CAROLINA POWER & LIGHT COMPANY

SHEARON HARRIS NUCLEAR POWER PLANT

DESIGN BASIS DOCUMENT

FUEL POOL COOLING AND CLEANUP SYSTEM

DBD-110

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SIGNATURES ON ORIGINAL

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1.0 FUNCTION

The Fuel Pool Cooling and Cleanup System (FPCCS) is designed to provide adequate cooling to the new and spent fuel during all plant operating conditions and to maintain water quality by removing the particulate and dissolved fission and corrosion products resulting from spent fuel in the fuel storage pools, the transfer canals, and the reactor cavity.

2.0 DESIGN BASES AND ASSUMPTIONS

2.1 General System Requirements

2.1.1 The Fuel Pool Cooling and Cleanup System (FPCCS) is designed to cool and clean the new fuel and spent fuel pools and is comprised of three subsystems: two redundant cooling loops, two cleanup loops, and a skimmer loop. Together the three subsystems remove residual heat from the spent fuel, maintain water quality, and remove debris from the surface of the pools, respectively.

2.1.2 The Fuel Handling Building (FHB) has two storage facilities with a common cask unloading pool. Each facility consists of a new fuel pool, a spent fuel pool, interconnecting transfer canals, and a FPCCS. The south end pools contain new and spent fuel and have a functional cooling and cleanup system. The north end pools contain water, but the cooling and cleanup system is not functional, as the piping is not complete and blanked off. The north end systems will be made functional when extra spent fuel storage is necessary. The north end new fuel pool will be used as a spent fuel pool. This arrangement is based on servicing spent fuel from Shearon Harris-1, plus additional fuel from Brunswick Units 1 and 2 and H.B. Robinson Unit 2.

2.1.3 To accommodate a single active component failure without loss of function, the Fuel Pool Cooling loop is designed with adequate redundancy:

a. The installation of two 100 percent capacity heat exchangers assures meeting the design heat removal capability of the cooling system if one heat exchanger is unavailable.

b. Two 100 percent capacity fuel pool cooling pumps installed in separate cooling loops assures the system pumping capacity should one pump become inoperable.

2.1.4 The demineralizer provides adequate purification of the fuel pool water and maintains optical clarity in the pool.

2.1.5 The FPCCS has one fuel pool demineralizer filter and one fuel pool and refueling water purification filter which removes particulate matter from the new fuel pool water.

2.1 General System Requirements (continued)

2.1.6 The skimmer system for the new and spent fuel pools consists of surface skimmers, a skimmer pump, and a filter. The surface skimmers float on the water surface and are connected via a 5-foot (approximate) flexible hose to the pump suction piping at various locations on the perimeter of the pools. Flow from the pump is routed through the skimmer filter and returned to the fuel pools below the water level. (See Section 2.5.4)

2.1.7 The fuel pool cooling piping is seismic Category 1 and designed to ASME B&PV Code, Section III, Class 3 requirements, 1971 Edition through Summer 1973 addenda.

The Fuel Pool Cleanup Skimmer System piping in nonseismic Category 1 and designed to ANSI B31.1, Power Piping Code (1973 Edition through Summer 1973 Addenda).

The Fuel Pool Cleanup System piping (with the exception of those portions penetrating containment is (nonseismic Category 1 and designed to ANSI B31.1, Power Piping Code) (1973 Edition through Summer 1973 Addenda). The piping including the isolation valves which penetrate containment is seismic Category I and designed to ASME Section III, Class 2 requirements (1971 Edition through Summer 1973 Addenda).

The fuel pool and refueling water purification system piping is nonseismic Category 1 and designed to ANSI B31.1, Power Piping Code (1973 Edition through Summer 1973 Addenda).

2.1.8 The fuel pool liners are classified as non-nuclear safety; however, they are designed and constructed to ASME Code, Section III, Division 1, Subsection ND, and are subject to the Quality Assurance criteria of 10CFR50, Appendix B.

The Permanent Cavity Seal Ring is designed and constructed to ASME Code Section III, Subsection ND, except that code stamping by ANI is not required. The PCSR is classified as nuclear safety related, Safety Class 3.

2.1.9 The Fuel Pool Cooling and Cleanup System is located in the Fuel Handling Building which is designed in accordance with Regulatory Guide 1.13, Revision 1, "Spent Fuel Storage Facility Design Basis", and provides protection against natural phenomena such as tornadoes, hurricanes, and floods.

2.1.10 The maximum heat loads for the FPCCS can be found in ESR 96-00126 (Reference 4.5.3). It includes the Incore Shuffle, Full Core Offload Shuffle, and Post Outage Full Core Offload for pools A & B (south pools). Note that the north pools cannot be loaded until they are functional. Additional fuel pool heatload applicability documentation can be found in ESR 97-00636 (Reference 4.5.18), and ESR 00-00046 (Reference 4.5.20).

2.1.11 The fuel pool water clarity and purity is maintained by passing approximately 6 percent of the cooling system flow through a cleanup loop consisting of two filters and a demineralizer.

2.1 General System Requirements (continued)

2.1.12 The suction line to the fuel pool cooling pump penetrates the fuel pool wall approximately 18 feet above the fuel assemblies which precludes uncovering the fuel assemblies as a result of a postulated suction line rupture. Syphoning of the pool is precluded by the location of the penetration and by terminating the piping penetration flush with the liner.

2.1.13 The design temperature of the concrete surrounding the pools is 150°F; therefore, the system is designed to limit the maximum temperature of the pools to 150°F. During Modes 1-4, the normal operating spent fuel pool temperature is limited to a maximum of 112°F. This value, in combination with the ability of plant operators to realign CCW to the SFP heat exchangers in less than 2.97 hours, ensures that the 150°F design temperature will not be exceeded when SFP cooling is terminated during the recirculation phase of a LOCA.

2.1.14 Butterfly valves are used throughout the system both to isolate components and as throttle valves providing flow control.

2.1.15 To maintain the Fuel Pool Cooling System requirements during a single train cooldown (that is, one train of the RHR/CCW is available to bring the reactor coolant temperature from a hot shutdown condition to 200°F or less within 36 hours of reactor shutdown), component cooling water can be diverted from all nonessential cooling loads.

2.1.16 The FPCCS is designed with flushable filters: fuel pool demineralizer filter, fuel pool and refueling water purification filter, and fuel pool skimmer filter.

The differential pressure across the flushable filters is measured with on-line instrumentation. When the filter differential pressure reaches a preset value, an alarm will alert the operator to initiate back-flushing.

2.1.16.1 The FPCCS filters back-washing piping and connections are designed to 200°F and 400 psig. They are subjected to 350 psig during N_2 back-washing operation.

2.1.16.2 The FPCCS filters are provided with vent and drain connections.

2.1.17 The fuel pool cooling piping and associated supports are analyzed for sustained loads (pressure, deadweight); thermal expansion; occasional loads (OBE, SSE); and jet impingement. In addition, the fuel pool cooling piping is analyzed to ensure that the external forces transmitted by the piping at the interface of pipe to equipment nozzles does not exceed the allowable limits set by the equipment vendor.

2.1.18 The cleanup loop may be operated on an intermittent basis as required by fuel pool water chemistry analyses.

2.1.19 The FPCCS is manually controlled and may be shut down safely for reasonable time periods (at least one hour, with actual time periods determined by the pool heat-up rate to the 150°F limit) for maintenance or replacement of malfunctioning components.

2.1 General System Requirements (continued)

2.1.20 Prior to placing spent fuel in the pool, component cooling water to the spent fuel heat exchangers is required to be operational.

2.1.21 Test requirements

2.1.21.1 The safety-related piping and components of the FPCCS will be in-service tested in accordance with ASME Boiler and Pressure Vessel Code, Section XI.

2.1.21.2 The pumps are tested in the field to demonstrate performance as governed by provisions of ASME Power Test Code for Centrifugal Pumps, PTC 8.2.

2.1.21.3 Testing of the fuel pool cooling heat exchangers to demonstrate performance is governed by provisions of ASME Power Test Code for Closed Feedwater Heaters, PTC 12.1.

2.1.22 Regulatory Requirements

2.1.22.1 Appendix A of 10CFR50, General Design Criteria for Nuclear Power Plants, establishes minimum requirements for the principal design criteria for water-cooled nuclear power plants as follows:

2.1.22.1.1 General Design Criterion 2, which relates to the system being capable of withstanding the effects of earthquakes.

2.1.22.1.2 General Design Criterion 4, which relates to structures housing the system and the system being capable of withstanding the effects of external missiles.

2.1.22.1.3 General Design Criterion 5, which relates to shared systems and components important to safety being capable of performing required safety functions.

2.1.22.1.4 General Design Criterion 44, which relates to:

a) The capability to transfer heat loads from the reactor system to a heat sink under both normal operating and accident conditions.

b) Redundancy of components so that under accident conditions, the safety function can be performed assuming a single active component failure.

c) The capability to isolate components, subsystems, or piping if required so that the system safety function will be maintained.

2.1.22.1.5 General Design Criterion 45, which relates to design provisions to permit periodic in-service inspection of system components and equipment.

2.1 <u>General System Requirements</u> (continued)

2.1.22.1.6 General Design Criterion 46, which relates to design provisions to permit appropriate functional testing of the system and components to assure structural integrity and leak-tightness, operability, and performance of active components and capability of the system to function as intended during normal, shutdown, and accident conditions.

2.1.22.1.7 General Design Criterion 61, which relates to the system design for fuel storage and handling of radioactive materials, including the following:

a) The capability for periodic testing of components important to safety.

b) Provisions for containment

c) Provisions or decay heat removal

d) The capability to prevent reduction in fuel storage coolant inventory under accident conditions

e) The capability and capacity to remove corrosion products, radioactive materials, and impurities from the pool water and reducing occupational exposures to radiation.

2.1.22.1.8 General Design Criterion 63, which relates to monitoring systems provided to detect conditions that could result in the loss of decay heat removal, to detect excessive radiation levels and to initiate appropriate safety actions.

2.1.23 NRC Regulatory Guide applicable to the design of the Fuel Pool Cooling and Cleanup System include 1.13 Rev. 1 for spent fuel storage facility design, 1,26 for quality classification, 1,29 for seismic design, and the NRC Standard Review Plan including Sections 9.1.3 and 9.2.5 (Branch Technical Position ASB 9-2). (See Reference 4.5.4.)

Conformance to applicable Regulatory Guides is discussed in FSAR Section 1.8 and is detailed in the design documents referenced in Section 4.2 and interfacing design basis documents.

2.1.24 The Component Cooling Water System supplies cooling water through the shell side of the fuel pool cooling heat exchangers while fuel pool water circulates through the tubes.

2.1.25 Demineralized water is provided to the suction of the fuel pool and refueling water purification pumps for flushing of the system piping.

2.1.26 The spent resin from the fuel pool demineralizer is sluiced to the Spent Resin Storage Tank via the Waste Processing System spent resin sluice header.

2.1 General System Requirements (continued)

2.1.27 The FPCCS purification loop has the capability of transferring borated water from the fuel pools, transfers canals, refueling cavity or reactor coolant drain tank to the Boron Recycle System recycle holdup tank.

2.1.28 The fuel pool and refueling water purification pumps have the capacity to provide makeup water at a rate greater than the loss of water due to normal leakage and evaporation.

2.1.29 The location of the inlet and outlet connections to the fuel pool precludes the possibility of coolant flow "short circuiting" the pool.

2.1.30 Provisions are incorporated in the layout of the system to allow for periodic inspection using visual and monitoring instrumentation. Equipment is arranged and shielded to permit inspection with limited personnel exposure.

2.1.31 Adequate provisions for the accessibility pull space and lay down area for the fuel pool heat exchangers, fuel pool cooling pumps, fuel pool and refueling water purification pumps, fuel pool skimmer pump, fuel pool demineralizer, associated equipment, and valves is incorporated in the plant designs.

2.1.32 All piping joints and connections are welded, except where flanged connections are required to facilitate equipment removal for maintenance and hydrostatic testing.

2.1.33 Design change ESR 96-00584 provides a flow path from the Primary Makeup Water System to the Spent Fuel Pool Cooling and Cleanup System. The interconnection is line 7PM1-233-1 between lines 7PM2-115-142 and 7SF2-193-1. Locked closed manual valve 7PM-V238-1 provides the isolation between the two systems. The purpose of the design change is to allow mildly tritiated water from the RMWST to be used to fill the Spent Fuel Pools. The tritiated water is used in the fuel pools instead of being released to the Harris Lake. The transfer rate from the PM system to the SF system is a few gallons per minute utilizing the available line pressure in the PM system. The PM water is clean, except for the tritium, and is less hazardous than the water from the RWST. The static head pressure of the water in the RMWST is sufficient to prevent backflow into the PM system from the SF system, even if the RMW pumps are not running. *(NOTE: It is possible to connect the systems in such a way as to get backflow; however, the consequences would not be severe. No system of interlocks or other design means of preventing inadvertent system interactions are included in the design. The plant procedures provide the backflow protection.)*

The amount of tritium released through the FHB exhaust will be limited to the amount evaporated from the pools. The analysis in the FSAR assumes a high release rate of tritium from the fuel. The total released to the environment is about 2,000 Curies/cycle(Table 11.1.6-1). This is split approximately equal between liquid and gas as the liquid released is about 1000 Curies (Table 11.2.3-1). While this system interconnection allows tritium to be evaporated, rather than discharged to the lake, there is no reduction in design margin. Increase in tritium levels in the SF system may use some of the current operating margin.

2.2 Instrumentation and Controls

2.2.1 The Fuel Pool Cooling and Cleanup System is manually operated from the Control Room. The operator has various local and control room alarms, indicators, inputs to computer, and lights to monitor system operating conditions and to take proper action to correct any failures or nonconformances.

2.2.2 The low water level in the spent fuel pool is 23 feet above the top of fuel rods within irradiated fuel assemblies seated in storage racks. The minimum required water level value is established so that 23' of water will be maintained above BWR and PWR spent fuel assemblies that are properly seated in their storage racks; and for BWR assemblies that are located in a storage cell, but are supported by their channel fasteners. The set points on the water level instrumentation will assure that a low water level alarm occurs before the minimum water level value is reached. This assures sufficient radiation shielding and submergence of cooling connections which are at the top of the pools. Also, the pools have to be prevented from overfilling so the level has to be maintained below a high limit. Therefore, safety-related instrumentation in both new and spent fuel pools is provided to give a high, low, and low-low level alarms in the Control Room and on local panel, along with digital inputs to computer and lights on the Main Control Board. Those alarms will alert the operator who can manually operate the system to maintain the proper level in these pools. A low flow alarm is provided to warn of interrupted cooling flow to the fuel pools.

2.2.3 The cooling system is designed to remove heat loads generated by the quantities of fuel stored in the pools. It is started manually by the operator from the Control Room. As a warning for the initiation of the second fuel pool cooling pump, high pool temperature alarms are provided in the Control Room along with analog inputs to computer and status lights on the Main Control Board. The temperature measurements are done by safety-related temperature instrumentation in both new and spent fuel pools.

2.2.4 Filters are back washed, strainers cleaned, and the fuel pool demineralizer resin sluiced when the operator receives an alarm for high differential pressure across this equipment.

2.2.4.1 Alarm is given on a local panel for the strainers on the inlet lines for both the cooling pumps and skimmer pumps and the fuel pool demineralizer.

2.2.4.2 Alarm is given on the Waste Processing Control Board along with analog inputs to the computer for the fuel pools and refueling water purification filters, fuel pool demineralizer filter, and the skimmer filter.

2.2.5 Local discharge pressure indication is provided for the fuel pool cooling pumps, the purification pumps, and the skimmer to allow the operator to monitor the proper functioning of the equipment. The fuel pool cooling and purification pumps low discharge pressure is alarmed on local panel to alert the operator of pump runout or loss of pump suction so he can manually shut it off.

2.2 Instrumentation and Controls (continued)

2.2.6 High temperature alarms are provided for the heat exchangers to inform the operator of a system malfunction. The temperature of the fuel pool water entering and leaving the heat exchangers is monitored and alarmed. This will help the operator to evaluate the performance of the heat exchangers.

2.2.7 For pump protection, vibration switches are installed on safety-related pumps (IWP-3000 requirement) and alarm on high vibration. This will alert the operator who can manually shut them off.

2.2.8 The outlet flow from the purification system is locally monitored and alarmed on the local panel to alert the operator of abnormalities (low or no-flow condition).

2.2.9 Local cooling flow indication to the spent fuel pool is available for ASME Section XI testing purposes.

2.3 Electrical

2.3.1 The electrical power supply for the subject equipment is from the 480-V and 120-V ESF System and the 480-V and 120-V non-ESF Systems and DC power from Panels DP-1A-SA and DP-1B-SB.

2.3.2 The system electrical power supply for the safety-related 150 HP fuel pool cooling pump Motors 1&4A-SA and 1&4B-SB are fed from 480-V ESF MCC 1&4A33-SA and 1&4B33-SB, respectively, located in FHB EL 261' powered from load centers 1A3SA and 1B3SB, respectively. These loads are continuous per DAC-1 (see Reference 4.5.1.4).

2.3.3 Non-ESF 480-V power is provided by MCCs 1-4A33 and 1-4B33 located in Waste Processing Building EL 291.0' (these are continuous loads per DAC-1), 1-4A1021 and 14B1021 located in Fuel Handling Building EL 261.0' (these are intermittent loads per DAC-1), fed from their respective load centers 14A3, 14B3, 14A1, 14B1. These MCCs can be aligned with "A" or "B" train power in the event of a failure of one train. 120-V power is provided by power panels fed from their respective MCCs.

2.3.4 Electrical cables supplying power and control to the Fuel Pool Cooling and Cleanup Systems were sized in accordance with SHNPP Unit 1 Electrical Criteria Nos. 8, 9, 17, 18, 19, and 20 (see DBD-202).

2.3.5 The cable and raceway system for this system is designed in accordance with SHNPP Unit 1 Electrical Design Criteria Nos. 3 and 4 (see DBD-200).

2.3.6 In the event of loss of normal power, the fuel pool cooling pumps will be powered from the Emergency Diesel Generators 1A-SA and 1B-SB.

2.4 Materials and Chemistry

2.4.1 Selection of materials for equipment, piping, and components is based on the compatibility with the design pressure and temperature considerations and chemistry of the system fluid.

2.4 Materials and Chemistry (continued)

2.4.2 All piping, equipment, and components in contact with the fuel pool water are of austenitic stainless steel.

2.4.3 The fuel pool cooling heat exchanger has a shell constructed of carbon steel with stainless steel tubes and channel and the tube sheet of carbon steel with a stainless steel overlay.

2.4.4 The major components of the fuel pool cooling pumps (upper and lower casing, impeller, impeller ring, shaft and shaft sleeves) are constructed of stainless steel.

2.4.5 The major components of the new fuel pool strainer and fuel pool skimmer pump strainer are constructed of stainless steel.

2.4.6 The major components of the fuel pool and refueling water purification pump (upper and lower casing, impeller, and shaft) are constructed of stainless steel.

2.4.7 The major components of the fuel pool demineralizer (shell, internals) are constructed of stainless steel.

2.4.8 The major components of the fuel pool skimmer pump (upper and lower casing, impeller, and shaft sleeves) are constructed of stainless steel having a shaft of carbon steel.

2.4.9 Local sample points are provided in the cleanup loop to permit analysis of ion exchanger and filter efficiencies.

2.4.10 Local sample point from the fuel pool demineralizer is taken for maintaining the correct water chemistry in the Fuel Pool Water System. Based on these samples and analysis, the ion-exchanger resin may be changed if decontamination factors across the demineralizer do not satisfy the DF factor requirements. When the DF across this equipment becomes significantly less than specified, it is an indication that the ion-exchanger resin needs replacement.

2.4.11 Normal makeup water to the fuel pool is supplied by the refueling water storage tank. A backup system for filling the fuel pool is available through flexible hoses from existing vent lines of the Emergency Service Water System

2.5 Failure Effects

2.5.1 The reliability of the Fuel Pool Cooling System is assured by powering the cooling pumps from two separate buses so that each pump receives power from a different source. If a total loss of off-site power should occur, the operator has the option of transferring the pumps to the emergency power service.

2.5.2 The FPCCS is protected against the effects of high energy and moderate energy fluid system piping failures and internally generated missiles.

2.5.3 The fuel pool cooling portion of the system is capable of performing its intended function (removal of decay heat) despite the single failure of any active component. See reference 4.5.17.

2.5 Failure Effects (continued)

2.5.4 Syphoning of the pools is prevented by limiting the skimmer hose length to approximately 5 feet. Syphoning due to any failure is prevented by the location of the penetrations and by terminating the piping penetrations flush with the liner (see Section 2.1.12).

2.5.5 Floor and equipment drain sumps and pumping systems are provided to collect and transfer any FPCCS leakage to the Waste Management System.

2.5.6 The Units 2&3 Spent Fuel Pools are designed to store water up to nominal pool levels, but are not designed to store fuel. The water chemistry shall satisfy Harris plant commitments regarding radioactivity and water quality.

3.0 Design Margins

The Fuel Pool Cooling and Cleanup System is designed with an additional 10 percent margin to accommodate the friction loss in the piping.

With the operation of only Unit 1, there is additional cooling and cleanup capacity since the Unit 2 pumps and pools will not be in service initially.

4.0 Document Reference List

4.1 Drawings

4.1.1 Flow Diagrams

CAR-2165-G-061 Fuel Pools Cleanup Systems, Sheet 1
CAR-2165-G-062 Fuel Pools Cleanup Systems, Sheet 2
CAR-2165-G-305 Fuel Pools Cleanup System, Unit 1
CAR-2165-G-811 Boron Recycle System, Sheet 1
CAR-2165-G-813 Containment Building, Waste Processing System
CAR-2165-G-815 Waste Processing System, Spent Resin Storage
CAR-2165-G-827 Waste Processing System Concentrates Storage and Spent Resin Transfer
CAR-2165-G-828 Waste Processing System, Spent Resin Transfer
CAR-2165-G-847 Fuel Handling Building, Filter Backwash System

4.1.2 General Arrangements

CAR-2165-G-023 Fuel Handling Building Plan EL. 236.00 ft.
CAR-2165-G-024 Fuel Handling Building Section A-A
CAR-2165-G-025 Fuel Handling Building Section A-A

4.1.3 Piping Drawings

CAR-2165-G-252 FHB Piping Plan - EL 216
CAR-2165-G-253 FHB Piping Plan - EL 216 and 261
CAR-2165-G-254 FHB Piping Plan - EL 236, Sheet 1
CAR-2165-G-255 FHB Piping Plan - EL 236, Sheet 1
CAR-2165-G-256 FHB Piping Plan - EL 286, Sheet 1
CAR-2165-G-257 FHB Piping Section, Sheet 1
CAR-2165-G-258 FHB Piping Section, Sheet 2
CAR-2165-G-259 FHB Piping Section, Sheet 3
CAR-2165-G-260 FHB Piping Section, Sheet 4
CAR-2165-G-261 FHB Piping Section, Sheet 5
CAR-2165-G-262 FHB Piping Section, Sheet 6

4.1 Drawings (continued)

CAR-2165-G-263 FHB Piping Section, Sheet 7
CAR-2165-G-266 FHB Piping Plan - EL 286, Sheet 2

4.1.4 Electrical Drawings

CAR-2166-G-030	480-V Auxiliary One-Line Wiring Diagram, Unit 1
CAR-2166-G-037S01	General Services Auxiliary One-Line Wiring Diagrams Bus 1-4A, Unit 1
CAR-2166-B-401	Power Distribution and Motor Data Sheets: 177 S01, 183 S01, 212, 227 S01, 227 S02, 238, 254 S01, 613, 615, 633, 650, 651, 674, and 678

4.1.5 Instrumentation and Control Drawings

CAR-2166-B-401	Control Wiring Diagrams Sheets: 881 thru 892, 895, 897, 904, 905, 906, 907
CAR-2166-B-430	Logic and Schematic Diagrams Sheets: 04.1 thru 04.8

4.1.6 EMDRAC Drawings

1364-048683	Spent Fuel Pool Water Purification Pumps Performance Curve
1364-001917	Spent Fuel Pool Demineralizer Nameplate Details
1364-005236	Spent Fuel Pool Cooling Pump FHB El. 236 Motor Data
1364-005238	Spent Fuel Pool Cooling Pump FHB El. 236 Motor Speed Torque
1364-016182	Spent Fuel Pool Cooling Pump Performance Curve
1364-044205	Spent Fuel Pool Cooling Pump Performance Curve

4.2 Specifications

4.2.1 Mechanical

CAR-SH-M24	Spent Fuel Pool Heat Exchanger
CAR-SH-M13	Class 3 Centrifugal Pumps
CAR-SH-M12	Centrifugal Pumps and Accessories
CAR-SH-M10	Centrifugal Pumps and Accessories
CAR-SH-M60	Self-Cleaning Strainer
CAR-SH-M49Z	Basket Strainers
CAR-SH-M44A	Stainless Steel Butterfly Valves
CAR-SH-M41	Diaphragm Valves
CAR-SH-M45	Plug Valves
CAR-SH-M47	Temporary Strainers
CAR-SH-M36R	2-Inch and Smaller Carbon and Stainless Steel Valves
CAR-SH-M70	Wafer Check Valves
CAR-SH-M32A	2 1/2-Inch and Larger Carbon and Stainless Steel Valves
CAR-SH-M66M	Miscellaneous Control Valves
CAR-SH-M34Y3/36Y	2-Inch and Smaller Carbon and Stainless Steel Valves
CAR-SH-M66V	Miscellaneous Control Valves
CAR-SH-M30	General Power Piping

4.2 Specifications (continued)

CAR-SH-M71	Design Specification for ASME Nuclear Safety Class 1, 2, & 3 and ANSI B31.1, Non-nuclear Safety/Seismic Category 1 and Seismically Designed Piping
CPL-HNP1-M-018	Permanent Cavity Seal Ring

4.2.2 Electrical

CAR-SH-E-10A	MCCs (non-1E)
CAR-SH-E-10B	MCCs (1E)
CAR-SH-E-12	Motors for Station Auxiliary Equipment up to 480-V and 250 HP

4.2.3 Instrumentation and Control

A-02	Nuclear Steam Supply System
IN-01	Electronic Instrumentation
IN-03	Orifice Plates
IN-04	Thermocouple and Test Thermowells
IN-06	Local Instrument Cabinets and Racks and Miscellaneous Instrumentation (Class 1E)
IN-07	Pressure Gages
IN-09	Temperature Switches (NNS)
IN-10	Pressure Switches (NNS)
IN-16	Waste Processing Control Board and HVAC Control Panel (NNS)
IN-32	Level Switches
IN-43	RTD's/Thermocouple Assemblies and est Thermowells
IN-46	Miscellaneous Instruments

4.2.4 Radwaste

CAR-SH-N-15	Spent Fuel Pool Demineralizer
CAR-SH-N-36	Backwash Flushable Filters

4.2.5 Civil

CAR-SH-AS-1	Containment Liner, Air Locks, and Hatch

4.3 Final Safety Analysis Report

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	3.2	9.1.3
	3.5	9.1.4
	3.6	9.2.5
	3.8.3	11.1.7
	3.8.4	15.7.5

4.4 Project Lists

CAR-1364-B-069	Valve and Specialty List
CAR-1364-B-070	Piping Line List
CAR-1364-B-432	Instrument List
CAR-1364-B-508	Setpoint Document

4.5 Miscellaneous

4.5.1 Calculation Index

4.5.1.1 Mechanical Calculations

05 SF-1	Line Sizing for New Fuel Cooling Pump
05 SF-4	Spent Fuel Pool Cooling Pumps
05 SF-7	Check on Assumption of Conservatism for Spent Fuel Decay Heat
05 SF-8	Sizing of Spent Fuel Pool Heat Exchanger
05 SF-11	Calculations to Fill Out Spent Fuel Heat Exchanger Specification
05 SF-12	Spent Fuel Cooling Heat Loads & Component Cooling Water Required
05 SF-13	Sent Fuel Pool Heat Exchanger Operating Pressure
05 SF-14	Sent Fuel Pool Heat Exchanger Test Pressure Determination
05 SF-17	Fuel Pool Skimmer System Line and Pump Sizing
05 SF-19	Spent Fuel Purification Pump Update
05 SF-21	Spent Fuel Pools Cooling Pump TDH
05 SF-22	Spent Fuel Pool Makeup Requirements
05 SF-24	Fuel Transfer Tube Support Loads
05 SF-25	Fuel Pool Cooling System Heat Load
05 SF-26	Fuel Pool Heatup
05 SF-27	Fuel Pool Heatup (Supplement to 05 SF-26)
05 SF-30	Restriction Orifices—Fuel Pool Gate Seals
05 SF-31	Spent Fuel Pools Equilibrium Temperatures
05 SF-32	Rate of Spent Fuel Temperature Rise
05 SF-33	Spectacle Blind Plate Thickness
SF-0036	Maximum Heat Load to Maintain the Spent Fuel Pool ≤212°F, ≤150°F, ≤140°F, and ≤137°F Under Full and Reduced CCW Flow
SF-0037	Maximum Heat Load to Maintain the Spent Fuel Pool ≤137°F Using Various CCW Temperatures
SF-0038	Spent Fuel Pool Heat Up Rate/ Time To Boil Calculation
SF-0039	Post-LOCA SFP Heat Exchanger Performance with Reduced CCW Flow
CC-0038	CCW Heat Exchanger Performance During Post-Accident Recirc Alignment

4.5.1.2 Radwaste Calculations

03R-14.12.048-1	Flushable Filters, Flushing Frequency, Crud Volumes
03R-14.12.000-10	Filter Backwash System Setpoint Derivation

4.5.1.3 Nuclear Engineering Calculations

No. 001—Parts 1-2 Decay Heat Release SHNPP Units 1 & 2 (File No. CPL Decay Heat)

4.5.1.4 Electrical Calculations

DAC-1 Auxiliary System Load Study

4.5.2 Instruction Manuals

Vacco Industries—Installation and Maintenance Instruction Manual Etched Pick Back Flushable Filters, Volumes I and II.

EMDRAC List—P.O. NY-435106

Ingersoll-Rand Comp—Spent Fuel Pool Refueling Water

4.5 Miscellaneous (continued)

Purification Pump and Condensate Transfer Pumps Instruction Manual

EMDRAC List—P.O. NY-435009

Goulds Pumps, Inc.—Spent Fuel Pool Cooling Pumps, Manual G-7

EMDRAC List—P.O. NY-435042

Zurn Industries, Inc.—Series 514 Sinlex Strainer, Manual No. Z1

EMDRAC List—P.O. NY-435163

Yuba Heat Transfer Corp—Spent Fuel Pool Heat Exchangers, Manual No. Y1

EMDRAC List—P.O. NY-435029

Hungerford & Terry—Spent Fuel Pool Demineralizer, Manual No. H5

EMDRAC List—P.O. NY-435028

4.5.3 ESR 96-00126, Rev. 0, Spent Fuel Pool Heatload Analyses Revision

ESR 97-00272, Rev. 0, Realignment of CCW to the SFP Heat Exchangers

ESR 97-00447, Rev. 0, SFP Hi Temperature Alarm Setpoint Change

4.5.4 CP&L Letter—CE-863185(E) dated April 29, 1986 (2902 Review of FSAR Amendment 22)

4.5.5 10CFR20, 21, 50, and 100

4.5.6 10CFR50, Appendix A, including General Design Criteria:

2 - Design Bases for Protection Against Natural Phenomena
4 - Environmental and Missile Design Bases
5 - Sharing of Structures, Systems, and Components
44 - Cooling Water System
45 - Inspection of Cooling Water System
46 - Testing of Cooling Water System
61 - Fuel Storage and Handling and Radioactivity Control
63 - Monitoring Fuel and Waste Storage

4.5.7 NRC Regulatory Guides

1.13 - Spent Fuel Storage Facility Design Basis, Rev. 1

1.26 - Quality Group Classifications and Standards for Water, Steam, and Radioactive Waste Containing Components of Nuclear Power Plants, Rev. 3

1.29 - Seismic Design Classification, Rev. 3

4.5.8 NUREG-75/087, Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants, applicable section including 9.1.3 and 9.2.5 (ASB 9-2)

4.5 Miscellaneous (continued)

4.5.9 NUREG-0800, Standard Review Plan, Section 9.1.3, Rev. 1, dated July 1981, original attachment for Appendix Item QA-M-CAR-16A, Rev. 0

4.5.10 ANS 57.2/ANSI N210-1976, "Design Objectives for Light Water Reactor Spent Fuel Storage Facilities at Nuclear Power Stations"

4.5.11 ANS N18.2-1973, "Nuclear Safety Criteria for the Design for Stationary Pressurized Water Reactor Plants" (including Revision and Addendum ANSI 18.2a, 1975)

4.5.12 Interfacing Design Basis Documents including:

DBD-104 Safety Injection System

DBD-109 Fuel Handling System

DBD-128 Normal and Emergency Service Water, Screen Wash and Traveling Screens, Waste Process Component Cooling Water Systems

DBD-131 Component Cooling Water System

DBD-135 FHB HVAC, WPB HVAC Systems

DBD-200 Electrical Cable, Cable Trays and Conduit, Cable Routing, Class I Underground Electrical, Conduit and Class I Electrical, Manholes

DBD-202 Plant Electrical System, Off-site Power System, Generator, Exciter, and Isophase Bus Duct., Generator and Exciter Mechanical Support Systems

DBD-304 Gross Failed Fuel Detection System, Radiation Monitoring System

4.5.13 ASME Boiler and Pressure Vessel Code, Sections II, III, V, IX, XI, 1971 Edition through Summer 1973 Addenda

4.5.14 ANSI B31.1, Power Piping Code, 1973 Edition through Summer 1973 Addenda

4.5.15 ASME Power Test Code for Closed Feedwater Heaters, PTC 12.1

4.5.16 ASME Power Test Code for Centrifugal Pumps, PTC 8.2

4.5.17 ESR 96-00217, Rev. 0, Single Failure Analysis of Spent Fuel Pool Cooling System

4.5.18 ESR 97-00636, Rev. 0, SFP Heatload Analysis for RF08 and Cycle 9

4.5.19 ESR 99-00208, Rev. 0, Revised Minimum Fuel Pool Water Level.

4.5.20 ESR 00-00046, Rev. 0, SFP Heatload Analysis for RF09 and Cycle 10

5.0 Appendix

5.1 Design Input Documents

QA-M-CAR-16
QA-M-CAR-16A

February 10, 1972
QA-M-CAR 16

Attachment 1
Revision 0
Page 1 of 1

To: R. Mahoney

From: R. W. McCaffrey

Subject: Shearon Harris Nuclear Power Station Spent Fuel Pool Cooling and Cleanup Flow Diagram Quality Assurance Record

Please develop a Spent Fuel Pool Cooling and Cleanup System Flow Diagram illustrating the system which will be shared by two units.

The criteria to be followed in design of this system are stated in:

PSAR Section 9.6
PSAR Chapter 15
Safety Guide 13
Westinghouse Reactor Fluid Systems Standard Design Package
STD-DES-3L-RFS-3L16
Project Specification Section 6.3.10

The system will be shared by two units with separate cooling and makeup lines from each unit.

The primary cooling loops and essential makeup lines will be designed to Seismic Class I requirements.

Please sign and return the original copy of this letter to indicate your intention to comply with the above stated requirements.

Prepared by R. W. McCaffrey SE/EN Project	*
Acknowledged by R. Mahoney EN Project	*
Approved by S.P. Hecker SU/EN Project	*

*--Signatures/initials located in DBD-110, Rev. 0

PROJECT: Shearon Harris Nuclear Power Plant

DEPARTMENT: Mechanical Design Engineering

DESIGN OUTPUT DOCUMENT: Flow Diagrams, Piping Drawings

SUBJECT: Fuel Pool Cooling System (FPCS)

A. SCOPE:

The scope of this document is to provide the criteria to develop the design documents as necessary for the Fuel Pool Cooling System. The Spent Fuel Pool Cleanup System and various auxiliary systems are designated as non-safety-related systems and are not part of this document.

B. FUNCTIONAL REQUIREMENTS:

The function of the FPCS is to remove residual heat generated by fuel stored in the fuel storage pools and to keep spent fuel assemblies covered with water during all storage conditions.

C. PERFORMANCE REQUIREMENTS:

The performance requirements of the FPCS are listed in the following documents:

1. ASME Boiler & Pressure Vessel Code, Section III
2. US NRC Standard Review Plan, Section 9.1.3
3. US NRC Standard Review Plan, Section 9.2.5
4. Ebasco Specification CAR-SH-M24, Spent Fuel Pool Heat Exchanger
5. Ebasco Specification CAR-SH-M13, Class 3 Centrifugal Pumps
6. Ebasco Specification CAR-SH-M49Z, Basket Strainers
7. US NRC Regulatory Guide 1.13, Revision 1, "Spent Fuel Storage Facility Design Basis"
8. FSAR Section 9.1.3

D. SYSTEM DESCRIPTION:

1. The FPCS shall provide two 100 percent capacity cooling loops capable of removing residual heat from the spent fuel. Each loop shall consist of a fuel pool heat exchanger, a fuel pool cooling pump, and a fuel pool strainer and shall be capable of cooling the new and spent fuel pools.

2. The FPCS shall be sized so that the temperature of the pool should be kept at or below the pool concentrate design temperature (150°F) under all conditions.

3. The Fuel Handling Building consists of two storage facilities having two sets of new and spent fuel pools which are served by two FPCS.

4. Each cooling loop shall be provided with one fuel pool cooling pump. The pump suction lines shall penetrate the fuel pool wall at least 10 feet above the fuel assemblies to prevent uncovering the fuel assemblies to prevent uncovering the fuel assemblies as a result of a postulated suction line rupture. Emergency cooling connections (valving and blind flanges) shall be provided to permit the installation of portable pumps to bypass each of the fuel pool cooling pumps.

5. Each cooling loop shall be provided with one fuel pool heat exchanger. Component cooling water shall be supplied to the shell side of the heat exchanger, while the fuel pool water shall be pumps through the tubes by the fuel pool cooling pump, and back to each of the pools. Basket-type strainers shall be provided on the cooling pumps suction line.

6. All FPCS piping in contact with fuel pool water shall be austenitic stainless steel. The piping shall be welded—except at the pumps, heat exchangers, and control valves—where flanged connections are provided for ease of installation and maintenance.

7. Manual stop valves shall be used to isolate equipment and lines and manual throttle valves shall be used to provide flow control. Valves in contact with fuel pool water shall be of austenitic stainless steel or an equivalent corrosion-resistant material.

8. Control Room and local alarms shall be provided to alert the operator of high and low pool water level and high temperature in the fuel pool. A low flow alarm shall be provided to warn of interruption of cooling flow.

9. The location of the inlet and outlet connections to the pools shall be located to prevent the possibility of coolant flow "short circuiting" the pool.

D. SYSTEM DESCRIPTION: (continued)

10. Floor and equipment drain sumps and pumping systems shall be provided to collect and transfer SFPCS leakage to the Waste Processing System. High-level alarms shall be provided and annunciated in the Waste Processing Control Room when high sump level is reached.

11. The new fuel pool and spent fuel pools shall be furnished with stainless steel liners. These liners shall be classified as non-nuclear safety; however, the liners shall be designed and constructed in accordance with the applicable portions of the ASME Section III code requirements. The fuel transfer canal, the main fuel transfer canal, and the cask-loading pit shall be furnished also with stainless steel liners.

12. Provisions shall be made to provide normal makeup water to the fuel pool from the refueling water storage tank. An emergency makeup connection shall also be provided so the emergency service water can be used as a backup source of makeup water. Makeup water shall normally be pumped to the pool by the fuel pool cooling pumps. Emergency cooling connections (valving and blind flanges) shall be provided to permit the installation of portable pumps to bypass each of the fuel pool cooling pumps. Provisions shall be provided so that the fuel pool cleanup loop pumps may also be used to provide the makeup water to the pools.

13. Draining or syphoning of the spent and new fuel pools via piping or hose connections to these pools or transfer canals shall be prevented by the locations of the penetrations, limitations on hose length, and termination of piping penetrations flush with the liner.

14. Safety class isolation valves shall be provided between the cooling loop and the cleanup loop.

E. SAFETY REQUIREMENTS:

The FPCS shall be designed in accordance with ASME Boiler & Pressure Vessel Code, Section II, Class 2 and Seismic Category I requirements. The SFPCS shall meet the requirements of NRC General Design Criteria 2, 4, 44, 45, 46, 61, and 63.

Each of the fuel pool cooling pumps shall be powered such that each pump receives power from a separate source. Provisions shall be made such that if a total loss of off-site power should occur, the operator has the option of transferring at least one pump to the emergency power source.

In the event of a single failure in one of the spent fuel cooling loops, the other loop shall provide adequate cooling.

The SFPCS shall be protected against the effects of internally and externally generated missiles.

E. <u>SAFETY REQUIREMENTS:</u> (continued)

The SFPCS shall be located in the Fuel Handling Building which is designed to Seismic Category I requirements as well as to withstand the effects of tornados.

F. <u>ATTACHMENTS</u>:

US NRC Standard Review Plan, Section 9.3.1, Revision 1, dated July 1981.

G. REVIEW AND APPROVAL:

Prepared by: ____________ * ____________

Reviewed by Lead System Engineer: ____________ * ____________

Approved by Mech Design Engineering Supervisor: ____________ * ____________

Accepted by Mech Design Supervisor: ____________ * ____________

Accepted by I&C Supervising Engineer: ____________ * ____________

*--Signatures/initials located in DBD-110, Rev. 0

REVISION SUMMARY

DBD-110 Revision 6

Basis for revision is ESR 97-00636.

The following changes were made in this revision:

Page 4, Section 2.1.10	Added - "Additional fuel pool heatload applicability documentation can be found in ESR 97-00636 (Reference 4.5.18)." Also removed cycle specific case designations.
Page 17, Section 4.5.18	Added ESR 97-00636 to list.

DBD-110 Revision 7

Basis for revision is ESR 99-00208.

The following changes were made in this revision:

All pages	Revised DBD revision number and number of pages.
Page 9, Section 2.2.2	Replaced the first sentence with wording provided in ESR 99-00208.
Page 17, Section 4.5.19	Added ESR 99-00208 to list.

DBD-110 Revision 8

Basis for revision is ESR 00-00046.

The following changes were made in this revision:

All pages	Revised DBD revision number and number of pages.
Page 4, Section 2.1.10	Added ESR 00-00046 to writeup.
Page 17, Section 4.5.20	Added ESR 00-00046 to list.