MOL.20000804.0001

OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT SYSTEM DESCRIPTION DOCUMENT COVER SHEET

1. QA: QA

2. SDD Title
Pool Water Treatment and Cooling System Description Document

3. Document Identifier (Including Rev. No. and Change No., if applicable)
SDD-PLS-SE-000001 REV 01 ICN 01

	Printed Name	Signature	Date
4. System Engineer	V. King	Varita King	6-19-00
5. Checker	F. Habashi	[signature]	6-19-00
6. Responsible Manager	R. M. Dulin	Robert M. Dulin	6/19/2000

7. Remarks:

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

The following TBDs/TBVs are used in this document:

TBD-393, TBD-395, TBD-398, TBD-405, TBD-406, TBD-409

OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT
SYSTEM DESCRIPTION DOCUMENT REVISION HISTORY

1. SDD Title
Pool Water Treatment and Cooling System Description Document

2. Document Identifier (Including Rev. No. and Change No., if applicable)
SDD-PLS-SE-000001 REV 01 ICN 01

3. Revision	4. Description of Revision
00	Initial Issue (issued using document identifier BCB000000-01717-1705-00033).
01	Issued Approved. This document is a complete rewrite, driven mainly by new design and regulatory requirements, and new document development procedures. The revision incorporated the reviewers' comments on the TECHNICAL REVIEW COPY of this SDD. This document supercedes the previous revision with the document identifier of BCB000000-01717-1705-00033.
ICN 01	Added Section 2 "Design Description"; made editorial changes, as necessary, throughout the document; deleted Section 1.4.1; deleted "Issue 3" from Appendix D concerning treatment and cooling requirements for additional pools. This information has been added in Section 2 of the SDD; renumbered tables and pages, as necessary; added four new references and updated reference(s). All changes are identified with sidebars on the right border of the affected pages.

CONTENTS

TABLES

Page

FIGURES

SUMMARY

The Pool Water Treatment and Cooling System is located in the Waste Handling Building (WHB), and is comprised of various process subsystems designed to support waste handling operations. This system maintains the pool water temperature within an acceptable range, maintains water quality standards that support remote underwater operations and prevent corrosion, detects leakage from the pool liner, provides the capability to remove debris from the pool, controls the pool water level, and helps limit radiological exposure to personnel. The pool structure and liner, pool lighting, and the fuel staging racks in the pool are not within the scope of the Pool Water Treatment and Cooling System.

Pool water temperature control is accomplished by circulating the pool water through heat exchangers. Adequate circulation and mixing of the pool water is provided to prevent localized thermal hotspots in the pool. Treatment of the pool water is accomplished by a water treatment system that circulates the pool water through filters, and ion exchange units. These water treatment units remove radioactive and non-radioactive particulate and dissolved solids from the water, thereby providing the water clarity needed to conduct waste handling operations. The system also controls pool water chemistry to prevent advanced corrosion of the pool liner, pool components, and fuel assemblies. Removal of radioactivity from the pool water contributes to the project ALARA (as low as is reasonably achievable) goals.

A leak detection system is provided to detect and alarm leaks through the pool liner. The pool level control system monitors the water level to ensure that the minimum water level required for adequate radiological shielding is maintained. Through interface with a demineralized water system, adequate makeup is provided to compensate for loss of water inventory through evaporation and waste handling operations. Interface with the Site Radiological Monitoring System provides continuous radiological monitoring of the pool water.

The Pool Water Treatment and Cooling System interfaces with the Waste Handling Building System, Site-Generated Radiological Waste Handling System, Site Radiological Monitoring System, Waste Handling Building Electrical System, Site Water System, and the Monitored Geologic Repository Operations Monitoring and Control System.

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 Pool Water Treatment and Cooling System are identified in the following sections. Throughout this document, the term "system" shall be used to indicate the Pool Water Treatment and Cooling System. The system architecture is provided in Appendix B.

1.1 SYSTEM FUNCTIONS

1.1.1 The system controls pool water temperature to support safe waste handling operations.

1.1.2 The system suppresses the growth of micro-organisms in the pool.

1.1.3 The system maintains water clarity in the pool.

1.1.4 The system treats the pool water to control radiological exposure to personnel and equipment.

1.1.5 The system controls pool water chemistry.

1.1.6 The system detects leaks through the pool liner.

1.1.7 The system provides the means for cleaning and removing debris from the pool surface.

1.1.8 The system monitors and controls the pool water level.

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

1.1.10 The system helps control the spread of radioactive particles in the pool during waste handling operations.

1.1.11 The system provides the required equipment to support pool liner cleaning.

1.1.12 The system provides indications and alarms of system parameters.

1.1.13 The system mitigates the consequences of equipment failures and off-normal conditions.

1.1.14 The system maintains occupational radiological exposures as low as is reasonably achievable.

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 be designed to maintain the bulk pool water temperature below 90°F during normal operations.

[F 1.1.1, 1.1.2][MGR RD 3.3.A]

1.2.1.2 The system shall be designed to provide for adequate mixing and circulation of the pool water to limit localized thermal hotspots in the pool.

[F 1.1.1, 1.1.2][MGR RD 3.1.G]

1.2.1.3 The system shall be designed to prevent the inadvertent loss of pool water inventory through the piping that enters the pool (i.e. siphoning).

[F 1.1.13][MGR RD 3.1.G, 3.3.A]

1.2.1.4 The system shall be designed with no system piping that will penetrate the pool wall below the minimum water depth required for radiological shielding.

[F 1.1.13][MGR RD 3.1.G, 3.3.A]

1.2.1.5 The system shall be designed to minimize the potential for contamination from the contaminated loop to the non-contaminated loop within the heat exchangers.

[F 1.1.13, 1.1.14][MGR RD 3.1.G, 3.3.A]

1.2.1.6 The system shall be designed such that the effects of adverse chemical interactions between the heat exchanger coolant and the pool water are mitigated.

[F 1.1.13][MGR RD 3.3.A]

1.2.1.7 The system shall be designed such that the pool water turnover time is 72 hours or less.

[F 1.1.2, 1.1.3, 1.1.4, 1.1.5][MGR RD 3.3.A]

1.2.1.8 The system shall be designed with a treatment system that maintains the pool water turbidity below (TBD-393), and, following immersion and opening of casks and canister lid cutting, is capable of returning the affected sections of the pool water to this clarity level within (TBD-393) hours.

[F 1.1.2, 1.1.3][MGR RD 3.1.G, 3.3.A]

1.2.1.9 The system shall be designed with a treatment system that can limit the annual average gross pool activity level to less than 5×10^{-4} microcurie/ml during normal operations.

[F 1.1.4][MGR RD 3.1.G, 3.3.A]

1.2.1.10 The system shall be designed with a treatment system that can maintain the proper pool water chemistry for controlling corrosion of the pool liner, pool components, and the fuel assemblies.

[F 1.1.5][MGR RD 3.1.G, 3.3.A]

1.2.1.11 The system shall be designed with the capability to remove debris from the pool.

[F 1.1.7, 1.1.14][MGR RD 3.1.G]

1.2.1.12 The system shall be designed to support waste handling operations, such as cask immersion and opening and canister lid cutting, as required.

[F 1.1.10]

1.2.1.13 The system shall be designed with features to support the cleaning of the pool liner.

[F 1.1.11]

1.2.1.14 The system shall be designed with a demineralized water makeup system (piping and associated components) that operates in conjunction with a level control system and can compensate for evaporative and operational losses during normal operations.

[F 1.1.8][MGR RD 3.1.G, 3.3.A]

1.2.1.15 The system shall be designed to eliminate or minimize the use of piping components (e.g. traps, loops, and flanges) that can accumulate radioactive materials.

[F 1.1.14][MGR RD 3.3.A]

1.2.1.16 The system shall be designed with the capability to detect and alarm any leakage from the pool liner.

[F 1.1.6][MGR RD 3.1.G, 3.3.A]

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

[MGR RD 3.2.C]

1.2.1.18 The system shall provide, as a minimum, equipment status for the items identified in Table 1.

Table 1. Equipment Status

Equipment	Status
Pumps	On/Off
Valves (Motor Operated and Air Actuated)	Open/Close
Chiller	On/Off
Waste Treatment Equipment	Provide adequate status for determining if significant system failure has occurred.

[F 1.1.12][MGR RD 3.3.A]

1.2.1.19 The system shall provide, as a minimum, monitoring and alarming of parameters identified in Table 2.

Table 2. System Parameters Monitoring

Parameter	Location	Characteristics
Water Level	Pool	Low, Low-Low, High
Temperature	Heat Exchanger Inlet	High
Temperature	Heat Exchanger Outlet	High
Differential Pressure	Filters	High
Differential Pressure	Heat Exchanger Shell & Tube	Low
Radiation	Pool Water	High
Radiation	Coolant Loop Heat Exchanger Discharge	Presence of Radiation
Radiation	Treatment Loop Pool Return	High
Conductivity	Ion Exchanger Inlet	High
Conductivity	Ion Exchanger Outlet	High

[F 1.1.12][MGR RD 3.1.G, 3.3.A]

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

[F 1.1.9][MGR RD 3.1.C][10 CFR 63.21(c)(17)]

1.2.2 Safety Criteria

1.2.2.1 Nuclear Safety Criteria

1.2.2.1.1 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 is Reasonably Achievable" (Regulatory Guide 8.8).

[F 1.1.14][MGR RD 3.1.B, 3.1.C, 3.1.G][10 CFR 63.111(a)(1), 63.112(e)(2), 63.112(e)(3)]

1.2.2.2 Non-nuclear Safety Criteria

1.2.2.2.1 The system shall be designed to provide shielding for equipment located in areas occupied or traversed by personnel and in which radioactive materials are concentrated (e.g. filters, ion exchange units)

[F 1.1.14][MGR RD 3.1.G, 3.3.A]

1.2.2.2.2 The system shall be designed, to the extent practicable, to incorporate the use of noncombustible and fire resistant materials.

[F 1.1.13][MGR RD 3.1.G]

1.2.3 System Environment Criteria

1.2.3.1 The system components shall be designed to withstand and operate in the temperature environment defined in Table 3 for the areas of the Waste Handling Building in which the components are located.

Table 3. Temperature Environment

Location of System Component	Normal Environment	Off-Normal Environment
Normally Occupied Areas (e.g., Offices, Maintenance Areas, Access Control)	78 - 70°F	(TBD-395) °F for (TBD-395) Hours
Normally Unoccupied Areas (e.g., Mechanical & Electrical Equipment Rooms, Cask Receiving & Handling Areas, Pool Areas)	92 - 63°F	(TBD-395) °F for (TBD-395) Hours
Unoccupied Areas (e.g., Assembly Cells, Canister Transfer Cells, DC Handling Cells, Emergency Generator Room)	106 - 63°F	(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)	74 - 70°F Note 1	74 - 70°F Note 1

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.

[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 4 for the areas of the Waste Handling Building in which the components are located.

Table 4. 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, humidifier) may be necessary.

[MGR RD 3.3.A]

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

[MGR RD 3.3.A]

1.2.4 System Interfacing Criteria

1.2.4.1 The system shall interface with the Waste Handling Building System for equipment space and layout, system operation space, shielding requirements, structural support, and other physical interfaces.

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

1.2.4.3 The system liquid and solid wastes shall be collected and processed by the Site Generated Radiological Waste Handling System.

[MGR RD 3.3.G]

1.2.4.4 The system radiation levels shall be monitored by the Site Radiological Monitoring System.

1.2.4.5 The system shall receive its supply of demineralized water from the Site Water System.

1.2.4.6 The system shall provide system and component status and variables input to, and, receive control output signals from the Monitored Geologic Repository Operations Monitoring and Control System.

1.2.5 Operational Criteria

1.2.5.1 The system design shall include provisions for isolating major components, such as heat exchangers, in the event of leaks.

[F 1.1.13][MGR RD 3.1.G]

1.2.5.2 The system shall be designed to permit periodic inspection, testing, and maintenance to ensure continued functioning and readiness of the system.

[MGR RD 3.1.C][10 CFR 63.112(e)(13)]

1.2.5.3 The inherent availability for this system shall be greater than (TBD-398).

[MGR RD 3.2.C, 3.3.A]

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).

[MGR RD 3.1.E]

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

[MGR RD 3.1.F]

1.2.6.3 The system design shall comply with applicable sections of "Design Criteria for an Independent Spent Fuel Storage Installation (Water Pool Type)," (ANSI/ANS-57.7-1988), and "Design of an Independent Spent Fuel Storage Installation (Water-Basin Type)," (Regulatory Guide 3.49).

[MGR RD 3.1.G, 3.3.A]

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

[MGR RD 3.3.A]

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

[MGR RD 3.3.A]

1.2.6.6 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]

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

[MGR RD 3.1.G]

1.2.6.8 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]

1.2.6.9 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]

1.2.6.10 The system shall be designed in accordance with applicable sections of the "1997 Uniform Building Code" (Volume 1, "Administrative, Fire- and Life-Safety, and Field Inspection Provisions").

[MGR RD 3.3.A]

1.2.6.11 The system shall be designed in accordance with applicable sections of the "1997 Uniform Building Code" (Volume 2, "Structural Engineering Design Provisions").

[MGR RD 3.3.A]

1.2.6.12 The system shall be designed in accordance with applicable sections of the "1997 Uniform Building Code" (Volume 3, "Material, Testing and Installation Standards").

[MGR RD 3.3.A]

1.2.6.13 The system shall comply with the applicable provisions of "Standards for Protection Against Radiation" (10 CFR 20).

[MGR RD 3.1.B]

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

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.

The following sections contain a detailed description of the system(s), including the assumptions used in the design of the system. Throughout this document, the term "system" shall be used to indicate the Pool Water Treatment and Cooling System. Information contained in this section has been obtained from the "Engineering Files for Site Recommendation" Attachment II Section 1.1.8.

2.1 SYSTEM DESIGN SUMMARY

The system is used to maintain proper water quality and characteristics for the pools and transfer canals used in the handling of fuel in the Assembly Transfer System (ATS). In this performance, the system accomplishes the following functions:

- Management of pool water temperature
- Management of pool water quality, clarity, and radiological activity
- Operation of the pool(s) leak detection system(s)
- Management of pool water level (including water makeup)

2.2 DESIGN ASSUMPTIONS

The principal supplementary assumptions that were used (in addition to the design criteria defined in Section 1) to develop the system design concept features are summarized below:

2.2.1 Two ATS lines with cask unloading and fuel staging pools are required to handle the waste throughput and support maintenance operations.

2.2.2 Four spent fuel pools, each sized to stage 1,250 MTU, or 3,000 SNF assemblies, are needed to provide for inventory blending requirements.

2.2.3 One non-standard fuel line is required to handle off-normal fuel passing through the ATS.

2.2.4 The system and equipment utilized for maintaining pool water quality (water treatment) and the system and equipment utilized for maintaining pool water temperature (water-cooling) is separate and independent.

2.2.5 Due to the potential of alpha contamination from the handling of non-standard fuel assemblies, the system functions for the off-normal handling pools is totally isolated from those systems serving other pool waters.

2.2.6 Sufficient space is available in the Waste Handling Building (WHB) to house pool water treatment and cooling equipment, and space is available external to the WHB for placement of the chilled-water package refrigeration units.

2.2.7 The system(s) equipment will be similar in design concept to that presented in "Design Criteria for an Independent Spent Fuel Storage Installation (Water Pool Type)", Appendix A of ANSI/ANS 57.7-1988.

2.3 DETAILED DESIGN DESCRIPTION

The function of the Pool Water Cooling System(s) is to remove heat from the pool water. This heat is the result of SFA decay heat continuously being transferred to the pool water. The removal of decay heat allows the pools to operate at a reduced temperature, (e.g., 60°F). This low temperature minimizes the amount of water being continuously evaporated from the pools, minimizes corrosion to pool components and fuel assemblies, and minimizes the occurrence of algal bloom within the pool, thereby facilitating the maintenance of water clarity.

The temperature of pool and transfer canal water is monitored and controlled on a continuous basis to maintain design temperature and to remove excess assembly decay heat. Pool and canal water-cooling systems are automatically controlled. When the water temperature rises to a set point, due to excess heat input, water is pumped through a heat exchanger to cool the water and return that cooled water to the source. The heat rejected by the pool water is transferred to an independent chilled-water (CHW) loop. The CHW loop, in turn, rejects the heat to a refrigerant system, which ultimately discharges the heat to the environment by means of air-cooled heat exchangers. The working fluid used in the refrigeration chiller is an environmentally acceptable refrigerant. The pressure on the chilled-water side of the heat exchangers is maintained above the pressure of the pool water being cooled. This reduces the possibility of the closed-loop-CHW being contaminated in the event of a heat exchanger failure. Figure 1 presents a simplified flow diagram for pool water-cooling.

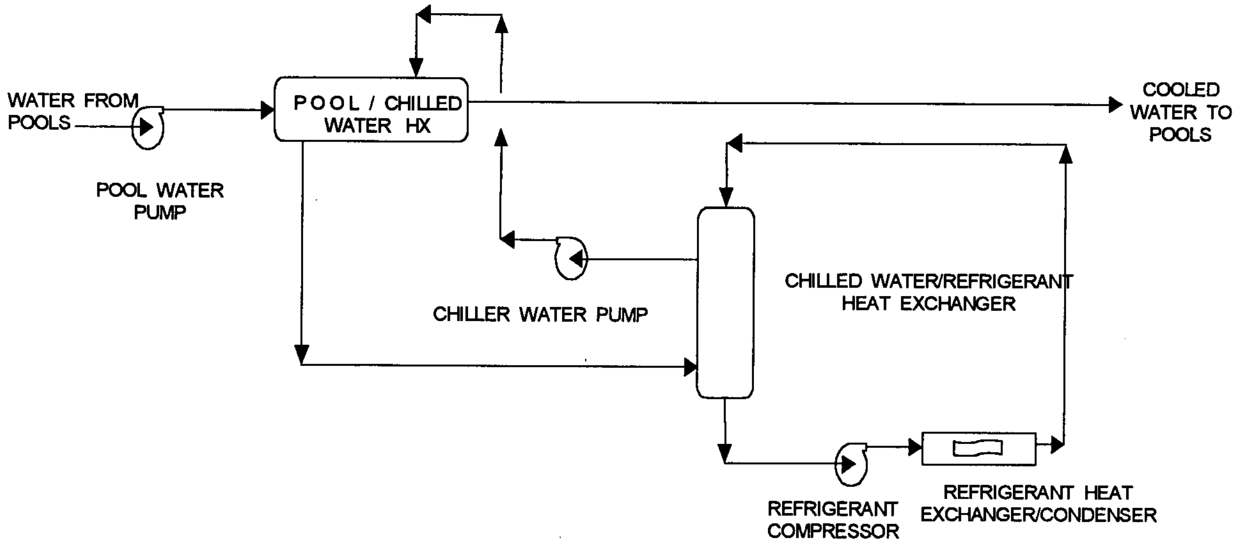

Figure 1. Pool Water Cooling Flow Diagram

Pool and canal water is subject to continuous contamination from the processing and storage of SFAs. To ensure that the pool water provides sufficient shielding for ALARA purposes, the pool water must be continuously treated to remove radioactive constituents. Additionally, crud particles can spall off the assemblies during assembly movement; these particles must be removed from both the water and pool liner surfaces for both ALARA and pool water clarity purposes. Pool water clarity can also be adversely impacted by algal bloom. Pool water is therefore treated to minimize the amount of algae in the water. Water turnover is a minimum of once every 72 hours.

Pool and canal water is continuously pumped through the treatment system(s). The water is initially passed through a filtration step to remove particulate materials. After filtration, the water passes through a mixed (cation and anion) bed ion exchange system to remove dissolved constituents. After ion exchange, the water is passed through a polishing filter to remove any ion exchange resin carried with the water. Finally, the water is passed through an ultra violet sterilization system to destroy algae. The water is then returned to the pool system.

Debris floating on the surface of the pool water is removed by weirs. A manually operated pool vacuum system is provided for the purpose of removal of accumulated debris on pool wall and floor surfaces. Water collected in these cleaning operations is passed through roughing filters for large particle removal before passing through the continuous water treatment system. Figure 2 shows a simplified process flow scheme for the Pool Water Treatment System.

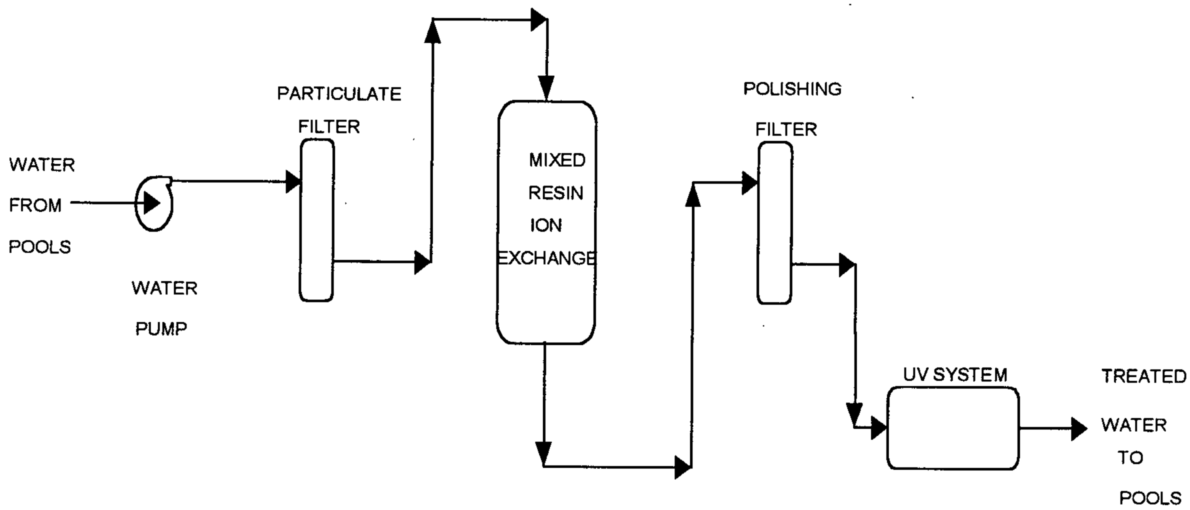

Figure 2. Pool Water Treatment Process Flow

A leak detection system is employed to identify, locate, and quantify any leakage between pool liners and outer concrete walls. Water collected from leak detection system(s) is collected into sumps located below pool bottom elevation. Collected water is sampled, analyzed, and then appropriately disposed as low-level liquid waste (either recyclable or non-recyclable) or transuranic liquid waste.

Overflow weirs are used on the ATS Transfer Pools to control the maximum pool water level during cask handling and unloading operations. Minimum water level is controlled through an automatic system that pumps (redundant pumps are provided) water into the pools if the water level is reduced below a control set point. Overflow water from the weirs is collected in a sump and then reused to maintain pool water level; if necessary, de-ionized water from the site de-ionized water system is used for pool water makeup.

2.3.1 Operational Description

- The Pool Water Cooling System(s) is operated under computer control. The system utilizes redundant pumps and chillers to ensure cooling is accomplished in the event of rotating equipment failure.

- The Pool Water Treatment System(s) is operated under computer control. The system utilizes redundant pumps, filters, and ion exchange beds to ensure treatment is accomplished in the event of equipment failure or change out of filters or ion exchange beds.

- Detection of pool leaks is an automatic function with alarms to alert operational personnel of a potential leak condition. Sampling of water collected in leak detection sumps and the disposition of that water is under operator control.

- The Pool Water Level Control System is under computer control. If water passes through a pre-determined low-level setpoint, operational personnel are alerted. Operational personnel can provide additional make-up water from the site de-ionized water system through manual valves.

2.3.2 Functional Description

The functions of the following systems are:

- Pool Water Cooling System(s) is to remove heat from the pool water.

- Pool Water Treatment System(s) is to continuously filter and purify pool and canal water.

- Pool Leak Detection System is to monitor for pool leaks and to alert operational personnel if a leak occurs.

- Pool Water Level Management System is to manage pool water level within design parameters. This is necessary to ensure that the pool water provides sufficient shielding for ALARA purposes.

- Pool Makeup Water System is to provide water to ensure proper water level is maintained and to compensate for evaporation and drag-out from the pools. Makeup water from the site de-ionized water system is provided.

2.3.3 Other System Features or Characteristics

Design analysis has not been completed sufficiently to describe system features to support required maintenance, in-service inspection, surveillance, recovery from anticipated system upsets, recovery from abnormal events, end of life decontamination and decommissioning, etc. System features will be addressed in future revisions of this SDD as the design of the system matures.

2.4 COMPONENT DESCRIPTION

This information will be provided in a future revision.

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.

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" 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 design temperature requirements for the pool water. Maintaining the proper temperature in the pool prevents the pool water from boiling, provides for safe waste handling operations by eliminating the potential for injury (burns) to personnel, and minimizes deterioration of the waste handling equipment.

This criterion identifies an applicable standard and supports MGR RD 3.3.A. Specific requirement in "Design Criteria for an Independent Spent Fuel Storage Installation (Water Pool Type)" (ANSI/ANS 57.7), Section 5.3.1 states, "Provide cooling capacity to maintain the specified annual average bulk pool water temperature for Design Event I." Design Event I per ANSI/ANS 57.7 consists of events that are expected to occur regularly or frequently in the course of normal operations. In addition, Section 6.3.2.1 of this standard states: "The design of the cooling system shall be based on the heat generation rate which would result from the maximum inventory of fuel units for the burnup and post irradiation decay (cooling) time of fuel to be stored in the facility."

In addition to the SNF decay heat, the pool water cooling system will remove heat added to the pool from other heat sources such as the system pump operation.

II. Criterion Performance Parameter Basis

A pool water temperature of less than 90 degrees F prevents boiling and allows safe waste handling operations. The specified temperature is based on the requirement of 90 degrees F or less specified in ANSI/ANS 57.7, Section 6.3.2.2.

1.2.1.2 Criterion Basis Statement

I. Criterion Need Basis

This criterion establishes the requirement for adequate water circulation and mixing to minimize the potential for localized thermal hotspots in the pool caused by inadequate water circulation and mixing. Maintaining a uniform temperature profile aids in more efficient decay heat removal, and prevents localized growth of micro-organisms in those areas with a higher temperature.

This criterion identifies an applicable regulatory document and supports MGR RD 3.1.G. Based on the requirement in "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants" (NUREG-800), Section 9.1.3, one of the considerations in design of the fuel pool cooling system is the ability to "...maintain uniform pool water temperature."

II. Criterion Performance Parameter Basis

N/A

1.2.1.3 Criterion Basis Statement

I. Criterion Need Basis

This criterion establishes the requirement for preventing the inadvertent loss of the pool water through the piping that enters the pool. Inadvertent loss of the pool water can result in loss of shielding effect and exposure of personnel to radioactivity.

This criterion identifies an applicable standard and a code of federal regulation (CFR) and supports MGR RD 3.3.A and 3.1.G.

Based on the requirements in "Design Criteria for an Independent Spent Fuel Storage Installation (Water Pool Type)" (ANSI/ANS 57.7), Sections 6.3.2.5 and 6.3.3.2, "The cooling system shall be designed to inhibit the escape of contaminated pool water," and, "The piping configuration for the cooling and cleanup system shall be such as to eliminate siphoning of the pool water to a level below the minimum water depth required for shielding." This requirement applies to all supply and return piping that enters the pool.

Also, based on the requirement in "Licensing Requirements for the independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste" (10 CFR 72), Part 72.122(h)(2), "systems for maintaining water purity and the pool water level must be designed so that any abnormal operations or failure in those systems from any cause will not cause the water level to fall below safe limits."

This criterion was also identified by specific guidance contained in the "MGR Compliance Program Package for the Pool Water Treatment and Cooling System," Guidance Statement 6.6g3.

II. Criterion Performance Parameter Basis

N/A

1.2.1.4 Criterion Basis Statement

I. Criterion Need Basis

This criterion establishes the requirement for preventing the inadvertent loss of the pool water through the system piping. Inadvertent loss of the pool water can result in loss of shielding effect and exposure of personnel to radioactivity.

This criterion identifies an applicable standard and a code of federal regulation (CFR) and supports MGR RD 3.3.A and 3.1.G.

Based on the requirement in "Design Criteria for an Independent Spent Fuel Storage Installation (Water Pool Type)" (ANSI/ANS 57.7) Section 6.3.3, "The pool penetrations for the cooling and cleanup system shall be above the minimum water depth required for shielding."

Also based on the requirement in "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste" (10 CFR 72), Part 72.122(h)(2), "The design must preclude installations of drains, permanently connected systems, and other features that could cause a significant loss of water."

This criterion was also identified by specific guidance contained in the "MGR Compliance Program Package for the Pool Water Treatment and Cooling System," Guidance Statement 6.6g3.

II. Criterion Performance Parameter Basis

N/A

1.2.1.5 Criterion Basis Statement

I. Criterion Need Basis

This criterion establishes the requirement for minimizing the potential for radioactive contamination of the coolant loop in case of heat exchanger tube failure. This criterion supports MGR RD 3.3.A by addressing occupational exposure concerns.

This criterion also supports MGR RD 3.1.G and supports guidance contained in the "MGR Compliance Program Package for the Pool Water Treatment and Cooling System," Guidance Statement 6.6g17.

II. Criterion Performance Parameter Basis

N/A

1.2.1.6 Criterion Basis Statement

I. Criterion Need Basis

This criterion establishes the requirement for the coolant medium not to cause adverse chemical reactions with the pool water, fuel components, and pool components and structures.

This criterion identifies an applicable standard and supports MGR RD 3.3.A. Based on the requirement in "Design Criteria for an Independent Spent Fuel Storage Installation (Water Pool Type)" (ANSI/ANS 57.7) Section 6.3.2.3.4, "...the coolant medium shall be compatible with the pool water and any of its contents."

II. Criterion Performance Parameter Basis

N/A

1.2.1.7 Criterion Basis Statement

I. Criterion Need Basis

This criterion establishes the requirement for the pool water turnover time (this is the amount of time that it would take to cycle the entire pool volume through the treatment system). Adequate water turnover rate will help in achieving the proper water quality by (preferably continuously) circulating the appropriate volume of water through the filtration and ion exchange units. Constant circulation of water will also minimize growth of micro-organisms on the structures inside the pool and the liner.

This criterion identifies an applicable standard and supports MGR RD 3.3.A. Based on the requirement in "Design Criteria for an Independent Spent Fuel Storage Installation (Water Pool Type)" (ANSI/ANS 57.7) Sections 6.3.2.6 and 6.3.2.6.3, the pool water treatment system shall be designed for a turnover time of 72 hours or less.

II. Criterion Performance Parameter Basis

The 72-hour requirement is from ANSI/ANS 57.7, Section 6.3.2.6.3.

1.2.1.8 Criterion Basis Statement

I. Criterion Need Basis

This criterion is based on the need for adequate visual clarity of the pool water to identify the location and type of waste for safe and efficient waste handling operations.

This criterion identifies an applicable standard and supports MGR RD 3.3.A. Based on the requirement in "Design Criteria for an Independent Spent Fuel Storage Installation

(Water Pool Type)" (ANSI/ANS 57.7) Section 6.3.2.6.1, the treatment system should "Maintain water clarity such that fuel assembly identification can be established with provided underwater viewing devices."

This requirement addresses pool water quality. In order to associate water quality with a verifiable and quantifiable requirement, this criterion is expressed in terms of water turbidity. Because certain operations at the facility, such as cask immersion or canister lid cutting, may result in significant localized increase in turbidity, to support safe waste handling operations and throughput, turbidity must be lowered within a given time period.

This criterion also supports MGR RD 3.1.G and guidance contained in the "MGR Compliance Program Package for the Pool Water Treatment and Cooling System," Guidance Statement 6.6g7.

II. Criterion Performance Parameter Basis

Turbidity value and the required time to return the pool water to the required clarity are TBD.

1.2.1.9 Criterion Basis Statement

I. Criterion Need Basis

This criterion establishes the requirement for limiting the annual average gross pool activity during normal operations (this is the activity level of the pool water, including the suspended solids, based on a daily, weekly, or other sampling frequency, averaged on an annual basis).

This criterion identifies an applicable standard and supports MGR RD 3.3.A. Based on the requirement in "Design Criteria for an Independent Spent Fuel Storage Installation (Water Pool Type)" (ANSI/ANS 57.7) Section 5.3.7, the treatment system will "Provide the capability to maintain an annual gross storage pool water activity level of 5x10-4 microcurie/ml or less for Design Event I." Design Event I in ANSI/ANS 57.7 constitutes normal waste handling operations.

It is expected that the 72 hour maximum turnover time would also result in meeting this activity requirement. However, due to the nature of operations at this facility, this criterion is included in addition to the 72 hour turnover time requirement.

This criterion also supports MGR RD 3.1.G and guidance contained in the "MGR Compliance Program Package for the Pool Water Treatment and Cooling System," Guidance Statement 6.6g7.

II. Criterion Performance Parameter Basis

The activity value is from ANSI/ANS 57.7, Section 5.3.7.

1.2.1.10 Criterion Basis Statement

I. Criterion Need Basis

This criterion establishes the requirement for maintaining a pool water chemistry that will not cause advanced corrosion of the pool liner, pool components, and the fuel assemblies during the operational life of the system.

This criterion identifies applicable standards and supports MGR RD 3.3.A.

Based on the requirement in "Design Criteria for an Independent Spent Fuel Storage Installation (Water Pool Type)" (ANSI/ANS 57.7) Section 6.3.2.6.2, the treatment system should "Control water chemistry to maintain fuel assembly cladding and structural member material properties during storage within the pool."

This criterion is also supported by the "Storage of Water Reactor Spent Fuel in Water Pools - Survey of World Experience" (IAEA Technical Report Series No. 218), which documents the results of a survey of more than 300 world nuclear facilities that store nuclear fuel in water pools. According to this report, (Section 5), "The water purity in storage pools is controlled to suppress conditions that might lead to a corrosive environment for the spent fuel and related pool components." In Section 5.2, the report adds, "Carbon dioxide absorbed from the atmosphere reacts with water to form carbonic acid, which tends to make the pH mildly acidic (pH 5.5). Water purity is maintained by ion exchange and filtration in most pools."

According to this report, other pool chemistries that were monitored were chlorine levels and conductivity of the pool water (see Appendix D of the IAEA report). Presence of chlorine in aqueous solutions can substantially increase the potential of stress-corrosion cracking and pitting corrosion of aluminum and stainless steel alloys. High water conductivity can also increase the potential for corrosion, especially when dissimilar metals are placed in the pool for long term storage.

This criterion also supports MGR RD 3.1.G and guidance contained in the "MGR Compliance Program Package for the Pool Water Treatment and Cooling System," Guidance Statement 6.6g19.

II. Criterion Performance Parameter Basis

N/A

1.2.1.11 Criterion Basis Statement

I. Criterion Need Basis

This criterion establishes the requirement for the system to have the capability to remove debris from the pool.

This criterion is based on a regulatory guide and supports MGR RD 3.1.G. Based on "Design of an Independent Spent Fuel Storage Installation (Water-Basin Type)" (Regulatory Guide 3.49) Section C.8, "...provisions should be made for the use of portable cleanup devices for areas within the storage pool in which contaminated particulate material could be deposited. These areas may include the pool corners or other areas where flow is reduced. Over long periods of time, these areas could become contamination sources that could increase the water radioactivity when disturbed."

II. Criterion Performance Parameter Basis

N/A

1.2.1.12 Criterion Basis Statement

I. Criterion Need Basis

This criterion establishes the requirement for the system to have the capability to support specific waste handling operations. Waste handling operations such as canister lid cutting or cask immersion may generate and spread significant amounts of particles and contamination throughout the pool. The system design will interface with or provide features that may be required to remove these particles before they can spread throughout the pool.

II. Criterion Performance Parameter Basis

N/A

1.2.1.13 Criterion Basis Statement

I. Criterion Need Basis

This criterion establishes the requirement for the system to have the capability to support pool liner cleaning operations. System design will include features to provide or support equipment (manual and remote) for cleaning the pool liner.

II. Criterion Performance Parameter Basis

N/A

1.2.1.14 Criterion Basis Statement

I. Criterion Need Basis

This criterion establishes the requirement for providing a pool water makeup system. The scope of the makeup system in this criterion is limited to the required piping and associated components and does not include the de-ionized water supply.

This criterion identifies an applicable standard and a regulatory document and supports MGR RD 3.3.A and 3.1.G.

Based on the requirement in "Design Criteria for an Independent Spent Fuel Storage Installation (Water Pool Type)" (ANSI/ANS 57.7) Section 6.3.2.4, "The normal pool water makeup system shall be designed to provide de-ionized water at a rate sufficient to compensate for evaporative losses." This criterion is also based on the general requirement in "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants" (NUREG-800) Section 9.1.3, which requires the design of the spent fuel pool cooling and cleanup system to include provisions for maintaining the pool water level and providing adequate makeup to the pool.

Waste handling operations are assumed to be performed continuously at this facility. Due to the nature of the activities, such as cask immersion and removal and assembly removal that result in the loss of pool water inventory, the makeup rate will compensate for operational losses as well as evaporative losses.

II. Criterion Performance Parameter Basis

N/A

1.2.1.15 Criterion Basis Statement

I. Criterion Need Basis

This criterion establishes the requirement for reducing the accumulation of radioactive material. This criterion identifies an applicable standard and supports MGR RD 3.3.A. Based on the requirement in "Design Criteria for an Independent Spent Fuel Storage Installation (Water Pool Type)" (ANSI/ANS 57.7) Section 6.3.2.10, "Piping shall be designed to eliminate traps, loops, and minimize flanges that might accumulate radioactive materials."

II. Criterion Performance Parameter Basis

N/A

1.2.1.16 Criterion Basis Statement

I. Criterion Need Basis

This criterion establishes the requirement for pool liner leak detection.

This criterion identifies applicable standards and a regulatory document and supports MGR RD 3.3.A and 3.1.G.

Based on the requirement in "Design Criteria for an Independent Spent Fuel Storage Installation (Water Pool Type)" (ANSI/ANS 57.7) Section 5.9.4, the system should "Provide the instrumentation and alarm functions for each process system to ensure that significant system failures can be detected and the systems can be placed in a safe condition for Design Events I and II." Design Events I consist of normal operations. Design Events II consist of events that are expected to occur with moderate frequency or once during any calendar year (e.g. equipment malfunction).

Also, based on the implied requirement in ANSI/ANS 57.7, Section 5.3.3, the system is to "Provide capability to recover from loss of cooling before the design limits of the pool structures are exceeded for Design Events II and III." Design Events III, as defined in ANSI/ANS 57.7, consist of the infrequent events that could reasonably be expected to occur once during the lifetime of the installation. Failure of a radioactive liquid retaining boundary and loss of power are given as examples of Design Events III in this standard (Section 2.1.3).

In addition, the general requirement in "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants" (NUREG-800), Section 9.1.3, requires that the spent fuel pool cooling and cleanup system provide the means for detection of system leaks or failures.

The "Storage of Water Reactor Spent Fuel in Water Pools - Survey of World Experience" (IAEA Technical Report Series No. 218) documents the results of a survey of more than 300 world nuclear facilities that store nuclear fuel in water pools. According to this report, (Section 7.2.1), "Many pools have leak collection systems integral with the liner, all along the seam welds, both vertical and horizontal. If leakage occurs, it is channeled to a detection and collection system." Except for a few isolated cases and special circumstances, according to the IAEA report, "Other pool liners have developed small leaks when the pool was first filled, but the leak rates have been sufficiently low so that no repair action has been necessary." The IAEA report summarizes that, "...SS liners have generally performed well in spent fuel pools. While some liner leaks have occurred in a number of spent fuel pools, leakage rates are small." Therefore, the primary purpose of this criterion is to provide the capability for detection of small leaks through the pool liner.

II. Criterion Performance Parameter Basis

N/A

1.2.1.17 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.

1.2.1.18 Criterion Basis Statement

I. Criterion Need Basis

This criterion establishes the requirement for system equipment status.

This criterion identifies an applicable standard and supports MGR RD 3.3.A. Based on the statement in Section 4.9 of "Design Criteria for an Independent Spent Fuel Storage Installation (Water Pool Type)" (ANSI/ANS 57.7), "For control and status indication, the system includes equipment to provide the operator with system status and allow for proper operations of the ISFSI."

Also, Section 5.9.4 of ANSI/ANS 57.7 states: "Provide the instrumentation and alarm functions for each process system to ensure that significant system failures can be detected and the systems can be placed in a safe condition for Design Events I and II." Design Events I consist of normal operations. Design Events II consist of events that are expected to occur with moderate frequency (e.g. equipment malfunction).

II. Criterion Performance Parameter Basis

N/A

1.2.1.19 Criterion Basis Statement

I. Criterion Need Basis

This criterion establishes the requirement for system instrumentation and alarms. This criterion identifies an applicable standard and CFR and supports MGR RD 3.3.A and 3.1.G.

Based on the requirement in "Design Criteria for an Independent Spent Fuel Storage Installation (Water Pool Type)" (ANSI/ANS 57.7) Section 5.9.4, the system is to "Provide the instrumentation and alarm functions for each process system to ensure that significant system failures can be detected and the systems can be placed in a safe condition for Design Events I and II." Design Events I consist of normal operations. Design Events II consist of events that are expected to occur with moderate frequency (e.g. equipment malfunction).

Also, based on the requirement in "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste" (10 CFR 72), Part 72.122(h)(2), "Pool water level equipment must be provided to alarm in a continuously manned location if the water level in the storage pools falls below a predetermined level."

This criterion was also identified by guidance contained in the "MGR Compliance Program Package for the Pool Water Treatment and Cooling System," Guidance Statements 6.1g2 and 6.1g4. Note that there is no requirement to automatically actuate the treatment system (as may be implied in Guidance Statement 6.1g4). However, instrumentation will be provided to provide adequate information for the operator to start the treatment system as needed.

II. Criterion Performance Parameter Basis

N/A

1.2.1.20 Criterion Basis Statement

I. Criterion Need Basis

This criterion supports MGR RD 3.1.C. Based on 10 CFR 63.21(c)(17), design of the system shall address considerations that are intended to facilitate permanent closure and decontamination or dismantlement of surface facilities.

II. Criterion Performance Parameter Basis

N/A

1.2.2.1.1 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 (e)(3); and MGR RD 3.1.G for the need to address radiological health and safety.

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."

This criterion also supports MGR RD 3.1.G and guidance contained in the "MGR Compliance Program Package for the Pool Water Treatment and Cooling System," Guidance Statements 6.6g17, 6.6g19, 6.8g1, 6.9g1, and 6.11g9.

II. Criterion Performance Parameter Basis

The project ALARA program goals are TBD.

1.2.2.2.1 Criterion Basis Statement

I. Criterion Need Basis

This criterion establishes the requirement for shielding components that are located in areas occupied or traversed by personnel and contains concentrated quantities of radioactive materials in order to minimize personnel exposure. This criterion identifies a standard and supports MGR RD 3.3.A. Based on "Design Criteria for an Independent Spent Fuel Storage Installation (Water Pool Type)" (ANSI/ANS 57.7) Section 6.3.2.11, "Equipment such as ion exchangers and filters should be individually shielded or located in a cell."

This criterion was also identified by guidance contained in the "MGR Compliance Program Package for the Pool Water Treatment and Cooling System," Guidance Statements 6.6g3, 6.6g17, and 6.6g19.

II. Criterion Performance Parameter Basis

N/A

1.2.2.2.2 Criterion Basis Statement

I. Criterion Need Basis

This criterion implements a fire safety requirement. This criterion is based on a regulatory guide and supports MGR RD 3.1.G. The requirement is 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

1.2.3.1 Criterion Basis Statement

I. Criterion Need Basis

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.

This criterion supports MGR RD 3.3.A.

II. Criterion Performance Parameter Basis

Temperature values are based on Criterion 1.2.1.1 of the "Waste Handling Building Ventilation System Description Document."

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

1.2.3.2 Criterion Basis Statement

I. Criterion Need Basis

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 SSCs 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.

This criterion supports MGR RD 3.3.A.

II. Criterion Performance Parameter Basis

Humidity values for occupied areas and electronics equipment areas are based on Criterion 1.2.1.2 of the "Waste Handling Building Ventilation System Description Document."

Humidity values for other areas are TBD.

1.2.3.3 Criterion Basis Statement

I. Criterion Need Basis

This criterion establishes the requirement for equipment environmental compatibility. This criterion supports MGR RD 3.3.A.

Radiation can affect the performance of 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, and neutrons) 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.

1.2.4.1 Criterion Basis Statement

I. Criterion Need Basis

This criterion specifies interfaces with the Waste Handling Building System. The interfaces include space for equipment installation and system operation, shielding requirements, structural support, and other physical interfaces with the pool structure, pool liner, leak collection system (e.g. channels, sumps), and building drains.

II. Criterion Performance Parameter Basis

N/A

1.2.4.2 Criterion Basis Statement

I. Criterion Need Basis

This criterion specifies interfaces with the Waste Handling Building Electrical System for electric power requirements for pump motors, valves, instrumentation, and other components that require electric power to operate.

II. Criterion Performance Parameter Basis

N/A

1.2.4.3 Criterion Basis Statement

I. Criterion Need Basis

In support of the requirement in MGR RD 3.3.G for control of site-generated low-level waste, the Pool Water Treatment and Cooling System interfaces with the Site Generated Radiological Waste Handling System. The interface includes provisions for collecting and transporting liquid and solid wastes (e.g., leaks, filter cartridges, resins) from the Pool Water Treatment and Cooling System to the Site Generated Radiological Waste Handling System.

II. Criterion Performance Parameter Basis

N/A

1.2.4.4 Criterion Basis Statement

I. Criterion Need Basis

The Pool Water Treatment and Cooling System interfaces with the Site Radiological Monitoring System. The interface includes piping and component physical and functional interface with the radiation monitors.

II. Criterion Performance Parameter Basis

N/A

1.2.4.5 Criterion Basis Statement

I. Criterion Need Basis

The Pool Water Treatment and Cooling System interfaces with the Site Water System for supply of demineralized water for pool makeup and cooling medium for the system equipment (motors, heat exchangers, etc.) as required.

II. Criterion Performance Parameter Basis

N/A

1.2.4.6 Criterion Basis Statement

I. Criterion Need Basis

The Pool Water Treatment and Cooling System interfaces with the Monitored Geologic Repository Operations Monitoring and Control System for centralized monitoring and control by providing system and component level input to this monitoring and control system and receiving control signals from this system as required.

II. Criterion Performance Parameter Basis

N/A

1.2.5.1 Criterion Basis Statement

I. Criterion Need Basis

This criterion identifies an applicable regulatory document and supports MGR RD 3.1.G. Based on "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants" (NUREG-800) Section 9.1.3, spent fuel pool cooling systems are required to provide the means for isolation of system components that could develop leaks or failures.

II. Criterion Performance Parameter Basis

N/A

1.2.5.2 Criterion Basis Statement

I. Criterion Need Basis

Derived from MGR RD 3.1.C, this criterion implements an applicable regulatory requirement from 10 CFR 63.112(e)(13) for system inspection, testing, and maintenance.

II. Criterion Performance Parameter Basis

N/A

1.2.5.3 Criterion Basis Statement

I. Criterion Need Basis

Inherent availability of systems, which have the potential to affect throughput, must be bounded by analysis. This criterion supports MGR RD 3.2.C and 3.3.A.

II. Criterion Performance Parameter Basis

The inherent availability value of this system is TBD.

1.2.6.1 Criterion Basis Statement

I. Criterion Need Basis

This criterion is based on MGR RD 3.1.E. This criterion requires that system design comply with the applicable sections of "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 is based on MGR RD 3.1.F. This criterion requires that system design comply with the applicable sections of "Safety and Health Regulations for Construction" (29 CFR 1926).

II. Criterion Performance Parameter Basis

N/A

1.2.6.3 Criterion Basis Statement

I. Criterion Need Basis

This criterion identifies an applicable industry standard and a regulatory guide, and supports MGR RD 3.3.A and 3.1.G.

"Design Criteria for an Independent Spent Fuel Storage Installation (Water Pool Type)" (ANSI/ANS 57.7) provides design criteria for systems and equipment of a facility designed for the receipt and storage of spent fuel. Waste handling operations at the WHB will be similar to such a facility. Although the entire standard is deemed applicable, Sections 6.3.1 (Codes & Standards), and 6.9.2.3 (System Status & Control) of ANSI/ANS 57.7 are found to be especially useful for the design of the Pool Water Treatment and Cooling System. "Design of an Independent Spent Fuel Storage Installation (Water-Basin Type)," (Regulatory Guide 3.49), provides guidance acceptable to the Nuclear Regulatory Commission for use in the design of this type of facility based on the requirements in ANSI/ANS 57.7.

This criterion was also identified by guidance contained in the "MGR Compliance Program Package for the Pool Water Treatment and Cooling System," Guidance Statements 6.7g1 and 7.2g1.

II. Criterion Performance Parameter Basis

N/A

1.2.6.4 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

1.2.6.5 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 "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

1.2.6.6 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

1.2.6.7 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 3.1.G. The DOE Good Practices Guide "Human Factors Engineering" (GPG-FM-027, paragraph 2.3.1) supports the use of NUREG-0700.

II. Criterion Performance Parameter Basis

N/A

1.2.6.8 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

1.2.6.9 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

1.2.6.10 Criterion Basis Statement

I. Criterion Need Basis

This criterion identifies an applicable industry code for this system and supports MGR RD 3.3.A. The specified industry code, "1997 Uniform Building Code" (Volume 1, "Administrative, Fire- and Life-Safety, and Field Inspection Provisions") invokes design criteria appropriate for the Pool Water Treatment and Cooling System.

II. Criterion Performance Parameter Basis

N/A

1.2.6.11 Criterion Basis Statement

I. Criterion Need Basis

This criterion identifies an applicable industry code for this system and supports MGR RD 3.3.A. The specified industry code, "1997 Uniform Building Code" (Volume 2, "Structural Engineering Design Provisions") invokes design criteria appropriate for the Pool Water Treatment and Cooling System.

II. Criterion Performance Parameter Basis

N/A

1.2.6.12 Criterion Basis Statement

I. Criterion Need Basis

This criterion identifies an applicable industry code for this system and supports MGR RD 3.3.A. The specified industry code, "1997 Uniform Building Code" (Volume 3, "Material, Testing and Installation Standards") invokes design criteria appropriate for the Pool Water Treatment and Cooling System.

II. Criterion Performance Parameter Basis

N/A

1.2.6.13 Criterion Basis Statement

I. Criterion Need Basis

MGR RD 3.1.B requires compliance with the applicable provisions of "Standards for Protection Against Radiation," 10 CFR 20.

II. Criterion Performance Parameter Basis

N/A

1.2.6.14 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 in the subject document. The approved assumptions will provide a consistent basis for continuing the system design.

II. Criterion Performance Parameter Basis

N/A

APPENDIX B ARCHITECTURE AND CLASSIFICATION

The System architecture and QA classification are identified in Table 5. The QA classifications are established in "Classification of the MGR Pool Water Treatment and Cooling System."

Table 5. System Architecture and QA Classification

Pool Water Treatment and Cooling System (PLS))	**QL-1**	**QL-2**	**QL-3**	**CQ**
Pool Water Treatment		X		
Pool Water Cooling				X
Pool Water Makeup			X	
Pool Water Level Control			X	
Pool Water Leak Detection			X	

APPENDIX C ACRONYMS, SYMBOLS, AND UNITS

C.1 ACRONYMS

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

ATS	Assembly Transfer System
ALARA	As Low As Reasonably Achievable
CQ	Conventional Quality
CHW	Chilled Water
DC	Disposal Container
DOE	U.S. Department of Energy
F	Function
HFE	Human Factors Engineering
HLW	High Level Waste
IAEA	International Atomic Energy Agency
IEEE	Institute of Electrical and Electronics Engineers
ISFSI	independent spent fuel storage installation
MGR RD	Monitored Geologic Repository System Requirements Document
MGR	Monitored Geologic Repository
N/A	Not Applicable
NRC	Nuclear Regulatory Commission
QA	Quality Assurance
QL	Quality Level
SDD	System Description Document
SFA	Spent Fuel Assembly
SNF	Spent Nuclear Fuel
SS	Stainless Steel
SSCs	Structures, Systems, and Components
TBD	To Be Determined
TBV	To Be Verified
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
ml	milliliter
pH	Hydrogen ion concentration potential

APPENDIX D FUTURE REVISION RECOMMENDATIONS AND ISSUES

This appendix identifies issues and actions that require further evaluation. The disposition of these issues and actions could alter the functions and design criteria that are allocated to this system in future revisions to this document. However, the issues and actions identified in this appendix do not require TBDs or TBVs beyond those already identified.

Issue 1 - Currently, there are uncertainties associated with the disposal of failed/damaged fuel assemblies (e.g., handling procedure, wet/dry handling, damage during shipping, etc.). Therefore, it is not clear if a failed assembly would require special provisions, and what its impact would be on the Pool Water Treatment and Cooling System. Additional design requirements may be added to the SDD when more information is available.

Issue 2 - Cask immersion, opening, and cutting operations have the potential of generating significant amounts of particles. Special design features may be required to limit the spread of these particles throughout the pool. The extent to which the Pool Water Treatment and Cooling System provides or interfaces with these design features, if any, is not known at this time. When more design detail is available, criterion 1.2.1.12 may be revised or deleted as required.

Issue 3 – Performance requirement of the cooling system depends on maximum inventory of the SNF in the pool. This information will be added to the SDD when available.

Issue 4 – Instrument setpoints will eventually have to be provided to finalize design. These setpoints (e.g. radiation monitoring setpoints based on ALARA and other requirements) will be determined in future and included in SDDs.

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.

"1997 Uniform Building Code." Volume 1, "Administrative, Fire- and Life-Safety, and Field Inspection Provisions." International Conference of Building Officials. April 1997. Whittier, California: International Conference of Building Officials. TIC: 233817.

"1997 Uniform Building Code." Volume 2, "Structural Engineering Design Provisions." International Conference of Building Officials. April 1997. Whittier, California: International Conference of Building Officials. TIC: 233818.

"1997 Uniform Building Code." Volume 3, "Material, Testing and Installation Standards." International Conference of Building Officials. April 1997. Whittier, California: International Conference of Building Officials. TIC: 233816.

"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.

"Classification of the MGR Pool Water Treatment and Cooling System." CRWMS M&O. ANL-PLS-SE-000001, Rev. 00. August 31, 1999. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19990928.0191.

"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 (Water Pool Type)." American Nuclear Society. ANSI/ANS-57.7-1988. 1988. La Grange Park, Illinois: American Nuclear Society. TIC: 238870.

"Design of an Independent Spent Fuel Storage Installation (Water-Basin Type)." U.S. Nuclear Regulatory Commission. Regulatory Guide 3.49, Rev. 0. December 1981. Washington, D.C.: U.S. Nuclear Regulatory Commission. Readily Available.

"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, Office of Standards Development. Readily Available.

"Guidelines for Designing User Interface Software." Smith, Sidney L., 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, Jr., James P.; 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 Field Management, 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).

"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.

"Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste." Nuclear Regulatory Commission. 10 CFR 72. January 1, 1999. Washington, D.C.: U.S. Government Printing Office. Readily Available.

"MGR Compliance Program Guidance Package for the Pool Water Treatment and Cooling System." King,V: Thom,CB. TER-PLS-SE-000001, Rev. 01. March 02, 2000. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.20000309.0299.

"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.

"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.

"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.

"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.

"Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants." U.S. Nuclear Regulatory Commission. NUREG-0800, LWR Edition. 1987. Washington, D.C.: U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation. TIC: 203894.

"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.

"Storage of Water Reactor Spent Fuel in Water Pools: Survey of World Experience." International Atomic Energy Agency. Technical Reports Series No. 218. 1982. Vienna, Austria: International Atomic Energy Agency. TIC: 221480.

"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. 2000. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.20000602.0059.