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Civilian Radioactive Waste Management System Requirements Document

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PART 1

INFORMATION ONLY

TBV/TBD/TBP Log

Number	Section Number	Resp. Org.	Due Date	Brief Description
TBV 3	3.6.1.3.7.1.H.1	RW-51	TBD	Environmental Assessment Benchmark Glass (ASTM C 1285-94)
TBV 4	3.6.1.3.7.2.C	RW-40	TBD	DOE SNF Canister Specifications
TBV 5	3.6.1.3.7.2.F	YMSCO	TBD	Thermal output of DOE SNF canister
TBV 6	3.6.1.3.7.1.A 3.6.1.3.7.1.K	EM	TBD	Rationales for Hanford 15 foot canister requirements
TBV 7	3.6.1.3.6.A.1	YMSCO	TBD	Canister gas leak rate
TBV 8	3.6.1.3.6.A.2	YMSCO	TBD	Canister internal gas pressure
TBV 9	3.6.1.3.6.A.3	YMSCO	TBD	Maximum detectable amount of organic
TBV 10	3.6.1.3.7.2.D	YMSCO	TBD	Maximum gamma-ray dose
TBV 11	3.6.1.3.7.2.E	YMSCO	TBD	Exemption for high dose rate
TBP 1	2.4.A.J, 3.3.C.E.2, I, 3.6.1.J.B-C, 3.6.1.3.1.B, 3.6.1.3.6.F.1	RW-51	TBD	MOAs between RW and EM and NNPP in development
TBD 1	Table 3-1	RW-51	TBD	Annual quantity of DOE HLW/SNF to be received at MGR
TBD 2	Table 3-3	RW-40	TBD	Total years of CISF operation
TBD 3	Table 3-3	RW-51	TBD	Quantity of DOE SNF to be received at Phase I CISF
TBD 4	Table 3-3	RW-51	TBD	Quantity of DOE SNF and year to be received at Phase II CISF
TBD 5	Table 3-3	RW-51	TBD	Quantity of HLW and year to be received at CISF
TBD 6	3.5.C	RW-40	TBD	HLW storage capacity of CISF

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1. INTRODUCTION

1.1 IDENTIFICATION

This document specifies the top-level requirements for the Civilian Radioactive Waste Management System (CRWMS). The document is referred to herein as the CRD, for **CRWMS Requirements Document**.

1.2 PURPOSE

The CRD establishes requirements for the design, development, and operation of the CRWMS. It specifically addresses the top-level governing laws and regulations (e.g., *Nuclear Waste Policy Act* (NWPA), 10 CFR Part 60, 10 CFR Part 71, etc.) along with specific policy, performance requirements, internal and external interface requirements, and system architecture. The CRD shall be used as a vehicle to incorporate specific changes in technical scope or performance requirements that may have significant program implications. Such may include changes to the program mission, changes to operational capability, internal or external interfaces, acceptance of additional waste forms, and high visibility stakeholder issues.

Interface requirements are covered in Section 3.6. For commercial spent nuclear fuel (SNF) technical requirements are covered by a general reference to the Standard Contract, 10 CFR Part 961. For Department of Energy (DOE) SNF and high-level radioactive waste (HLW), acceptance criteria are included in Section 3.6.1.3.

1.3 SYSTEM OVERVIEW

The mission, top-level functions, waste management concept and performance period of the system and system elements are defined in this section.

1.3.1 CRWMS Mission

The NWPA assigned the DOE the mission to develop and operate an integrated waste management system for acceptance, transportation, storage (if approved), and disposal of SNF and HLW. The NWPA also established the Office of Civilian Radioactive Waste Management (RW) to carry out that mission. RW, in turn, is developing the CRWMS as the operational and physical system capable of performing the integrated management system functions. RW's plan for successfully addressing this mandated mission is documented in the draft Office of Civilian Radioactive Waste Management Program Plan, Revision 1. The mission of the CRWMS is to provide for the timely disposal of the nation's SNF and HLW in a geologic repository in a manner that protects the health and safety of the public and of workers, and maintains the quality of the environment.

At present, a Centralized Interim Storage Facility (CISF) is not included in the cost and schedule baselines. However, the CRD includes, on a contingency basis, requirements with regard to

performance of a CISF. Requirements for and discussion of the CISF in Sections 3.5 and 3.6 are applicable only if a CISF is approved. However the requirements may be used for generic non-site specific contingency planning.

1.3.2 CRWMS Top-Level Functions

The top-level function of the CRWMS is to "Dispose of Waste," which includes directing or controlling any physical activity, operation, or process conducted to accept title and possession, transport, store (if approved), and emplace and isolate SNF and HLW. For planning, systems analysis, and conceptual design purposes, Dispose of Waste is broken down into three subfunctions that the CRWMS must perform: Accept and Transport Waste, Store Waste (if approved), and Emplace and Isolate Waste. The CRWMS functions are shown below in Figure 1-1. The top-level function flow for Dispose of Waste and its subfunctions is shown in Figure 1-2. A more detailed definition of the functions is provided in Appendix A.

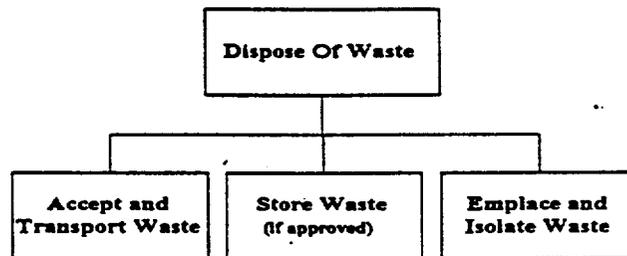


Figure 1-1 CRWMS Function Hierarchy

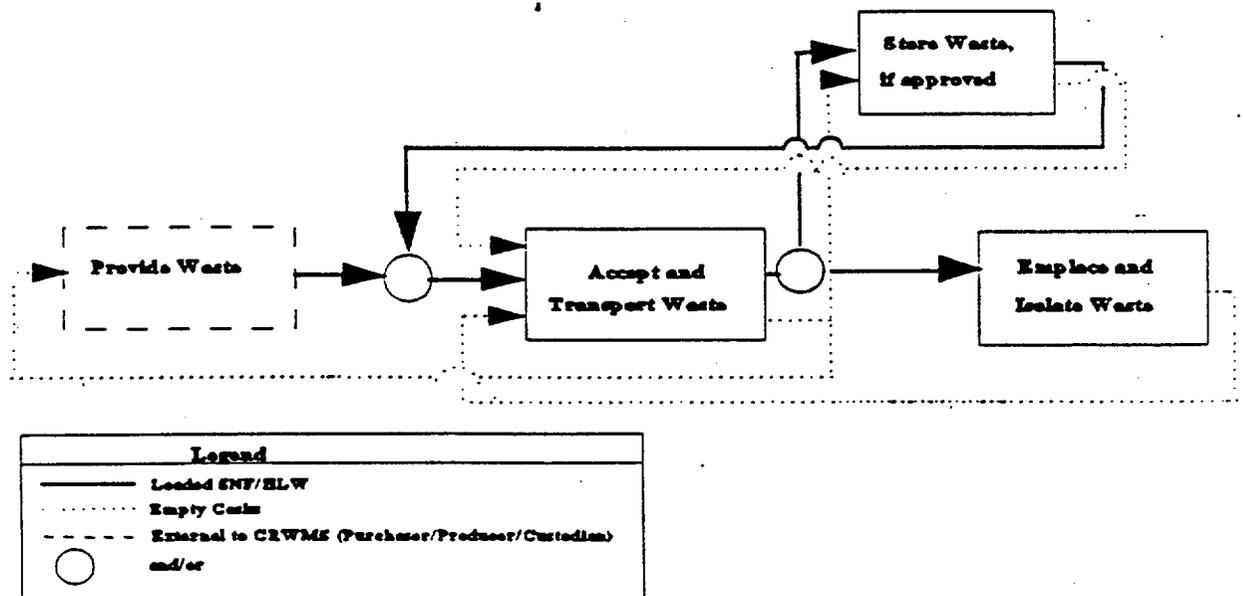


Figure 1-2 CRWMS Function Flow Diagram with Store Waste shown as if approved

1.3.3 Waste Management System Concept

The Dispose of Waste function is accomplished by three system elements. They are:

- Waste Acceptance and Transportation (Configuration Item: D00000000)
- CISF (if approved) (Configuration Item: C00000000)
- Monitored Geologic Repository (MGR) (Configuration Item: B00000000)

The CISF is not currently approved except for contingency planning. The allocation of functions to these elements is as follows:

- Accept and Transport Waste - Waste Acceptance and Transportation Element
- Store Waste - CISF Element
- Emplace and Isolate Waste - MGR Element

These system elements work in conjunction with each other to fulfill a variety of functional and performance requirements intended to make the transportation, storage (if approved), and permanent emplacement and isolation of waste in a geologic medium safe, environmentally acceptable, and cost effective. The CRWMS will provide appropriately documented conformance verification, accountability, and traceability of the waste from initial acceptance to final closure of the MGR. The system architecture is portrayed in Figure 1-3. A top-level description of the CRWMS and its concept of operations is provided in the *CRWMS Total System Description* (DOE/RW-0500).

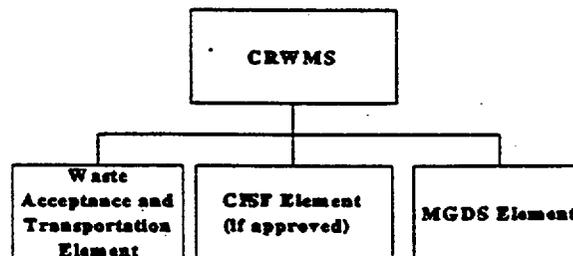


Figure 1-3 CRWMS Architecture

1.3.4 CRWMS Performance Period

CRWMS system performance begins with the start of site characterization; involves the acceptance, transportation, interim storage, and emplacement of SNF and HLW; and continues through the isolation of the waste from the accessible environment in a geologic repository, which may be at least 10,000 years following permanent closure of the MGR facility. The construction of facilities for the MGR operational period is preceded by site characterization activities essential to the design process, a viability assessment, an environmental impact statement, a site recommendation, and the licensing process. The site characterization activities require the construction of test facilities, which may, in part, be incorporated into the disposal system. Thus, requirements and planning documents must integrate the design for both the characterization period and the extended period of system performance.

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2. REQUIREMENTS IMPLEMENTATION

2.1 PRECEDENCE

The order of precedence to be applied for external sources of requirements is as follows: Federal law (i.e., statutes and treaties; regulations and executive orders); state and tribal laws; local ordinances; and national and international standards.

2.2 QUALITY ASSURANCE DOCUMENTATION

The requirements defined in Section 3 will be met by the engineering development of a variety of structures, systems, and components (SSCs). The appropriate classification of SSCs and the engineering documentation produced to meet the requirements are prepared in accordance with the *Quality Assurance Requirements and Description (QARD)* (DOE/RW-0333P) requirements.

2.3 CONFORMANCE VERIFICATION

Documentation will be produced for each system element that further defines and implements the requirements defined in Section 3 and will provide an explanation of how the requirements allocated to that element have been satisfied. The methods selected for conformance verification should be consistent with the OCRWM Test and Evaluation Master Plan.

2.4 PLANNING CONSIDERATIONS

Various planning considerations have been imbedded in the development of the requirements of Section 3. These include:

- A. Transportation equipment design and shipping responsibilities for DOE SNF are documented in the Office of Environmental Management (EM)/RW Memorandum of Agreement (MOA) for Acceptance of DOE SNF and HLW, and the Naval Nuclear Propulsion Program (NNPP)/RW MOA for Acceptance of Naval SNF (TBP 1). When issued, the appropriate transportation requirements will be incorporated in the technical baseline.
- B. CRWMS facilities will be designed to minimize the generation of hazardous, low level, and mixed waste.
- C. Custodians are responsible for any conditioning to the DOE SNF required to ensure its transportability, storability, disposability and compliance with licensing and acceptance requirements.
- D. For the purpose of Site Recommendation and License Application Design, the number of HLW canisters to be included in the MGR design shall be that amount needed to support a repository area emplacing 63,000 Metric Ton Heavy Metal (MTHM) commercial SNF and

2333 MTHM DOE SNF, considering current disposal concepts (e.g., HLW/DOE SNF co-disposal). The actual total number of HLW canisters emplaced during repository operations shall be consistent with the NWPA, Sections 114(d) and 161(b).

- E. The continuing heat generation of waste packages after emplacement must be considered in the design of the system. Temperatures that may lead to structural failure within the waste package or that may cause adverse effects on the waste isolation capability of the geologic setting must be avoided.
- F. The assumption used in developing this requirements document regarding the extent of any blending of SNF (or HLW) that may be required is limited to that blending that can be accomplished through management of the waste stream. Limited blending of SNF can be accomplished at the CISF (if approved) and/or the MGR. If additional blending is required, this could have a major impact on CISF and MGR design and operations, as well as use of canisters in the system; or will require negotiations with Purchasers, should blending of wastes loaded into canisters or transportation casks at Purchaser sites be recommended. These issues will be the subject of system studies. If these studies show that changes in system design requirements are necessary, this requirements document will be revised.
- G. To support the draft Program Plan, revision 1, the CRWMS must be designed to accomplish its performance functions with, or without, a CISF. To maintain the ability for expeditious implementation, the CISF remains an element of the CRWMS architecture.
- H. This requirements document addresses the requirements for retrieving waste from the repository, as mandated by the NWPA (42USC10142) and 10 CFR Part 60.111(b). These requirement sources do not provide guidance on what will happen to the retrieved waste. If special capabilities are required, there will be time to design and construct them when retrieval is authorized. Requirements for any special capabilities that are necessary will be deferred until concepts are developed and analyzed.
- I. Transportation requirements and architecture will not be maintained for post-retrieval waste transport capability. This is because it is reasonable to believe that the MGR could serve as a post-retrieval storage site, and if not, that a "new" transport capability could be developed in the expected time frame during which substantive waste retrieval was being conducted.
- J. For transportation of DOE SNF and HLW as defined in the EM/RW MOA (TBP 1), and for transportation of commercial SNF, private industry will be used to the fullest extent practicable. Federal services for such transportation will be used only when private industry is unable or unwilling to provide such services at reasonable cost, as determined by the Secretary, Department of Transportation (DOT), in consultation with DOE.
- K. CRWMS design and operations planning will be compatible with transportation of SNF and HLW to the repository by rail, heavy haul vehicle, and legal weight truck.

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- L. The CRWMS is being designed and implemented to meet all applicable Nuclear Regulatory Commission (NRC) regulations for the protection of SNF. According to the terms of the agreement between the United States Department of State and the International Atomic Energy Agency (IAEA), any facility that is licensed by the NRC and is not determined to be important to national security is eligible to be selected by the IAEA for inspection. Since CRWMS facilities will be licensed by the NRC, the IAEA will be able to select the CRWMS facilities for inspection. If any CRWMS facility is selected by IAEA for inspection, any resulting requirements would be codified in 10 CFR Part 75. This would obligate CRWMS facilities to comply with IAEA requirements for the safeguarding of special nuclear material contained within SNF. The OCRWM Spent Nuclear Fuel Verification Plan describes RW's approach to meeting NRC and IAEA Safeguard requirements.
- M. The RW receipt facility(ies) will be capable of receiving the mix of pressurized water reactor (PWR) and boiling water reactor (BWR) SNF approved under 10 CFR Part 961. Additionally, the truck/rail split will satisfy the Annual Capacity Report (ACR)/Acceptance Priority Ranking (APR) allocation.
- N. The DOE materials (including DOE SNF) delivery schedules will be coordinated with the commercial SNF delivery schedule to facilitate mixed emplacement underground.
- O. The MGR design will maintain flexibility by considering pending changes to 10 CFR Part 60 and the Environmental Protection Agency (EPA) radiation protection standard.
- P. For planning purposes RW shall accept up to 7,000 MTHM commercial high-level waste (CHLW), defense high-level waste (DHLW), and DOE-owned SNF. The planning base allocation for disposal of DOE-owned material within the first repository will be one-third DOE-owned SNF and two-thirds vitrified HLW. The nominal 4667 MTHM of vitrified HLW will be accepted from the New York State Energy Research and Development Authority (NYSERDA) (pending execution of an acceptance and disposal contract) and Savannah River Site (SRS). Unused capacity within the current 2/3 HLW allocation will be filled with vitrified HLW from Hanford and the Idaho National Engineering and Environmental Laboratory (INEEL). Waste from these sites will also be considered for any additional allocation that becomes available.
- Q. Disposal of West Valley Demonstration Project (WVDP) CHLW, presently owned by NYSERDA, is contingent upon the establishment of an acceptance and disposal contract. Upon execution of this contract between NYSERDA and DOE, the acceptance requirements applicable to CHLW documented in Section 3.6 will be established and formally imposed on the NYSERDA CHLW.

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3. REQUIREMENTS

3.1 REGULATORY REQUIREMENTS

3.1.1 Primary Regulatory Requirements

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

- A. All CRWMS elements shall comply with the applicable provisions of 42USC10101et seq.
- B. All CRWMS elements shall comply with the applicable provisions of 10 CFR Part 20, "Standards for Protection Against Radiation".
- C. The CRWMS MGR element shall comply with the applicable provisions of 10 CFR Part 60, "Disposal of High-Level Radioactive Waste in Geologic Repositories".
- D. The CRWMS Waste Acceptance and Transportation element shall comply with the applicable provisions of 10 CFR Part 71, "Packaging and Transportation of Radioactive Material".
- E. The Waste Acceptance and Transportation element shall comply with the applicable provisions of DOT regulations as documented in Title 49 of the Code of Federal Regulations.
- F. The CRWMS CISF element shall comply with the applicable provisions of 10 CFR Part 72, "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High Level Radioactive Waste".
- G. All CRWMS elements shall comply with the applicable provisions of 10 CFR Part 73, "Physical Protection of Plants and Materials".
- H. The CRWMS Waste Acceptance and Transportation 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".
- I. All CRWMS elements shall comply with the applicable provisions of 29 CFR Part 1910, "Occupational Safety and Health Standards".

3.1.2 Additional Laws and Regulations

In addition to meeting the primary requirements identified in Section 3.1.1, the CRWMS shall comply with other applicable Laws, Statutes, U.S. Codes, Treaties, Code of Federal Regulations (CFRs), Executive Orders, State and Local codes and Regulations, and DOE Orders as identified through analyses of the system elements. A list of potentially applicable laws and regulations is provided in Appendix C.

3.2 OVERALL SYSTEM - LEVEL REQUIREMENTS

3.2.1 Overall System Performance

- A. The CRWMS shall be designed to dispose of commercial SNF, DOE SNF, DHLW and CHLW.
- B. The CRWMS shall be capable of accepting, transporting, and emplacing and isolating SNF and HLW at the annual rates specified in Table 3-1.

Table 3-1. CRWMS Receipt Rates ¹ (In MTHM or Equivalent/Year)

Year	Commercial SNF	HLW/DOE SNF
	Received annually at Repository	Received annually at Repository
2010	400 ²	TBD 1 ³
2011	600 ²	TBD 1
2012	1,200 ²	TBD 1
2013	2,000	TBD 1
2014	3,000	TBD 1
2015 -2031	3,000	400 TBD 1
2032	3,000	200 TBD 1
2033	1,900	0 TBD 1
Total	63,000	7,000

¹ The actual operational load is a function of the numbers, types and sizes of casks and canisters in which the SNF and HLW are accepted from the points of origin. Since these specific numbers will not be determined until Purchaser/Producer/Custodian agreements are reached and schedules are established, the required rates are estimated in terms of desired systems-level MTHM acceptance rates.

² This ramp-up is a minimum; the Waste Acceptance & Transportation, CISF and MGR elements may mutually develop an accelerated schedule.

³ According to the DOE/Navy/State of Idaho Settlement Agreement (Oct 17, 1995), all DOE SNF at INEEL is to be removed from Idaho by 2035. Navy fuel will be among the early shipments to an CRWMS receiving facility. The specific schedule for acceptance and disposal of DOE SNF to satisfy this agreement has not been determined. The schedule will be determined after the EM/RW and NNPP/RW MOAs are approved.

- C. The CRWMS shall accept the MTHM or equivalent of SNF/HLW for disposal in the first repository that is authorized by the governing regulations. The currently planned amounts of waste, prior to a second repository being in operation, are shown in Table 3-2.

Table 3-2. Amount of SNF/HLW To Be Accepted in First Repository (In MTHM or Equivalent)

Type	Amount
Commercial SNF	63,000
Commercial HLW	640
Defense HLW	4,027
DOE SNF	2,333
Total	70,000

- D. The CRWMS shall only dispose of SNF or HLW that is not subject to regulation as hazardous waste under the Resource Conservation and Recovery Act (RCRA) Subtitle C in the first geologic repository licensed by NRC under the NWPA. Prior to acceptance for disposal, Producers and Custodians must determine and document that RCRA-regulated wastes are not present, and develop appropriate data to assure relevant state and/or EPA requirements are addressed. RW shall collect and review the available data and documentation for commercial SNF.
- E. CRWMS elements and facilities shall be capable of accommodating a range of storage and transportation technologies, including multi-purpose, dual-purpose, and single purpose canisters.
- F. CRWMS facilities shall be capable of opening sealed storage/transportable canisters, handling the SNF and managing associated site generated waste streams.
- G. CRWMS facilities shall establish and maintain material balance, inventory and records for stored materials in accordance with 10 CFR Part 72.72.

3.2.2 Site Generated Wastes

- A. CRWMS facilities shall maintain the separation of hazardous, non-hazardous, and radioactive wastes.
- B. CRWMS site-generated hazardous and mixed waste shall be transported to government-approved off-site facilities for disposal.

3.2.3 Industry Codes and Standards

All CRWMS element SSCs shall be designed and fabricated in accordance with appropriate industry codes, standards, engineering principles and practices with particular attention to those which incorporate system safety, human factors, reliability, availability, maintainability, and habitability standards.

3.3 WASTE ACCEPTANCE AND TRANSPORTATION ELEMENT REQUIREMENTS

This section contains the requirements allocated to the Waste Acceptance and Transportation Element.

- A. The Waste Acceptance and Transportation Element shall be capable of transporting commercial SNF from the Purchaser sites to the MGR or CISF (if approved) and from the CISF (if approved) to the MGR.
- B. The Waste Acceptance and Transportation Element shall be capable of transporting standard, failed, and nonstandard commercial SNF described in 10 CFR Part 961.
- C. The Waste Acceptance and Transportation Element shall be capable of transporting HLW and DOE SNF described in the EM/RW MOA (TBP 1) from the Producer/Custodian sites to the MGR or CISF (if approved) and from the CISF (if approved) to the MGR.
- D. The Waste Acceptance and Transportation Element shall be capable of transporting NRC-certified transportation casks, including the following general types:
 - Single-Purpose Casks
 - Canister Casks (Multi Purpose Canister (MPC) and Dual Purpose Canister (DPC))
 - Transportable Storage Casks (TSCs)
 - HLW Casks
 - Specialty Casks

These cask types are defined in Appendix B.

- E. CRWMS Waste Acceptance and Transportation Element shall collect necessary information in support of CRWMS activities. The type of data required includes, but is not limited to, the following:
 1. Contracts and Fees Information - Purchaser Contracts; Custodian and Producer Agreements and changes thereto; records of fee payments.
 2. Planning and Scheduling Information - Delivery Commitment Schedules (DCS), DCS Exchanges, Final Delivery Schedules (FDS), integrated Acceptance Schedule developed in accordance with the EM/RW and NNPP/RW MOAs (TBP 1), Purchaser and Custodian SNF data, campaign schedules, acceptance, transportation, delivery, storage and emplacement schedules.

3. Operations Support Information - Characterization data for Purchaser and Custodian SNF and Producer waste sufficient to satisfy 10 CFR Part 60.21(c)(5), loading safeguards verification data.
 4. Safeguards and Security Information - inventory reports, accounting reports, inventory change reports, material status reports, special reports.
- F. CRWMS Waste Acceptance and Transportation Element shall process the above information in such a manner, including automated and manual data processing, to ensure availability to meet schedules.
 - G. Information system security shall be provided to a level commensurate with the classification of the material being processed including physical security for data processing and record storage facilities, and restrictions on access to information.
 - H. CRWMS Waste Acceptance and Transportation Element shall perform records management, including classification, receipt, storage, information retrieval and dispositioning of records identified in E above.
 - I. Waste Acceptance and Transportation Element shall accomplish planning and scheduling according to the provisions of the Standard Contract (10 CFR Part 961) and the EM/RW and NNPP/RW MOAs (TBP 1).
 - J. Integrated plans for CRWMS activities shall be developed and updated as needed to respond to changed data and operating conditions. Planning involves allocating system capacity, evaluating schedule requests, and establishing the CRWMS operations schedule.
 - K. Records validation shall be initiated upon receipt of Purchaser/Producer/Custodian forms describing the SNF/HLW to be delivered.
 - L. Waste Acceptance and Transportation shall validate title and/or transfer of responsibility and custody documentation from the Purchasers/Producers/Custodians.

3.4 MGR ELEMENT REQUIREMENTS

This section contains the requirements allocated to the MGR Element.

- A. The MGR design shall permit emplacement of 70,000 MTHM or equivalent of SNF and HLW. The MGR shall be designed to be capable of accommodating the total inventory of SNF and HLW consistent with current disposal concepts (e.g., HLW/DOE SNF co-disposal). However, MGR operational capacity shall be restricted to within the statutory limit of 70,000 MTHM or equivalent of SNF and HLW.
- B. The waste packages shall be designed such that substantially complete containment of the waste can be demonstrated for at least 1,000 years.

3.5 CISF ELEMENT REQUIREMENTS

If a CISF is approved, the following allocated requirements shall be met.

- A. The CISF shall be designed to expedite operations by using a phased approach with Phase 1 having the capability to receive and store licensed dual purpose and multi-purpose systems only and Phase 2 having the capability to receive and store SNF in licensed dual purpose and multi-purpose systems and as individual assemblies at the rates indicated in Table 3-3.

Table 3-3. CISF Receipt Rates⁴ (In MTHM or Equivalent/Year)

Phase	Year of Operation	Commercial SNF	DOE SNF	HLW
I	1	1200	TBD 3 ⁵	0
I	2	1200	TBD 3	0
II	3 and 4	2000	TBD 4	TBD 5
II	5	2700	TBD 4	TBD 5
II	6 and subsequent	3000	TBD 4	TBD 5
II	TBD 2	3000	TBD 4	TBD 5

- B. The CISF shall have a minimum storage capacity of 10,000 MTHM of SNF.
- C. The CISF shall have a HLW storage capacity of (TBD 6).
- D. The CISF shall be capable of preparing SNF and HLW for off-site transport.

3.6 INTERFACE REQUIREMENTS

This section identifies the interface requirements between CRWMS system elements, and external interfaces with organizations outside CRWMS (e.g., Purchasers, Producers, Custodians, state and local governments).

3.6.1 External Interface Requirements

This section describes interface requirements between external organizations and the CRWMS.

⁴ Receipt rates in this table are only applicable if a CISF is approved.

⁵ According to the DOE/Navy/State of Idaho Settlement Agreement (Oct 17, 1995), all DOE SNF at INEEL is to be removed from Idaho by 2035. Navy fuel will be among the early shipments to an CRWMS receiving facility. The specific schedule for acceptance and disposal of DOE SNF to satisfy this agreement has not been determined. The schedule will be determined after the EM/RW and NNPP/RW MOAs are approved.

3.6.1.1 Waste Acceptance and Transportation - Purchasers/Producers/Custodians Interface Requirements

The interface requirements in this section are applicable to the interface between Waste Acceptance and Transportation and the Purchaser/Producer/Custodian.

- A. Producer/Custodian and Waste Acceptance and Transportation shall ensure that waste forms and any canisters and CRWMS SSC designs are physically, chemically, dimensionally, functionally, and operationally compatible.
- B. Waste Acceptance and Transportation shall exchange planning and operational information with the Purchasers/Producers/Custodians, as required in 10 CFR Part 961 and the EM/RW MOA (TBP 1), for campaign planning and preparation, and to accomplish cask loading and off-site transport.
- C. For HLW as defined in the EM/RW MOA (TBP 1), and for commercial SNF, Waste Acceptance and Transportation shall provide appropriately configured NRC-certified transportation casks, and provide the required ancillary equipment to Purchaser/Producer sites.
- D. Waste Acceptance and Transportation shall verify that the SNF or HLW is properly loaded and packaged in accordance with the transportation cask certificate of compliance and the cask is properly marked and labeled and ready for transportation (including appropriate shipping documents) in accordance with applicable regulations and RW-established safeguards verification procedures prior to acceptance for transportation to a CRWMS facility.

3.6.1.2 Waste Acceptance and Transportation - Purchaser Interface Requirements

- A. Commercial SNF shall meet the requirements specified in 10 CFR Part 961, as modified by individual Purchaser contracts.

3.6.1.3 Waste Acceptance and Transportation - Producers/Custodians Interface Requirements

- A. HLW and/or DOE SNF that meet the procedural requirements specified in Sections 3.6.1.3.1-3.6.1.3.4, and the regulatory acceptance criteria specified in Section 3.6.1.3.5 shall be accepted into the CRWMS.
- B. A **nonconforming canistered waste form** is defined as HLW and/or DOE SNF that does not meet the applicable requirements in Sections 3.6.1.3.6 and 3.6.1.3.7. To request acceptance of a nonconforming canistered waste form, the Producer/Custodian shall submit an action plan for correction or disposition for approval. The action plan must adequately identify and describe the nonconformance, any action to change or correct the existing nonconformance and an evaluation of how the nonconformance will impact repository performance. RW shall either approve or disapprove the action plan within four (4) months of receipt. Disapprovals shall be accompanied by an explanation. The action plan must be signed by authorized RW and Producer/Custodian representatives.

- C. A **nonstandard canistered waste form** is defined as a nonconforming canistered waste form that has been reviewed and deemed acceptable for entry into the CRWMS. After approval of the action plan, RW will advise EM or NNPP within four (4) months as to the technical feasibility of acceptance according to the Integrated Acceptance Schedule, and any schedule adjustment for such services. EM shall implement the approved actions and document in the records package that the action plan has been completed.

3.6.1.3.1 Preconditions

This section provides the preconditions that must be satisfied prior to acceptance of any HLW and/or DOE SNF into the CRWMS for disposal.

- A. Acceptance and Disposal Contract/MOA - An appropriate agreement reflecting the terms and conditions consistent with those specified in 10 CFR Part 961.11 shall be established prior to acceptance of any HLW and/or DOE SNF.
- B. Disposal Fees - No HLW and/or DOE SNF generated or owned by any department of the United States may be disposed of in any repository constructed under the NWPA unless such department transfers, for deposit in the Nuclear Waste Fund or Defense Waste Fund, amounts equivalent to the fees that would be paid to the Secretary under 10 CFR Part 961 if such HLW and/or DOE SNF were generated by any other entity. Disposal fees for naval SNF shall be in accordance with the NNPP/RW MOA. (TBP 1)
- C. Compliance with CRWMS Requirements - Records and compliance documentation shall be developed to demonstrate compliance of HLW and/or DOE SNF with CRWMS requirements and criteria. The records include (1) reports needed to comply with EPA and NRC regulations and support the license application, for example, material control and accountability paperwork, certification that the HLW and/or DOE SNF meets RCRA requirements; and (2) data and information needed for performance assessment, for example radionuclide inventory and materials inventory. These reporting requirements will be developed later.
- D. Quality Assurance (QA) Requirements
1. The Producer/Custodian shall establish, maintain, and execute a QA program satisfying each of the applicable criteria of the OCRWM QARD.
 2. The Producer/Custodian shall prepare and maintain QA records documentation sufficient to demonstrate compliance with CRWMS requirements and criteria, as well as applicable Producer/Custodian documents (e.g., for HLW, the Waste Form Compliance Plan (WCP), the Waste Form Qualification Report (WQR), Production Records, and Storage and Shipping Records). Other documentation generated during preparation and implementation of the WCP and WQR shall be collected and maintained as records in accordance with the QARD.
 3. Copies of completed DOE SNF and HLW data packages shall be made available for RW review twelve (12) months prior to the scheduled acceptance. Producers/Custodians shall

transfer the original completed DOE SNF and HLW data records package (or a copy in accordance with requirements for QA records packages) to RW, at the time of acceptance.

3.6.1.3.2 Transfer of Responsibility and Custody

- A. Acceptance in writing by RW of any HLW and/or DOE SNF shall constitute a transfer of responsibility and custody to RW at the Producer/Custodian site, or, in the case of NNPP SNF, at the RW facility.
- B. RW shall accept HLW and/or DOE SNF at a designated loading facility, or, in the case of NNPP SNF, at the RW facility.
- C. RW shall be solely responsible for control of all material upon transfer of responsibility and custody. RW will dispose of this material in a manner consistent with existing regulations.
- D. The Producer/Custodians shall provide the HLW and/or DOE SNF loaded and prepared for shipment. NNPP SNF shall be transported to the RW facility by NNPP.

3.6.1.3.3 Notification of Improperly Described HLW and/or DOE SNF Prior to Acceptance into the CRWMS

If DOE SNF and/or HLW is determined by RW to be improperly described prior to acceptance by RW at EM's site, RW shall notify EM in writing of such determination within ten (10) days. RW reserves the right to refuse to accept such DOE SNF and/or HLW until the DOE SNF and/or HLW has been properly described. EM shall not transfer such SNF and/or HLW to RW unless RW agrees to accept such SNF and/or HLW under such other arrangements as may be agreed to, in writing, by the parties.

3.6.1.3.4 Resolution of Improperly Described HLW and/or DOE SNF After Acceptance into the CRWMS

- A. When notified by the MGR and/or CISF of improperly described HLW and/or DOE SNF, RW shall resolve the waste description with the Producer/Custodian.
- B. If subsequent to its acceptance EM or RW finds that DOE SNF and/or HLW is improperly described, the discovering party shall notify the other party within ten (10) days, in writing, of such finding. In the event of such notification, EM shall provide RW with a proper designation within thirty (30) days. In the event of a failure by EM to provide proper designation, RW may hold in abeyance any and all pickups scheduled thereafter.

3.6.1.3.5 Acceptance Criteria (Regulatory)

- A. All HLW and/or DOE SNF shall comply with the applicable provisions of the NWSA, appropriate EPA, DOT, and NRC regulations for transportation, storage (if approved) and geologic disposal. The latter include but are not limited to 10 CFR Part 60, 10 CFR Part 71, 10 CFR Part 72 and 10 CFR Part 73.

B. General Criteria

1. The HLW and/or DOE SNF shall be in solid form and placed in sealed canisters. A limited amount of bare DOE SNF may be accepted by RW in accordance with the EM/RW MOA.
2. The HLW and/or DOE SNF shall be consolidated, if in particulate form, (for example, by incorporation into an encapsulating matrix) to limit the availability and generation of particulates.
3. Combustible HLW and/or DOE SNF shall be reduced to a form such that they are noncombustible in the repository environment unless it can be demonstrated that a fire involving the waste packages containing combustibles will not adversely affect other waste packages, any SSCs important to safety, or the repository's ability for waste isolation.

C. Criticality

1. All HLW and/or DOE SNF systems for processing, transporting, handling, storage, retrieval, emplacement, and isolation of radioactive waste shall be designed to ensure that together with the components of the CRWMS, nuclear criticality is not possible unless at least two unlikely, independent, and concurrent or sequential changes have occurred in the conditions essential to nuclear criticality safety. All system components (e.g., DOE SNF and any canister) must be such that the system of which they are part will comply with this requirement.
2. All HLW and/or DOE SNF systems shall be designed for criticality safety assuming occurrence of design basis events.
3. The calculated effective multiplication factor (k_{eff}) must be sufficiently below unity to show at least a 5% margin, after allowance for bias in the method of calculation and the uncertainty in experiments used to validate the method of calculation. All system components (e.g., DOE SNF and any canister) must be such that the system of which they are part will comply with this requirement.

D. Confinement

1. The HLW and/or DOE SNF shall not contain or generate materials that are explosive, pyrophoric, or chemically reactive (in the repository environment) in a form or amount that could compromise the repository's ability to perform its waste isolation function or satisfy its performance objectives.
2. The HLW and/or DOE SNF shall not contain or generate free liquids in the waste package to an amount that could compromise the ability of the waste package to achieve the performance objectives related to containment of the waste form or result in spillage and spread of contamination in the event of waste package perforation during the period from placement in a waste package through permanent closure of the repository.

E. Canister Label

1. The canister label shall be an integral part of the canister (e.g., embossed) to assist in remaining legible at least to the end of the period of retrievability in a repository.
2. The canister label shall have a unique alphanumeric identifier and this identifier must appear on all documentation pertinent to that particular canister.
3. The canister label shall not impair the integrity of the canister.

3.6.1.3.6 Acceptance Criteria (Imposed for all Producer/Custodian waste forms by RW)

A. Confinement

1. Inert cover gas leak rate of the outermost closure shall be less than 1×10^{-4} atm-cc/sec. (TBV 7)
2. After closure, the canistered waste form shall not contain or generate free gas other than air, residuals of air, inert cover, and radiogenic gases with an immediate internal gas pressure not to exceed 150 kPa (22 psia) at 25°C. (TBV 8)
3. After closure, the canistered waste form shall not contain detectable amounts of organic materials. (TBV 9)

B. RCRA - The CRWMS shall only accept HLW and/or DOE SNF that is not subject to regulation as hazardous waste under the 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 EPA requirements are addressed.

C. Material Compatibility - The HLW and/or DOE SNF and 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.

D. Surface Contamination - The levels of non-fixed (removable) radioactive contamination on external surfaces of each canister should be as low as is reasonably achievable (ALARA). The level of non-fixed radioactive contamination may be determined by wiping an area of 300 cm² of the surface concerned with an absorbent material, using moderate pressure, and measuring the activity on the wiping material. Sufficient measurements must be taken in the most appropriate location to yield a representative assessment of the non-fixed contamination levels. Other methods of assessment of equal or greater efficiency may be used. At the time of acceptance, the non-fixed radioactive contamination on the wiping material shall not exceed 2,200 dpm/100 cm² of canister surface wiped for alpha emitting radionuclides and 22,000 dpm/100 cm² of canister surface wiped for beta and gamma emitting radionuclides.

E. Canister Label

1. The canister label shall be a material compatible with the canister material and the waste package material.
2. The canister label shall be visible on the top and side of the canister.
3. The canister label shall not cause the dimensional limits to be exceeded.

F. Safeguards Verification

1. DOE SNF and/or HLW - During transportation cask loading and prior to acceptance by RW for transportation to the CRWMS facility, the DOE SNF and/or HLW description of the shipping lot shall be subject to safeguards verification by RW. To the extent the DOE SNF and/or HLW is consistent with the description submitted and approved, in accordance with the detailed description of material as required in the EM/RW and NNPP/RW MOAs (TBP 1), RW agrees to accept such DOE SNF and/or HLW for disposal when RW has verified the DOE SNF and/or HLW description, determined the material is properly loaded, packaged, marked, labeled and ready for transportation, and has taken custody, as evidenced in writing, of the material at the Producer/Custodian site, f.o.b. carrier. A properly executed off-site radioactive shipment record, describing cask contents must be prepared by the Producer/Custodian along with a signed certification which states: "This is to certify that the above-named materials are properly described, classified, packaged, marked and labeled and are in proper condition for transfer according to applicable regulations of the U. S. Department of Transportation and the transportation cask Certificate of Compliance". (Note - RW will not transport naval SNF, so NNPP is exempt from this requirement.)
2. Material Control and Accounting
 - a. The Producers shall provide information through the HLW Production Records and the Custodians shall provide information through the DOE SNF site compliance documentation to support the RW Material Control and Accounting program for waste acceptance. The data shall be generated, documented, maintained and reported under the OCRWM QARD or an NRC accepted QA Program.
 - b. A Nuclear Material Transaction Report (DOE/NRC Form-741) shall be completed and distributed by the Producer/Custodian, whenever the HLW and/or DOE SNF is transferred into CRWMS. This shall include:
 - (1) The total and fissile uranium and plutonium content of each canister in grams.
 - (2) The concentration of plutonium in grams per cubic meter for each canister.
 - (3) The ratio by weight of the total element of the following isotopes: U-233, U-234, U-235, U-236, U-238, Pu-238, Pu-239, Pu-240, Pu-241, and Pu-242.

3. Observation by RW - If requested, the Producer/Custodian shall allow a representative(s) that RW designates access to the site for observation of preparatory activities (includes loading cask for transport, and/or loading DOE SNF into canisters).

3.6.1.3.7 Acceptance Criteria (Imposed for specific HLW and/or DOE SNF by RW)

3.6.1.3.7.1 HLW

A. Canister Specifications (e.g. dimensions, weight, etc.)

1. The standard HLW form shall be borosilicate glass sealed inside an austenitic stainless steel canister(s) with a concentric neck and lifting flange.
 2. Total length shall be 3.000 meters (+0.005, -0.020 m)⁶ or alternatively 4.500 meters (+0.005, -0.020 m)⁶ for the Hanford Site (TBV 6).
 3. Diameter shall be 61.0 centimeters (+1.5, -1.0 cm).⁶
 4. Weight shall not exceed 2500 kilograms or alternatively 4200 kilograms for the Hanford site (TBV 6).
 5. Fill height shall be equivalent to at least:
 - a. 80% of the volume of the empty canister for WVDP and SRS.
 - b. 87% of the volume of the empty canister for the Hanford site (TBV 6).
 6. Total heat generation rate shall not exceed 1500 watts per canister at the year of shipment or alternatively 2540 watts per canister at the year of shipment for the Hanford site (TBV 6).
- B. Material Compatibility - The Producer shall report to RW the American Society for Testing and Materials alloy specification (or other nationally recognized specification) and composition of the fill canister material, secondary canister material, canister label material, and any filler material used for welding, and the method of fabrication of the fill canister and any secondary canister.
- C. Radiation Protection Criteria - The canistered HLW shall not exceed a maximum surface gamma dose rate of 10^5 rem per hour and a maximum neutron dose rate of 10 rem per hour at the time of shipment. The dose rate may either be measured or calculated from a radionuclide content.

⁶ The minimum dimension may be measured prior to filling.

D. Surface Contamination

1. The Producer shall inspect the canistered waste form and remove visible waste glass from the exterior surface of the canister prior to shipment.
2. The Producer shall report to RW an estimate of the amount of canister material (particularly wall thickness) removed during decontamination of the canister surface.

E. Chemical Composition

1. The Producer shall report to RW the chemical composition and crystalline phase projections for the waste form.
2. The Producer shall report to RW the oxide composition of the waste form for the oxides of elements present in concentrations greater than 0.5% by weight and the estimate of the error of the composition.

F. Radionuclide Inventory - The Producer shall report to RW the estimated total 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% of the total radioactive inventory. The estimates shall be indexed to the years 2015 and 3115. The Producer shall also report the estimate of the uncertainty with the radionuclide inventories.

G. Phase Stability and Integrity

1. The Producer shall ensure the phase structure and composition of the canistered waste form are not degraded after initial cooldown by maintaining the waste form below 400°C to ensure the glass transition temperature is not exceeded.
2. The Producer shall provide the Time Temperature Transformation diagrams and data for the waste form.

H. 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. (TBV 3)
2. For acceptance, the 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.

I. Canister Impact Characteristics

1. Requirements shall be allocated to the handling facility, barriers, transfer cell and canister to protect the safety of the work force and the public. The HLW canisters shall be capable

of withstanding a drop of 7 meters onto a flat, essentially unyielding surface without breaching or dispersing radionuclides.

2. Drop test results shall include information on the measured canister leak rates and canister deformation after the test.

J. Canister Handling

1. The Producer shall provide a grapple design suitable for use in loading or unloading a transportation cask with a standard HLW canister.
2. 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.
3. The grapple shall be capable of being remotely engaged with and remotely disengaged from the HLW canister flange.
4. The grapple shall be capable of being engaged or disengaged while remaining within the projected diameter of the waste form canister.
5. The grapple shall include features that prevent inadvertent release of a suspended canistered waste form.

K. Condition at Delivery - At time of delivery, the HLW form shall stand upright without support on a flat horizontal surface and properly fit into a right-circular, cylindrical cavity (64 cm diameter and 3.01 m length or alternatively 64 cm (TBV 6) diameter and 4.51 m length for the Hanford Site).

L. Safeguards - The concentration of plutonium in each canister shall be less than 2500 grams/cubic meter.

M. Reporting Requirements

1. The Producer shall submit documentation to RW to demonstrate compliance of the HLW form with CRWMS acceptance criteria. This documentation includes a WCP, WQR, Production Records, and Storage and Shipping Records.
2. EM, as the cognizant organization within DOE for HLW form production, shall produce waste form production specifications, which describe the form and content to demonstrate compliance with CRWMS acceptance criteria.
3. The WCP shall describe the Producer plan for demonstrating compliance with CRWMS acceptance criteria, including a description of tests, analyses, and process controls to be performed by the Producer. The WCP also identifies records that will be provided as evidence of compliance.

4. The WQR shall compile the results from waste form testing and analysis to demonstrate the ability of the Producer to comply with CRWMS acceptance criteria.
5. The Production Records shall describe the actual canistered waste form.
6. The Storage and Shipping Record shall describe the physical attributes of each canistered waste form and identify any unexpected events, such as thermal excursions, which have occurred during storage. Specifically, the Shipping records for HLW shall provide written documentation and certification:
 - a. Of cask conditions and contents prior to transfer to the receiving party.
 - b. That the transportation cask subsystem has been packaged to meet DOE, DOT, and NRC requirements, and to transfer care, custody and control of the shipment.
 - c. Of the activity in terms of the appropriate International System of Units (SI) (e.g. Becquerel, Terabecquerel, etc.) contained in each shipping package and the name of each radionuclide in each shipping package in accordance with 49 CFR Part 172.203(d)(1) and (4).
 - d. That the standard HLW did not exceed 400°C after initial cooldown to ensure the glass transition temperature was not exceeded.
7. Producer shall provide annual reports of waste generation and projections of quantities of vitrified HLW requiring disposal.

3.6.1.3.7.2 Canistered DOE SNF

The following acceptance criteria are for canistered DOE SNF. Upon request from EM, and approval by RW, DOE SNF may be accepted as bare fuel. The specific acceptance criteria for this bare fuel will be developed on a case by case basis.

Characteristics and amounts of the different types of DOE SNF are extracted from the EM Integrated Spent Nuclear Fuel Database System (ISNFDS). The DOE SNF inventory projected to the year 2035 totals approximately 2720 MTHM. Table 3-5 contains a list of DOE SNF inventory projected for repository disposal. This inventory includes SNF owned or managed by the DOE and the Department of Navy. As a planning base, 2333 MTHM of DOE SNF will be allocated for disposal in the first repository.

Table 3-5. DOE SNF Types and Amount

SNF Type Group	Representative SNF Type	Mass of Heavy Metal (MTHM)	Volume (cubic meters)
Uranium Metal Matrix, Zirconium Clad	N-Reactor SNF	2102	206
Uranium Metal Matrix, Aluminum Clad	Single Pass Reactor SNF	18	3
Uranium Oxide Matrix, Zirconium Clad	Commercial SNF	99	58
Uranium-Thorium Oxide Matrix, Zirconium Clad	Shippingport Light Water Breeder Reactor SNF	39	52
Uranium-Thorium Oxide Matrix, Stainless Steel Clad	Pathfinder SNF	8	4
Uranium Oxide Matrix, Failed Clad or Declad	Three Mile Island Core 2 Debris	83	148
Naval Propulsion Reactor SNF	Naval SNF	65	888
Uranium Oxide Matrix, Ceramic	Power Burst Facility Driver Core	1	2
Uranium Molybdenum Matrix, Zirconium Clad	Fermi Core	4	1
Uranium Aluminum Matrix, Aluminum Clad	Advanced Test Reactor SNF, Research Reactor SNF	23	234
Uranium-Carbide/ Thorium-Carbide Matrix, Graphite Clad	Fort St Vrain SNF, Peachbottom SNF	26	233
Mixed Oxide Matrix	Fast Flux Test Reactor SNF	12	35
Uranium-Zirconium Hydride Matrix	Training Reactor, Isotopics, General Atomics (TRIGA)	2	8
Misc SNF not Previously Listed	Misc. one-of-a-kind SNF	28	29
Total		2509^{a,b}	1901^{a,b}

a Total does not include Metallic Sodium Bonded (Experimental Breeder Reactor (EBR)-II SNF, Fermi Blanket), 60 MTHM/27 m³ and Canyon Stabilization with EM Record of Decision (Savannah River Site Driver Fuel & Targets, EBR II Targets), 151 MTHM/97 m³, which are candidate fuels for treatment or processing prior to disposal.

b Totals may not sum due to rounding.

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- A. Transportation and Storage Certification - The cask/canister used for delivery of DOE SNF shall be NRC-approved for transportation under 10 CFR Part 71, and NRC-approved for storage under 10 CFR Part 72 (if storage is needed). The DOE SNF storage system and equipment shall be licensed for use at the CRWMS storage facility. Ancillary equipment and hardware and special tools and fixtures necessary to handle and transfer loaded canisters and storage modules at the CRWMS facility shall be proven concepts utilized at a facility regulated by NRC under 10 CFR Part 50 or 10 CFR Part 72.
- B. Disposal Criteria - DOE SNF shall support overall repository performance requirements by meeting all acceptance criteria for the specific fuel grouping as bounded in the Viability Assessment Design and as specified in the License Application. Failure to comply with these criteria may result in the need for the Custodian to modify or repackage the DOE SNF.
- C. Canister Specifications (e.g., dimensions, weight, etc.) (TBV 4)
1. The canistered DOE SNF shall be standardized to accommodate waste package design.
 2. Canister maximum length: (TBV 4)
Canister maximum diameter: (TBV 4)
 3. The maximum weight of a loaded DOE SNF canister, fully loaded in its overpack, shall not exceed 130 tons.
- D. Radiation Protection Criteria - The canistered DOE SNF shall not exceed a maximum gamma-ray dose rate of 10^5 rem per hour and a maximum neutron dose rate of 10 rem per hour at a distance of 1 meter from any accessible surface without intervening shielding at the time of acceptance. (TBV 10)
- E. Physical Protection (10 CFR Part 73) Exemption for High External Radiation Dose Rate - The canister shall have a total external dose rate in excess of 100 rem per hour at a distance of 3 feet (~ 0.9 meter) from any accessible surface without intervening shielding at the time of acceptance. NNPP SNF is exempt from this requirement. Other forms with a total external dose rate less than the above will be addressed on a case by case basis. (TBV 11)
- F. Thermal Considerations - After packaging for disposal, the thermal output of the canistered DOE SNF shall be such that the total disposal package does not exceed a thermal output of 14.2 kilowatts⁷ (TBV 5) at the time of acceptance.
- G. Canister Impact Characteristics - Requirements shall be allocated to the handling facility, barriers, transfer cell and canister to protect the safety of the work force and the public. Canisters shall be evaluated on a case by case basis.

⁷ This value will need to be reevaluated for compatibility with CRWMS waste package design and repository loading scenarios.

H. Canister Handling

1. Handling equipment design shall be provided suitable for use in loading or unloading the canistered DOE SNF (as handled at the repository) from a transportation cask or waste package.
 2. The handling equipment shall comply with applicable regulatory guidelines and national standards, such as Nuclear Regulatory Commission NUREG 0612 and American National Standards Institute (ANSI) N14.6 for lifting/handling devices.
 3. The handling equipment shall be capable of:
 - a. moving the canistered DOE SNF in the vertical direction when attached to the hoist and engaged.
 - b. engaging remotely with and disengaging remotely from the canistered DOE SNF.
 - c. engaging or disengaging while remaining within the projected perimeter of the canistered DOE SNF.
 - d. preventing with appropriate design features inadvertent release of a suspended canistered DOE SNF (not disengage under load).
 - e. allowing confirmation of engagement prior to lifting.
 4. A means shall be provided for lifting a canister after the lids and all SNF assemblies have been removed.
- I. Tamper-Safe and Inspection - Canistered DOE SNF (DPCs or MPCs) shall be designed to permit use of a tamper-safe seal as provided in 10 CFR Part 70.51(e)(1)(I) for safeguards purposes. It must be designed such that the integrity of the weld or tamper-indicating devices may be inspected periodically.

J. Reporting Requirements

1. EM, as the cognizant organization within DOE for DOE SNF management, shall produce specifications, which demonstrate compliance with CRWMS acceptance criteria.
2. Final Description of DOE SNF - Except as otherwise agreed to by RW, the Custodian shall describe in writing the material in each shipping lot eighteen (18) months prior to the scheduled transportation of that shipping lot.
3. Shipping Records for DOE SNF - The Custodian shall provide written documentation and certification:
 - a. Of cask conditions and contents prior to transfer to the receiving party.

- b. That the transportation cask subsystem has been packaged to meet DOE, DOT, and NRC requirements and to transfer care, custody and control of the shipment.
- c. Of the activity in terms of the appropriate SI units (e.g. Becquerel, Terabecquerel, etc.) contained in each shipping package and the name of each radionuclide in each shipping package in accordance with 49 CFR Part 172.203(d)(1) and (4).

3.6.1.4 Waste Acceptance and Transportation - Government Agency Interface Requirements

Waste Acceptance and Transportation shall interface with appropriate federal, state, tribal, and local government agencies to meet legal, regulatory and operational requirements for acceptance and transportation of SNF and HLW, such as route selection, approval, scheduling and notification, emergency planning and response, and security.

3.6.1.5 MGR External Interface Requirements

MGR shall interface with appropriate federal, state, tribal, and local government agencies to meet legal, regulatory and operational requirements for emplacement and isolation of waste, such as scheduling, permitting, notifications, emergency planning and response, and security.

3.6.1.6 CISF External Interface Requirements (if CISF approved)

CISF shall interface with appropriate federal, state, tribal, and local government agencies to meet legal, regulatory and operational requirements for storage of waste, such as scheduling, notifications, emergency planning and response, and security.

3.6.2 System-Level Interface Requirements

This section describes interface requirements between CRWMS Elements.

Assumptions developed during design of Element SSCs shall be reviewed and agreed upon by other elements if they impact inter-element interfaces.

3.6.2.1 Waste Acceptance and Transportation - MGR Interface Requirements

This section identifies the interface requirements between Waste Acceptance and Transportation and MGR regarding the receipt, unloading, and return of transportation casks.

- A. Transportation equipment and the MGR site roads, railways, queuing points, and the site layout shall be physically and functionally compatible to accommodate movement of transporters, consistent with the expected cask receipt and return rates necessary to meet requirements in Section 3.2.1.B.
- B. Transportation equipment and the MGR equipment shall be physically and functionally compatible to accommodate required handling functions consistent with the expected cask

receipt and return rates.

- C. Waste Acceptance and Transportation and MGR shall coordinate to provide for radiological surveys, decontamination, and security inspections of transportation equipment upon arrival at the MGR.
- D. Waste Acceptance and Transportation and MGR shall coordinate to provide for radiological surveys, decontamination, inspection, and testing of transportation equipment prior to departure from the MGR.
- E. Waste Acceptance and Transportation shall exchange technical, planning and operational information with the MGR to facilitate receipt, handling, and return of transportation equipment.
- F. Waste Acceptance and Transportation and MGR communications equipment shall be compatible and provide for necessary communication between the elements.
- G. Waste Acceptance and Transportation and MGR information systems shall provide for necessary data exchange between the elements.
- H. MGR shall have the capability to perform incidental transportation cask maintenance necessary to support cask receipt and return rates.
- I. Waste Acceptance and Transportation and MGR shall exchange technical, planning and operational information to ensure waste is accepted into the system and delivered to the MGR in accordance with emplacement and isolation capabilities.

3.6.2.2 Waste Acceptance and Transportation - CISF Interface Requirements (if approved)

This section identifies the interface requirements between Waste Acceptance and Transportation and CISF.

- A. Transportation equipment and the CISF site roads, railways, queuing points, and the site layout shall be physically and functionally compatible to accommodate movement of transporters, consistent with the expected cask receipt and return rates necessary to meet requirements in Section 3.2.1.B.
- B. Transportation equipment and the CISF equipment shall be physically and functionally compatible to accommodate required handling functions consistent with the expected cask receipt and return rates.
- C. Waste Acceptance and Transportation and CISF shall coordinate to provide for radiological surveys, decontamination, and security inspections of transportation equipment upon arrival at the CISF.
- D. Waste Acceptance and Transportation and CISF shall coordinate to provide for radiological

surveys, decontamination, inspection, and testing of transportation equipment prior to departure from the CISF.

- E. Waste Acceptance and Transportation shall exchange technical, planning and operational information with the CISF to facilitate receipt, handling, and return of transportation equipment.
- F. Waste Acceptance and Transportation and CISF communications equipment shall be compatible and provide for necessary communication between the elements.
- G. Waste Acceptance and Transportation and CISF information systems shall provide for necessary data exchange between the elements.
- H. CISF shall have the capability to perform incidental cask maintenance necessary to support cask receipt and return rates.
- I. Waste Acceptance and Transportation and CISF shall exchange technical, planning and operational information to ensure waste is accepted into the system and delivered to the CISF in accordance with interim storage capabilities.

3.6.2.3 MGR - CISF Interface Requirements (if CISF approved)

This section identifies the interface requirements between MGR and CISF.

- A. MGR and CISF communications equipment shall be compatible and provide for necessary communication between the elements.
- B. MGR and CISF information systems shall provide for necessary data exchange between the elements.

APPENDIX A. FUNCTION DEFINITION

This Appendix provides definition of the functions which are depicted in Figure 1-1. These definitions are not requirements but represent the essential functions which must be performed in order for the CRWMS to accomplish its mission.

A.1 Dispose of Waste Function

Manage and dispose of the nation's SNF and HLW by conducting any physical activity, operation, or process required to accept, transport, store in a CISF (if approved), and emplace and isolate SNF and HLW in a geologic repository in a timely manner, and in a manner that protects the health and safety of the public and of workers and the quality of the environment.

A.1.1 Accept and Transport Waste Function

This function includes the acceptance by RW of loaded casks for transport, the movement of loaded and unloaded casks between Purchaser/Producer/Custodian sites and retrieval from DOE CRWMS facilities, and the movement of loaded and unloaded casks between DOE CRWMS facilities. NNPP shall deliver NNPP SNF to the RW facility.

Based on final delivery schedules and waste form descriptions, develop and distribute campaign plans, to affected parties that identify shipping schedules, equipment requirements, technical support requirements, operations contingencies, transport mode requirements, and advance preparations requirements. Whenever external factors or variances change the existing campaign plans, reinitiate planning. Reissue revised plans and coordinate with those affected. Provide technical assistance and funding for training public safety officials of local governments and Indian Tribes through whose jurisdiction SNF and HLW will be shipped. Provide for the receipt, organization, storage, and dissemination of CRWMS operational, MC&A and other waste information.

Provide operational, logistical, and administrative support for operating and maintaining the transportation system. Receive, transport and deliver transportation cask subsystems and ancillary equipment to support acceptance and transportation of SNF and HLW. Receive transportation cask subsystems (including canisters) from cask fabricators for transport in accordance with DOT and NRC regulations. Check the cask system readiness (evidence of CoC for new cask subsystems), prepare the cask subsystem for shipment, including inspection, certification of condition and documentation, and transfer of responsibility for shipment.

Move the unloaded and new cask subsystems and ancillary equipment to Purchaser/Producer/Custodian sites. Prior to transfer of title and/or responsibility and custody, ensure acceptability of the waste form for transportation, storage and emplacement, and resolve any identified discrepancy between the description of the waste provided in documentation and the actual contents of the transportation cask with the Purchaser/Producer/Custodian. Provide technical support for cask and canister loading operations, including assistance as requested to Purchaser/Producer/Custodian in cask and canister handling and loading, use of site-specific equipment needed in the shipping campaign, training of personnel in cask loading and waste safeguards verification operations and in providing technical advice and assistance to Purchasers/Producers during cask and canister handling, loading, and preparation for

shipment. Transfer documents between the Purchaser/Producer/Custodian and RW at the time of acceptance. Provide loading, acceptance and shipping phase conformance and safeguards verification. Confirm completeness and compliance, accept title and/or responsibility and custody to waste, and release for transportation. Inspect the loaded cask documentation to ensure compliance with regulatory requirements. Brief the transporter crew and escorts, and confirm compliance with regulatory requirements. Certify that the shipment is in proper condition for transportation, and provide required documentation to the carrier crew. Receive carrier acknowledgment of transfer of responsibility for the shipment by carrier signing the bill of lading.

Provide physical containment of waste in a manner that meets the requirements of the NRC CoC. Transport the loaded cask subsystem from the Purchaser/Producer/Custodian site to a CRWMS site (or between CRWMS sites). Issue appropriate notices to appropriate Federal, State, and Tribal authorities, and shipping and receiving activities, in accordance with the operational procedures, campaign plans, and coordinated schedules. Monitor and provide direction for the operators of cask subsystem equipment while it is engaged in physically transporting SNF/HLW. Support transportation operations with training, technical assistance, in-transit maintenance, and assistance in recovering an in-transit cask system in the event of an incident/accident. Monitor progress reports of shipments and develop system status metrics. Maintain up-to-date system status information and projections.

Deliver the loaded cask to a CISF, the MGR, or other designated location. Conduct a physical inspection of the loaded cask and debrief the carrier crew upon arrival at the designated site. Deliver the shipping document package to the consignee, along with any supplemental documentation provided by the shipper and transfer responsibility for the loaded cask to the consignee. Provide for service if a vehicle or transporter requires repair, as identified during the debrief.

Provide utilities and services in support of waste acceptance and transportation operations. Provide general protective services and safeguarding of nuclear materials and security of non-nuclear assets to ensure the safety and security of personnel, materials, and operations during transportation operations under both normal and off-normal conditions. Define, collect, process, and disseminate information on acceptance and transportation operations. Provide for the central collection, storage and dissemination of CRWMS operational records. Manage the inventory of transportation equipment, including the casks, canisters, transporters, ancillary equipment, special tools and fixtures, spare parts and consumable supplies that are used in performance of transportation functions. Provide general administrative support for the transportation system, including, but not limited to, records maintenance, engineering, human resources, training, procurement, public relations, and financial accounting. Collect, store, sort, treat, package, and dispose of the wastes that are generated during transportation operations. Maintain transportation operating facilities. Operate equipment, buildings, and utilities. Provide facilities and equipment to support a QA program which is required for all transportation system quality affecting work.

Decontaminate equipment and prepare for its disposal. Decontaminate and demolish facilities and reclaim site.

A.1.2 Store Waste Function (if approved)

This function includes the storage of SNF/HLW in a manner that protects the health and safety of the public and maintains the quality of the environment, with the intent to retrieve the SNF/HLW for disposal.

Handle both truck and rail shipments of SNF/HLW which may arrive canistered or uncanistered in transportation casks. Transfer casks from incoming vehicles to site handling vehicles and decontaminate and inspect the external surfaces of the casks and associated vehicles. Provide on-site lag storage of shipping casks, both loaded and unloaded. Prepare the SNF/HLW for storage, transfer the SNF/HLW to its interim storage location, retrieve the SNF/HLW from interim storage, and prepare the SNF or HLW for transport for permanent disposal. Place uncanistered SNF in canisters prior to storage. Provide for handling abnormal conditions, if encountered during these processes. Store the SNF /HLW in an environment designed to prevent its degradation. Monitor the status of the waste to ensure that its safe condition is maintained.

Provide operational, logistical, and administrative support for operating, maintaining, and decommissioning the CISF. Define, collect, process, and disseminate information on storage operations. Provide utilities and services, including, but not limited to, communication, water, power, illumination, emergency medical treatment, fire protection, radiological protection, environmental monitoring, and on-site transportation in support of CISF operations. Provide general protective services and safeguarding of nuclear materials and security of non-nuclear assets to ensure the safety and security of personnel, materials, and operations at the CISF under both normal and off-normal conditions. Provide general administrative support to storage, including, but not limited to, records maintenance, engineering, human resources, training, procurement, public relations, and financial accounting. Prepare and dispose of all forms of wastes that are generated at the CISF. Collect, store, sort, treat, package, and dispose of the wastes generated. Maintain CISF operating facilities. Provide facilities and equipment to support a QA program which is required for all CISF quality affecting work. Receive, interpret, and distribute external direction (permits, regulations, procedures, etc.) to all Store Waste functions for implementation. Support the operations and maintenance of the CISF.

A.1.3 Emplace and Isolate Waste Function

This function includes emplacing SNF and HLW in a geologic medium and isolating such wastes from the accessible environment.

Operate surface and subsurface facilities to handle radioactive wastes (including receiving, preparing, transferring, temporarily storing, emplacing, and retrieving [if required] radioactive wastes), and provide operational, logistical, and administrative support for operating and maintaining the MGR (including, but not limited to supplying utilities and services, security, QA, and administration). Define, collect, process, and disseminate information on emplacement and isolation operations. Continue and complete the development of underground openings necessary for the successful operation of the MGR. Confine the waste in a disposal container and limit release from the container. Prepare and dispose of hazardous and mixed waste off-site.

Inhibit transport of radionuclides to the accessible environment so that amounts and concentrations of these materials are kept within prescribed limits.

Estimate the ability of the repository system to comply with regulations governing its preclosure and postclosure performance objectives and its effects on the environment; update compliance documents and support continuing development of the system; and conduct performance confirmation and environmental monitoring programs to supply data for estimates. Assess need for postclosure monitoring.

Permanently close the subsurface MGR to human access. At closure, remove subsurface equipment; backfill subsurface openings and boreholes; and seal shafts, ramps and boreholes. Backfilling may include all or part of the underground facility (i.e., emplacement drifts) if deemed necessary by analysis and authorized by the license. Permanently remove surface facilities and components necessary only for preclosure operations from service after repository closure, in accordance with regulatory requirements and environment policies. Decontaminate, dismantle, and remove facilities and reclaim the site. Establish institutional controls for restricting access and avoiding disturbance to the MGR controlled area and minimize or prevent intentional and unintentional activities in and around the MGR that could breach the barrier systems. Restore the MGR site to an acceptable condition that requires minimal on-going maintenance. (This does not preclude partial backfilling before permanent closure.)

APPENDIX B. DEFINITIONS

B.1 GLOSSARY

This section provides definitions of key terms used in the CRD. These definitions are not requirements but are provided to ensure consistency when describing the CRWMS and its requirements.

Acceptance, as used in this document, 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.

Architecture is the physical system to be built, found, or selected to perform a function subject to its stated requirements.

As low as is reasonably achievable (ALARA) means making every reasonable effort to maintain exposures to radiation as far below the dose limits in 10 CFR Part 20 as is practical consistent with the purpose for which the licensed activity is undertaken, taking into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and licensed materials in the public interest. (As defined in 10 CFR Part 20.1003.)

Blending is (1) selecting SNF assemblies of different characteristics for inclusion in an MPC, transportation cask, storage mode, or waste package, or (2) selecting HLW of different characteristics for inclusion in a transportation cask or waste package to meet design goals.

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

Campaign is the activities required to prepare for and execute a consecutive set of shipments from a given shipping (originating) site over a fixed period of time.

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 purpose: (1) for solidified HLW, its purpose is a pour mold and (2) for SNF, it may provide structural support for intact SNF, loose rods, nonfuel components, or confinement of radionuclides.

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:

1. **Single-Purpose Casks** - These transportation casks are primarily intended for transporting uncanistered, standard and nonstandard SNF from Purchaser/Custodian sites to a CRWMS site.
2. **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.
3. **Transportable Storage Casks (TSCs)** - These transportation casks are for storing uncanistered SNF at Purchaser sites, transporting SNF from Purchaser sites to CRWMS facilities, and storing SNF at the CISF.
4. **HLW Casks** - These transportation casks are for transporting commercial and defense HLW from Producer sites to the MGR.
5. **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.

Centralized Interim Storage Facility (CISF) is a federally licensed facility for acceptance of spent nuclear fuel and high-level nuclear waste from owners and generators for temporary storage prior to permanent disposal in a repository. It will be designed, constructed, and operated for the receipt, transfer, handling, packaging, possession, safeguarding, and storage of SNF pending shipment to MGR for disposal. A CISF requires an Act of Congress.

Certificate of Compliance (CoC) is a certificate approving for use, with identified limitations, a specific packaging for quantities of radioactive materials exceeding A1/A2 quantities as defined in 10 CFR Part 71 and 49 CFR Part 173. As used in this document, CoC refers to a certificate issued by the NRC. (As defined in DOE Order 1540.3 Section 4.a.)

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 spent nuclear fuel and high-level radioactive waste disposal.

Commercial High Level Radioactive Waste (CHLW) is the high-level radioactive waste, as defined by NWPA 42USC10101(12), resulting from reprocessing spent nuclear fuel in a commercial facility.

Commercial Spent Nuclear Fuel is SNF resulting from operation of a commercial nuclear power reactor. Specifically in this document, SNF includes (1) intact, non-defective fuel assemblies; (2) failed fuel assemblies in canisters; (3) fuel assemblies in canisters; (4) consolidated fuel rods in canisters; (5) nonfuel components inserted in PWR fuel assemblies, including, but not limited to, control rod assemblies, burnable poison assemblies, thimble plug assemblies, neutron source assemblies, and instrumentation assemblies; (6) fuel channels attached to BWR fuel assemblies; and (7) nonfuel components and structural parts of assemblies in canisters.

Conformance Verification is the process used to demonstrate that DOE SNF and/or HLW are in accordance with CRWMS acceptance criteria.

Configuration Item is an aggregation of hardware, software, or any of its discrete components that satisfies individual physical, functional and/or interface characteristics and is controlled by configuration management as a distinct item. CIs may vary widely in complexity, size, and type. CIs are those items or activities whose performance parameters and physical characteristics are separately controlled and defined to achieve the overall end use function and performance during design and development, procurement, manufacturing, testing, and installation.

Container is the component of the waste package that is placed around the waste form or the canistered waste form.

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

Controlled area or controlled use area means an area, outside of a restricted area but inside the site boundary, access to which can be limited by the licensee for any reason. (As defined in 10 CFR Part 20.1003.)

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

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

Preclosure controlled area means that surface area surrounding the geologic repository operations area for which the licensee exercises authority over its use, in accordance with the provisions of this part, until permanent closure has been completed.

Custodian means any government agency which possesses spent nuclear fuel which is a candidate for disposal in the CRWMS.

Decommission means to remove safely from service and reduce residual radioactivity to a level that permits: for land or facilities, release of the property for unrestricted use and termination of license (for the repository, some restrictions on use of the area above the repository will apply); and for casks, release of the cask for appropriate disposal. (As defined in 10 CFR Part 72.3.)

Defense high-level radioactive waste (DEHLW) is the high-level radioactive waste, as defined by NWSA 42USC10101(12), resulting from reprocessing spent nuclear fuel in a defense facility.

Disposal is the isolation of radioactive wastes from the accessible environment. (As defined in 10 CFR Part 60.2.) Disposal means the emplacement of high-level radioactive waste, spent nuclear fuel, or

other highly radioactive material in a repository with no foreseeable intent of recovery, whether or not such emplacement permits the recovery of such waste. (As defined in 10 CFR Part 961.11 and NWPA 42USC10101(9))

Disposal system is any combination of engineered and natural barriers that isolate spent nuclear fuel or radioactive waste after disposal.

Dispose of means the sum of the functions performed by the CRWMS to accept, transport, store and emplace and isolate waste.

DOE-owned spent nuclear fuel (DOE SNF) is SNF that is currently managed by DOE, 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, naval fuel, and some fuel from commercial power reactors. The inventory of DOE SNF projected to the year 2035 is provided in Table 3-5 in this document.

DOE/NRC Form-741 is a Nuclear Material Transaction Report and is completed whenever SNF or HLW is transferred or received. [10 CFR Parts 75.31, .33, .35]

DOE/NRC Form-742 is a Material Balance Report and when completed documents the quantities of SNF and/or HLW contained at an installation as of the initial inventory reporting date. [10 CFR Parts 75.31, .32, .33, .35]

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.

Geologic repository is a system that is intended to be used for, or may be used for, the disposal of radioactive wastes in excavated geologic media. A geologic repository includes: (1) the geologic repository operations area, and (2) the portion of the geologic setting that provides isolation of the radioactive waste. (As defined in 10 CFR Part 60.2.)

Geologic repository operations area (GROA) is a high-level radioactive waste facility that is part of a geologic repository, including both surface and subsurface areas, where waste handling activities are conducted. (As defined in 10 CFR Part 60.2.)

Glass transition temperature is the temperature at which, upon heating, the glass transforms from a rigid solid to a viscous liquid. This temperature corresponds to glass viscosity of approximately 10^{13} poise, and is less than 500°C, for most, if not all, borosilicate glass.

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

and (2) other highly radioactive material that the Nuclear Regulatory Commission, consistent with existing law, determines by rule requires permanent isolation. The CRWMS will only accept solidified HLW. For the purposes of this document, HLW is vitrified borosilicate glass cast in a stainless steel canister. (As defined in NWSA 42USC10101(12), 10 CFR Part 72.3, 10 CFR Part 960.2, 10 CFR Part 961.11. (Note that the 10 CFR Part 60 definition of HLW includes SNF. See definitions of commercial HLW and defense HLW.))

(Items) Important to safety with reference to structures, systems, and components, means those engineered features of the repository whose function is: (1) To provide reasonable assurance that high-level waste can be received, handled, packaged, stored, emplaced, and retrieved without exceeding the requirements of 10 CFR Part 60.111(a) for Category 1 design basis events; or (2) To prevent or mitigate Category 2 design basis events that could result in doses equal to or greater than the values specified in 10 CFR Part 60.136 to any individual located on or beyond any point on the boundary of the preclosure controlled area.

(Items) Important to waste isolation means the natural and engineered barriers that are relied on for achieving the postclosure performance objectives in 10 CFR Part 60 Subpart E.

Institutional barrier system consists of the active and passive institutional controls.

Active institutional controls include: (1) Controlling access to MGR by any means other than passive institutional controls; (2) Controlling or cleaning up release from a site; (3) Monitoring parameters related to disposal system performance; or (4) Performing maintenance operations or remedial actions at a site.

Passive institutional controls include: (1) Permanent markers placed at a disposal site; (2) Public records and archives; (3) Government ownership and relationship and regulations regarding land or resource use, and (4) other means of preserving knowledge about the location, design, and contents of a disposal system.

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.

Isolation is inhibiting the transport of radioactive material so that amounts and concentrations of this material entering the accessible environment will be kept within prescribed limits. (As defined in 10 CFR Part 60.2.)

Licensee is a person who is authorized to conduct activities under a license or construction permit issued by the Nuclear Regulatory Commission. (As defined in 10 CFR Part 2.4.)

Metric Tons Heavy Metal (MTHM), as used in this document, refers to the quantity of heavy metal as used in NWSA, or equivalent.

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

Nonconforming waste - HLW and/or DOE SNF that does not meet the applicable requirements in Sections 3.6.1.3.6 and 3.6.1.3.7.

Nonstandard waste is nonconforming HLW and/or DOE SNF that has been reviewed and deemed acceptable into the CRWMS. Nonstandard waste may also be in a condition which requires special handling. This general definition is specifically applied to HLW and SNF in this requirements document.

Overpack is a structural component used to hold and protect the MPC so that the combination meets the NRC requirements for its application. There are several types of overpacks: one for transportation, 10 CFR Part 71; one for transfer, 10 CFR Part 72; one for storage, 10 CFR Part 72; and one for disposal, 10 CFR Part 60. An overpack is designed for its particular use in conjunction with the MPC.

Owner is any person who has title and/or responsibility and custody to spent nuclear fuel or high-level radioactive waste. (As defined in 10 CFR Part 961.3.)

Package is the packaging together with its radioactive contents as presented for transport. (As defined in 10 CFR Part 71.4.)

Packaging is the assembly of components necessary to ensure compliance with packaging requirements of 10 CFR Part 71. It may consist of one or more receptacles, absorbent materials, spacing structures, thermal insulation, radiation shielding, and devices for cooling or absorbing mechanical shocks. The vehicle, tie-down system, and auxiliary equipment may be designated as part of the packaging. (As defined in 10 CFR Part 71.4.)

Performance Requirement means a defined capability the CRWMS or one of its elements must have to accomplish its allocated functions.

Person means: (1) Any individual, corporation, partnership, firm, association, trust, estate, public or private institution, group, Government agency other than the NRC or the DOE, and State or any political subdivision of or any political entity within a State, any foreign government or nation or any political subdivision of any such government or nation, or other entity; and (2) Any legal successor, representative, agent, or agency of the foregoing. (As defined in 10 CFR Part 20.1003.)

Physical system means the CRWMS consisting of the composite of the sites, and all facilities, systems, equipment, materials, information, activities, and the personnel required to perform those activities necessary to Dispose of Waste.

Producer is any generator of high-level radioactive waste 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, WVDP, which has commercial HLW, will be considered a "Producer" only when an acceptance and disposal contract is executed.

Product Consistency Test is a test developed to determine the composition and homogeneity of complex and varied radioactive waste glasses. [Ref. ASTM C-1285-94]

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

Purchaser is any person, other than a Federal agency, who is licensed by the NRC to use a utilization or production facility under the authority of Sections 103 or 104 of the Atomic Energy Act of 1954 (42USC2133, 2134), or who has title to SNF or HLW and who has executed a contract or other contractual agreement with DOE. Purchaser SNF includes Government-owned SNF from commercial industry and civilian development programs for which fees have been paid under the Standard Contract, 10 CFR Part 961.

Repository is synonymous with geologic repository.

Requirement is a qualitative or quantitative statement of how well a function must be performed.

Safeguards Verification is the process used to demonstrate that for all special nuclear material (as defined in 10 CFR Part 70), appropriate safeguards are in place.

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

Site characterization means the program of exploration and research, both in the laboratory and in the field, undertaken to establish the geologic conditions and the ranges of those parameters of a particular site relevant to the procedures under 10 CFR Part 60. Site characterization includes borings, surface excavations, excavation of exploratory shafts, limited subsurface lateral excavations and borings, and in situ testing at depth needed to determine the suitability of the site for a geologic repository, but does not include preliminary borings and geophysical testing needed to decide whether site characterization should be undertaken. (As defined in 10 CFR Part 60.2.)

Special nuclear material means (1) plutonium, uranium 233, uranium enriched in the isotope 233 or in the isotope 235, and any other material that the NRC, pursuant to the provisions of Section 51 of the Atomic Energy Act of 1954 as amended, determines to be special nuclear material, but does not include source material; or (2) any material artificially enriched by any of the foregoing but does not include source material. (As defined in 10 CFR Part 70.4.)

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. (As defined in NWPA 42USC10101(23) and 10 CFR Part 961.11.)

Standard waste is HLW and/or DOE SNF that meets the physical characteristics specified in this requirements document as standard. Other standard HLW forms will be defined in subsequent revisions of the CRD. This general definition is specifically applied to HLW and SNF in this requirements document.

Storage and Shipping Records are the documents that describe the physical attributes of the canistered waste forms. The records also identify any unexpected events, such as thermal excursions, which have occurred during storage.

Structures, Systems, and Components, or SSC, is a general term that means the standard English definition of those individual words. In this document, if and when an SSC is used in a way that requires any qualification, such as important to safety or important to waste isolation, that qualifier will also be provided.

System element is one of the three major configuration items which are required to accomplish the functions of the CRWMS. The three system elements are Waste Acceptance and Transportation, CISF 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 or Waste Acceptance, Storage and Transportation (WAST) 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.

Time-temperature-transformation diagrams identify the duration of exposure at any temperature that causes significant changes in either the phase structure, the phase compositions, or the PCT response of the borosilicate glass waste type.

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

To Be Published (TBP) is used to identify memoranda that are yet to be published.

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 spent nuclear fuel and/or high-level radioactive waste that meets all applicable regulatory requirements.

Transportation cask segment, as a minimum, includes the complete cask, canister (when required), truck trailer or rail car (defined as the transporter), a tie down system, an intermodal transfer device (when required), special tools and ancillary equipment.

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

Unrestricted area for the MGR means any area, access to which is not controlled by the licensee for the purposes of protection of individuals from exposure to radiation and radioactive materials, and any area used for residential quarters.

Validation is the process whereby data submitted is checked for legibility, reproducibility, completeness, arithmetical correctness and consistency. It is meant to distinguish this process from verifying the data, which implies an auditing process. In the case of data validation, the data will be required to be submitted under an NRC-approved QA program, and thus verification will not be

necessary. However, validation will be performed to ensure that the data is complete and to limit the possibility for typographical errors.

Waste is SNF and HLW.

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

Waste form is the radioactive waste materials and any encapsulating or stabilizing matrix. A loaded MPC is a canistered waste form as defined in 10 CFR Part 60.2.

Waste Form Compliance Plan (WCP) is a document prepared by a waste producer describing planned analyses, tests, and engineering development work to be undertaken and information to be included in individual waste form production records to demonstrate compliance of a proposed waste form with waste acceptance specifications.

Waste Form Qualification Report (WQR) is documentation prepared by a waste producer which describes results of analyses, tests, and engineering development work actually performed to demonstrate waste form compliance with waste acceptance specifications.

Waste handling activities include receipt of waste, preparation of waste for storage or disposal, transfer of waste from one cask to another or to its place of emplacement, emplacement of waste, and retrieval of waste.

Waste package is the waste form and any containers, shielding, packing, and other absorbent materials immediately surrounding an individual waste container. (As defined in 10 CFR Part 60.2.)

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B.2 ACRONYMS AND ABBREVIATIONS

This section provides a listing of acronyms and abbreviations used in the CRD, along with their definitions.

ALARA	As low as is reasonably achievable
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
BWR	Boiling Water Reactor
CFR	Code of Federal Regulations
CHLW	Commercial High-Level Radioactive Waste
CI	Configuration Item
CISF	Centralized Interim Storage Facility
CoC	Certificate of Compliance
CRD	CRWMS Requirements Document
CRWMS	Civilian Radioactive Waste Management System
DCS	Delivery Commitment Schedule
DHLW	Defense High-Level Radioactive Waste
DOE	U.S. Department of Energy
DOE/NR	DOE/Office of Naval Reactors
DOT	U.S. Department of Transportation
DPC	Dual Purpose Canister
EM	DOE/Office of Environmental Management
EPA	U.S. Environmental Protection Agency
FDS	Final Delivery Schedule
HLW	High Level Radioactive Waste
IAEA	International Atomic Energy Agency
INEEL	Idaho National Engineering and Environmental Laboratory
ISNFDS	Integrated Spent Nuclear Fuel Database System
MC&A	Material Control & Accounting
MGR	Monitored Geologic Repository
MOA	Memorandum of Agreement
MPC	Multi Purpose Canister
MTHM	Metric Tons Heavy Metal
NNPP	Naval Nuclear Propulsion Program
NRC	Nuclear Regulatory Commission
NUREG	Nuclear Regulatory Commission Technical report
NWPA	Nuclear Waste Policy Act of 1982
NWPAA	Nuclear Waste Policy Amendments Act of 1987
NYSERDA	New York State Energy Research and Development Authority
OCRWM	Office of Civilian Radioactive Waste Management
OWAST	Office of Waste Acceptance, Storage and Transportation
PL	Public Law
PWR	Pressurized Water Reactor
QA	Quality Assurance
QARD	Quality Assurance Requirements and Description

RCRA	Resource Conservation and Recovery Act
RW	Office of Civilian Radioactive Waste Management
SI	International System of Units
SNF	Spent Nuclear Fuel
SRS	Savannah River Site
SSC	Structure, System, and Component
STD	Standard
TBD	To Be Determined
TBP	To Be Published
TBV	To Be Verified
Trans	Transportation
TSC	Transportable Storage Cask
USC	United States Code
WCP	Waste Form Compliance Plan
WQR	Waste Form Qualification Report
WVDP	West Valley Demonstration Project
YMSCO	Yucca Mountain Site Characterization Office

APPENDIX C. POTENTIALLY APPLICABLE LAWS AND REGULATIONS

This Appendix identifies Laws, Statutes, U.S. Codes, Treaties, CFRs, Executive Orders, State and Local Codes and Regulations, and DOE Orders and other publications, not specifically called out in 3.1.1, which are potentially applicable to the design and development of the CRWMS system elements. Lower level requirements and design documents may include specific requirements from these sources or use them as the basis for requirements.

Code of Federal Regulations and Executive Orders

<u>Document Number</u>	<u>Document Title</u>
10 CFR Part 2	Rules of Practice for Domestic Licensing Proceedings and Issuance of Orders
10 CFR Part 19	Notices, Instructions and Reports to Workers: Inspection and Investigations
10 CFR Part 40	Domestic Licensing of Source Material
10 CFR Part 51	Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions
10 CFR Part 61	Licensing Requirements for Land Disposal of Radioactive Waste.
10 CFR Part 75	Safeguards on Nuclear Material-Implementation of US/IAEA Agreement
10 CFR Part 100	Reactor Site Criteria
10 CFR Part 707	Workplace Substance Abuse Programs at DOE Sites
10 CFR Part 830	Nuclear Safety Management
10 CFR Part 835	Occupational Radiation Protection
10 CFR Part 960	General Guidelines for the Recommendation of Sites for Nuclear Waste Repositories
10 CFR Part 1022	Compliance with Floodplain/Wetlands Environmental Review Requirements
29 CFR Part 1926	Safety and Health Regulations for Construction
29 CFR Part 1960	Basic Program Elements for Federal Employee Occupational Safety and Health Programs and Related Matters
33 CFR Part 323	Permits for Discharges of Dredged or Fill Material into Waters of the United States
33 CFR-Chapter I	Coast Guard Department of Transportation (Parts 1-199)
36 CFR Part 800	Protection of Historic and Cultural Properties
40 CFR Part 50	National Primary and Secondary Ambient Air Quality Standards
40 CFR Part 60	Standards of Performance for New Stationary Sources
40 CFR Part 61	National Emission Standards for Hazardous Air Pollutants
40 CFR Part 122	EPA Administered Permit Programs: The National Pollutant Discharge Elimination System
40 CFR Part 125	Criteria and Standards for the National Pollutant Discharge Elimination System
40 CFR Part 133	Secondary Treatment Regulation
40 CFR Part 136	Guidelines Establishing Test Procedures for the Analysis of Pollutants
40 CFR Part 141	National Primary Drinking Water Regulations
40 CFR Part 142	National Primary Drinking Water Regulations Implementation
40 CFR Part 143	National Secondary Drinking Water Regulations
40 CFR Part 144	Underground Injection Control Program

40 CFR Part 165	Regulations for the Acceptance of Certain Pesticides and Recommended Procedures for the Disposal and Storage of Pesticides and Pesticide Containers
40 CFR Part 191	Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes
40 CFR Part 204	Noise Emission Standards for Construction Equipment
40 CFR Part 205	Transportation Equipment Noise Emission Controls
40 CFR Part 241	Guidelines for the Land Disposal of Solid Wastes.
40 CFR Part 243	Guidelines for the Storage and Collection of Residential, Commercial, and Institutional Solid Waste
40 CFR Part 246	Source Separation for Materials Recovery Guidelines
40 CFR Part 257	Criteria for Classification of Solid Waste Disposal Facilities and Practices
40 CFR Part 260	Hazardous Waste Management System: General
40 CFR Part 261	Identification and Listing of Hazardous Waste
40 CFR Part 262	Standards Applicable to Generators of Hazardous Waste
40 CFR Part 263	Standards Applicable to Transporters of Hazardous Waste
40 CFR Part 265	Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR Part 268	Land Disposal Restrictions
40 CFR Part 280	Technical Standards and Corrective Action Requirements for Owners and Operators of Underground Storage Tanks (UST)
40 CFR Part 503	Standards for the Use or Disposal of Sewage Sludge
40 CFR Part 747	Metalworking Fluids
40 CFR Part 761	Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions
41 CFR Part 101	Federal Property Management Regulations
49 CFR Part 171	General Information, Regulations and Definitions
49 CFR Part 172	Hazardous Materials Table, Special Provisions, Hazardous Materials Communications Requirements and Emergency Response Information Requirements
49 CFR Part 173	Shippers--General Requirements for Shipments and Packagings
49 CFR Part 174	Carriage by Rail
49 CFR Part 176	Carriage by Vessel
49 CFR Part 177	Carriage by Public Highway
49 CFR Part 178	Shipping Container Specifications
49 CFR Part 180	Continuing Qualification and Maintenance of Packagings
49 CFR Part 392	Driving of Motor Vehicles
49 CFR Part 393	Parts and Accessories Necessary for Safe Operation
50 CFR Part 17	Endangered and Threatened Wildlife and Plants
50 CFR Part 402	Interagency Cooperation - Endangered Species Act of 1973, as Amended
Exec. Order 11988	Floodplain Management
Exec. Order 12344	Naval Nuclear Propulsion Program

Other Documents, Orders and Directives

<u>Document Number</u>	<u>Document Title</u>
AAR Rule 91	1993 Field Manual of Association of American Railroads Interchange Rules (AAR Interchange Rule 91, Weight Limitations)
BLM Manual, Sec. 9113	Bureau of Land Management Manual, Road Standards
DOE Order 151.1	Comprehensive Emergency Management System
DOE Order 200.1	Information Management Program
DOE Order 430.1	Life Cycle Asset Management
DOE Order 440.1	Worker Protection Management for DOE Federal and Contractor Employees
DOE Order 460.2	Departmental Materials Transportation and Packaging Management
DOE Order 3790.1B	Federal Employees Occupational Safety and Health Program (Chapter VIII only)
DOE Order 4330.4B	Maintenance Management Program
DOE Order 5000.3B	Occurrence Reporting and Processing of Operations Information
DOE Order 5300.1C	Telecommunications
DOE Order 5480.3	Safety Requirements for the Packaging and Transportation of Hazardous Materials, Hazardous Substances, and Hazardous Wastes
DOE Order 5480.4	Environmental Protection, Safety, and Health Protection Standards (Except for Attachment 2, Para. 2C, 2D(2)-(3), 2E(1)-(8), and Attachment 3, Para. 2C, 2D(2)-(3), 2E(1)-(7), which are canceled by DOE Order 440.1)
DOE Order 5480.7	Fire Protection
DOE Order 5632.1C	Protection Program Operation
DOE Order 6430.1A	General Design Criteria
DOE Order 1321.1	Civilian Radioactive Waste Management Facilities--Exemption from Departmental Directives
DOE/EA-0179	Environmental Assessment Waste Form Selection for Savannah River HLW
DOE/EH-0256T	DOE Radiological Control Manual
DOE/RW-0184	Characteristics of Potential Repository Wastes, Volumes 1-4
DOE/RW-0194P	Records Management Policies and Requirements
DOE/RW-0328P	Acceptance Priority Ranking
DOE/RW-0333P	OCRWM Quality Assurance Requirements and Description
DOE/RW-0457	1995 Acceptance Priority Ranking and Annual Capacity Report
DOE-STD-1020	Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities
DOE-STD-1021	Natural Phenomena Hazards Performance Categorization Criteria for Structures, Systems and Components
DOE-STD-1022	Natural Phenomena Hazards Site Characterization Criteria
DOE-STD-1023	Natural Phenomena Hazards Assessment Criteria (Draft)
DOE-STD-1024	Guidelines for Use of Probabilistic Seismic Hazard Curves at Department of Energy Sites

DOE-STD-1062	Ergonomic and Human Factors Design Criteria ⁸
Fed-Std-795	Uniform Federal Accessibility Standards
GSA-FSS-W-A-450/1-17	General Service Administration Interim Federal Specification
MOA DP/RW	Policy for Shipping Defense High-Level Waste (DHLW) to a Civilian Radioactive Waste Repository
MOA RW/NS	Nuclear Safety Requirement
MOU DOE/DOL	Mining Safety
NRC RG 1.13	NRC Regulatory Guide 1.13, Spent Fuel Storage Facility Design Basis
NRC RG 1.76	NRC Regulatory Guide 1.76, Design Basis Tornado for Nuclear Power Plants
NRC RG 8.8	Information Relevant to Ensuring That Occupational Radiation Exposure at Nuclear Power Stations Will Be As Low As Is Reasonably Achievable
NRC RG 8.10	Operating Philosophy for Maintaining Occupational Radiation Exposure As Low As Is Reasonably Achievable
NUREG 0700	Guidelines for Control Room Design Reviews
NUREG 0856	Final Technical Position on Documentation of Computer Codes for High-Level Waste Management
Presidential Memo (04/30/85)	Dispose of Defense Waste in a Commercial Repository

⁸ This standard is complete, but has not been formally published at this time. However, it is included here as a source, since it consists of a compilation of requirements from accepted sources. Those sources include CFRs, NUREGs, MIL-STDs, ANSI, NASA, and EPRI standards, and recognized design handbooks and guides that govern standard engineering practice

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