14,500 canisters for Hanford [Picha, K.G., Jr. 1998a (attachment I)]; 1,190 for INEEL [Picha, K.G., Jr. 1997 (Table ID-2)]; 300 canisters for West Valley [Picha, K.G., Jr. 1998b (Attachment, page 2, upper limit of range 260-300)]; and an estimated 100 canisters for Argonne National Laboratory [Goff, K.M. 1998 (attachment 1, page 1)]. This total also includes an additional 100 HLW canisters that are anticipated to result from a 15 percent HLW displacement (by volume) in the 670 IPWF canisters (DOE 1999c, Section 2.4.2.2.2).
[m] White House, 1993.

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APPENDIX A

GLOSSARY

GLOSSARY

Acceptance is the process by which the CRWMS will take title and/or responsibility and custody and physical possession of SNF or HLW from the Purchaser/Producer/Custodian. Conceptually, acceptance is accomplished by execution of the Accept and Transport Waste functions. Specifically, acceptance is the planning, preparation, and completion of the documentation necessary to transfer title and/or responsibility and custody. Any actual handling of the SNF and HLW related to their transfer is accomplished by other CRWMS elements: primarily the Waste Acceptance and Transportation element and/or the Purchaser/Producer/Custodian.

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:

1. naval reactors development
2. weapons activities including defense inertial confinement fusion
3. verification and control technology
4. defense nuclear materials production
5. defense nuclear waste and materials by-products management
6. defense nuclear materials security and safeguards and security investigations
7. 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 confinement of radionuclides. (See definition of an MPC.)

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 that meets all applicable regulatory requirements. 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 (MPC 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 (Dyer, J.R., 1999).

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

DOE-Managed Spent Nuclear Fuel (DOE SNF) is SNF that is currently managed by DOE EM, and includes fuel that has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated. DOE SNF includes, but is not limited to, production reactor fuel, research reactor fuel (foreign and defense), Fort St. Vrain fuel, and miscellaneous small-quantity fuels.

DOE Spent Nuclear Fuel of Commercial Origin is SNF that is owned by the U.S. Department of Energy for which a fee equivalent to that required by 10 CFR Part 961 has been paid.

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 or storage and disposal.

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, and IPWF) 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).

Immobilized Plutonium Waste Form (IPWF) means the canistered Pu immobilized waste that will be accepted by the repository. It consists of an HLW canister filled with HLW glass surrounding the canned Pu ceramic forms.

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) refers to the combined geologic repository, all accesses into and from the repository, the surface facilities needed to support operation of the repository, and administrative activities needed to support repository design, regulatory compliance, and operations.

Multi-Purpose Canister (MPC) refers to a sealed, metallic container maintaining multiple SNF assemblies in a dry, inert environment, and overpacked separately and uniquely for the various system elements of storage, transportation, and disposal. (See definition of waste form.)

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.

Packaging means any engineered structure used to facilitate handling and transportation of radioactive waste.

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 authority of sections 103 and 104 of the Atomic Energy Act of 1954 (42 U.S.C. 2133,

2134) or who has title to spent nuclear fuel or high level radioactive waste and who has executed a contract with DOE.

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 a 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.

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 and Transportation, ISF 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 Characterization Project).

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.

To Be Determined (TBD) is used as a placeholder to identify information that is not yet defined.

To Be Verified (TBV) is used to identify information that is unqualified, preliminary, or that needs to be reevaluated.

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

Transportation Cask System includes the complete cask package, truck trailer or rail car (defined as the transporter), a tie-down system, and any other equipment associated with the transport of the loaded cask to the CRWMS.

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

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 (Dyer, J.R., 1999).

Waste Owner is used as a collective term that includes the Purchaser (Standard Contract holder) for commercial SNF and the Producer/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 (Dyer, J.R., 1999).

APPENDIX B

SAMPLE FORWARD CALCULATION TO DETERMINE CANISTER SOURCE TERM

Deleted.

APPENDIX C

INTERFACE FOR MULTI-PURPOSE CANISTERS (MPC)

INTERFACE FOR MULTI-PURPOSE CANISTERS (MPC)

C.1. Scope and Definitions

The scope of this appendix is to provide the Multi-Purpose Canister (MPC) suppliers with the interface details between multi-element disposable canisters for commercial SNF (multi-purpose canisters or MPC's), their disposal containers, and the emplacement environment that will contain the MPC and make up the total waste package.

The requirements for the MPC, a disposable canister, are discussed in Section 4.5 of the Waste Acceptance Systems Requirements Document. Multi-element disposable canisters of commercial SNF (including those with DOE SNF of commercial origin) that will not be opened and will not have contents removed for repackaging prior to emplacement are referred to as Multi-Purpose Canisters and also as Multi-Element Disposal Canisters. The MPC is a sealed right circular cylindrical metallic canister used for storage, transportation, and disposal of SNF in a dry, inert environment. The MPC is overpacked separately and uniquely for storage, transportation, and geologic disposal. The overpack for geologic disposal is referred to as a disposal container. When the disposal container is sealed with the MPC and its contents inside, the composite entity is referred to as the waste package.

C.2. General

The proposed Monitored Geologic Repository (MGR) at Yucca Mountain is designed to safely receive, handle, emplace, and monitor radioactive waste and to provide a combination of natural and engineered features repository is to contain and isolate waste for 10,000 years (Dyer, J.R. 1999, Section 113 (b)), and is expected to contain and isolate waste for hundreds of thousands of years. This combination of using natural and engineered features serves to provide an environment that is safe for workers and the public during the period that the repository is open. After closure of the repository, engineered barriers limit the water contacting the waste packages (WPs), and reduce the radionuclide concentration during transport from the WPs. The MPC and the disposal container are critical components of the engineered features (CRWMS M&O 2000d).

The above references and text are in CRWMS M&O 2000c, section 2.

C.3. Disposal Container

The disposal container is a two layer, right-circular cylinder consisting of an inner shell of stainless steel and an outer barrier of nickel-based alloy ASTM B 575 N06022, hereinafter referred to as Alloy 22.

Disposal containers have two bottom lids that are welded during disposal container fabrication. These are made of the same two materials as the disposal containers

cylinders. The disposal containers have three top lids, welded on during disposal container closure. The inner lid is stainless steel, and the outer two lids are Alloy 22.

Following acceptance of the welds, the disposal container and its contents are referred to as a Waste Package (WP)(CRWMS M&O 2000c).

C.4. Estimation of Cladding Temperature

Time dependence of decay heat shall be appropriate for the specific SNF in the canister.

Temperatures at the external waste package surface (approximate repository environment after canister emplacement) should be as in Table C-1, with "Year Zero" being the time the waste leaves the waste-custodian site.

Table C-1. External Waste Package Temperatures as a Function of Time

Year	Temperature
0 - 1	150-200 (TBV-5003)
1 - 5	150-200 (TBV-5003)
5 - 50	150-200 (TBV-5003)
>50	150-200 (TBV-5003)

C.5. Canister Waste Package Fill Gas

Waste packages will be back filled and sealed prior to burial. The fill gas, fill temperature, and fill pressure are all TBV (TBV-5002).

APPENDIX D

TRACEABILITY WITH CRD

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

CRD Requirement, Rev. 5, DCN 4		WASRD Rev. 4	
Requirement	**Subject**	**Corresponding WASRD Requirement**	**Title/Subject in WASRD**
3.1.1	Primary regulatory requirements	3.1	Primary regulatory requirements
3.1.1.A	Comply with applicable NWPA provisions	4.2.1	Compliance with the Nuclear Waste Policy Act definition of SNF and HLW
3.1.1.B	Comply with 10 CFR Part 20	The applicability and implementability of this CRD requirement will be fully assessed in future WASRD revisions.	
3.1.1.D	WAT Comply with 10 CFR Part 71	The applicability and implementability of this CRD requirement will be fully assessed in future WASRD revisions.	
3.1.1.E	WAT comply with 49 CFR Part	The applicability and implementability of this CRD requirement will be fully assessed in future WASRD revisions.	
3.1.1.G	All CRWMS elements comply with 10 CFR Part 73	The applicability and implementability of this CRD requirement will be fully assessed in future WASRD revisions.	
3.1.1.H	WAT comply with 10 CFR Part 961	The applicability and implementability of this CRD requirement will be fully assessed in future WASRD revisions.	
3.1.1.I	Compliance with applicable provisions of 29 CFR Part 1910	The applicability and implementability of this CRD requirement will be fully assessed in future WASRD revisions.	
3.1.1.J	Compliance with applicable provisions of 10 CFR Part 75 (US/IAEA Agreement)	The applicability and implementability of this CRD requirement will be fully assessed in future WASRD revisions. Primary Regulatory Requirements	
3.2.1.A	Types of nuclear wastes to be accepted	4.2.1	SNF and HLW as defined under the NWPA
3.2.1 B	Receipt rates	Section 7.0	Projected Initial Acceptance Capacity And Overall Schedule
3.2.1.C	First repository operational limits	Section 7.0	Projected Initial Acceptance Capacity And Overall Schedule
3.2.1.D	Restricted to only non-RCRA waste	4.2.2	Compliance with Hazardous Waste Regulations
3.2.1.E	Capability of CRWMS facilities to accommodate range of storage and transportation technologies	The applicability and implementability of this CRD requirement will be fully assessed in future WASRD revisions.	
3.2.1.F	Capability to open canisters and managing resulting site-generated wastes	The applicability and implementability of this CRD requirement will be fully assessed in future WASRD revisions.	
3.2.1.G	Material balance, inventory, and records management in accordance with 10 CFR Part 72.72	The applicability and implementability of this CRD requirement will be fully assessed in future WASRD revisions.	
3.2.2	Management of hazardous, mixed, and radioactive wastes generated at CRWMS facilities	The CRD's site generated waste requirements are not applicable to Waste Acceptance.	

CRD Requirement, Rev. 5, DCN 4		WASRD Rev. 4	
Requirement	**Subject**	**Corresponding WASRD Requirement**	**Title/Subject in WASRD**
3.2.3	Appropriate industry codes, standards, engineering principles, and practices	The applicability and implementability of this CRD requirement will be fully assessed in future WASRD revisions.	
3.3.A	Capability of WAT Element to transport Commercial SNF from Purchaser sites to MGR	The applicability and implementability of this CRD requirement will be fully assessed in future WASRD revisions.	
3.3.B	Capability of WAT Element to transport standard, failed, and non-standard commercial SNF	The applicability and implementability of this CRD requirement will be fully assessed in future WASRD revisions.	
3.3.C	Capability of WAT Element to accept and transport HLW and DOE EM SNF as required in EM/RW MOA and naval SNF as required in NNPP/RW MOA	3.5	CRWMS-Waste Owner Interfaces
		Section 7.0	Projected Initial Acceptance Capacity And Overall Schedule
		The applicability and implementability of this CRD requirement in the above and other WASRD provisions will be fully assessed in future revisions.	
3.3.D	Capability of WAT Element to transport NRC-certified transportation casks	3.3	Transportation Element Performance Requirements
		4.9	Transportation Cask System Interface
		The applicability and implementability of this CRD requirement in the above and other WASRD provisions will be fully assessed in future revisions.	
3.3.E	Collect enough information in support of activities	The applicability and implementability of this CRD requirement will be fully assessed in future WASRD revisions.	
3.3.E.1	Contracts and fees information	The applicability and implementability of this CRD requirement will be fully assessed in future WASRD revisions.	
3.3.E.2	Planning and scheduling information	The applicability and implementability of this CRD requirement will be fully assessed in future WASRD revisions.	
3.3.E.3	Operations support information	The applicability and implementability of this CRD requirement will be fully assessed in future WASRD revisions.	
3.3.E.4	Safeguards and security information	3.1	Primary Regulatory Requirements
		The applicability and implementability of this CRD requirement in the above and other WASRD provisions will be fully assessed in future revisions.	
3.3.F	Process information in 3.3.E to ensure availability to meet schedule	The applicability and implementability of this CRD requirement will be fully assessed in future WASRD revisions.	
3.3.G	Provide information system security	The applicability and implementability of this CRD requirement will be fully assessed in future WASRD revisions.	
3.3.H	Perform records management of records in 3.3.E	The applicability and implementability of this CRD requirement in the above and other WASRD provisions will be fully assessed in future revisions.	
3.3.I	Accomplish planning and scheduling according to 10 CFR Part 961 and the EM/RW and NNPP/RW MOAs	3.1	Primary Regulatory Requirements
		3.5	CRWMS-Waste Owner Interfaces
		4.1	Requirements For Commercial Spent Nuclear Fuel

CRD Requirement, Rev. 5, DCN 4		WASRD Rev. 4	
Requirement	**Subject**	**Corresponding WASRD Requirement**	**Title/Subject in WASRD**
		4.5	Specific Requirements for DOE Spent Nuclear Fuel of commercial origin in disposable canisters
		Section 7.0	Projected Initial Acceptance Capacity And Overall Schedule
		The applicability and implementability of this CRD requirement in the above and other WASRD provisions will be fully assessed in future revisions.	
3.3.J	Develop/update integrated plans for CRWMS activities	3.5	CRWMS-Waste Owner Interfaces
		Section 7.0	Projected Initial Acceptance Capacity And Overall Schedule
		The applicability and implementability of this CRD requirement in the above and other WASRD provisions will be fully assessed in future revisions.	
3.3.K	Records validation upon receipt of Purchaser/ Producer/Custodian forms describing SNF/HLW	The applicability and implementability of this CRD requirement in the above and other WASRD provisions will be fully assessed in future revisions.	
3.3.L	Validate title and/or transfer of responsibility	The applicability and implementability of this CRD requirement in the above and other WASRD provisions will be fully assessed in future revisions.	
3.6.1	Waste Acceptance and Transportation-Government Agency Interface Requirements	3.5	CRWMS-Waste Owner Interfaces
		The applicability and implementability of this CRD requirement in the above and other WASRD provisions will be fully assessed in future revisions.	
3.6.2	MGR External Interface Requirements	The applicability of the interface requirements that are to result from the MGR's implementation of this CRD provision will be fully assessed in future WASRD revisions.	
3.6.3	CISF External Interface Requirements	N/A	
3.6.4	CRWMS Interface Requirements with EM and MD	N/A	
3.6.5.1	WAT-MGR Interface Requirements	3.4.1	Waste Acceptance to Monitored Geologic Repository (MGR) Interfaces
		The applicability and implementability of this CRD requirement in the above and other WASRD provisions will be fully assessed in future revisions.	
3.6.5.2	WAT-CISF Interface Requirements (If approved)	3.4.2	Waste Acceptance to Interim Storage Facility (If authorized) Interfaces
3.6.5.3	MGR-CISF Interface Requirements (If CISF approved)	N/A	

The following number is for OCRWM Records Management purposes only and should not be used when ordering this publication

Accession No.:

January 2002

This publication was produced by the U.S. Department of Energy's Office of Civilian Radioactive Waste Management (OCRWM)

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January 2002