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OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT SYSTEM DESCRIPTION DOCUMENT COVER SHEET

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Assembly Transfer System Description Document

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OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT
SYSTEM DESCRIPTION DOCUMENT REVISION HISTORY

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3. Revision	4. Description of Revision
00	Initial Issue. This document was previously issued using document identifier BCB000000-01717-1705-00023. This document supersedes the previous issuance. This document is a complete rewrite of the superseded document, driven largely by the use of an alternate source of regulatory requirements, the implementation of the License Application Design Selection effort, and the use of a new document development procedure.
ICN 01	1) All Table titles changed from "Table I"- to "Table". 2) Section 2 has been added. 3) Updated and added references. 4) Updated criteria in 1.2. 5) Content of section 1.4 has been deleted. 6) All Changes are identified with sidebars on the right border of the affected pages.

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SUMMARY

The Assembly Transfer System (ATS) receives, cools, and opens rail and truck transportation casks from the Carrier/Cask Handling System (CCHS). The system unloads transportation casks consisting of bare Spent Nuclear Fuel (SNF) assemblies, single element canisters, and Dual Purpose Canisters (DPCs). For casks containing DPCs, the system opens the DPCs and unloads the SNF. The system stages the assemblies, transfer assemblies to and from fuel-blending inventory pools, loads them into Disposal Containers (DCs), temporarily seals and inerts the DC, decontaminates the DC and transfers it to the Disposal Container Handling System. The system also prepares empty casks and DPCs for off-site shipment. Two identical Assembly Transfer System lines are provided in the Waste Handling Building (WHB). Each line operates independently to handle the waste transfer throughput and to support maintenance operations.

Each system line primarily consists of wet and dry handling areas. The wet handling area includes a cask transport system, cask and DPC preparation system, and a wet assembly handling system. The basket transport system forms the transition between the wet and dry handling areas. The dry handling area includes the dry assembly handling system, assembly drying system, DC preparation system, and DC transport system. Both the wet and dry handling areas are controlled by the control and tracking system.

The system operating sequence begins with moving transportation casks to the cask preparation area. The cask preparation operations consist of cask cavity gas sampling, cask venting, cask cool-down, outer lid removal, and inner shield plug lifting fixture attachment. Casks containing bare SNF (no DPC) are filled with water and placed in the cask unloading pool. The inner shield plugs are removed underwater. For casks containing a DPC, the cask lid(s) is removed, and the DPC is penetrated, sampled, vented, and cooled. A DPC lifting fixture is attached and the cask is placed into the cask unloading pool. In the cask unloading pool the DPC is removed from the cask and placed in an overpack and the DPC lid is severed and removed.

Assemblies are removed from either an open cask or DPC and loaded into assembly baskets positioned in the basket staging rack in the assembly unloading pool. A method called "blending" is utilized to load DCs with a heat output of less than 11.8 kW. This involves combining hotter and cooler assemblies from different baskets. Blending requires storing some of the hotter fuel assemblies in fuel-blending inventory pools until cooler assemblies are available. The assembly baskets are then transferred from the basket staging rack to the assembly handling cell and loaded into the assembly drying vessels. After drying, the assemblies are removed from the assembly drying vessels and loaded into a DC positioned below the DC load port. After installation of a DC inner lid and temporary sealing device, the DC is transferred to the DC decontamination cell where the top area of the DC, the DC lifting collar, and the DC inner lid and temporary sealing device are decontaminated, and the DC is evacuated and backfilled with inert gas to prevent prolonged clad exposure to air. The DC is then transferred to the Disposal Container Handling System for lid welding.

In another cask preparation and decontamination area, lids are replaced on the empty transportation casks and DPC overpacks, the casks and DPC overpacks are decontaminated, inspected, and transferred to the Carrier/Cask Handling System for shipment off-site. All system

equipment is designed to facilitate manual or remote operation, decontamination, and maintenance.

The system interfaces with the Carrier/Cask Handling System for incoming and outgoing transportation casks and DPCs. The system also interfaces with the Disposal Container Handling System, which prepares the DC for loading and subsequently seals the loaded DC. The system support interfaces are the Waste Handling Building System and other internal WHB support systems.

QUALITY ASSURANCE

The quality assurance (QA) program applies to the development of this document. The "SDD Development/Maintenance (Q SDDs) (WP# 16012126M5)" activity evaluation has determined the development of this document to be subject to "Quality Assurance Requirements and Description" requirements. This document was developed in accordance with AP-3.11Q, "Technical Reports."

1. SYSTEM FUNCTIONS AND DESIGN CRITERIA

The functions and design criteria for the system are identified in the following sections. Throughout this document the term "system" shall be used to indicate the Assembly Transfer System. The system architecture and classification are provided in Appendix B.

1.1 SYSTEM FUNCTIONS

1.1.1 The system receives transportation casks from the Carrier/Cask Handling System.

1.1.2 The system samples, vents, and cools transportation casks containing SNF.

1.1.3 The system samples and vents transportation casks containing DPCs.

1.1.4 The system penetrates, samples, vents, and cools DPCs containing SNF.

1.1.5 The system transfers transportation casks into the pool.

1.1.6 The system opens transportation casks and DPCs for unloading.

1.1.7 The system unloads SNF assemblies and single-element canisters from transportation casks and DPCs.

1.1.8 The system stores SNF assemblies and single element canisters in the pool.

1.1.9 The system decontaminates transportation casks and DPCs.

1.1.10 The system returns empty casks and DPCs to the Carrier/Cask Handling System.

1.1.11 The system dries SNF assemblies and single element canisters prior to DC loading.

1.1.12 The system receives empty DCs configured for loading from the Disposal Container Handling System.

1.1.13 The system loads SNF assemblies and single element canisters into the DC.

1.1.14 The system seals, evacuates oxidizing gases, and backfills the DC with inert gas.

1.1.15 The system decontaminates the DC external surfaces.

1.1.16 The system transfers the DC to the Disposal Container Handling System.

1.1.17 The system supports the collection of material control and accounting data.

1.1.18 The system operates in the environmental conditions established for the Waste Handling Building System.

1.1.19 The system provides remote handling and control features to minimize radiation exposure to workers.

1.1.20 The system provides features and equipment for reducing the risk of, responding to, and recovering from off-normal events and credible design basis events.

1.1.21 The system ensures criticality control is maintained during all waste handling operations.

1.1.22 The system provides features for the inspection, testing, calibration, and maintenance of system equipment.

1.1.23 The system provides features that facilitate decontamination and decommissioning at repository closure.

1.1.24 The system provides for the monitoring and control of its operation by either local or remote means.

1.1.25 The system provides safety features to protect personnel and equipment during normal and off-normal conditions.

1.1.26 The system provides non-standard canister handling.

1.2 SYSTEM DESIGN CRITERIA

This section presents the design criteria for the system. Each criterion in this section has a corresponding Criterion Basis Statement in Appendix A that describes the need for the criterion as well as a basis for the performance parameters imposed by the criterion. Each criterion in this section also contains bracketed traces indicating traceability, as applicable, to the functions (F) in Section 1.1, the "Monitored Geologic Repository Requirements Document" (MGR RD) and "Revised Interim Guidance Pending Issuance of New U.S. Nuclear Regulatory Commission (NRC) Regulations (Revision 01, July 22, 1999), for Yucca Mountain, Nevada." In anticipation of the interim guidance being promulgated as a Code of Federal Regulations, it will be referred to as "10 CFR 63" in this system description document. For the applicable version of the codes, standards, and regulatory documents, refer to Appendix E.

1.2.1 System Performance Criteria

1.2.1.1 The system shall have an operational life of 40 years.

[F 1.1.1, 1.1.16][MGR RD 3.2.C]

1.2.1.2 The system shall transfer intact fuel assemblies from the assembly classes identified in Table 1 (TBV-455).

Table 1. Assembly Classes

Assembly Class	Type	Assembly Class	Type
Big Rock Point	BWR	Humboldt Bay	BWR
B&W 15x15	PWR	Indian Point	PWR
B&W 17x17	PWR	LaCrosse	BWR
CE 14x14	PWR	Palisades	PWR
CE 16x16	PWR	San Onofre 1	PWR
CE System 80	PWR	South Texas	PWR
Dresden 1	BWR	St. Lucie 2	PWR
Fort Calhoun	PWR	WE 14x14	PWR
GE BWR 2, 3	BWR	WE 15x15	PWR
GE BWR 4, 5, 6	BWR	WE 17x17	PWR
Haddam Neck	PWR	Yankee Rowe	PWR

NOTE: See Appendix C for acronym definitions.

[F 1.1.7, 1.1.13][MGR RD 3.2.A, 3.2.C]

1.2.1.3 The system shall remove SNF assemblies from the DPCs.

[F 1.1.4, 1.1.6, 1.1.7][MGR RD 3.2.A, 3.2.C, 3.2.D, 3.2.E, 3.3.D]

1.2.1.4 The system shall be designed to accommodate rail and truck transportation casks identified in Table 2.

Table 2. Transportation System

Cask Designation/Proposed System Name	Manufacturer or Owner	NRC Docket Number	Mode of Transportation
GA-9	GA	71-9221	LWT
GA-4	GA	71-9226	LWT
NAC-LWT	NAC	71-9225	LWT
NAC-STC	NAC	71-9235	Rail
NUHOMS® MP-187	Vectra	71-9255	Rail
HI-STAR 100	Holtec	71-9261	Rail
Large MPC (21P/44B)	WGESCO	71-9264 and 71-9265	HHT or Rail
Small MPC (12P/24B)	WGESCO	71-9266 and 71-9267	HHT or Rail
WESFLEX (21P/44B)	WGESCO	-	-
TranStor™	SNC	71-9268	Rail
NAC-UMS™ UTC	NAC	71-9270	Rail
Proposed Long South Texas Project	-	-	Rail

NOTE: The MPC is included as part of the NAC-STC transportation system.

NOTE: See Appendix C for acronym definitions.

NOTE: The manufacturer, NRC docket number, and mode of transportation are provided where available.

[F 1.1.5, 1.1.6][MGR RD 3.3.D, 3.3.H, 3.4.2.B]

1.2.1.5 The system shall have the capability to transfer SNF assemblies at a (TBD-3897) annual throughput.

[F 1.1.1, 1.1.16][MGR RD 3.2.C, 3.2.E]

1.2.1.6 The system shall support an average transportation cask turnaround time back to the Regional Servicing Contractor as identified in the Table 3 (TBV-0098).

Table 3. Cask Turnaround Time

Waste Type	Transportation Mode	Waste Form	Turnaround Time (Days)
CSNF	Truck	UCF	5
	Rail	UCF	5

NOTE: See Appendix C for acronym definitions.

[F 1.1.10][MGR RD 3.4.2.B]

1.2.1.7 The system shall provide storage for 5,000 MTU of SNF assemblies.

[F 1.1.8][MGR RD 3.2.C, 3.2.E]

1.2.1.8 The system shall provide features to sample, measure, and monitor the transportation cask and DPC parameters prior to and during the cooling and opening process as defined in Table 4 (TBD-317).

Table 4. Parameters

Parameters	Measurement Range
Temperature	TBD
Pressure	TBD
Radiation Levels	TBD
Gas Analysis	TBD

[F 1.1.2, 1.1.3, 1.1.4][MGR RD 3.2.C, 3.3.A]

1.2.1.9 The system shall dry SNF assemblies to a combined concentration of less than or equal to 0.25 volume percent for O_2, H_2O, CO_2, and CO (TBV-094) for a loaded disposal container.

[F 1.1.11][MGR RD 3.1.C][10 CFR 63.113(b)]

1.2.1.10 The system shall temporarily seal, evacuate gases, and backfill the DC with inert gas to preclude oxidation of the SNF assemblies.

[F 1.1.14][MGR RD 3.1.C][10 CFR 63.113(b)]

1.2.1.11 The system shall provide capability for non-standard canister handling.

[F 1.1.26] [MGR RD 3.4.2.D]

1.2.2 Safety Criteria

1.2.2.1 Nuclear Safety Criteria

1.2.2.1.1 The system design shall reduce the probably of a spent fuel assembly basket drop onto another spent fuel assembly basket during dry handling operations to less than a Frequency Category 1 design basis event (TBV-3693).

[F 1.1.20][MGR RD 3.1.C][10 CFR 63.111(a)(2), 63.111(b)(2), 63.112(e)(8)]

1.2.2.1.2 The spent fuel assembly transfer baskets and basket staging racks shall be designed for a Frequency Category 2 (TBV-1246) design basis earthquake.

[F 1.1.20][MGR RD 3.1.C][10 CFR 63.111(b)(2), 63.112(e)(8)]

1.2.2.1.3 The overhead cranes and fuel transfer machines shall be designed to retain their loads for Frequency Category 1 (TBV-1246) design basis earthquake.

[F 1.1.20][MGR RD 3.1.C][10 CFR 63.111(a)(2), 63.112(e)(8)]

1.2.2.1.4 The overhead cranes and fuel transfer machines shall be for a Frequency Category 2 (TBV-1246) design basis earthquake and not be dislodged from their rails.

[F 1.1.20][MGR RD 3.1.C, 3.1.G][10 CFR 63.111(b)(2), 63.112(e)(8)]

1.2.2.1.5 The system shall be designed to retain suspended loads during and after a loss of electrical power.

[F 1.1.20][MGR RD 3.1.C][10 CFR 63.111(a)(2), 63.112(e)(8)]

1.2.2.1.6 The system shall be designed for criticality safety under normal and accident conditions. Criticality safety analyses for accident conditions are based on two unlikely, independent, and concurrent or sequential changes occurring in the conditions essential to nuclear criticality safety. Safety limits for criticality are met with a calculated effective multiplication factor (k_{eff}) below 0.95 after allowance for the bias in the method of calculation and the uncertainty in the experiments used to validate the method of calculation.

[F 1.1.20, 1.1.21][MGR RD 3.1.C, 3.3.A][10 CFR 63.112(e)(6)]

1.2.2.1.7 The system shall be designed to maintain control of SNF and permit prompt termination of operations during an emergency.

[F 1.1.20][MGR RD 3.1.C, 3.3.A][10 CFR 63.112(e)(10)]

1.2.2.1.8 The system shall be designed to ensure that occupational doses are as low as is reasonably achievable (ALARA) in accordance with the project ALARA program goals (TBD-406), and the applicable guidelines in "Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations will be as Low as Reasonably Achievable" (Regulatory Guide 8.8).

[F 1.1.19, 1.1.20][MGR RD 3.1.B, 3.1.C, 3.1.G][10 CFR 63.111(a)(1), 63.112(e)(2)]

1.2.2.1.9 The system shall enable reverse operations to close casks containing assemblies, return assemblies from the drying station to wet storage, unload assemblies from the DC.

[F 1.1.20][MGR RD 3.3.A]

1.2.2.1.10 The system design shall define safe load paths for the movement of heavy loads to minimize the potential for drops on SNF.

[F 1.1.20][MGR RD 3.1.C, 3.1.G][10 CFR 63.111(a)(2), 63.112(e)(8)]

1.2.2.1.11 The system shall provide overload limit sensing and alarming capabilities to automatically stop handling operations and warn operators of unsafe conditions.

[F 1.1.20, 1.1.25][MGR RD 3.1.C, 3.1.G, 3.3.A][10 CFR 63.111(a)(2), 63.112(e)(8)]

1.2.2.1.12 The maximum allowable removable contamination level on the exterior surfaces of transportation casks and DPCs to be shipped from the repository, as assessed by the "wiping" method, shall be less than 22 dpm/cm^2 for beta-gamma emitting radionuclides and low toxicity alpha emitting radionuclides; and 2.2 dpm/cm^2 for all other alpha emitting radionuclides. If assessment methods of equal or greater efficiency are employed, the efficiency must be considered and the maximum contamination limit may not exceed ten times the values above.

[F 1.1.9][MGR RD 3.1.G, 3.4.2.H]

1.2.2.1.13 The system shall decontaminate the DC external surfaces to less than (TBD-169) dpm/100 cm^2.

[F 1.1.15][MGR RD 3.1.B, 3.1.C][10 CFR 63.111(a)(1)]

1.2.2.2 Non-nuclear Safety Criteria

1.2.2.2.1 The system shall be designed to incorporate the use of noncombustible and heat resistant materials to the extent practicable.

[MGR RD 3.1.G]

1.2.2.2.2 The system design shall include provisions for decommissioning and decontamination, including the removal of potentially contaminated SSCs.

[F 1.1.23][MGR RD 3.1.C, 3.1.G][10 CFR 63.21(c)(17)]

1.2.3 System Environmental Criteria

1.2.3.1 The system components shall be designed to withstand and operate in the temperature environment defined in Table 5, for the area in which the component is located.

Table 5. Temperature Environment

Location of System Component	Normal Environment	Off-Normal Environment
Normally Occupied Areas (e.g., Offices, Maintenance Areas, Access Control)	76 - 72°F Note 1	(TBD-395) °F for (TBD-395) Hours
Normally Unoccupied Areas (e.g., Mechanical & Electrical Equipment Rooms, Cask Receiving & Handling Areas, Pool Areas)	90 - 65°F Note 1	(TBD-395) °F for (TBD-395) Hours
Unoccupied Areas (e.g., Assembly Cells, Canister Transfer Cells, DC Handling Cells)	104 - 65°F Note 1	(TBD-395) °F for (TBD-395) Hours
Electronics Equipment Areas (e.g., Control Rooms, Computer Rooms, Communications Equipment Rooms, Data Processing and Recording Equipment Rooms)	70 - 74°F Note 1	70 - 74°F Note 2

Note 1: It is intended to maintain these areas at the specified temperature under all anticipated conditions. However, due to economic or design impracticability, areas that house less sensitive electronic components may not be maintained at this temperature. For these components, cooling would be provided for the electronic components, but not necessarily the entire area.

[F 1.1.18][MGR RD 3.3.A]

1.2.3.2 The system components shall be designed to withstand and operate in the humidity environment defined in Table 6 for the areas of the Waste Handling Building in which the components are located.

Table 6. Humidity Environment

Location of System Component	Normal Environment
Normally Occupied Areas (e.g., Offices, Maintenance Areas, Access Control)	30% - 60%
Normally Unoccupied Areas (e.g., Mechanical & Electrical Equipment Rooms, Cask Receiving & Handling Areas, Pool Areas)	Humidity Not Controlled (TBD-409) Note 1
Unoccupied Areas (e.g., Assembly Cells, Canister Transfer Cells, DC Handling Cells, Emergency Generator Room)	Humidity Not Controlled (TBD-409) Note 1
Electronics Equipment Areas (e.g., Control Rooms, Computer Rooms, Communications Equipment Rooms, Data Processing and Recording Equipment Rooms)	40% - 50%

Note 1: Humidity control is not provided in most of these areas. Therefore, components susceptible to extreme humidity conditions must be evaluated for low and/or high humidity environments since special provisions (e.g., heater strips, and humidifier) may be necessary.

[F 1.1.18][MGR RD 3.3.A]

1.2.3.3 The system shall be designed such that components susceptible to radiation can operate in and withstand the radiation environment (TBD-405) in which the component is located.

[F 1.1.18][MGR RD 3.3.A]

1.2.4 System Interfacing Criteria

1.2.4.1 The system shall receive configured DCs from the Disposal Container Handling System for loading.

[F 1.1.12][MGR RD 3.2.C]

1.2.4.2 The system shall receive transportation casks from the Carrier/Cask Handling System for unloading.

[F 1.1.1][MGR RD 3.2.C]

1.2.4.3 The system shall return decontaminated transportation casks and DPC overpacks to the Carrier/Cask Handling System.

[F 1.1.10][MGR RD 3.2.C]

1.2.4.4 The system shall provide loaded DCs to the Disposal Container Handling System.

[F 1.1.16][MGR RD 3.2.C]

1.2.4.5 The system shall receive and provide the operational information, status, and control data defined in Table 7 to the Monitored Geologic Repository Operations Monitoring and Control System.

Table 7. System Inputs/Outputs

Inputs	Outputs
Radiation monitoring system data and status	Equipment status and status of operations
Transportation cask and carrier tracking data	Equipment alarm status
Facility system status	Control equipment status and alarms
Facility, interfacing and support system readiness status	Interlock status
Operational message advisory	Video signals
Activity plans and procedures	Communications equipment status
Emergency response commands	Timeout warnings for handling equipment
MGR operational alarm status	Control loads left in improper states (suspended loads, unattended controls, etc.)
Supervisory control	

[F 1.1.24][MGR RD 3.2.C, 3.3.K]

1.2.4.6 The system shall receive electrical power from the Waste Handling Building Electrical System.

[MGR RD 3.2.C]

1.2.4.7 The system shall provide features to obtain the cask, DPC, assembly, and DC identification numbers and storage locations for data input into Safeguards and Security System.

[F 1.1.17][MGR RD 3.1.C, 3.1.D, 3.3.K][10 CFR 63.78]

1.2.4.8 The system shall limit static and dynamic loads to the transportation casks, SNF assemblies, single-element canisters, DPCs, DCs, facility, and support systems to within their design limits.

[F 1.1.5, 1.1.7, 1.1.11, 1.1.16, 1.1.25][MGR RD 3.3.A]

1.2.4.9 The system shall interface with the Waste Handling Building System for operating space, storage pools, and support services.

[MGR RD 3.2.C]

1.2.4.10 The system shall receive assembly storage and loading assignments from the material control and accounting subsystem of the Safeguards and Security System to ensure thermal loading constraints are met.

1.2.5 Operational Criteria

1.2.5.1 The inherent availability for the system shall be greater than 0.9541 (TBV-4655).

[F 1.1.1, 1.1.16][MGR RD 3.2.C, 3.3.A]

1.2.5.2 The system shall include provisions for the maintenance, periodic inspection, testing, and decontamination of system equipment including recovery of remotely operated equipment.

[F 1.1.22][MGR RD 3.1.C, 3.1.G, 3.3.A][10 CFR 63.112(e)(13)]

1.2.6 Codes and Standards Criteria

1.2.6.1 The system shall be designed in accordance with the applicable sections of "Occupational Safety and Health Standards" (29 CFR 1910).

[F 1.1.25][MGR RD 3.1.E]

1.2.6.2 The system shall be designed in accordance with the applicable sections of "Rules for Construction of Overhead and Gantry Cranes (Top Running Bridge, Multiple Girder)" (ASME NOG-1-1995).

[MGR RD 3.1.G]

1.2.6.3 The system shall be designed in accordance with the applicable sections of "Design Requirements for Light Water Reactor Fuel Handling Systems" (ANSI/ANS-57.1-1992).

[MGR RD 3.1.G]

1.2.6.4 The system shall be designed in accordance with the applicable sections of "Design Criteria for an Independent Spent Fuel Storage Installation (Water Pool Type)" (ANSI/ANS 57.7-1988).

[MGR RD 3.1.G]

1.2.6.5 The system shall be designed in accordance with the applicable sections of "Design Criteria for an Independent Spent Fuel Storage Installation (Dry Type)" (ANSI/ANS 57.9-1992).

[MGR RD 3.1.G]

1.2.6.6 The system shall be designed in accordance with the applicable sections of "Specifications for Top Running Bridge and Gantry Type Multiple Girder Electric Overhead Traveling Cranes" (CMAA-70-94).

[MGR RD 3.1.G]

1.2.6.7 The system shall be designed in accordance with the applicable sections of "Specifications for Top Running & Under Running Single Girder Electric Overhead Traveling Cranes Utilizing Under Running Trolley Hoist" (CMAA-74-94).

[MGR RD 3.1.G]

1.2.6.8 The system shall be designed in accordance with the applicable sections of "Standard Specification for Boron-Based Neutron Absorbing Material Systems for Use in Nuclear Spent Fuel Storage Racks" (ASTM C992-89).

[MGR RD 3.1.G]

1.2.6.9 The system shall be designed in accordance with the applicable sections of "Design Objectives for Highly Radioactive Solid Material Handling and Storage Facilities in a Reprocessing Plant" (ANSI N305-1975).

[MGR RD 3.1.G]

1.2.6.10 The system shall be designed in accordance with the applicable sections of "American National Standard for Radioactive Materials - Special Lifting Devices for Shipping Containers Weighing 10000 Pounds (4500 kg) or More" (ANSI N14.6-1993).

[MGR RD 3.1.G]

1.2.6.11 The system shall be designed in accordance with the applicable sections of "Guide for the Installation of Electrical Equipment to Minimize Electrical Noise Inputs to Controllers from External Sources" (IEEE Std 518-1982).

[MGR RD 3.3.A]

1.2.6.12 The system shall be designed in accordance with applicable sections of the "Department of Defense Design Criteria Standard, Human Engineering" (MIL-STD-1472E).

[MGR RD 3.3.A]

1.2.6.13 The system shall be designed in accordance with applicable sections of "Human Factors Design Guidelines for Maintainability of Department of Energy Nuclear Facilities" (UCRL-15673).

[MGR RD 3.3.A]

1.2.6.14 The system shall be designed in accordance with applicable sections of "Human-System Interface Design Review Guideline" (NUREG-0700).

[MGR RD 3.3.A]

1.2.6.15 The system shall be designed in accordance with applicable sections of "Safety Color Code" (ANSI Z535.1-1998), "Environmental and Facility Safety Signs" (ANSI Z535.2-1998), "Criteria for Safety Symbols" (ANSI Z535.3-1998), "Product Safety Signs and Labels" (ANSI Z535.4-1998), and "Accident Prevention Tags (for Temporary Hazards)" (ANSI Z535.5-1998).

[MGR RD 3.3.A]

1.2.6.16 The system shall be designed in accordance with applicable sections of "American National Standard for Human Factors Engineering of Visual Display Terminal Workstations" (ANSI/HFS 100-1988), "Ergonomic Requirements for Office Work with Visual Display Terminals (VDTs) - Part 3: Visual Display Requirements" (ISO 9241-3), and "Ergonomic Requirements for Office Work with Visual Display Terminals (VDTs) - Part 8: Requirements for Displayed Colours" (ISO 9241-8).

[MGR RD 3.3.A]

1.2.6.17 The system shall be designed in accordance with applicable sections of "Guidelines for Designing User Interface Software" (ESD-TR-86-278), "Ergonomic Requirements for Office Work with Visual Display Terminals (VDTs) - Part 10: Dialogue Principles" (ISO 9241-10), "Ergonomic Requirements for Office Work with Visual Display Terminals (VDTs) - Part 14: Menu Dialogues" (ISO 9241-14), and "Ergonomic Requirements for Office Work with Visual Display Terminals (VDTs) - Part 15: Command Dialogues" (ISO 9241-15).

[MGR RD 3.3.A]

1.2.6.18 The system shall be designed in accordance with the applicable sections of the "National Electrical Code" (NFPA 70).

[MGR RD 3.3.A]

1.2.6.19 The system shall be designed in accordance with the applicable sections of "Standard for the Protection of Electronic Computer/Data Processing Equipment" (NFPA-75).

[MGR RD 3.3.A]

1.2.6.20 The system shall be designed in accordance with the applicable sections of "IEEE Recommended Practice for Powering and Grounding Sensitive Electronic Equipment" (IEEE Std 1100-1992).

[MGR RD 3.3.A]

1.2.6.21 The system shall be designed in accordance with the applicable sections of "IEEE Standard for Information Technology - Open Systems Interconnection (OSI) Abstract Data Manipulation - Application Program Interface (API) [Language Independent]" (IEEE Std 1224-1993).

[MGR RD 3.3.A]

1.2.6.22 The system shall be designed in accordance with the applicable sections of "Application of Safety Instrumented Systems for the Process Industries" (ANSI/ISA-S84.01-1996).

[MGR RD 3.3.A]

1.2.6.23 The system shall be designed in accordance with the applicable sections of "Standard Guide for Design of Equipment for Processing Nuclear and Radioactive Materials" (ASTM C 1217-92).

[MGR RD 3.1.G]

1.2.6.24 The system shall comply with the applicable assumptions contained in the "Monitored Geologic Repository Project Description Document."

1.2.6.25 The system shall be constructed in accordance with the applicable sections of "Safety and Health Regulations for Construction" (29 CFR 1926).

[MGR RD 3.1.F]

1.3 SUBSYSTEM DESIGN CRITERIA

There are no subsystem design criteria for this system.

1.4 CONFORMANCE VERIFICATION

This section will be provided in a future revision.

2. DESIGN DESCRIPTION

Section 2 of this SDD summarizes information which is contained in other references. By assembling system specific information contained elsewhere (i.e., analyses, technical reports, etc.), Section 2 provides insight into the current state of the design of this system. However, due to the nature of design development, the information contained in this section will continue to change as the design matures.

Section 2 content is based on information from the "Engineering Files for Site Recommendation," Attachment II, Section 1.1.1.

2.1 SYSTEM DESIGN SUMMARY

The two nearly identical Assembly Transfer System (ATS) lines are provided in the WHB. The ATS lines include the fuel-blending inventory pools area and the nonstandard fuel pool area. Each line operates independently to handle the waste transfer throughput and to support maintenance operations.

The ATS receives, cools, and opens rail and truck transportation casks from the Carrier/Cask Handling System (CCHS). The system unloads commercial spent nuclear fuel (CSNF) consisting of bare assemblies and single element canisters, and dual-purpose canisters (DPCs) from the transportation casks. For casks containing a DPC, the system opens the DPC and then unloads the spent nuclear fuel (SNF). The system stages or stores the assemblies, loads them into a DC, temporarily fills the DC with inert gas and seals the DC, decontaminates the DC, and transfers the DC to the Disposal Container Handling System (DCHS). The system repackages nonstandard fuel assemblies into acceptable packages. The system also prepares empty casks and DPC overpacks for offsite shipment.

Each ATS line consists of a cask unloading area and a hot cell area. The cask unloading area includes a cask preparation and decontamination area and a pool area. The pool area contains a cask unloading pool and an assembly unloading pool. A single transfer canal connects the two pools. The hot cell area consists of an assembly handling cell, a DC loading cell, and a DC decontamination cell. An incline transfer canal is used to move the SNF from the assembly unloading pool to the assembly handling cell. The assembly handling cell is equipped with two drying stations, a DC loading port, an assembly transfer machine, a DC loading manipulator, an in-cell service crane, and a maintenance bay.

One of the ATS lines is specifically designed and equipped to handle shipments of nonstandard CSNF. The ATS line is connected to the nonstandard fuel handling room by an underwater transfer canal equipped with isolation gates and a SNF transfer cart. All the ATS pools and fuel-blending inventory pools have isolation gates to allow each pool to be segregated from the other pools, if necessary.

The ATS operating sequence begins with moving transportation casks to the cask preparation area. The cask preparation operations consist of remote cask cavity gas sampling, cask venting, cask cool-down, cask lid unbolting and removal, shield plug unbolting, and shield plug lifting fixture attachment. Casks containing bare SNF (no DPC) are filled with water in the cask preparation area and placed in the cask unloading pool. The shield plugs are removed underwater. For casks containing a DPC, the cask lid(s) is remotely removed, the DPC vent valves are opened, and the DPC cavity is sampled, vented, and cooled. A DPC lifting fixture is remotely attached and the cask is placed into the cask unloading pool. In the cask unloading pool, the DPC is removed from the cask and placed in a canister overpack where the DPC lid is severed and removed.

Assemblies are individually removed from either an open cask or DPC and loaded into assembly baskets positioned in the assembly unloading pool or in the assembly basket transfer cart. The assembly baskets are then transferred to the fuel-blending inventory pools area. Two fuel basket transfer canals, each equipped with an assembly basket transfer cart, interconnect the ATS assembly unloading pools of both ATS lines with the fuel-blending inventory pools area. The fuel-blending inventory pools area consists of four pools.

The assembly baskets are transferred to the fuel-blending inventory pools only when CSNF to be loaded in the DC is generating heat at a rate more than 11.8 kW. The assembly baskets are transferred from the fuel-blending inventory pools only when CSNF to be loaded into the DC is generating heat at a rate less than 11.8 kW. It has been determined that approximately 12,000 SNF assemblies and 2,800 assembly baskets will accumulate in the fuel-blending inventory pools during the emplacement period to satisfy the blending requirement. This amount of SNF can be held in four fuel-blending inventory pools each sized to blend 1,250 metric tons uranium (MTU) or 750 fuel baskets.

From the fuel-blending inventory pools, assembly baskets are moved to a dry assembly handling cell and loaded into one of two SNF drying vessels. After drying, the assemblies are individually removed from the drying vessels and loaded into a DC positioned below the DC load port. After installation of a DC inner lid sealing device, the DC is transferred to the DC decontamination cell where the top area of the DC and the DC inner lid sealing device are decontaminated, and the DC is evacuated and filled with nitrogen gas. The DC is then transferred to the DCHS for lid welding and inspection.

In the second cask preparation and decontamination area, lids are replaced on the empty transportation cask and DPC overpack, and the cask and DPC overpack are decontaminated, inspected, and transferred to the CCHS for shipment off site. Cask preparation equipment is designed to facilitate remote or manual operation, decontamination, and contact maintenance.

The ATS interfaces with the CCHS for incoming transportation casks and outgoing casks and DPC overpacks. The system also interfaces with the DCHS, which prepares the empty DC for loading and subsequently closes and seals the DC. The ATS also interfaces with the WHB System, the WHB Electrical System, and other WHB utility systems for operational support.

2.2 DESIGN ASSUMPTIONS

2.2.1 Approximately 11 ft of water will provide safe and adequate gamma and neutron shielding of spent fuel elements. The water will also shield and contain alpha and beta radiation contamination sources and prevent nearly all radioactive particulate matter from becoming airborne. This is based on the proven nuclear power plant practice of using a pool for both a shield and a confinement for radionuclides.

2.2.2 The boiling water reactor (BWR) assembly baskets will each accommodate 8 BWR fuel assemblies.

2.2.3 The DC is equipped with standardized lifting and base-collars for handling purposes.

2.2.4 An empty DC is fitted with a device to temporarily seal the inner lid of the DC before and after fuel assembly loading to prevent spread of contamination from the ATS to other systems.

2.2.5 Adequate tools, spares, maintenance personnel, inventory area, and equipment will be readily available to immediately repair failed system equipment. Since the ATS is used continuously, the system is continuously maintained over its operating life.

2.2.6 The assembly basket staging racks in each ATS assembly unloading pool provides capacity to stage 16 assembly baskets.

2.2.7 The operating schedule for the ATS is three shifts per day, 120 hrs per week, and 50 weeks per year (6,000 hrs per year).

2.2.8 The pressurized water reactor (PWR) assembly baskets will each accommodate 4 PWR fuel assemblies.

2.2.9 A segregated unloading pool facility equipped for remote underwater handling will be provided to process nonstandard fuel into disposable forms.

2.2.10 Two fuel basket transfer canals are needed to convey fuel baskets from the assembly unloading pools and to return fuel baskets to the ATS lines.

2.3 DETAILED DESIGN DESCRIPTION

Two nearly identical ATS lines are provided in the WHB. Each line is operated concurrently to handle the waste throughput and to support maintenance operations. Each line consists of an airlock, a cask preparation and decontamination area, a cask unloading and assembly unloading pool area, and a hot cell area.

An airlock provides air confinement between the pool and the WHB Carrier Bay. The cask preparation and decontamination area consists of two cask preparation and decontamination rooms. Each room contains a station for unloading and loading transportation casks from a cask transfer cart to and from a cask preparation pit for preparation of loaded casks or decontamination of empty casks and DPC overpacks. Each cask preparation pit is equipped with access platforms that are adjustable for the various cask diameters and a remotely operated gantry-mounted cask preparation manipulator and hoist that straddles the pit and access platforms. A variety of tools and accessories are available for the performance of remote preparation and decontamination activities using the cask preparation manipulator and hoist. Each ATS line is equipped with a large overhead bridge crane. The cask preparation area includes a crane maintenance bay for contact maintenance of the bridge crane.

The pool area contains a cask unloading pool and an assembly unloading pool. The two pools are interconnected by a transfer canal. The assembly unloading pool is connected to the dry assembly handling cell by an incline transfer canal. Two fuel basket transfer canals, each equipped with a basket transfer cart, interconnect the assembly unloading pools of both ATS lines with the fuel-blending inventory pools. A third transfer canal connects the cask unloading pool and the nonstandard fuel pool.

The cask preparation and pool area equipment consists of the cask transfer carts, the cask unloading area bridge crane, and two gantry-mounted cask preparation manipulators with hoists. Cask and DPC lifting yokes, fixtures, remote tools, and accessories are also provided. The cask unloading and assembly unloading pools are equipped with pool-deck-mounted assembly transfer machines, wet assembly lifting grapples, DPC lid severing tools, DPC overpacks, assembly baskets, basket staging racks, two assembly unloading pool transfer canal carts, and incline transfer canal carts.

The fuel-blending inventory pools area consists of four large water basins. Each basin is capable of storing 750 baskets of CSNF. All four pools are interconnected using the two fuel basket transfer canals. A separate nonstandard fuel pool is provided for handling off-normal and damaged fuel assemblies in single-element canisters. The five pools are housed in an annex to the WHB. At all times, spent fuel and basket handing operations are conducted underwater, with 11 ft of water coverage over the fuel elements.

From the time that the fuel is unloaded from the cask until the fuel is dried for loading into the DC, fuel is handled in standard size spent fuel baskets containing 4 PWR or 8 BWR assemblies. A maximum of 16 fuel baskets may be staged in the ATS assembly unloading pool at any time.

The hot cell area consists of an assembly handling cell, a DC load cell, and a DC decontamination cell. The assembly handling cell is interconnected to the pool area assembly unloading pool by the incline transfer canal. The assembly handling cell contains two assembly drying vessels, a DC load port, a dry assembly transfer machine, dry assembly lifting grapples, an assembly handling cell bridge crane, an assembly handling cell manipulator, a DC load port shield plug, an assembly drying vessel shield plug, an equipment maintenance bay, and recessed lid and shield plug unloading areas. The DC load cell is located below the assembly handling cell and the DC decontamination cell is located below the assembly handling cell equipment maintenance bay.

The equipment maintenance bay, which is used to perform contact maintenance on the dry assembly transfer machine, the bridge crane, and the assembly handling cell manipulator, is separated from the assembly handling cell by a multi-segment isolation door. The maintenance bay is also interconnected to an overhead equipment transfer corridor by means of a shielded access hatch.

The DC load cell and the DC decontamination cell are serviced by a DC transfer cart which is used to transfer a DC between the DC handling cell, the DC decontamination cell, and the DC load cell. An isolation door is provided between the DC load cell and the DC decontamination cell and a shield door is provided between the DC decontamination cell and the DC handling cell. A DC load port mating device in the DC load cell provides a contamination barrier between the assembly handling cell, the DC load port, and the DC during SNF transfer operations. The DC decontamination cell is equipped with a bridge-mounted DC inerting manipulator, a bridge-mounted decontamination manipulator, a DC decontamination tool, and a DC contamination sample pass-through glove box. The pass-through glove box is used to transfer contamination survey samples into an adjacent operating gallery for counting.

All ATS remote operations are controlled from operating galleries adjacent to each hot cell. Strategically located closed-circuit television (CCTV) systems and shield windows support the remote operations. All hot cell area equipment is designed to facilitate remote operation and remote removal for contact decontamination and maintenance. Interchangeable components are provided where appropriate. The equipment is also designed to provide safe and efficient recovery from failures and malfunctions.

2.3.1 System Arrangement

Figures 1, 2, 3, and 4 depict the operations of the ATS. The following subsections describe the operational steps for each ATS area in the WHB.

2.3.1.1 Airlock

A commercial SNF transportation cask is unloaded from its truck or rail carrier and is transferred into the ATS line from the CCHS using the carrier bay crane. The cask is upended on the carrier, lifted vertically, transferred to the ATS line cask transfer cart, and secured against overturning. The cask transfer cart is moved into the ATS line airlock. The airlock is provided with isolation doors at both ends to maintain a slightly negative air pressure in the ATS work areas compared to the carrier bay. The cask transfer cart is then used to move the cask to the cask preparation area.

2.3.1.2 Cask Preparation Area

The casks are removed from the cask transfer cart using the dry cask lifting yoke and the cask unloading area bridge crane and placed into a cask preparation pit in one of the cask preparation and decontamination rooms. The access platforms are adjusted to accommodate the cask diameters. The cask preparation activities are performed by a combination of remote and contact operations, using the crane, manipulator, and associated tools. The cask preparation operations consist of remote cask cavity gas sampling, cask venting, gas and water cool-down, shield plug unbolting, and attachment of the shield plug lifting fixture. For casks containing fuel assemblies within a DPC, the cask outer lid is remotely or manually removed in the preparation pit, the DPC is remotely or manually sampled, vented, and cooled, and a DPC lifting fixture is remotely or manually attached. Following cask preparation operations, the bridge crane and lifting yoke are used to transfer the cask to the cask unloading pool for fuel and DPC unloading.

2.3.1.3 Cask Unloading and Assembly Unloading Pools

For casks containing bare fuel assemblies, the cask is placed in the cask unloading pool and the shield plug is removed underwater in the cask unloading pool. For casks containing a DPC, the DPC is removed from the cask and placed in the canister overpack using the bridge crane. The DPC lid is then severed and removed using the DPC lid severing tools and bridge crane.

Fuel assemblies are individually removed from either an open shipping cask or an open DPC by the wet assembly transfer machine and loaded into assembly baskets in the assembly unloading pool or the assembly basket transfer cart. The empty cask and the canister overpack, containing the empty DPC and the severed lid, are returned to the cask preparation and decontamination area where they are prepared for offsite shipment. Prior to shipment, lid installation, bolting, drying, contamination survey testing, and decontamination is performed, as required.

2.3.1.4 Fuel-Blending Inventory Pools

When the assembly baskets in the assembly unloading pool are full, they are removed from the assembly basket staging rack by the wet assembly transfer machine and placed in one of the fuel basket transfer canal carts. The fuel basket transfer canal cart is then used to transfer the loaded fuel baskets to one of the fuel-blending inventory pools for fuel blending. CSNF blending requires that any loaded DC generate heat at a rate not exceeding 11.8 kW. Loading of the DC is allowed only when the inventory of spent fuel is sufficient to provide a mixture of fuel assemblies that average 562 watts for PWR fuel and 268 watts for BWR fuel. Unless sufficient quantities of fuel generating heat below these average values is available, a DC cannot be loaded until the heat generation is reduced by radioactive decay or cooler fuel arrives.

When a loaded fuel basket is selected from the fuel-blending inventory pools for DC loading, the fuel basket is once again placed in one of the assembly basket transfer canal carts and transferred back to the ATS assembly unloading pool. The loaded assembly basket is then removed from the cart by the wet assembly transfer machine and placed in an incline transfer canal cart. The incline transfer cart is used to transfer loaded assembly baskets up the incline transfer canal, out of the pool, and into the dry assembly handling cell.

2.3.1.5 Non-standard Fuel Handling Room

The non-standard fuel handling room processes failed and nonstandard size SNF that does not meet the criteria for DC loading. To meet the DC loading criteria, nonstandard single-element canisters, consolidated SNF canisters, and over-size canisters are subjected to cutting, unloading, and repackaging operations. All of these operations take place under water in the nonstandard fuel pool. The nonstandard fuel handling room is located in the fuel-blending inventory pools area annex of the WHB. A transfer canal, with normally closed isolation gates at each end, connects one ATS cask unloading pool with the nonstandard fuel pool.

A cask containing nonstandard SNF is directed to the appropriate ATS line. After completion of the cask preparation operations, the cask is placed in the ATS cask unloading pool. The cask is opened and the isolation gates between the ATS cask unloading pool and the nonstandard fuel pool are opened. The ATS wet assembly transfer machine unloads the assemblies from the cask and places them in assembly baskets located into the nonstandard assembly basket transfer cart. The transfer cart is moved to the nonstandard fuel pool. Once the fuel unloading and transfer operation is completed, the isolation gates between the two pools are closed. Using an overhead bridge crane, the assembly baskets are removed from the nonstandard fuel transfer cart and placed into the nonstandard fuel pool basket-staging rack. After the fuel has been repackaged, it is loaded into the assembly basket again and sent back to the ATS cask unloading pool by reversing the above operational sequences. Once in the ATS cask unloading pool, the loaded fuel baskets are directed either to the fuel-blending inventory pools or to the assembly handling hot cell.

2.3.1.6 Assembly Handling Cell and DC Load Cell

In the assembly handling cell, the assembly basket is removed from the incline transfer canal cart by the dry assembly transfer machine and loaded into one of two assembly drying vessels. SNF assembly drying operations are performed to meet performance criteria. An empty DC, equipped with a lifting collar, a base collar, and an inner lid sealing device, is transferred into the DC load cell and mated with the DC load port. The dry assembly transfer machine is then used to remove the DC load port lid and the inner lid-sealing device from the DC. After the fuel assemblies are dry, the dry assembly transfer machine is used to remove fuel assemblies, one at a time, from the baskets in the drying vessel and load the assemblies into the DC positioned below the DC load port. The empty assembly baskets are returned to the fuel-blending inventory pools, using the incline transfer canal and fuel basket transfer canal carts.

When the DC is filled with fuel assemblies, the DC inner lid sealing device and the load port lid are re-installed by the transfer machine. The DC is disengaged from the DC load port and transferred to the DC decontamination cell using the DC transfer cart. In the DC decontamination cell, the lid area of the DC and the DC inner lid sealing device are decontaminated. The DC is evacuated and filled with nitrogen gas to exclude oxygen using the DC inerting manipulator. The DC is then transferred to the DCHS using the DC transfer cart for lid welding, inspection, and subsequent emplacement in the repository subsurface.

2.4 COMPONENT DESCRIPTION

This information will be provided in a future issue.

2.5 CRITERIA COMPLIANCE

The surface facility is developed conceptually at this time without criteria compliance analyses. The criteria compliance for this system will be addressed in future issues of this SDD as the design and analysis of the system matures.

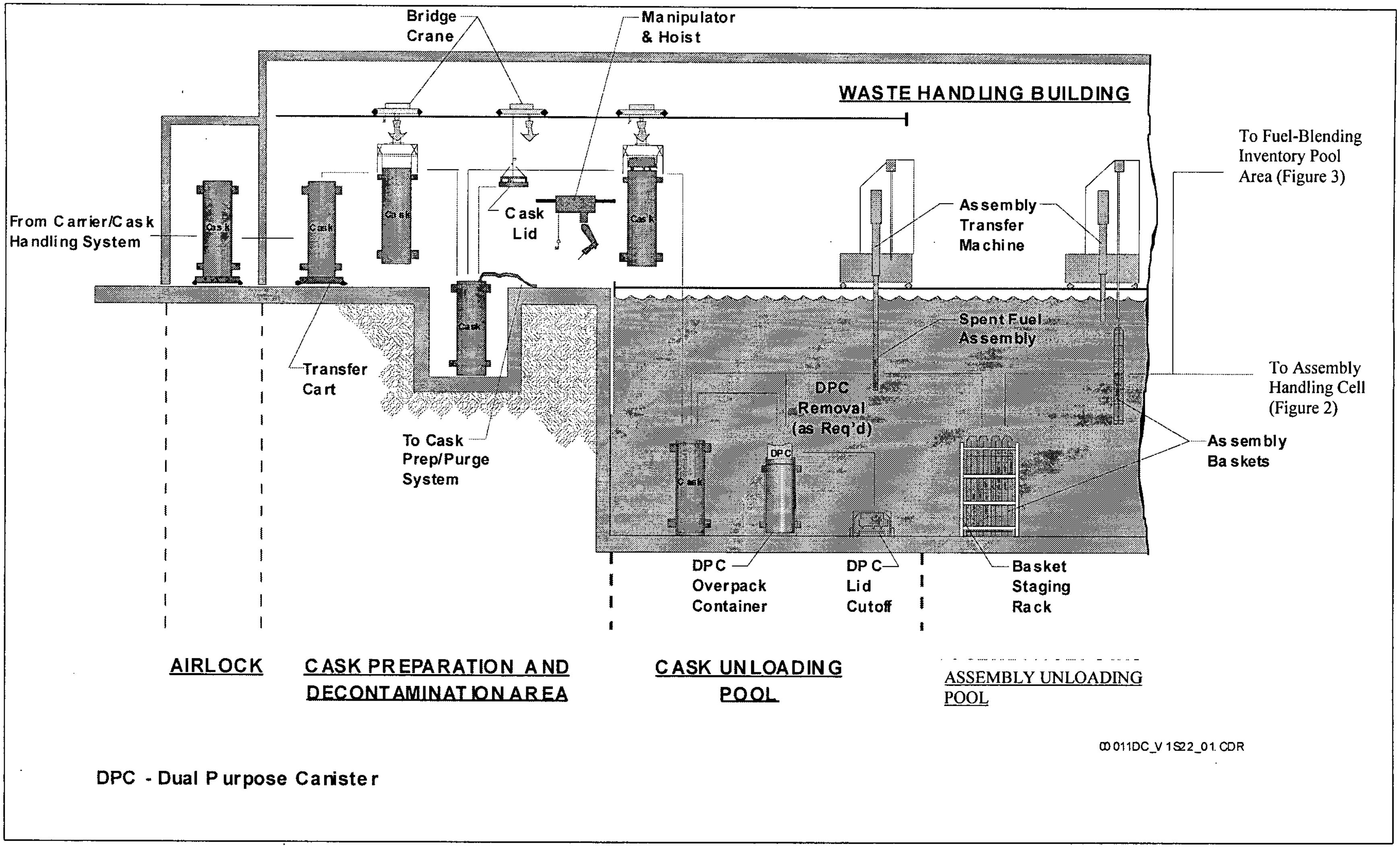

Figure 1. Assembly Transfer System Pool Area Operations

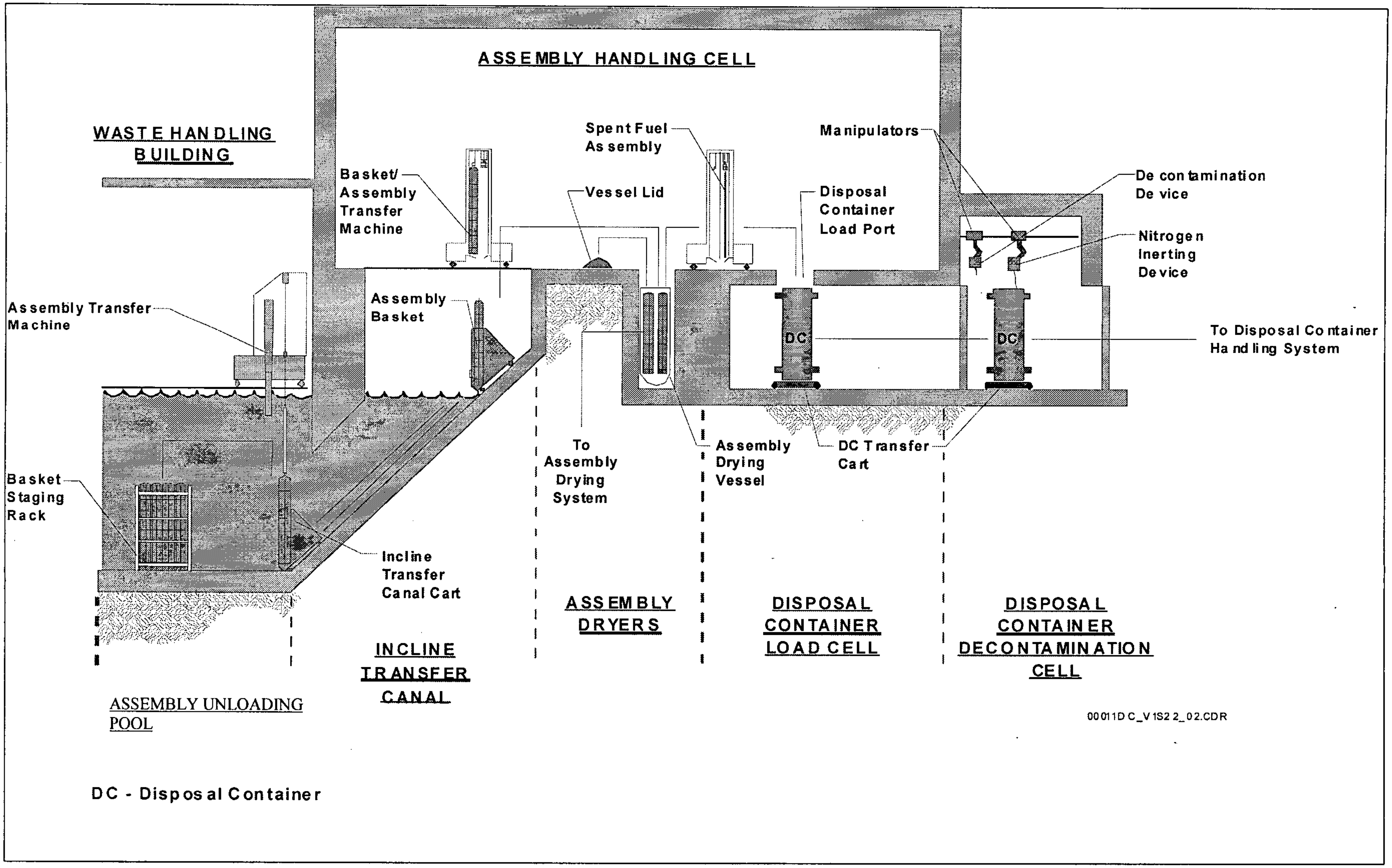

Figure 2. Assembly Transfer System Hot Cell Operations

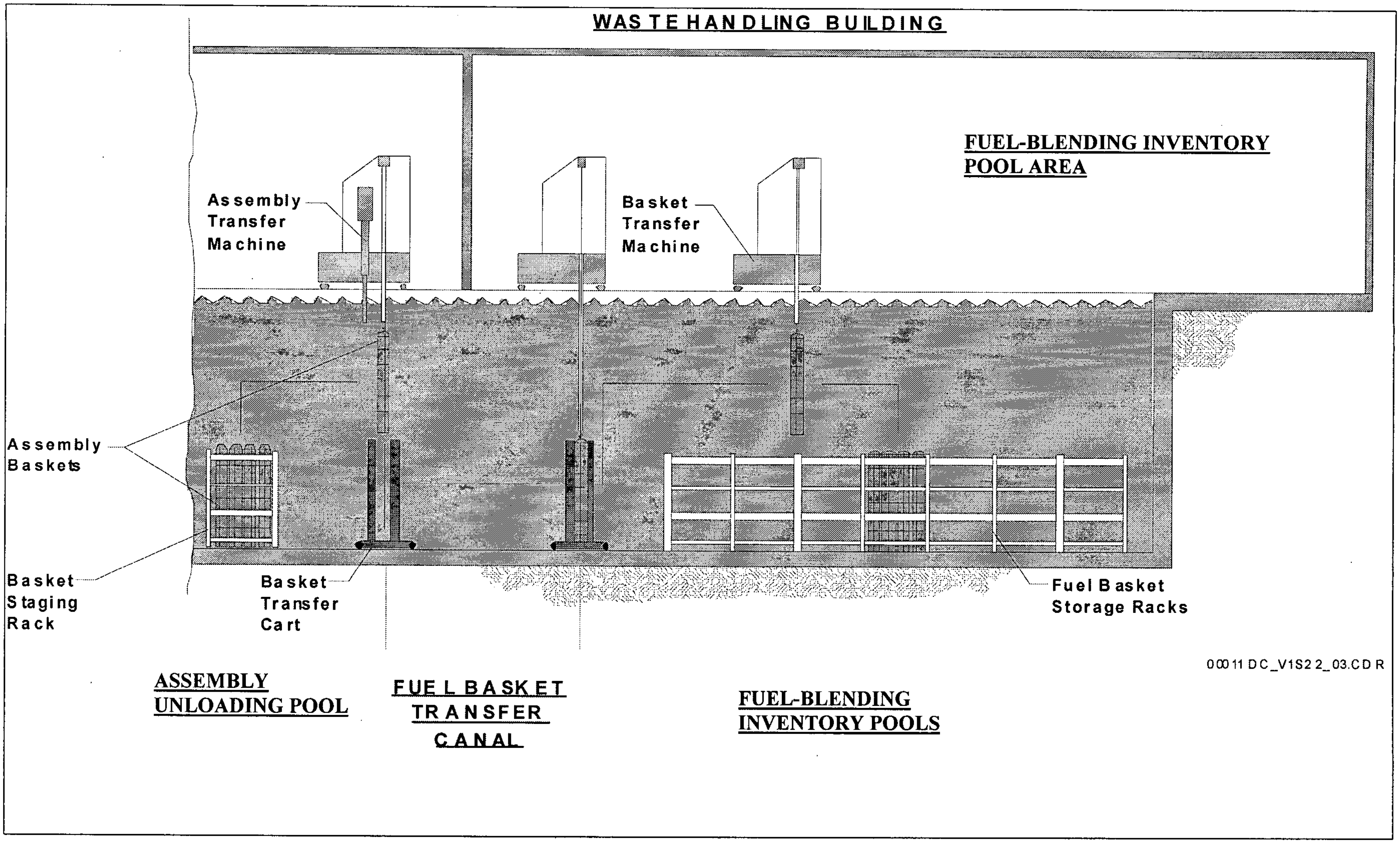

Figure 3. Assembly Transfer System Fuel-blending Inventory Pools Area Operations

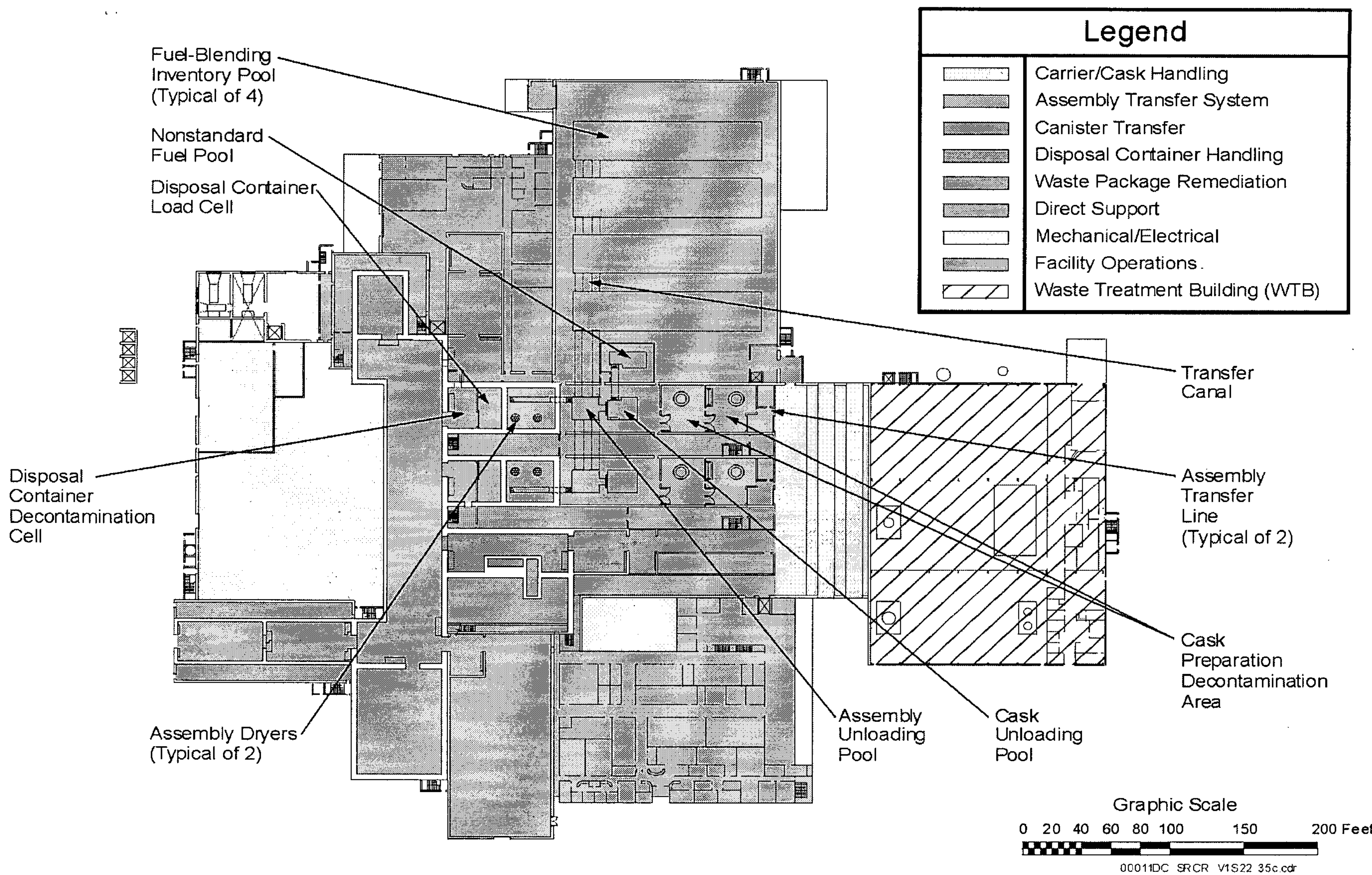

Figure 4. Assembly Transfer System (Plan View)

3. SYSTEM OPERATIONS

This section will be completed in a later revision.

4. SYSTEM MAINTENANCE

This section will be completed in a later revision.

APPENDIX A CRITERION BASIS STATEMENTS

This section presents the criterion basis statements for criteria in Section 1.2. Descriptions of the traces to "Monitored Geologic Repository Requirements Document" (MGR RD) and "Revised Interim Guidance Pending Issuance of New U.S. Nuclear Regulatory Commission (NRC) Regulations (Revision 01, July 22, 1999), for Yucca Mountain, Nevada" are shown as applicable. In anticipation of the interim guidance being promulgated as a Code of Federal Regulations, it will be referred to as "10 CFR 63" in this system description document.

1.2.1.1 Criterion Basis Statement

I. Criterion Need Basis

This criterion establishes the operational life of the system. This criterion is required because this system supports the waste handling operations at the repository as required by MGR RD 3.2.C. Additional system operating life that may be needed to support performance confirmation or retrieval operations conducted after cessation of waste emplacement operations, is not covered by this criterion. To meet the operational life requirement, system components may require replacement in addition to any required preventive maintenance program.

II. Criterion Performance Parameter Basis

Performance requirement MGR RD 3.2.C requires the MGR to be capable of receiving, packaging, emplacing, and isolating nuclear waste at the annual rates specified in Table 3-2 of the MGR RD. Table 3-2 of the MGR RD indicates that waste receipt will commence in the year 2010 and is expected to be completed by the year 2041, spanning a total of 32 years. To account for future potential schedule fluctuations caused by uncertainties in waste remediation, early receipt, and plant life extensions, a 25 percent margin is added, resulting in an operational life of 40 years.

1.2.1.2 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.2.A and 3.2.C. The criterion defines the assembly classes to be handled by the system in support of the overall repository mission.

II. Criterion Performance Parameter Basis

The assembly classes are defined in the "Characteristics of Potential Repository Wastes," Tables 1.2 and 1.3. The data from the subject reference has not been qualified and, therefore, has been identified with TBV-0455.

It should be noted that Elk River fuel is not included. According to "Characteristics of Potential Repository Wastes," Section 4.5.11 and last paragraph of Section 2.6.6, it is believed that some of Elk River fuel has been reprocessed and the remainder is stored at the Savannah River Site (would be received at the MGR as U.S. Department of Energy (DOE) fuel).

1.2.1.3 Criterion Basis Statement

I. Criterion Need Basis

The criterion defines the potential types of DPCs containing SNF waste in support of the overall repository mission. This criterion supports MGR RD 3.2.A, 3.2.C, 3.2.D, 3.2.E, and 3.3.D.

II. Criterion Performance Parameter Basis

N/A

1.2.1.4 Criterion Basis Statement

I. Criterion Need Basis

This criterion explicitly identifies the transportation systems that the system must be able to handle. This criterion is needed to ensure that the system is able to handle the existing transportation systems that may be reasonably believed to be received at the surface repository. This criterion supports MGR RD 3.3.D, 3.3.H, and 3.4.2.B.

II. Criterion Performance Parameter Basis

N/A

1.2.1.5 Criterion Basis Statement

I. Criterion Need Basis

This criterion defines the speed at which the system has to process assembly waste so that the overall MGR receipt rates can be met. This criterion supports MGR RD 3.2.C and 3.2.E.

II. Criterion Performance Parameter Basis

The annual throughput quantities for Site Recommendation have not been defined. This criterion has been identified as TBD-3897.

1.2.1.6 Criterion Basis Statement

I. Criterion Need Basis

This criterion defines the speed at which the system must return transportation casks to the Carrier/Cask Handling System in support of the higher level MGR requirement for returning a usable transportation cask to service for the Regional Servicing Contractor. This criterion supports MGR RD 3.4.2.B.

II. Criterion Performance Parameter Basis

The cask turnaround time values were obtained from input transmittal "Monitored Geologic Repository System Throughput and Cask Turnaround Rates" Table 7.2-5. This criterion contains TBV-098.

1.2.1.7 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports the system's ability to blend SNF waste and to accommodate unplanned shutdowns. A method called blending is utilized to load DCs with a heat output of less than 11.8 kW. This involves combining hotter and cooler assemblies from different baskets. Blending requires storing some of the hotter fuel assemblies in a fuel-blending inventory pools until cooler assemblies are available. This criterion supports MGR RD 3.2.C and 3.2.E. The need to accommodate blending is identified in "Monitored Geologic Repository Project Description Document" (Section 5.2.14) to meet the waste package heat output limit.

II. Criterion Performance Parameter Basis

N/A

1.2.1.8 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports the MGR waste preparation process by determining the cask condition prior to and during the opening process. This criterion supports MGR RD 3.2.C and 3.3.A. The need to perform cask inspection is identified in "Design Criteria for an Independent Spent Fuel Storage Installation (Water Pool Type)" (ANSI/ANS 57.7-1988), paragraphs 6.4.2.2 and 6.4.2.3.

II. Criterion Performance Parameter Basis

The actual parameters to be evaluated have not been confirmed and, therefore, are identified with a TBD-317.

1.2.1.9 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports the requirements to limit the amount of water contained within the loaded DC prior to welding. This criterion supports MGR RD 3.1.C and 10 CFR 63.113(b).

II. Criterion Performance Parameter Basis

The value of 0.25 volume percent for assembly vacuum drying came from the "Standard Review Plan for Dry Cask Storage Systems," p. 8-4. This value needs to be verified for long-term disposal and has been identified with TBV-094.

1.2.1.10 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports regulatory requirements by preventing oxidation of the fuel prior to welding. Fuel oxidation could prevent the waste package from meeting its long-term performance objectives. This criterion supports MGR RD 3.1.C and 10 CFR 63.113(b).

II. Criterion Performance Parameter Basis

N/A

1.2.1.11 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports the MGR waste acceptance and transportation process by handling any canistered waste forms that require remedial processing. This criterion supports MGR RD 3.4.2.D.

II. Criterion Performance Parameter Basis

N/A

1.2.2.1.1 Criterion Basis Statement

I. Criterion Need Basis

This criterion is derived from MGR RD 3.1.C, 10 CFR 63.111(a)(2), 63.111(b)(2), and 63.112(e)(8) requirements to mitigate the effects from design basis events and ensure the SSCs important to safety will perform their necessary safety functions. The drop of a spent fuel assembly basket onto another assembly basket is the bounding consequence Category 2 event for the system. This criterion provides requirements on the dry assembly handling SSCs to ensure that the drop of a loaded SNF assembly basket onto another loaded SNF assembly basket does not become a Category 1 or 2 design basis event.

II. Criterion Performance Parameter Basis

The Category 1 and 2 internal design basis events involving spent fuel assemblies are identified in Table 7 of the "Preliminary Selection of MGR Design Basis Events." The design basis event frequencies for the system have not been verified; therefore, this criterion is identified with TBV-3693.

1.2.2.1.2 Criterion Basis Statement

I. Criterion Need Basis

This criterion is derived from MGR RD 3.1.C, 10 CFR 63.111(b)(2), and 63.112(e)(8) requirements to mitigate the effects from design basis events and ensure the SSCs important to safety will perform their necessary safety functions. This criterion establishes a requirement on the spent fuel assembly transfer baskets and basket staging racks to withstand a Frequency Category 2 design basis earthquake to prevent criticality. The need to maintain criticality as a Beyond Design Basis Event is identified in Table 10 and Section 6.2.5.8 of the "Preliminary Selection of MGR Design Basis Events."

II. Criterion Performance Parameter Basis

The design basis earthquake frequency category has not been confirmed; therefore, it has been identified with TBV-1246.

1.2.2.1.3 Criterion Basis Statement

I. Criterion Need Basis

This criterion is derived from MGR RD 3.1.C, 10 CFR 63.111(a)(2), and 63.112(e)(8) requirements to mitigate the effects from design basis events and ensure the SSCs important to safety will perform their necessary safety functions. This criterion provides requirements on SNF assembly/assembly basket lifting systems to prevent a radiological release in the event of a Frequency Category 1 design basis earthquake. The need to design SSCs important to safety to withstand the effects of design basis earthquake is identified in section 6.1.3.2 of the "Preliminary Selection of MGR Design Basis Events."

II. Criterion Performance Parameter Basis

The design basis earthquake frequency category has not been confirmed; therefore, it has been identified with TBV-1246.

1.2.2.1.4 Criterion Basis Statement

I. Criterion Need Basis

This criterion is derived from MGR RD 3.1.C, 3.1.G, 10 CFR 63.111(b)(2), and 63.112(e)(8) requirements to mitigate the effects from design basis events and ensure that SSCs important to safety will perform their necessary safety functions. This criterion provides requirements to prevent overhead cranes and fuel handling machines from falling onto unconfined SNF in the event of a Frequency Category 2 design basis earthquake. The need to design SSCs important to safety to withstand the effects of design basis earthquake is identified in section 6.1.3.2 of the "Preliminary Selection of MGR Design Basis Events." This criterion was identified by specific guidance contained in the "Monitored Geologic Repository (MGR) Compliance Program Guidance Package for the Assembly Transfer System," Guidance Statement 6.3g1.

II. Criterion Performance Parameter Basis

The design basis earthquake frequency category has not been confirmed; therefore, it has been identified with TBV-1246.

1.2.2.1.5 Criterion Basis Statement

I. Criterion Need Basis

This criterion is derived from MGR RD 3.1.C, 10 CFR 63.111(a)(2), and 63.112(e)(8) requirements to mitigate the effects from design basis events and ensure that SSCs important to safety will perform their necessary safety functions. This criterion reduces the probability of design basis events due to a loss of electrical power. The need to design SSCs important to safety to retain the load during loss of electrical power is identified in Section 6.1.3.1 of the "Preliminary Selection of MGR Design Basis Events."

II. Criterion Performance Parameter Basis

N/A

1.2.2.1.6 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports criticality control for the system. This criterion is derived from MGR RD 3.1.C, 3.3.A, and 10 CFR 63.112(e)(6). The need for criticality control is identified in Section 6.2.5.8 of the "Preliminary Selection of MGR Design Basis Events."

II. Criterion Performance Parameter Basis

The performance parameters for this requirement are taken from Sections IV.1 and IV.2 (p. 6-1) of the "Standard Review Plan for Dry Cask Storage Systems" (NUREG-1536).

1.2.2.1.7 Criterion Basis Statement

I. Criterion Need Basis

This criterion identifies the need to provide for emergency shutdown of the system in a controlled manner. This criterion implements MGR RD 3.1.C, 3.3.A, and 10 CFR 63.112(e)(10). This criterion is also identified in "Design Criteria for an Independent Spent Fuel Storage Installation (Dry Type)" (ANSI/ANS 57.9-1992, paragraph 6.2.1.1.2).

II. Criterion Performance Parameter Basis

N/A

1.2.2.1.8 Criterion Basis Statement

I. Criterion Need Basis

This criterion implements the requirements from MGR RD 3.1.B for the identification of "Standards for Protection Against Radiation" (10 CFR 20); MGR RD 3.1.C for the identification of 10 CFR 63.111(a)(1) and 10 CFR 63.112(e)(2); and MGR RD 3.1.G for the need to address radiological health and safety. This criterion is also supported by specific guidance contained in the "Monitored Geologic Repository (MGR) Compliance Program Guidance Package for the Assembly Transfer System," Guidance Statements 6.5g1 and 6.6g1.

The primary requirement for ALARA is contained in 10 CFR 20.1101(b), which states: "The licensee shall use, to the extent practicable, procedures and engineering controls based upon sound radiation protection principles to achieve occupational doses and doses to the members of the public that are as low as is reasonably achievable (ALARA)."

Compliance with "Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations will be as Low as is Reasonably Achievable" (Regulatory Guide 8.8) is invoked because this regulatory guide is one of the primary regulatory documents that addresses ALARA and is acceptable to the U.S. Nuclear Regulatory Commission. This regulatory guide provides guidelines on achieving the occupational ALARA goals during the planning, design, and operations phases of a nuclear facility. According to Section B of this guide: "Effective design of facilities and selection of equipment for systems that contain, collect, store, process, or transport radioactive material in any form will contribute to the effort to maintain radiation doses to station personnel ALARA." Section C.2 addresses facility and equipment design features. The design process of each system must include an evaluation of the applicable requirements in Section C.2 of Regulatory Guide 8.8.

In addition to following the guidelines in Regulatory Guide 8.8, the design of the system must meet the project ALARA program goals. The project ALARA program will include both qualitative and quantitative goals. Regarding the ALARA program of a licensee, Section C.1.a.(2) of Regulatory Guide 8.8 states: "The policy and commitment should be reflected in written administrative procedures and instructions for operations involving potential exposures of personnel to radiation and should be reflected in station design features. Instructions to designers, constructors, vendors, and station personnel specifying or reviewing station features, systems, or equipment, should reflect the goals and objectives to maintain occupational radiation exposures ALARA."

II. Criterion Performance Parameter Basis

The ALARA program goals are TBD-406.

1.2.2.1.9 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.3.A for the identification of recovery features for equipment failures, off-normal events, and accidents. Specifically, the need for recovery features is identified in "Design Criteria for an Independent Spent Fuel Storage Installation (Dry Type)" (ANSI/ANS-57.9-1992) paragraph 6.2.1.1.11.

II. Criterion Performance Parameter Basis

N/A

1.2.2.1.10 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.1.C, 3.1.G, 10 CFR 63.111(a)(2), and 63.112(e)(8) for the identification of applicable regulatory requirements to reduce the potential for design basis events. Specifically, this criterion reduces the potential effects of dropping transportation casks and or DPC overpacks on spent fuel assemblies located below. This criterion was identified by specific guidance contained in the "Monitored Geologic Repository (MGR) Compliance Program Guidance Package for the Assembly Transfer System," Guidance Statement 6.8g4.

II. Criterion Performance Parameter Basis

N/A

1.2.2.1.11 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.1.C, 3.1.G, 3.3.A, 10 CFR 63.111(a)(2), and 63.112(e)(8) for the identification of applicable regulatory requirements to reduce the potential for design basis events. Specifically, this criterion identifies the need to detect changes in lifting loads during handling to protect SSCs from damage and reduce the potential for design basis events. This criterion was identified by specific guidance contained in the "Monitored Geologic Repository (MGR) Compliance Program Guidance Package for the Assembly Transfer System," Guidance Statement 6.15g1. This criterion is also supported by "Design Criteria for an Independent Spent Fuel Storage Installation (Water Pool Type)" (ANSI/ANS-57.7-1988, paragraph 6.5.2.16).

II. Criterion Performance Parameter Basis

N/A

1.2.2.1.12 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.1.G and 3.4.2.H and defines the allowable levels of radiological contamination on the exterior surface of packages offered for shipment.

II. Criterion Performance Parameter Basis

"Shippers. General Requirements for Shipments and Packagings." (49 CFR 173, Ch.1, Section 443) relates to allowable levels of fixed-plus removable contamination on packages of radioactive materials offered for shipment.

1.2.2.1.13 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.1.B and 3.1.C. This criterion reduces the spread of radioactive contamination and supports radiological safety for personnel as defined in "Standards for Protection Against Radiation" (10 CFR 20 (all)) and 10 CFR 63.111(a)(1). This criterion defines an intermediate level of decontamination prior to the DC going to the Disposal Container Handling System.

II. Criterion Performance Parameter Basis

The actual parameters to be evaluated have not been confirmed. As a result, this criterion is identified with a TBD-169.

1.2.2.2.1 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.1.G for fire safety requirements derived from NRC regulatory guides. The subject criterion is specifically identified in "General Fire Protection Guide for Fuel Reprocessing Plants" (Regulatory Guide 3.38), Sections C.2a and C.4a.

II. Criterion Performance Parameter Basis

N/A

1.2.2.2.2 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.1.C, 3.1.G, and 10 CFR 63.21(c)(17) for the need to facilitate decommissioning and decontamination at the end of the system life. This criterion was also identified by specific guidance contained in the "Monitored Geologic Repository (MGR) Compliance Program Guidance Package for the Assembly Transfer System," Guidance Statement 6.3g2.

II. Criterion Performance Parameter Basis

N/A

1.2.3.1 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports the flowdown of codes and standards from MGR RD 3.3.A. Temperature can directly affect the performance or result in advanced degradation of a component. To ensure proper performance, many equipment manufacturers specify the normal temperature environment in which the component must operate. Manufacturers may also specify the maximum off-normal temperature environment that the components can be exposed to or operate in for a limited time. The off-normal condition may be caused by loss of electric power or failure of the ventilation system.

II. Criterion Performance Parameter Basis

Temperature values are based on input from, "Waste Handling Building Ventilation System Description Document."

Temperature environment during off-normal conditions for all areas (except the electronics equipment areas) are TBD (TBD-0395).

1.2.3.2 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports the flowdown of codes and standards from MGR RD 3.3.A. Humidity can affect performance of computers, electronic, electrical, and mechanical components. Low humidity may result in static discharge in electrical and electronic equipment. High humidity can result in advanced corrosion or biological growth within the component. High humidity may also affect the operation of recorders that use paper. High humidity is not expected to be a major concern at the MGR due to the generally dry climate; however, depending on the nature of the operations, some areas may exhibit high humidity conditions. To ensure proper performance, many equipment manufacturers specify the humidity environment in which the component must operate. This criterion establishes the indoor humidity environment in which components are expected to operate based on the intended installation location.

Humidity is not controlled during off-normal conditions because of the generally mild humidity environment at the repository, and the expected short-term duration of off-normal conditions, such as loss of power or ventilation system failure.

II. Criterion Performance Parameter Basis

Humidity values for occupied areas and electronics equipment areas are based on input from, "Waste Handling Building Ventilation System Description Document."

Humidity values for other areas are TBD (TBD-0409).

1.2.3.3 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports the waste handling requirements of MGR RD 3.3.A by identifying the radiation environment in which the waste handling equipment will be exposed. Radiation from fuel assemblies, high-level waste canisters, or other radioactive sources can affect electrical and electronic components. Accumulated doses of radiation (also referred to as Total Integrated Dose) can cause eventual degradation of components containing organic compounds, such as electrical insulation and lubricants. Accumulated doses can also cause damage to components containing polymers. In addition to the material degradation issue, real-time operation of an electronic device may be compromised by the type of radiation it receives, such as neutrons colliding with the lattice atoms of the semiconductor.

Most of the electronic and electrical components will be located in mild environments with small radiation doses. Components that will be installed in radiation environments should be evaluated for the radiation doses that they can receive and, where applicable, susceptibility to the type of radiation (X-ray, Gamma) should also be considered.

Shielding, distance, and duration of exposure can significantly reduce the radiation dose and type of radiation that a component receives. Therefore, detailed analyses on a case by case basis will determine the economic feasibility and practicability of providing shielding, distance from the source, minimizing exposure time, frequent replacement of the affected component, or qualification of the component for the radiation environment.

It should be emphasized that this criterion addresses the radiation doses that can affect operability of the components during normal operations, and is not intended to invoke environmental qualification requirements for post-accident operability.

II. Criterion Performance Parameter Basis

The radiation environment is TBD-405.

1.2.4.1 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports the waste handling operations of MGR RD 3.2.C. This criterion is needed to ensure that the system is compatible with interfacing MGR systems. Specifically, the empty DC needs to be received from the Disposal Container Handling System prior to SNF loading by the system. The DC also needs to be configured for the expected type of fuel to be loaded (e.g., baskets).

II. Criterion Performance Parameter Basis

N/A

1.2.4.2 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports the waste handling operations of MGR RD 3.2.C. This criterion is needed to ensure that the system is compatible with interfacing MGR systems. Specifically, this criterion identifies interfaces with the Carrier/Cask Handling System for receiving transportation casks containing SNF for unloading.

II. Criterion Performance Parameter Basis

N/A

1.2.4.3 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports the waste handling operations of MGR RD 3.2.C. This criterion is needed to ensure that the system is compatible with interfacing MGR systems. Specifically, this criterion identifies interfaces with the Carrier/Cask Handling System for returning transportation casks and DPCs after they have been unloaded.

II. Criterion Performance Parameter Basis

N/A

1.2.4.4 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports the waste handling operations of MGR RD 3.2.C. This criterion is needed to ensure that the system is compatible with interfacing MGR systems. Specifically, this criterion identifies interfaces with the Disposal Container Handling System after the DC has been loaded.

II. Criterion Performance Parameter Basis

N/A

1.2.4.5 Criterion Basis Statement

I. Criterion Need Basis

This criterion is needed to ensure that the system is compatible with interfacing MGR systems. Specifically, this criterion identifies interfaces with Monitored Geologic Repository Operations Monitoring and Control System for centralized monitoring and control. This criterion supports the waste handling operations of MGR RD 3.2.C. This criterion also supports the interface ability to provide communications and control of MGR RD 3.3.K with this waste handling system. This criterion identifies typical summary level inputs and outputs of the system.

II. Criterion Performance Parameter Basis

N/A

1.2.4.6 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports the waste handling operations of MGR RD 3.2.C. This criterion is needed to ensure that the system is compatible with interfacing MGR systems. Specifically, this criterion identifies interfaces with the Waste Handling Building Electrical System for power to operate system equipment.

II. Criterion Performance Parameter Basis

N/A

1.2.4.7 Criterion Basis Statement

I. Criterion Need Basis

This criterion provides for the tracking of all casks, DPCs, assemblies, and DCs handled by the system. This criterion supports MGR RD 3.3.K requirements to maintain nuclear inventories and support safeguards and security activities. This requirement supports the MGR RD 3.1.D requirement to implement applicable provisions of "Physical Protection of Plants and Materials" (10 CFR 73, Section 45(d)(1)(iii)). This requirement also supports MGR RD 3.1.C for the interim guidance of 10 CFR 63.78.

II. Criterion Performance Parameter Basis

N/A

1.2.4.8 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.3.A for engineering principles and practices. This criterion is needed to ensure that the system is compatible with external interfacing MGR systems. Specifically, this criterion identifies interfaces with system equipment for static and dynamic loads.

II. Criterion Performance Parameter Basis

N/A

1.2.4.9 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports the waste handling operations of MGR RD 3.2.C. This criterion is needed to ensure that the system is compatible with interfacing MGR systems. Specifically, this criterion identifies interfaces with the Waste Handling Building System for operating space, storage pools, and support services.

II. Criterion Performance Parameter Basis

N/A

1.2.4.10 Criterion Basis Statement

I. Criterion Need Basis

This criterion is derived as a result of the License Application Design Selection effort. This criterion plays a role in the thermal loading of the repository. The waste package power output limitation of 11.8 kW was obtained from "Monitored Geologic Repository Project Description Document" (Section 5.2.13).

II. Criterion Performance Parameter Basis

N/A

1.2.5.1 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.2.C and 3.3.A. The subject requirement addresses and quantifies the parent requirement for availability.

II. Criterion Performance Parameter Basis

The value for the availability is from the "Bounded Minimum Inherent Availability Requirements for the System Description Documents," Table 7.2-1. This value is from an uncontrolled source and is therefore TBV (TBV-4655).

1.2.5.2 Criterion Basis Statement

I. Criterion Need Basis

This criterion implements applicable regulatory guidance from MGR RD 3.1.C, 3.1.G, and 10 CFR 63.112(e)(13) for maintenance, periodic inspection, testing, and decontamination of system equipment. This criterion also addresses the recovery of remotely operated equipment located in radiation environments. This criterion was identified by specific guidance contained in the "Monitored Geologic Repository (MGR) Compliance Program Guidance Package for the Assembly Transfer System," Guidance Statement 6.3g3.

This criterion also supports MGR RD 3.3.A for the need to recover failed equipment as identified in "Design Criteria for an Independent Spent Fuel Storage Installation (Dry Type)" (ANSI/ANS-57.9-1992, paragraph 6.2.1.1.11).

II. Criterion Performance Parameter Basis

N/A

1.2.6.1 Criterion Basis Statement

I. Criterion Need Basis

This criterion identifies applicable codes and standards and supports the requirements of MGR RD 3.1.E. This criterion requires that system safety criteria be considered in the design of the MGR using "Occupational Safety and Health Standards" (29 CFR 1910).

II. Criterion Performance Parameter Basis

N/A

1.2.6.2 Criterion Basis Statement

I. Criterion Need Basis

This criterion identifies applicable codes and standards and supports the requirements of MGR RD 3.1.G. This criterion requires the design of equipment to be in accordance with "Rules for Construction of Overhead and Gantry Cranes (Top Running Bridge, Multiple Girder)" (ASME NOG-1-1998). This criterion was identified by specific guidance contained in the "Monitored Geologic Repository (MGR) Compliance Program Guidance Package for the Assembly Transfer System," Guidance Statement 7.14g1.

II. Criterion Performance Parameter Basis

N/A

1.2.6.3 Criterion Basis Statement

I. Criterion Need Basis

This criterion identifies applicable codes and standards and supports the requirements of MGR RD 3.1.G. This criterion requires the design of equipment to be in accordance with

"Design Requirements for Light Water Reactor Fuel Handling Systems" (ANSI/ANS 57.1-1992). This criterion was identified by specific guidance contained in the "Monitored Geologic Repository (MGR) Compliance Program Guidance Package for the Assembly Transfer System," Guidance Statement 7.3g1.

II. Criterion Performance Parameter Basis

N/A

1.2.6.4 Criterion Basis Statement

I. Criterion Need Basis

This criterion identifies applicable codes and standards and supports the requirements of MGR RD 3.1.G. This criterion requires the design of equipment to be in accordance with "Design Criteria for an Independent Spent Fuel Storage Installation (Water Pool Type)" (ANSI/ANS 57.7-1988). This criterion was identified by specific guidance contained in the "Monitored Geologic Repository (MGR) Compliance Program Guidance Package for the Assembly Transfer System," Guidance Statement 7.4g1.

II. Criterion Performance Parameter Basis

N/A

1.2.6.5 Criterion Basis Statement

I. Criterion Need Basis

This criterion identifies applicable codes and standards and supports the requirements of MGR RD 3.1.G. This criterion requires the design of equipment to be in accordance with "Design Criteria for an Independent Spent Fuel Storage Installation (Dry Type)" (ANSI/ANS 57.9-1992). This criterion was identified by specific guidance contained in the "Monitored Geologic Repository (MGR) Compliance Program Guidance Package for the Assembly Transfer System," Guidance Statement 7.5g1.

II. Criterion Performance Parameter Basis

N/A

1.2.6.6 Criterion Basis Statement

I. Criterion Need Basis

This criterion identifies applicable codes and standards and supports the requirements of MGR RD 3.1.G. This criterion requires the design of equipment to be in accordance with "Specifications for Top Running Bridge and Gantry Type Multiple Girder Electric

Overhead Traveling Cranes" (CMAA-70-94). This criterion was identified by specific guidance contained in the "Monitored Geologic Repository (MGR) Compliance Program Guidance Package for the Assembly Transfer System," Guidance Statement 7.1g1.

II. Criterion Performance Parameter Basis

N/A

1.2.6.7 Criterion Basis Statement

I. Criterion Need Basis

This criterion identifies applicable codes and standards and supports the requirements of MGR RD 3.1.G. This criterion requires the design of equipment to be in accordance with "Specifications for Top Running & Under Running Single Girder Electric Overhead Traveling Cranes Utilizing Under Running Trolley Hoist" (CMAA-74-94). This criterion was identified by specific guidance contained in the "Monitored Geologic Repository (MGR) Compliance Program Guidance Package for the Assembly Transfer System," Guidance Statement 7.2g1.

II. Criterion Performance Parameter Basis

N/A

1.2.6.8 Criterion Basis Statement

I. Criterion Need Basis

This criterion identifies applicable codes and standards and supports the requirements of MGR RD 3.1.G. This criterion requires the design of equipment to be in accordance with "Standard Specification for Boron-Based Neutron Absorbing Material Systems for Use in Nuclear Spent Fuel Storage Racks" (ASTM C992-89). This criterion was identified by specific guidance contained in the "Monitored Geologic Repository (MGR) Compliance Program Guidance Package for the Assembly Transfer System," Guidance Statement 7.17g1.

II. Criterion Performance Parameter Basis

N/A

1.2.6.9 Criterion Basis Statement

I. Criterion Need Basis

This criterion identifies applicable codes and standards and supports the requirements of MGR RD 3.1.G. This criterion requires the design of equipment to be in accordance with "Design Objectives for Highly Radioactive Solid Material Handling and Storage

Facilities in a Reprocessing Plant" (ANSI N305). This criterion was identified by specific guidance contained in the "Monitored Geologic Repository (MGR) Compliance Program Guidance Package for the Assembly Transfer System," Guidance Statement 7.8g1.

II. Criterion Performance Parameter Basis

N/A

1.2.6.10 Criterion Basis Statement

I. Criterion Need Basis

This criterion identifies applicable codes and standards and supports the requirements of MGR RD 3.1.G. This criterion requires the design of equipment to be in accordance with "American National Standard for Radioactive Materials - Special Lifting Devices for Shipping Containers Weighing 10000 Pounds (4500 kg) or More" (ANSI N14.6-1993). This criterion was identified by specific guidance contained in the "Monitored Geologic Repository (MGR) Compliance Program Guidance Package for the Assembly Transfer System," Guidance Statement 7.7g1.

II. Criterion Performance Parameter Basis

N/A

1.2.6.11 Criterion Basis Statement

I. Criterion Need Basis

This criterion identifies applicable codes and standards and supports the requirements of MGR RD 3.3.A. This criterion requires the design of equipment to be in accordance with "Guide for the Installation of Electrical Equipment to Minimize Electrical Noise Inputs to Controllers from External Sources" (IEEE Std 518-1982). This criterion defines the engineering and installation practices that will be used in the design of the MGR to protect against electromagnetic interference.

The ability of the control system to perform according to the manufacturer's guarantees is dependent on the quality of the signal of the attached transducer. The signal quality will depend on the elimination or attenuation of noise on the transducer's signal. Two types of external noise that will be picked up on the signal leads are normal mode and common mode. Engineering practices do not intend to recommend an internal design of equipment for the prevention of the generation of electrical noise resulting from equipment operation. All electrical noise can be protected against with proper installation. Most noise will be eliminated by following industry guides (such as IEEE) that suggest a systematic approach to eliminate noise interference with electrical controllers. Most popular guides on noise elimination follow simple industry rules such as spacing recommendations, shielded cable, separate instrument and safety ground systems. A large percentage of noise interference will be eliminated with adequate design guides and proper planning. However, even in the most stringent installations, a small percentage of signals will be affected by external noise usually due to ground loops, improper installation, or an unshielded signal. The small percentage of affected signals are caught and corrected during system checkout.

II. Criterion Performance Parameter Basis

N/A

1.2.6.12 Criterion Basis Statement

I. Criterion Need Basis

Design, selection, arrangement, configuration, and integration of SSCs involve many elements, including monitoring, operating, maintaining, and observing the facilities and systems. To accomplish an effective and safe work environment, the human-system interface must incorporate human factors engineering (HFE) criteria. Use of the "Department of Defense Design Criteria Standard, Human Engineering" (MIL-STD-1472E), in conjunction with the other HFE standards and guidelines cited in this system description document (SDD), will provide a human-system interface that maximizes performance and minimizes risk to personnel.

In support of MGR RD 3.3.A, this criterion ensures that the system will be designed to be safely and effectively used by all expected users. The DOE Good Practices Guide "Human Factors Engineering" (GPG-FM-027, paragraph 2.3.1), endorses the use of MIL-STD-1472E (GPG-FM-027 references an earlier version of MIL-STD-1472).

II. Criterion Performance Parameter Basis

N/A

1.2.6.13 Criterion Basis Statement

I. Criterion Need Basis

Maintainability of system equipment involves many factors, including the human-machine interface. This interface must address the design for maintainability through the incorporation of HFE criteria. In support of MGR RD 3.3.A, this criterion ensures that the system will be designed to be safely and effectively maintained through compliance with applicable industry standards. The DOE Good Practices Guide "Human Factors Engineering" (GPG-FM-027, paragraph 2.3.1), endorses the use of "Human Factors Design Guidelines for Maintainability of Department of Energy Nuclear Facilities" (UCRL-15673) for addressing HFE maintainability design criteria.

II. Criterion Performance Parameter Basis

N/A

1.2.6.14 Criterion Basis Statement

I. Criterion Need Basis

Design, selection, arrangement, configuration, and integration of control rooms, operating galleries, and related SSCs (e.g., controls, displays, labels, workspaces, human-computer interfaces) involve many factors, including the human-machine interface. Through compliance with "Human-System Interface Design Review Guideline" (NUREG-0700), in conjunction with other HFE standards and guidelines, this criterion ensures that control rooms, operating galleries, and related SSCs will be designed in a safe and effective manner.

This criterion supports MGR RD 3.3.A. The DOE Good Practices Guide "Human Factors Engineering" (GPG-FM-027, paragraph 2.3.1) supports the use of NUREG-0700.

This criterion was also identified by specific guidance contained in the "Monitored Geologic Repository (MGR) Compliance Program Guidance Package for the Assembly Transfer System," Guidance Statement 6.9g1.

II. Criterion Performance Parameter Basis

N/A

1.2.6.15 Criterion Basis Statement

I. Criterion Need Basis

Information being communicated by safety signs and tags must be capable of being quickly and easily read and uniformly understood. The ANSI Z535 series standards (i.e., "Safety Color Code" (ANSI Z535.1-1998), "Environmental and Facility Safety Signs" (ANSI Z535.2-1998), "Criteria for Safety Symbols" (ANSI Z535.3-1998), "Product Safety Signs and Labels" (ANSI Z535.4-1998), and "Accident Prevention Tags (for Temporary Hazards)" (ANSI Z535.5-1998)) are recognized in the nuclear industry for the design and use of safety signs and tags. In support of MGR RD 3.3.A, this criterion ensures that, when used in conjunction with other HFE standards and guidelines, the design of safety signs and tags will help provide a safer working environment.

II. Criterion Performance Parameter Basis

N/A

1.2.6.16 Criterion Basis Statement

I. Criterion Need Basis

Design, selection, and integration of computer display terminals and workstations, equipment, and workspaces involve many factors, including the human-computer interface. "American National Standard for Human Factors Engineering of Visual Display Terminal Workstations" (ANSI/HFS 100-1988), "Ergonomic Requirements for Office Work with Visual Display Terminals (VDTs) - Part 3: Visual Display Requirements" (ISO 9241-3), and "Ergonomic Requirements for Office Work with Visual Display Terminals (VDTs) - Part 8: Requirements for Displayed Colours" (ISO 9241-8), support MGR RD 3.3.A by ensuring that HFE criteria will be incorporated into the selection and design of computer equipment and workspaces through compliance with applicable industry standards. The DOE Good Practices Guide "Human Factors Engineering" (GPG-FM-027, paragraph 2.3.1) endorses use of the ISO 9241 standard. When used in conjunction with other HFE standards and guidelines, these codes and standards will ensure a safe and efficient design.

II. Criterion Performance Parameter Basis

N/A

1.2.6.17 Criterion Basis Statement

I. Criterion Need Basis

Design, selection, and integration of software supporting the user interface in computer systems must consider the characteristics of the user population. In support of MGR RD 3.3.A, the application of "Guidelines for Designing User Interface Software" (ESD-TR-86-278), "Ergonomic Requirements for Office Work with Visual Display Terminals (VDTs) - Part 10: Dialogue Principles" (ISO 9241-10), "Ergonomic Requirements for Office Work with Visual Display Terminals (VDTs) - Part 14: Menu Dialogues" (ISO 9241-14), and "Ergonomic Requirements for Office Work with Visual Display Terminals (VDTs) - Part 15: Command Dialogues" (ISO 9241-15), ensures that HFE criteria will be incorporated into the selection, design, and integration of user interface software.

The DOE Good Practices Guide "Human Factors Engineering" (GPG-FM-027, paragraphs 2.3.1) endorses the use of the ISO 9241 standard. When used in conjunction with other HFE standards and guidelines, these codes and standards will ensure a safe and efficient design implementation.

II. Criterion Performance Parameter Basis

N/A

1.2.6.18 Criterion Basis Statement

I. Criterion Need Basis

This criterion identifies applicable codes and standards and supports the requirements of MGR RD 3.3.A. The "National Electrical Code" (NFPA 70, 1999) contains provisions considered necessary for safeguarding of personnel and SSCs from hazards arising from the use of electricity.

II. Criterion Performance Parameter Basis

N/A

1.2.6.19 Criterion Basis Statement

I. Criterion Need Basis

This criterion identifies applicable codes and standards and supports the requirements of MGR RD 3.3.A. The "Standard for the Protection of Electronic Computer/Data Processing Equipment" (NFPA-75) provides minimum requirements for the protection of electronic computer/data processing equipment from damage by fire or its associated effects; i.e., smoke, corrosion, heat, water.

II. Criterion Performance Parameter Basis

N/A

1.2.6.20 Criterion Basis Statement

I. Criterion Need Basis

This criterion identifies applicable codes and standards and supports the requirements of MGR RD 3.3.A. "IEEE Recommended Practice for Powering and Grounding Sensitive Electronic Equipment" (IEEE Std 1100-1992) provides a consensus of recommended practices in an area where conflicting information and confusion, stemming primarily from different view points of the same problem, have dominated. IEEE Std 1100-1992 addresses electronic equipment performance issues while maintaining a safe installation.

II. Criterion Performance Parameter Basis

N/A

1.2.6.21 Criterion Basis Statement

I. Criterion Need Basis

This criterion identifies applicable codes and standards and supports the requirements of MGR RD 3.3.A. "IEEE Standard for Information Technology - Open Systems Interconnection (OSI) Abstract Data Manipulation - Application Program Interface (API) [Language Independent]" (IEEE Std 1224-1993) provides a language-independent specification of an interface and environment to support application portability at the source code level.

II. Criterion Performance Parameter Basis

N/A

1.2.6.22 Criterion Basis Statement

I. Criterion Need Basis

This criterion identifies applicable codes and standards and supports the requirements of MGR RD 3.3.A. The "Application of Safety Instrumented Systems for the Process Industries" (ANSI/ISA-S84.01-1996) provides design requirements for safety instrumented systems for process industries.

II. Criterion Performance Parameter Basis

N/A

1.2.6.23 Criterion Basis Statement

I. Criterion Need Basis

This criterion identifies applicable codes and standards derived from NUREGs and Regulatory Guides and supports the requirements of MGR RD 3.1.G. This criterion requires the design of equipment to be in accordance with "Standard Guide for Design of Equipment for Processing Nuclear and Radioactive Materials" (ASTM C 1217-92). This criterion was identified by specific guidance contained in the "Monitored Geologic Repository (MGR) Compliance Program Guidance Package for the Assembly Transfer System," Guidance Statement 7.18g1.

II. Criterion Performance Parameter Basis

N/A

1.2.6.24 Criterion Basis Statement

I. Criterion Need Basis

The "Monitored Geologic Repository Project Description Document" allocates controlled project assumptions to systems. This criterion identifies the need to comply with the applicable assumptions identified in the subject document. The approved assumptions will provide a consistent basis for continuing the system design.

II. Criterion Performance Parameter Basis

N/A

1.2.6.25 Criterion Basis Statement

I. Criterion Need Basis

This criterion identifies applicable codes and standards and supports the requirements of MGR RD 3.1.F. This criterion requires that system safety criteria be considered in the construction of the MGR using "Safety and Health Regulations for Construction" (29 CFR 1926).

II. Criterion Performance Parameter Basis

N/A

APPENDIX B ARCHITECTURE AND CLASSIFICATION

The system architecture and classification are identified in Table 8. The QA classifications are established in "Classification of the MGR Assembly Transfer System."

Table 8. System Architecture and QA Classification

Assembly Transfer System (ATS)	QL-1	QL-2	QL-3	CQ
Assembly Drying System		X		
Assembly Handling System, Dry				
Assembly Cell Manipulator				X
Bridge Crane		X		
DC Load Port Mating Device		X		
Dry Assembly Transfer Machine		X		
Lifting Fixtures		X		
Assembly Handling System, Wet				
Assembly Transfer Baskets	X			
Basket Staging Racks	X			
Wet Assembly Transfer Machine		X		
Basket Transport Systems				X
Cask & DPC Preparation System				
Bridge Crane		X		
Cooling System		X		
Decontamination System		X		
DPC Lid Severing Tool		X		
Lifting Fixtures		X		
Preparation Manipulator			X	
Sampling System				X
Cask Transport System				X
Control and Tracking System		X		
DC Preparation System				
DC Decontamination System		X		
DC Inerting System		X		
DC Transport System				X

APPENDIX C ACRONYMS, SYMBOLS, AND UNITS

C.1 ACRONYMS

This section provides a listing of acronyms used in this document.

ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers
ALARA	As Low as Reasonably Achievable
ATS	Assembly Transfer System
BWR	Boiling Water Reactor
CCHS	Carrier/Cask Handling System
CCTV	Closed-Circuit Television
CSNF	Commercial Spent Nuclear Fuel
CQ	Conventional Quality
DC	Disposal Container
DCHS	Disposal Container Handling System
DOE	U.S. Department of Energy
DPC	Dual-Purpose Canister
F	Function
HFE	Human Factors Engineering
HHT	Heavy Haul Trucks
HI-STAR	Holtec International-Storage, Transport, and Repository
IEEE	Institute of Electrical and Electronics Engineers
LWT	Legal-Weight Truck
MGR RD	Monitored Geologic Repository System Requirements Document
MGR	Monitored Geologic Repository
MPC	Multi-Purpose Canister
NAC	Nuclear Assurance corporation (NAC) International, Inc.
NUHOMS®	Nutech Horizontal Modular System®
PWR	Pressurized Water Reactor
QA	Quality Assurance
QL	Quality Level
SDD	System Description Document
SNF	Spent Nuclear Fuel
SSCs	Structures, Systems, and Components
STC	Storage and Transportation Cask or Canister
TBD	To Be Determined
TBV	To Be Verified
UCF	Uncanistered Commercial Fuel
UMS™	Universal MPC System™
UTC	Universal Transport Canister
WHB	Waste Handling Building

C.2 SYMBOLS AND UNITS

This section provides a listing of symbols and units used in this document.

%	percent
°F	degrees Fahrenheit
cm	centimeters
CO	carbon monoxide
CO_2	carbon dioxide
dpm	disintegration per minute
H_2O	water
ft	feet
k_{eff}	k effective
KW	kilo watt
MTU	metric tons uranium
O_2	oxygen

APPENDIX D FUTURE REVISION RECOMMENDATIONS AND ISSUES

The waste stream for License Application needs to be established.

APPENDIX E REFERENCES

This section provides a listing of references used in this SDD. References list the Accession number or Technical Information Catalog number at the end of the reference, where applicable.

"Accident Prevention Tags (for Temporary Hazards)." National Electrical Manufacturers Association. ANSI Z535.5-1998. 1998. Rosslyn, Virginia: National Electrical Manufacturers Association. TIC: 242949.

"American National Standard For Human Factors Engineering of Visual Display Terminal Workstations." American National Standards Institute. ANSI/HFS 100-1988. 1988. Santa Monica, California: The Human Factors Society, Inc. TIC: 211186.

"American National Standard for Radioactive Materials - Special Lifting Devices for Shipping Containers Weighing 10000 Pounds (4500 kg) or More." American National Standards Institute. ANSI N14.6-1993. 1993. New York, New York: American National Standards Institute. TIC: 236261.

"Application of Safety Instrumented Systems for the Process Industries." Instrument Society of America. ANSI/ISA-S84.01-1996. February 15, 1996. Research Triangle Park, North Carolina: Instrument Society of America. TIC: 244098.

"Bounded Minimum Inherent Availability Requirements for the System Description Documents." CRWMS M&O. B00000000-01717-0200-00147, Rev. 00. March 13,1998. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19980416.0791.

"Characteristics of Potential Repository Wastes." Oak Ridge National Laboratory. DOE/RW-0184-R1. July 1992. Oak Ridge, Tennessee: U.S. Department of Energy, Office of Scientific and Technical Information. ACC: HQO.19920827.0001; HQO.19920827.0002; HQO.19920827.0003; HQO.19920827.0004.

"Classification of the MGR Assembly Transfer System." CRWMS M&O. ANL-ATS-SE-000001, Rev. 00. August 31, 1999. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19990928.0215.

"Criteria for Safety Symbols." National Electrical Manufacturers Association. ANSI Z535.3-1998. 1998. Rosslyn, Virginia.: National Electrical Manufacturers Association. TIC: 242943.

"Department of Defense Design Criteria Standard, Human Engineering." U.S. Department of Defense. MIL-STD-1472E. October 31, 1996. Washington, D.C.: U.S. Department of Defense. TIC: 235204.

"Design Criteria for an Independent Spent Fuel Storage Installation (Dry Type)." American Nuclear Society. ANSI/ANS-57.9-1992. 1992. La Grange Park, Illinois: American Nuclear Society. TIC: 3043.

"Design Criteria for an Independent Spent Fuel Storage Installation (Water Pool Type)." American Nuclear Society. ANSI/ANS-57.7-1988. 1988. La Grange Park, Illinois: American Nuclear Society. TIC: 238870.

"Design Objectives for Highly Radioactive Solid Material Handling and Storage Facilities in a Reprocessing Plant." American Institute of Chemical Engineers. ANSI N305-1975. March 1975. New York, New York: American Institute of Chemical Engineers. TIC: 231659.

"Design Requirements for Light Water Reactor Fuel Handling Systems." American Nuclear Society. ANSI/ANS-57.1-1992. 1992. La Grange Park, Illinois: American Nuclear Society. TIC: 238364.

"Engineering Files for Site Recommendation." CRWMS M&O. TDR-WHS-MD-000001, Rev. 00. 2000. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.20000607.0232.

"Environmental and Facility Safety Signs." National Electrical Manufacturers Association. ANSI Z535.2-1998. 1998. Rosslyn, Virginia.: National Electrical Manufacturers Association. TIC: 242942.

"Ergonomic Requirements for Office Work with Visual Display Terminals (VDTs) - Part 10: Dialogue Principles." International Organization for Standardization. ISO 9241-10, First Edition. May 1, 1996. Geneva, Switzerland: International Organization for Standardization. TIC: 239287.

"Ergonomic Requirements for Office Work with Visual Display Terminals (VDTs) - Part 14: Menu Dialogues." International Organization for Standardization. ISO 9241-14, First Edition. June 1, 1997. Geneva, Switzerland: International Organization for Standardization. TIC: 239290.

"Ergonomic Requirements for Office Work with Visual Display Terminals (VDTs) - Part 15: Command Dialogues." International Organization for Standardization. ISO 9241-15, First Edition. December 15, 1997. Geneva, Switzerland: International Organization for Standardization. TIC: 239291.

"Ergonomic Requirements for Office Work with Visual Display Terminals (VDTs) - Part 3: Visual Display Requirements." International Organization for Standardization. ISO 9241-3, First Edition. July 15, 1992. Geneva, Switzerland: International Organization for Standardization. TIC: 239283.

"Ergonomic Requirements for Office Work with Visual Display Terminals (VDTs) - Part 8: Requirements for Displayed Colours." International Organization for Standardization. ISO 9241-8, First Edition. October 1, 1997. Geneva, Switzerland: International Organization for Standardization. TIC: 239285.

"General Fire Protection Guide For Fuel Reprocessing Plants." U.S. Nuclear Regulatory Commission. Regulatory Guide 3.38, Rev. 0. June 1976. Washington, D.C.: U.S. Nuclear Regulatory Commission. Readily Available.

"Guide for the Installation of Electrical Equipment to Minimize Electrical Noise Inputs to Controllers from External Sources." Institute of Electrical and Electronics Engineers, Inc. IEEE Std 518-1982. October 1, 1982. New York, New York: Institute of Electrical and Electronics Engineers, Inc. TIC: 238872.

"Guidelines for Designing User Interface Software." Smith, Sidney L., and Mosier, Jane N. ESD-TR-86-278. August 1986. Bedford, Massachusetts: The MITRE Corporation. TIC: 210805.

"Human Factors Design Guidelines for Maintainability of Department of Energy Nuclear Facilities." Bongarra, James P. Jr.; VanCott, Harold P.; Pain, Richard F.; Peterson, L. Rolf; Wallace, Ronald I. UCRL-15673. June 18, 1985. Livermore, California: Lawrence Livermore National Laboratory. TIC: 206097.

"Human Factors Engineering." Office of Project and Fixed Asset Management. GPG-FM-027. March 1996. Washington, D.C.: U.S. Department of Energy, Office of Project and Fixed Asset Management. TIC: 240421.

"Human-System Interface Design Review Guideline." U.S. Nuclear Regulatory Commission. NUREG-0700, Rev. 1. June 1996. Washington, D.C.: U.S. Nuclear Regulatory Commission, Office of Nuclear Regulatory Research. TIC: 246624 (Volume 1).

"IEEE Recommended Practice for Powering and Grounding Sensitive Electronic Equipment." Institute of Electrical and Electronics Engineers, Inc. IEEE Std 1100-1992. 1992. New York, New York: Institute of Electrical and Electronics Engineers, Inc. TIC: 247015.

"IEEE Standard for Information Technology - Open Systems Interconnection (OSI) Abstract Data Manipulation - Application Program Interface (API) [Language Independent]." Institute of Electrical and Electronics Engineers, Inc. IEEE Std 1224-1993. September 29, 1993. New York, New York: Institute of Electrical and Electronics Engineers, Inc. TIC: 246297.

"Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations will be as Low as is Reasonably Achievable." U.S. Nuclear Regulatory Commission. Regulatory Guide 8.8, Rev. 3. June 1978. Washington, D.C.: U.S. Nuclear Regulatory Commission, Office of Standards Development. Readily Available.

"Monitored Geologic Repository (MGR) Compliance Program Guidance Package for the Assembly Transfer System." CRWMS M&O. TER-ATS-SE-000001, REV 00. October 29, 1999. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19991110.0069.

"Monitored Geologic Repository Project Description Document." CRWMS M&O. TDR-MGR-SE-000004, REV 01 ICN 01. June 2000. Las Vegas, Nevada: CRWMS M&O. URN-0377

"Monitored Geologic Repository Requirements Document." U.S. Department of Energy. YMP/CM-0025, Rev. 3, DCN 02. May 2000. Las Vegas, Nevada: U.S. Department of Energy, Office of Civilian Radioactive Waste Management, Yucca Mountain Site Characterization Office. URN-0376.

"Monitored Geologic Repository System Throughput and Cask Turnaround Rates." CRWMS M&O. RSO-RSO-99335.T. December 9, 1999. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19991209.0104.

"National Electrical Code." National Fire Protection Association. NFPA 70, 1999 Edition. August 6, 1998. Quincy, Massachusetts: National Fire Protection Association. TIC: 240528.

"Occupational Safety and Health Standards." Occupational Safety and Health Administration, Department of Labor. 29 CFR 1910. July 1, 1999. Washington, D.C.: U.S. Government Printing Office. Readily Available.

"Physical Protection of Plants and Materials." U.S. Nuclear Regulatory Commission. 10 CFR 73. January 1, 1999. Washington, D.C.: U.S. Government Printing Office. Readily Available.

"Preliminary Selection of MGR Design Basis Events." CRWMS M&O. ANL-WHS-SE-000003, REV 00. September 1999. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19990720.0406.

"Product Safety Signs and Labels." National Electrical Manufacturers Association. ANSI Z535.4-1998. 1998. Rosslyn, Virginia.: National Electrical Manufacturers Association. TIC: 242945.

"Quality Assurance Requirements and Description." U.S. Department of Energy. DOE/RW-0333P, Rev. 10. April 2000. Washington, D.C.: U.S. Department of Energy, Office of Civilian Radioactive Waste Management. ACC: MOL.20000427.0422.

"Revised Interim Guidance Pending Issuance of New U.S. Nuclear Regulatory Commission (NRC) Regulations (Revision 01, July 22, 1999), for Yucca Mountain, Nevada." U.S. Department of Energy. OL&RC:SB-1714. September 3, 1999. North Las Vegas, Nevada: U.S. Department of Energy, Office of Civilian Radioactive Waste Management, Yucca Mountain Site Characterization Office. ACC: MOL.19990910.0079.

"Rules for Construction of Overhead and Gantry Cranes (Top Running Bridge, Multiple Girder)." American Society of Mechanical Engineers. ASME NOG-1-1995. 1995. New York, New York: American Society of Mechanical Engineers. TIC: 238309.

"Safety and Health Regulations for Construction." Occupational Safety and Health Administration, Department of Labor. 29 CFR 1926. July 1, 1999. Washington, D.C.: U.S. Government Printing Office. Readily Available.

"Safety Color Code." National Electrical Manufacturers Association. ANSI Z535.1-1998. 1998. Rosslyn, Virginia.: National Electrical Manufacturers Association. TIC: 242940.

"SDD Development/Maintenance (Q SDDs) (WP# 16012126M5)." CRWMS M&O. October 11, 1999. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19991025.0001.

"Shippers. General Requirements for Shipments and Packagings." Research and Special Programs Administration, Department of Transportation. 49 CFR 173. October 1, 1999. Washington, D.C.: U.S. Government Printing Office. Readily Available.

"Specifications for Top Running & Under Running Single Girder Electric Overhead Traveling Cranes Utilizing Under Running Trolley Hoist." Crane Manufacturers Association of America, Inc. CMAA-74-1994. 1994. Charlotte, North Carolina: Material Handling Institute. TIC: 240768.

"Specifications for Top Running Bridge and Gantry Type Multiple Girder Electric Overhead Traveling Cranes." Crane Manufacturers Association of America, Inc. CMAA-70-94. 1994. Charlotte, North Carolina: Material Handling Institute. TIC: 240767.

"Standard for the Protection of Electronic Computer/Data Processing Equipment." National Fire Protection Association. NFPA 75. 1989. Quincy, Massachusetts: National Fire Protection Association. TIC: 4116.

"Standard Guide for Design of Equipment for Processing Nuclear and Radioactive Materials." American Society for Testing and Materials. ASTM C 1217-92. 1992. Philadelphia, Pennsylvania: American Society for Testing and Materials. TIC: 238943.

"Standard Review Plan for Dry Cask Storage Systems." U.S. Nuclear Regulatory Commission. NUREG-1536, Final Report. January 1997. Washington, D.C.: U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation. TIC: 232373.

"Standard Specification for Boron-Based Neutron Absorbing Material Systems for Use in Nuclear Spent Fuel Storage Racks." American Society for Testing and Materials. ASTM C992-89. 1989. West Conshohocken, Pennsylvania: American Society for Testing and Materials. TIC: 238942.

"Standards for Protection Against Radiation." U.S. Nuclear Regulatory Commission. 10 CFR 20. January 1, 1999. Washington, D.C.: U.S. Government Printing Office. Readily Available.

"Technical Reports." U.S. Department of Energy Office of Civilian Radioactive Waste Management. AP-3.11Q, Rev. 1, ICN 0. May 16, 2000. Las Vegas, Nevada: U.S. Department of Energy Office of Civilian Radioactive Waste Management. ACC: MOL.20000516.0008.

"Waste Handling Building Ventilation System Description Document." CRWMS M&O. SDD-HBV-SE-00001, REV 01. April 2000. Las Vegas, Nevada: CRWMS M&O. MOL.20000602.00509.