USAR-9.6

Auxiliary Systems

Spent Fuel Pool Cooling System

Rev 10

Safety Classification:

Safety

Usage Level:

Information

Change No.:	**EC 53955**
Reason for Change:	**Clarify information of the fuel being discharged from the core to the SFP and revise the Spent Fuel Pool (SFP) Time-To-Boil value to reflect the boiling point of 210°F versus 212°F due to FCS barometric pressure based for the 1000 ft. elevation.**
Preparer:	**R. Roenigk**
Issued:	**02-23-12 3:00pm**

Fort Calhoun Station

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9.6 Spent Fuel Pool Cooling System

9.6.1 Design Bases

The spent fuel pool cooling system was designed to remove decay heat from spent fuel assemblies stored in the pool and to control and maintain the chemistry and clarity of the pool water. It can remove decay heat from a full core discharged from the reactor 72 hours after shutdown at a rate of 3 assemblies/hour from a power level of 1500 MWt, while maintaining the pool water temperature below 140°F (a heat load of 20.7 x 10^6 Btu/hr). (Reference 9.6.8.8) The pool has the capability to accommodate 1083 unconsolidated fuel assemblies while the reactor is unloaded for maintenance and repairs. (Reference 9.6.8.1)

The piping is so arranged that failure of any pipeline connected to the pool will not drain the pool below the top of the spent fuel racks.

The spent fuel pool cooling system was designed and constructed to Seismic Class I standards (see Appendix F).

9.6.2 System Description

The spent fuel pool cooling system is shown in P&ID 11405-M-11. The system consists of two storage pool circulation pumps, a storage pool heat exchanger, a demineralizer and filter, two fuel transfer canal drain pumps, piping, valves and instrumentation.

The storage pool pumps circulate borated water through the storage pool heat exchanger and return it to the pool. Cooling water to the heat exchanger is provided by the component cooling water system (see Section 9.7). The purity and clarity is maintained by diverting a portion of the circulated water through the demineralizer and the filter. The fuel transfer canal drain pumps are utilized to:

- Provide pool make-up water from the safety injection and refueling water (SIRWT);
- Drain the fuel transfer canal and return the refueling water to the SIRWT or the radioactive waste disposal system (RWDS).

During refueling periods the demineralizer and filter can provide a purification system for the refueling water in the containment refueling cavity. This is accomplished with the reactor coolant drain tank pumps. They take suction from the containment refueling cavity and circulate the borated water through the demineralizer and filter and return it to the spent fuel pool.

While the plant is shutdown, and the core is fully off loaded, the shutdown cooling system provides an emergency backup for the spent fuel pool cooling system in case of failure of that system.

This emergency backup cooling capability of the shutdown cooling system is not available when the CCW or RW systems are out of service for maintenance. This condition is acceptable due to the short duration of the system outages, close attention to the fuel pool heatup rate, and the availability of makeup water sources.

9.6.3 System Components

The design and operating data for the spent fuel pool cooling system components are shown in Table 9.6-1:

Table 9.6-1 - Spent Fuel Cooling System, Design and Operating Data

Storage Pool Circulation Pumps, Item No's AC-5A and AC-5B

Number Installed	2
Type	Horizontal, Centrifugal
Capacity, gpm/pump	900
TDH, ft	120
Nominal Operating Temperature, °F	110
Material of Construction	Austenitic Stainless Steel
Motor Enclosure	Totally Enclosed

Storage Pool Heat Exchanger, Item No. AC-8

Number Installed	1
Type	Shell and U-Tube
Code	ASME Section III, Class C, 1968 and TEMA Class R
Capacity, Btu/hr	9 x 106 to 20.7 x 106*
Materials of Construction	
Shell Side	Carbon Steel
Tube Side	Type 304 SS

*Heat removal capacity varies with pool circulating water temperature conditions. The AC-8 has been rerated as a result of the 1994 spent fuel pool rerack project thermal hydraulic analysis (Reference 9.6.8.1).

Table 9.6-1 (Continued)

Demineralizer, Item No. AC-7

Number Installed	1
Type	Mixed Bed, Non-Regenerative
Code	ASME Section III, Class C, 1968
Flow Rate, gpm	75 to 300
Material of Construction	Austenitic SS

Filter, Item No. AC-6

Number Installed	1
Type	Vertical Cylinder, Non-Back-flushable
Code	ASME Section III, Class C, 1968
Flow Rate, gpm	75 to 300
Retention of 200 Micron Particles, %	95
Material of Construction	Austenitic SS

Fuel Transfer Canal Drain Pumps, Item No's AC-13A and AC-13B

Number Installed	2
Type	Horizontal, Centrifugal
Capacity, gpm/pump	250
TDH, ft	100
Nominal Operating Temperature, °F	110
Material of Construction	Austenitic SS
Motor Enclosure	Drip-Proof

Spent Fuel Pool Strainer, Item No. AC-14

Number Installed	1
Size, inch	8
Material of Construction	Austenitic SS

Piping

Code	USAS B31.7 1968, Class III and B31.1 1967
Material	ASTM A312, Type 304 SS

9.6.4 System Operation

All system functions are locally controlled. The equipment and instruments are accessible during normal operation. An analysis of fluid samples provides the operator with data for selection and adjustment of flow through the demineralizer-filter circuit. Temperature regulation is accomplished by adjustment of the component cooling water flow to the storage pool heat exchanger. All pumps are started locally.

9.6.5 Design Evaluation

The gross volume of the spent fuel pool is approximately 215,000 gallons. The system is designed to cool the pool water by recirculating the contents through the cooling loop once every two hours with both pumps operating. The tie to the shutdown cooling system provides a redundant fuel pool cooling loop. The demineralizer-filter circuit can, under normal operating conditions, process one half of the pool contents in 24 hours. To preclude carry-over of resin into the spent fuel pool, the filter is installed downstream of the demineralizer. The demineralizer and the filter can be isolated individually for maintenance purposes, without interruption of the normal cooling operation. To accommodate refueling water purification during refueling periods, the demineralizer and filter have an operating capacity four times as high as the normal requirements. This assures the system's capability to maintain the desired purity and clarity of the pool water.

Make-up to the spent fuel pool, to compensate for evaporation losses, for example, is normally from the SIRWT. Demineralized water can be used for makeup. If necessary, pool water can be pumped to the radioactive waste processing system for disposal.

9.6.6 Availability and Reliability

All the equipment in the system is manually operated; there are no pneumatically or electrically actuated valves. Metals in contact with borated water are austenitic stainless steel. The tie to the shutdown cooling system from the spent fuel pool cooling system adds an independent source of fuel pool cooling.*

With a freshly unloaded full core in the pool assumed to be discharged from the reactor 72 hours after shutdown and upon failure of the spent fuel pool cooling system at the peak temperature instant, the pool temperature (135°F) would rise to the boiling point of 210°F within 7.0 hours. This scenario conservatively assumes the spent fuel pool has 1339 spent fuel assemblies with consolidation. The boiling point of 210°F is due to the FCS barometric pressure based for the 1000 ft. elevation. (Reference 9.6.8.8)

9.6.7 Tests and Inspections

All equipment in the system was cleaned and tested prior to installation in accordance with the applicable codes. The system was also cleaned and hydrostatically tested after installation. Welds were inspected as required by the code and all other connections checked for tightness.

Prior to fuel loading the system was tested with regard to flow paths, flow capacity, heat transfer capability, mechanical operability and purification efficiency. Pressure, temperature, flow and level indicating instruments were calibrated and checked for operability.

The equipment is accessible for inspection and maintenance at all times and is tested periodically in accordance with ASME Section XI Boiler and Pressure Vessel Code.

* This independent source of cooling is not available when the CCW or RW systems are out of service for maintenance. See Section 9.6.2.

9.6.8 References

9.6.8.1 MR-FC-91-009, Spent Fuel Pool Rerack

9.6.8.2 NRC Safety Evaluation Report Supporting Amendment Number 13, July 2, 1976

9.6.8.3 NRC Safety Evaluation Report Related to the Modification of the Spent Fuel Pool, September 9, 1983

9.6.8.4 NRC Safety Evaluation Report Related to Ultrasonic Fuel Inspection in the Spent Fuel Pool, March 12, 1987

9.6.8.5 IE Bulletin Number 78-08, Radiation Levels From Fuel Element Transfer Tubes, June 12, 1978

9.6.8.6 Engineering Analysis EA-FC-92-077, Licensing Report for Spent Fuel Pool Storage Expansion

9.6.8.7 MF987, Society of Manufacturing Engineers, Rating Disposable Filters, September 1987

9.6.8.8 FC05988, Revision 4, Thermal-Hydraulic Analysis of Fort Calhoun Station Spent Fuel Pool with Maximum Density Storage