



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

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***CIVILIAN RADIOACTIVE WASTE MANAGEMENT  
SYSTEM REQUIREMENTS DOCUMENT (CRD)***

***DOE/RW-0406***

***Revision 7, ICN 0***

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Effective Date:

5/10/06

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<b>OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT PROGRAM  BASELINE CHANGE CONTROL BOARD  REVISION/CHANGE RECORD</b>			
<b>Document Number: DOE/RW-0406/A00000000-00811-1708-0003</b> <b>Document Title: Civilian Radioactive Waste Management System Requirements Document</b>			
<b>Rev/DCN Number &amp; Date</b>	<b>BCP Number</b>	<b>Revision/Change Description</b>	<b>Pages Affected</b>
Rev. 01 March 1994	BCP-00-94-0001	Incorporates the Multi-Purpose Canister (MPC) concept into the CRWMS technical baseline.	All
Rev. 01, DCN 01 May 1995	BCP-00-94-0005	Resolves issues needed for the procurement of the MPC system. Also incorporates the collocation of the Cask Maintenance Facility at the MGDS. Additional changes were made to address CAR HQ-93-031.	Misc.
Rev. 02 December 1995	BCP-00-94-0005	General revision to incorporate the Program Approach.	All
Rev. 02, DCN 01 June 1996	BCP-00-96-0002	Provides notice to users on MPC Policy Change, i.e., The CRWMS will accept and accommodate a variety of cask/canister systems for commercial SNF which are currently available or are being developed. These may be individual spent fuel assemblies; or single, dual or triple purpose cask or canister systems. The existing MPC design, if deployed, will be in accordance with the MPC procurement specification. Until specific canister or cask systems are developed, certified and licensed, interface requirements affecting the designs of CRWMS structures, systems and components must be adequately documented and controlled in accordance with the OCRWM QARD (DOE/RW-0333). Some items may be identified as To Be Verified or To Be Determined.	Misc.
Rev. 02, DCN 02 December 1996	BCP-00-96-0005	Revision to incorporate BCP-00-96-0005 "Incorporate DOE SNF in Baseline." Also addresses management guidance from BCP-00-96-0009 Rev. 1 "Technical Baseline Streamlining."	6 to 9a, 13, 18, 18a, 20, 20a, 24, 26, 27, 27a, 28, 30, 31, 35 to 45d, 52, 55, 55a, 62, 66, 68, 68a, 81, 88 to 99a, 105, 113 to 115a, 119 to 123a, 127, 156, 157, 161
Rev. 03 November 1996	BCP-00-96-0009	Streamlines the CRD to include only Program-level requirements. The Waste Acceptance System Requirements Document (SRD), Storage SRD and Transportation SRD are transferred to the WAST Project (the Mined Geologic Disposal System Requirements Document was previously transferred to YMSCO by BCP-01-96-0047). Custodian requirements (e.g., DOE SNF) will be transferred from the	All

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		WASRD to the CRD in the next revision of the CRD.	
Rev. 04 May 1998	BCP-00-98-0004	Incorporates Producer/Custodian (DOE SNF, HLW, Navy SNF) requirements and the Hanford 15 ft. canister.	Misc.
Rev. 05 January 1999	BCP-00-99-0001	Incorporates Immobilized Plutonium Waste Form (IPWF) and mixed oxide SNF into the HLW requirements. Incorporates the signed MOA for Acceptance of DOE SNF and HLW as well as naval SNF. Incorporates for planning purposes expanded repository capacities. Defines the Level 0 Scope Baseline. Incorporates the repository closure policy. Incorporates DOE SNF in Government-managed Nuclear Material.	Misc.
Rev. 05, DCN 01 May 2000	BCP-00-99-0004 BCP-00-99-0006 BCP-00-99-0007 B-00-2000-0004	Incorporates requirements to comply with Interim Regulatory Guidance, solar power requirement, repository closure as early as 30 years after emplacement of the last waste package, and repository thermal constraints. Adds definitions of terms used in new requirements.	9, 14, 14a, 14b, B-3, B-8, B-9, B-10, B-11
Rev. 05, DCN 02 December 2000	B-00-2000-0009	Updates inventory of nuclear materials and incorporates it as design basis for SR in a new requirement 3.2.1.H. Modifies MGR requirement 3.4.A accordingly. Removes planning considerations 2.4.C and 2.4.D. Also revises/expands a footnote to Table 1 under requirement 3.2.1.B to recognize that NNPP has requested increased ramp-up receipt rates for naval SNF.	5, 6, 10, 12, 13, 14, 14a
Rev. 05, DCN 03 March 2001	N/A	Adds a footnote to Table 1 under requirement 3.2.1.B to clarify: "The rates in this schedule are targets only and do not create any binding legal obligation on the Department of Energy."	10
Rev. 05, DCN 04 June 2001	B-00-2001-0001	Modifies requirement 3.4.C to incorporate the flexible design concept as established by Baseline Change Proposal (BCP)B-00-2001-0001, <i>Update Technical Requirements in the Program, Project and Contractor Baselines to Support the Flexible Operating Concept</i> . Clarifies requirement 3.2.1.B to differentiate design flexibility from operational flexibility.	10, 14, 14a
Rev. 05, DCN 05 May 2002	ATI-2002-005	Eliminates Planning Consideration 2.4.N and revises regulatory requirement 3.1.1.C to reflect 10 CFR Part 63, 40 CFR Part 197, and 10 CFR Part 963. Deletes requirement 3.2.1G and revises all relevant definitions in the Glossary section for consistency with 10 CFR Part 63. This DCN also replaces/deletes the text in requirements 3.5 (CISF Element	vii, viii, ix, 1, 2, 5, 6, 7, 9, 12, 13, 14a, 15, 16, 17, 18, A-4, A-5, B1, B-4, B-5, B-6,

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		Requirements), 3.6.3 (CISF External Interface Requirements), and 3.6.5.2 (Waste Acceptance and Transportation – CISF Interface Requirements) with ‘reserved’ and in other sections with ‘if approved’.	B-7, B-8, B-9, B-10, B-11
Rev. 06 September 2004	PMA-2004-010	Updates the definition of Level 0 Scope Baseline in Section 2.5. Streamlines Section 1 by deleting unnecessary sections. Separates Waste Acceptance and Transportation elements for consistency with OCRWM reorganization. Deletes Planning Considerations section, and when appropriate, elevates some to requirements. Incorporates a new Programmatic Requirements section. Updates and streamlines requirements, reallocating requirements to related system elements sections when appropriate. Incorporates and updates requirements on physical protection of SNF and HLW, cost reduction practices, compliance with Integrated Interface Control Document, compliance with National Environmental Policy Act, compliance with DOE Orders. Revises provisions on emplacement inventory, efficient energy management, and repository thermal ranges. Deletes 10 CFR Part 72 compliance, rock temperature and cladding temperature requirements. Deletes Centralized Interim Storage Requirements and Interface Requirements in their entirety. Updates Table 1 to reflect the recent DOE decision on Immobilized Plutonium Waste Form (IPWF) disposal and the target receipt rates for naval SNF.	Misc.

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Rev. 07 March 2006	PMA-2006-006	Updates the Programmatic Requirements section (3.1) by specifically requesting compliance with DOE O 413.3 and associated manual (3.1.1.C, 3.1.1.H). Updates Programmatic Requirements section by specifically requesting compliance with DOE O 413.3 (3.1.1.C), configuration control board procedures (3.1.1.D), and existing memoranda of agreement (3.1.2.D). Revises timetable for conducting “bottoms-up” Total System Life Cycle Cost Assessment (3.1.1.G). Adds new requirement 3.1.1.J to require the development of a System Startup Plan. Incorporates vitrified Plutonium as waste form to be accepted at the repository. (3.2.1.A). Requests use of NRC-reviewed and accepted technology (3.1.1.F). Describes preliminary target receipt rates and system operating conditions (3.2.1.B). Expands the types of storage and transportation technologies to be accommodated at the repository ( 3.2.1.F, 3.4.F). Requires compliance with accepted NRC standards and guides, DOE Orders, and sometimes industry codes (3.2.1.K). Breaks up Section 3.3 (Waste Acceptance and Transportation Elements Requirements) into two separate sections (Waste Acceptance (3.3) and Transportation (3.4). Incorporates new Transportation Element requirements 3.4.E (truck and rail capability). Updates MGR Element Requirements section by incorporating new requirement 3.5.C (phased modular design and construction), revising 3.5.E (to require permanent closure to occur at least 50 years from completion of waste emplacement), and 3.5.G (initiation of emplacement during the first year of MGR operations). Updates and streamlines Appendix A (Glossary, Acronyms/Abbreviations) and the reference sections 4.1 (Documents Cited) and 4.2 (Codes, Standards, Regulations, Procedures, and Directives).	ii-v, vii-ix, 1, 2, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, A-3, A-6, A-8, A-9, A-10, Back Cover Page

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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 addresses the requirements of Department of Energy (DOE) Order 413.3-Change 1, *Program and Project Management for the Acquisition of Capital Assets*, by providing the Secretarial Acquisition Executive (Level 0) scope baseline and the Program-level (Level 1) technical baseline. The Secretarial Acquisition Executive approves the Office of Civilian Radioactive Waste Management's (OCRWM) critical decisions and changes against the Level 0 baseline; and in turn, the OCRWM Director approves all changes against the Level 1 baseline. This baseline establishes the top-level technical scope of the CRMWS and its three system elements, as described in section 1.3.2. The organizations responsible for design, development, and operation of system elements described in this document must therefore prepare subordinate project-level documents that are consistent with the CRD. Changes to requirements will be managed in accordance with established change and configuration control procedures.

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* (NWPAct), 10 Code of Federal Regulations (CFR) Part 63, 10 CFR Part 71, etc.) along with specific policy, performance requirements, 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, and high visibility stakeholder issues.

The CRD uses a systems approach to: 1) identify key functions that the CRWMS must perform, 2) allocate top-level requirements derived from statutory, regulatory, and programmatic sources, and 3) define the basic elements of the system architecture and operational concept. Project-level documents address CRD requirements by further defining system element functions, decomposing requirements into significantly greater detail, and developing designs of system components, facilities, and equipment.

The CRD addresses the identification and control of functional, physical, and operational boundaries between and within CRWMS elements. The CRD establishes requirements regarding key interfaces between the CRWMS and elements external to the CRWMS. Project elements define interfaces between CRWMS program elements.

The Program has developed a change management process consistent with DOE Order 413.3-Change 1. Changes to the Secretarial Acquisition Executive and Program-level baselines must be approved by a Program Baseline Change Control Board. Specific thresholds have been established for identifying technical, cost, and schedule changes that require approval.

The CRWMS continually evaluates system design and operational concepts to optimize performance and/or cost. The Program has developed systems analysis tools to assess potential enhancements to the physical system and to determine the impacts from cost saving initiatives, scientific and technological improvements, and engineering developments. The results of systems analyses, if appropriate, are factored into revisions to the CRD as revised Programmatic Requirements.

### **1.3 SYSTEM OVERVIEW**

The mission and waste management concept of the system and system elements are described in this section.

#### **1.3.1 CRWMS Mission**

The NWPAs assigned the U.S. Department of Energy (DOE) the mission to develop and operate an integrated waste management system for acceptance, transportation, and disposal of Spent Nuclear Fuel (SNF) and High-Level Radioactive Waste (HLW). The NWPAs 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. The mission of the CRWMS is to manage and dispose of SNF and HLW in a manner that protects health, safety and the environment; enhances national and energy security; and merits public confidence.

The CRWMS is developing a monitored geologic repository (MGR) at Yucca Mountain, Nevada—a site recommended by the President and approved by Congress in July 2002. A license application for the MGR is being developed to dispose of 70,000 metric tons of SNF and HLW, as authorized by the NWPAs, Section 114(d). Projections of SNF and HLW that are expected to be generated indicate that significantly more than 70,000 metric tons will require geologic disposal.

Although RW has analyzed the impacts of disposal of more than 70,000 metric tons in a single repository, RW will request a license from the Nuclear Regulatory Commission for emplacement of only 70,000 metric tons. In accordance with the Nuclear Waste Policy Act, the Secretary of Energy will report to Congress on the need for a second repository between January 1, 2007, and January 1, 2010. The report will consider the total projected future inventory of SNF and HLW, the physical capacity of the first repository site at Yucca Mountain, and the capabilities of existing and future waste form development technologies.

#### **1.3.2 Waste Management System Concept**

The mission of the CRWMS is accomplished by three system elements: Waste Acceptance, Transportation, and Monitored Geologic Repository. These system elements work in conjunction with each other to fulfill a variety of functional and performance requirements intended to make the transportation and disposal of SNF and HLW in a geologic medium safe, environmentally acceptable, and cost effective. The CRWMS will provide appropriately documented conformance verification, accountability, and traceability of the SNF and HLW from initial acceptance to final closure of the MGR.

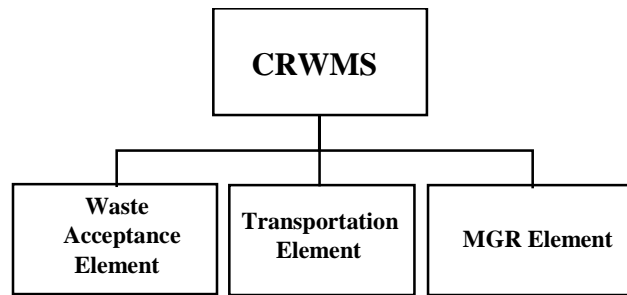


Figure 1. CRWMS Architecture

The responsibilities of each element are summarized below:

- The Waste Acceptance element is the primary interface with Purchasers (non-Federal entities who have entered into a contractual agreement with DOE), Custodians (government entities possessing SNF considered candidate for disposal), and Producers (generators of HLW). The element establishes the waste acceptance and waste form requirements; manages the contract/agreement process; accepts title to the waste; and maintains records of CRWMS capacity, SNF/HLW quantities, location and characteristics.
- The Transportation element is responsible for designing, acquiring, constructing, operating, and maintaining the infrastructure necessary to transport SNF and HLW from Purchaser/Custodian/Producer sites to the Monitored Geologic Repository. This element is also responsible for establishing the institutional relations with industry, States, tribes, and local governments needed to support the Transportation mission.
- The Monitored Geologic Repository element is responsible for designing, licensing, constructing, operating, and permanently closing the geologic repository at the Yucca Mountain site to emplace and isolate 70,000 metric tons of SNF and HLW.

The CRWMS architecture is influenced by supporting elements that ensure a systems approach is utilized in the development, evolution, and acquisition of the system elements. These supporting elements ensure that continued, ongoing enhancements are factored into all Program activities, including:

- Systems Analysis and Strategy Development supporting element implements technical management approaches at the Program-level and provides policy guidance to system elements. These approaches include top-level design and operations concept system analyses and analyses of total system life cycle costs of the CRWMS.
- Science and Technology and International supporting element evaluates alternative, cutting-edge technologies and improved scientific methodologies, and recommends initiatives for implementation to system elements for further development. This supporting element also monitors international approaches to waste management and incorporates beneficial plans, policies, and techniques into the CRWMS.

## **2. REQUIREMENTS IMPLEMENTATION**

### **2.1 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 each system element's applicable quality assurance program.

### **2.2 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 *Civilian Radioactive Waste Management Major System Management Policy* (DOE/RW-0528).

### **2.3 REQUIREMENTS APPLICABILITY**

Consistent with DOE HQ Order 250.1, *Civilian Radioactive Waste Management Facilities--Exemption from Departmental Directives*, and unless otherwise indicated in Section 3 of this document, whenever applicable Departmental requirements overlap or duplicate applicable requirements of the Nuclear Regulatory Commission (NRC) related to radiation protection, nuclear safety (including quality assurance), and safeguards and security of nuclear material, NRC requirements alone will apply to the design, construction, operation, and decommissioning of CRWMS facilities.

### **3. REQUIREMENTS**

#### **3.1 PROGRAMMATIC REQUIREMENTS**

##### **3.1.1 Policy Driven Requirements**

This section identifies the requirements derived from Program policies.

- A. The Level 0 Scope Baseline of the CRWMS shall be defined as “Construct a repository that is licensed by the NRC for the permanent disposal of 70,000 MTHM of high-level radioactive waste and spent nuclear fuel at the Yucca Mountain site. Acquire the transportation and waste acceptance systems and services needed to perform repository operations safely.” Level 0 cost and schedule requirements that are part of the integrated scope, cost and schedule system are defined in DOE/RW-0562, *Program Phase-2 Cost and Schedule Baseline*. Procedures and thresholds for changing these requirements are documented in procedure LP-PMC-009-OCRWM, *Program Change Control*.
- B. All subordinate Project-level documents prepared to address the design, acquisition, development, and operation of system elements shall be fully consistent with the *Civilian Radioactive Waste Management System Requirements Document* (DOE/RW-0406).
- C. All CRWMS projects shall conduct their activities in accordance with the requirements in DOE Order 413.3-Change 1, *Program and Project Management for the Acquisition of Capital Assets*, and accompanying manual. Implementation of CRWMS activities shall be consistent with the technical management approach defined in the *Civilian Radioactive Waste Management Major System Management Policy* (DOE/RW-0528).
- D. All CRWMS elements shall manage changes to baselined configurations, requirements, work scope, costs, and schedules in accordance with established Change Control and Configuration Control Board procedures. Any change to a Work Breakdown Structure level 3 Program element shall require notification to or approval by the OCRWM Configuration Control Board.
- E. All CRWMS elements shall comply with the applicable principles of the “Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management” (INFCIRC/546).
- F. To the maximum extent practical, all CRWMS elements shall utilize proven commercial technology, including facilities and equipment previously reviewed and accepted by NRC, as appropriate, which will satisfy the intended function of any system, structure, or component.
- G. At least every two years, OCRWM shall conduct a “bottoms-up” Total System Life Cycle Cost Assessment with separate analyses for: a) the currently authorized

legislative limit for the first repository and b) future inventories of SNF and HLW as projected by the Energy Information Administration, Office of Environmental Management, Naval Reactors, and any other owner of SNF and HLW that requires geologic disposal.

- H. All CRWMS organizations shall conduct, prior to a major critical decision milestone, independent cost estimating reviews consistent with DOE Order 413.3-Change 1, *Program and Project Management for the Acquisition of Capital Assets* and accompanying manual. As part of these reviews, each organization shall assess the effectiveness of project management goals and develop approaches to integrate science, technology, and operational advancements into cost savings.
- I. The CRWMS evaluation on the need for a second repository, in accordance with NWPA Section 161(b), shall consider the following factors: the total projected inventory of all spent nuclear fuel and high-level radioactive waste, the ability to expand the first repository, and potential alternative technologies for waste management.
- J. CRWMS Elements responsible for development of the MGR shall develop a System Startup Plan, consistent with requirements of the NWPA, Section 114(e)(1), as well as good engineering and operational practices.

### **3.1.2 Statutory or Regulatory Driven Requirements**

This section identifies the primary requirements of the CRWMS as established by, or derived from, key Federal laws and regulations. According to these laws and regulations, all CRWMS elements shall:

- A. Comply with the applicable provisions of 42 U.S.C. 10101 et seq., “The Nuclear Waste Policy Act of 1982”, as amended.
- B. Comply with the applicable provisions of 10 CFR Part 20, “Standards for Protection Against Radiation.”
- C. Comply with the provisions of 10 CFR Part 961, “Standard Contract for Disposal of Spent Nuclear Fuel and/or High-Level Radioactive Waste.”
- D. Be capable of accepting, transporting, and disposing of DOE HLW and SNF, and of accepting and disposing naval SNF, from the Producer/Custodian site to the MGR.<sup>1</sup>
- E. Comply with the applicable provisions of 29 CFR Part 1910, “Occupational Safety and Health Standards” and 29 CFR Part 1926, “Safety and Health Regulations for Construction”.

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<sup>1</sup> RW intends to replace existing agreements with the Office of Environmental Management and the Naval Nuclear Propulsion Program with a Departmental Policy Directive to comply with the provisions of the Nuclear Waste Policy Act and 10 CFR 961.5.

- F. Comply with applicable provisions of 10 CFR Part 75, “Safeguards on Nuclear Materials-Implementation of U.S./IAEA Agreement.”
- G. Ensure the physical protection of SNF and HLW while in their possession or custody within any facility or in transit, in accordance with all applicable safeguards and security requirements.

## **3.2 OVERALL SYSTEM-LEVEL REQUIREMENTS**

### **3.2.1 Overall System Performance**

- A. The CRWMS shall be designed to accept, transport, and dispose of commercial SNF; DOE SNF; vitrified defense HLW (DHLW), including a vitrified plutonium waste form; and vitrified commercial HLW, in accordance with the NWPA and implementing regulations.
- B. The CRWMS shall be capable of receiving mostly by rail SNF and HLW at the system operating conditions and receipt rates<sup>2,3,4</sup> specified in this Section.
  - 1. In the first full year of operation, the CRWMS shall:
    - a. Accept and receive 400 MTHM commercial SNF and HLW
    - b. Accept and receive at least 3 naval SNF canisters
    - c. Accept and receive 66 DOE SNF canisters and 193 DHLW canisters.
  - 2. During years two through four of operations, the CRWMS shall:
    - a. Accept and receive, at least, 3,800 MTHM commercial SNF and HLW
    - b. Accept and receive, at least, 15 naval SNF canisters
    - c. Accept and receive, at least, 257 DOE SNF canisters and 1,143 DHLW canisters.

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<sup>2</sup> 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 receipt rates are estimated in terms of desired systems-level acceptance rates.

<sup>3</sup> The rates in this schedule are targets only and do not create any binding legal obligation on the Department of Energy.

<sup>4</sup> The preliminary target receipt rates for naval SNF, DOE SNF and HLW originate from the draft Integrated Acceptance Schedule (Huizenga 2001). The DOE Office of Environmental Management (EM), in coordination with the Naval Nuclear Propulsion Program, is currently revising the Integrated Acceptance Schedule. An updated version is expected to be available for use in CRWMS planning during April 2006. When available, this *CRWMS Requirements Document* will be revised. The official target rates will be contained in the final Integrated Acceptance Schedule to be provided by EM and NNPP, and approved by OCRWM, 5 years prior to acceptance. For planning purposes, naval SNF is to be included among the earliest shipments to the repository. The steady-state rates provided in this requirement correspond to the projected maximum rates listed in the draft Integrated Acceptance Schedule; the actual rates will be determined based on a number of operational factors including commercial SNF receipt rates and thermal limits for emplacement.

3. On year five, at the start of full-scale, steady-state operations, the CRWMS shall:
  - a. Accept and receive 3,000 MTHM commercial SNF and HLW annually
  - b. Accept and receive, at least, 15 naval SNF canisters annually<sup>5</sup>
  - c. Accept and receive 179 DOE SNF canisters and 763 DHLW canisters annually.
- C. The following conditions shall apply to achieving CRWMS capability identified in Section 3.2.1.B above:
  1. In the event that DOE determines that rail access to the MGR site will be unavailable to support system operating conditions and receipt rates, the acceptance rates above will not apply and will, instead, be based on the availability of truck transportation capability.
  2. In each year of operations, RW shall be capable of accepting, transporting, and disposing of commercial SNF where at least 90 percent is received in Transport, Aging and Disposal canisters and no more than 10 percent is received as uncanistered (bare, intact) assemblies.
- D. The CRWMS shall accept 70,000 MTHM of SNF/HLW for disposal in the first repository as authorized by the NWPA, Section 114(d). The allocation, by waste type, is specified in Table 1.

Table 1. Amount of SNF/HLW To Be Accepted in First Repository  
(in MTHM)

Type	Amount
Commercial SNF and HLW	63,000
Defense HLW	4,667
DOE and naval SNF	2,333
Total	70,000

- E. The CRWMS shall only accept, transport, and dispose of SNF or HLW that is approved by license or certificate granted by NRC under the NWPA. CRWMS facilities and equipment are not subject to Treatment, Storage, and Disposal facility requirements under the Resource Conservation and Recovery Act.
- F. CRWMS elements and facilities shall be capable of accommodating a range of storage and transportation technologies, including Transport, Aging and Disposal, dual-purpose, single-purpose, DOE SNF Standard, naval SNF, and HLW canisters, as well as Multi-Canister Overpacks and limited quantities of bare SNF assemblies.

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<sup>5</sup> Naval Nuclear Propulsion Program activities can prepare up to 24 naval SNF canisters annually for shipment to the MGR. For CRWMS design purposes, this value should be used for maximum receipt rates of naval SNF canisters.



- G. CRWMS facilities shall be capable of opening sealed storage/transportable commercial canisters, handling the SNF, and managing associated site generated waste streams.
- H. The CRWMS design shall comply with the agreements established under the Integrated Interface Control Document (DOE/RW-0511) to ensure:
  - 1. compatibility of DOE-owned SNF and HLW waste forms with MGR surface facility interfaces, including canister handling interfaces, and
  - 2. compatibility between transportation equipment (e.g., transporters) and transported items (e.g., casks and canisters) with mechanical interfaces (e.g., cask handling skid equipment and facility lifting equipment) and envelop interfaces (e.g., canister dimensions and weights).
- I. The CRWMS is responsible for the transportation of DOE SNF and HLW in casks certified by the NRC. NNPP is responsible for canistering and transporting naval SNF to the repository.
- J. CRWMS facilities shall manage hazardous, nonhazardous, and mixed radioactive wastes generated during on-site operations in a cost effective manner that meets or exceeds compliance with applicable regulations and protects the health and safety of the public, workers, and the environment consistent with DOE Order O 450.1, *Environmental Protection Program*.
- K. All CRWMS elements's structures, systems, and components shall be designed and fabricated in accordance with accepted NRC standards and guides, as appropriate, and applicable DOE Orders, with particular attention to those which incorporate system safety, human factors, reliability, availability, maintainability, habitability standards, and environmental protection. In the absence of appropriate NRC and DOE standards, applicable industry codes should be used.

### **3.3 WASTE ACCEPTANCE ELEMENT REQUIREMENTS**

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

- A. The Waste Acceptance Element shall collect necessary information in support of CRWMS activities. The type of data required includes, but is not limited to, the following:
  - 1. Contracts and Fees Information - Purchaser Contracts; Custodian and Producer Agreements and changes thereto; records of fee payments.
  - 2. Planning and Scheduling Information - Delivery Commitment Schedules (DCS), DCS Exchanges, Final Delivery Schedules, integrated Acceptance Schedule, Purchaser and Custodian SNF data, campaign schedules, acceptance, transportation, delivery, storage, and emplacement schedules, current projections of the full inventory of SNF and HLW expected to require disposal.
  - 3. Operations Support Information - Characterization data for Purchaser and Custodian SNF and Producer HLW. This data shall be sufficient to satisfy the loading safeguards verification requirements of 10 CFR Part 63.21(c)(4).
  - 4. Safeguards and Security Information - Nuclear Material Transaction reports (reports (10 CFR Part 74.15(a)), Nuclear Material Balance reports (10 CFR Part 75.35(a)), and other information specifically agreed to (e.g., verification forms).
- B. Waste Acceptance shall validate title and/or transfer of responsibility and custody documentation from the Purchasers/Producers/Custodians.
- C. Acceptance of West Valley Demonstration Project (WVDP) Commercial High-Level Radioactive Waste (CHLW), presently owned by the New York State Energy Research and Development Authority (NYSERDA), is contingent upon NYSERDA executing an acceptance and disposal contract, and paying a fee as required under the NWPA.

### **3.4 TRANSPORTATION ELEMENT REQUIREMENTS**

This section contains the requirements allocated to the Transportation Element of the CRWMS.

- A. The Transportation Element shall comply with the applicable provisions 42 U.S.C. 4321 et seq., “The National Environmental Policy Act of 1969” as amended.
- B. The Transportation Element shall comply with the applicable provisions of 10 CFR Part 71, “Packaging and Transportation of Radioactive Material.”
- C. The Transportation Element shall comply with the applicable provisions of DOT regulations as documented in Title 49 of the Code of Federal Regulations.

- D. The Transportation Element shall comply with all applicable DOE Orders and Directives, including those in the areas of radiation protection, safeguards and security, physical protection, material control and accounting, contingency, and quality assurance.
- E. The Transportation Element shall be capable of transporting NRC-certified transportation casks primarily by rail, and by truck beginning in the initial year of CRWMS operations.
- F. The Transportation Element shall be capable of transporting NRC-certified transportation casks (defined in Appendix A), including the following general types:
  - Single-Purpose Casks
  - Canister Casks (Transport, Aging and Disposal Canister and Dual-Purpose Canister (DPC))
  - Transportable Storage Casks
  - HLW Casks
  - Specialty Casks

### **3.5 MGR ELEMENT REQUIREMENTS**

This section contains the requirements allocated to the MGR Element.

- A. The MGR shall comply with the requirements of the Nuclear Regulatory Commission (10 CFR Part 63) and the Environmental Protection Agency (40 CFR Part 197).
- B. The MGR shall be designed and constructed to accommodate emplacement of 70,000 MTHM of SNF and HLW, as specified in the Nuclear Waste Policy Act. The MGR shall not preclude, subject to approval of a license amendment, the ability to accept additional quantities of nuclear waste up to the projected inventory in the Final Environmental Impact Statement for a Geologic Repository for the Disposal of SNF and HLW at Yucca Mountain, Nye County, Nevada (DOE/EIS-0250).
- C. The MGR surface and subsurface facilities shall be designed and constructed in phases to allow for the modular development of repository capabilities.
- D. For the full range of operating conditions, the MGR shall be designed not to preclude permanent closure for up to 300 years from the start of waste emplacement.
- F. The MGR shall ensure the physical protection of SNF and HLW received at the repository for disposal in accordance with the safeguards and security requirements in 10 CFR Part 63.21(b)(3), the applicable material control and accounting provisions of 10 CFR Part 63.78, the safeguards information protection provisions in 10 CFR Part 73.21, and any applicable interim compensatory measures issued by the NRC.
- G. The MGR shall have the capability to initiate emplacement during the first year of operations.

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10 CFR Part 63. Energy: Disposal of High-Level Radioactive Wastes in a Geologic Repository at Yucca Mountain, Nevada. ACC: MOL.20050405.0118.

10 CFR Part 70. Energy: Domestic Licensing of Special Nuclear Material. ACC: MOL.20050523.0021.

10 CFR Part 71. Energy: Packaging and Transportation of Radioactive Material. ACC: MOL.20050523.0022.

10 CFR Part 72. Energy: Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste. ACC: MOL.20050411.0074.

10 CFR Part 73. Energy: Physical Protection of Plants and Materials. ACC: MOL.20050523.0016.

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10 CFR Part 961. 1994. Energy: Standard Contract for Disposal of Spent Nuclear Fuel and/or High-Level Radioactive Waste. ACC: MOL.20050406.0172.

29 CFR Part 1910. Labor: Occupational Safety and Health Standards. ACC: MOL.20050411.0148.

29 CFR 1926. 2004 Labor: Safety and Health Regulations for Construction. ACC: MOL.20050411.0134.

40 CFR Part 197. 2001. Protection of Environment: Public Health and Environmental Radiation Protection Standards for Yucca Mountain, Nevada. ACC: MOL.20050411.0311.

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**APPENDIX A**  
**DEFINITIONS**

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## **DEFINITIONS**

### **A.1 GLOSSARY**

This section provides definitions of key terms used in the CRD. Rather than requirements, the purpose of these definitions is 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.

**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 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 (Transport, Aging and Disposal canister or DPC) containing SNF from Purchaser/Custodian sites to CRWMS sites and between CRWMS sites.
3. **Transportable Storage Casks** - These transportation casks are for storing uncanistered SNF at Purchaser sites and for transporting SNF from Purchaser sites to CRWMS facilities.
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.

**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 42 U.S.C. 10101(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 determine that systems comply with CRWMS requirements or to demonstrate that SNF and/or HLW are in accordance with CRWMS acceptance criteria.

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

**Custodian** means any government agency that possesses spent nuclear fuel that is eligible for disposal in the CRWMS.

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

**Disposal** is the emplacement of radioactive wastes in a geologic repository with the intent of leaving it there permanently. (As defined in 10 CFR Part 63.2.) 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 42 U.S.C 10101(9).)

**Dispose of** means the sum of the functions performed by the CRWMS to accept, transport, store, 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.

**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 the engineered barrier system and the portion of the geologic setting that provides isolation of the radioactive waste. (As defined in 10 CFR Part 63.2.)

**Government-Managed Nuclear Materials** comprises DOE SNF (commercial and defense), naval SNF, and HLW.

**Hazardous waste** means any solid waste that exhibits certain characteristics, including corrosivity, ignitability, reactivity, or toxicity, or is specifically listed by the Environmental Protection Agency in its regulations under 40 CFR Part 264. EPA regulations under 40 Part CFR 261, et seq. implement the statutory provisions of the Resource Conservation and Recovery Act.

**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.

**(Items) Important to Safety** with reference to structures, systems, and components, means those engineered features of the geologic 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 63.111(b)(1) for Category 1 event sequences; or (2) To prevent or mitigate Category 2 event sequences that could result in radiological exposures exceeding the values specified in 10 CFR Part 63.111 (b)(2) to any individual located on or beyond any point on the boundary of the site .

**(Items) Important to Waste Isolation**, with reference to design of the engineered barrier system and characterization of natural barriers, means those engineered and natural barriers whose function is to provide a reasonable expectation that high-level waste can be disposed without exceeding the requirements of 10 CFR Part 63.113 (b) and (c).

**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.

**Interim compensatory measures** are steps in the Orders issued by NRC in response to the September 11<sup>th</sup> terrorist incidents directing licensees to take immediate action until vulnerability studies are completed and further security enhancements can be determined. **Interim compensatory measures** are considered sensitive information and therefore are unavailable to the public.

**Isolation** is inhibiting the transport of radioactive material to: (1) The location of the reasonably maximally exposed individual so that radiological exposures will not exceed the requirements of 63.113(b); and (2) The accessible environment so that releases of radionuclides into the accessible environment will not exceed the requirements of 63.113 (c). (As defined in 10 CFR Part 63.2.)

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

**Naval SNF** is DOE SNF that is currently managed by NNPP, and is fuel that has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated. Naval SNF will be placed in sealed canisters designed specifically for storage, transportation, and disposal.

**Overpack** is a structural component used to hold and protect the Transport, Aging and Disposal canister or DPC 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. An overpack is designed for its particular use in conjunction with the Transport, Aging and Disposal canister or DPC.

**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.

**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 comprising the “Dispose of Waste” function.

**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.

**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 (42 U.S.C 2133, 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.

**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 (does not include source material); or (2) any material artificially enriched by any of the foregoing (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 42 U.S.C. 10101(23) and 10 CFR Part 961.11.)

**Structures, Systems, and Components**, or SSCs, is a general term that means the standard English definition of those individual words. In this document, if and when 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** refers to any of the three major systems required to accomplish the functions of the CRWMS. The three system elements are Waste Acceptance, Transportation, and MGR. This differs from the “project” that may be initiated by DOE to manage and control development of one or more system elements.

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

**Transportation Cask** is a container for shipping spent nuclear fuel and/or high-level radioactive waste that meets all applicable regulatory requirements.

**Transport, Aging and Disposal (TAD) Canister** is a multifunctional canister for commercial SNF assemblies, which will accommodate transportation by DOE and aging (to reduce thermal output from SNF over time) at a suitable facility in NRC certified casks. The canister will be placed in a waste package for disposal in an NRC licensed repository.

**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.

**Vitrified Plutonium Waste Form** is a HLW canister, which contains canned vitrified plutonium surrounded by HLW glass.

**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. (As defined in 10 CFR Part 63.2.)



## **A.2 ACRONYMS AND ABBREVIATIONS**

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

### **B**

<b>BCP</b>	Baseline Change Proposal
<b>BWR</b>	Boiling Water Reactor

### **C**

<b>CFR</b>	Code of Federal Regulations
<b>CHLW</b>	Commercial High-Level Radioactive Waste
<b>CRD</b>	CRWMS Requirements Document
<b>CRWMS</b>	Civilian Radioactive Waste Management System

### **D**

<b>DCN</b>	Document Change Notice
<b>DCS</b>	Delivery Commitment Schedule
<b>DHLW</b>	Defense High-Level Radioactive Waste
<b>DOE</b>	U.S. Department of Energy
<b>DOT</b>	U.S. Department of Transportation
<b>DPC</b>	Dual Purpose Canister

### **E**

<b>EIS</b>	Environmental Impact Statement
<b>EM</b>	DOE/Office of Environmental Management
<b>EPA</b>	U.S. Environmental Protection Agency

### **F**

<b>FR</b>	Federal Register
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### **H**

<b>HLW</b>	High-Level Radioactive Waste
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### **I**

<b>IAEA</b>	International Atomic Energy Agency
<b>ICN</b>	Interim Change Notice

**M**

**MGR**                      Monitored Geologic Repository  
**MTHM**                    Metric Tons Heavy Metal

**N**

**NNPP**                    Naval Nuclear Propulsion Program  
**NRC**                      Nuclear Regulatory Commission  
**NWPA**                    Nuclear Waste Policy Act of 1982  
**NYSERDA**                New York State Energy Research and Development Authority

**O**

**OCRWM**                Office of Civilian Radioactive Waste Management

**P**

**PWR**                    Pressurized Water Reactor

**Q**

**QA**                      Quality Assurance  
**QARD**                    Quality Assurance Requirements and Description

**R**

**RW**                      Office of Civilian Radioactive Waste Management

**S**

**SNF**                    Spent Nuclear Fuel  
**SR**                      Site Recommendation  
**SRD**                    System Requirements Document  
**SSCs**                    Structures, Systems, and Components

**T**

**TAD**                    Transport, Aging and Disposal Canister  
**TBD**                    To Be Determined

**U**

**U.S.C.**                    United States Code

**W**

<b>WASRD</b>	Waste Acceptance System Requirements Document
<b>WVDP</b>	West Valley Demonstration Project

**Y**

<b>YMSCO</b>	Yucca Mountain Site Characterization Office (known now as the Office of Repository Development)
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**This publication was produced by the U.S. Department of Energy's Office of Civilian  
Radioactive Waste Management (OCRWM)**

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