10.9 RHR SERVICE WATER SYSTEM

10.9.1 Safety Objective

The ultimate safety objective of the RHR Service Water System is heat removal from the primary water of the RHR Systems, using cooling water from Wheeler Reservoir delivered by service water pumps located within the intake pumping station. The system also provides standby core and containment cooling and supplies water to the Emergency Equipment Cooling Water System.

10.9.2 Safety Design Basis

1. The system shall be manually operated to supply cooling water to the primary RHR System heat exchangers and provide standby core and containment cooling, and shall be automatically operated to supply water to the EECW System.

2. Piping and equipment, including support structures, shall be designed to withstand the effects of an earthquake without failure.

3. The pumps on the intake pumping station shall be designed to withstand tornado winds and weather.

10.9.3 Description

The RHR Service Water System, although it is a plant-shared system, is remote-manually operated from each of the three unit control rooms to pump raw river water from the intake station to the RHR heat exchangers and provide standby core cooling (see Subsection 4.8). The RHR Service Water System operates automatically to supply water to the EECW System (see Subsection 10.10).

The RHRSW is a twelve-pump, four-header system with four pairs of pumps normally assigned to the RHR System and four additional pumps normally assigned to the EECW System. Each of the pairs (assigned to the RHRSW System) feeds one independent RHR service water header which, in turn, feeds one RHR heat exchanger in each unit. The four pumps assigned to the EECW (A3, B3, C3, D3) are also paired, one pair serving each of the two EECW headers. If necessary, one of each pair of pumps normally assigned to the RHRSW can be manually realigned to the EECW. On a per-unit and -plant basis, the system provides several ways to supply water to shut down equipment. Each RHR service water and EECW header is physically, mechanically, and electrically independent of the alternate headers performing the same function. (See Appendix F for more details.) A flow diagram is shown in Figures 10.9-1a sheets 1, 2, and 3. System instrumentation is shown in Figures 10.9-1b, 10.9-2a, 10.9-2b, 10.9-2c, 10.9-2d, and 10.9-2e.

The RHRSW pumps take suction below the breach of Wheeler Dam (El. 529.0) and will, therefore, remain operable in the unlikely event of failure of the dam. Each pump is rated at 400-hp with a capacity of 4500 gpm at 275-foot total head. Each pump has the capacity to supply 100 percent of the cooling water required by one RHR heat exchanger.

The RHRSW-EECW system has the capability of utilizing FLEX (Flexible and Diverse Coping Mitigation Strategies) pumps to provide make-up water to the RPV and SFP, Drywell Spray header, and cooling water to the RHR heat exchanger and other essential equipment such as the Core Spray Room Coolers. The FLEX connections to RHRSW headers in Intake Pump Station Rooms B and D are designed to be utilized during a Beyond Design Basis External Event (BDBEE) condition for a loss of off-site power event and if the site Emergency Diesel Generators are inoperable.

RHRSW pumps A2 and C2 are tripped by the Common Accident Signal Logic to prevent overloading 4kV Shutdown Bus 1. As ECCS pumps are secured and loads are reduced on the 4kV Shutdown Buses, the RHRSW pumps may be manually re-started by operators as desired to support long term post accident recovery and shutdown of the non-accident units. Within 1 hour following a design basis accident, six RHR service water pumps will be required to supply cooling water to the RHR heat exchangers and two to supply EECW requirements.

Connections are provided on the RHR Service Water System for use as a supply of cooling water to the standby coolant supply system. Standby coolant for Units 1 and 2 is provided by the "D" service water header and by the "B" header for Units 2 and 3.

Although individual service water supply headers are provided to each RHR heat exchanger, the discharges from two adjacent exchangers (A and C, or B and D) are joined as a common discharge. Prior to discharge into Wheeler Reservoir, this common discharge is split and subsequently recombined with the discharge from the other pair of heat exchangers. This configuration provides a more uniform temperature of discharge into Wheeler Reservoir. The layout of the discharge lines from the RHR heat exchangers to the reservoir is shown on FSAR Figure 10.9-1b.

The discharge piping for RHR Heat Exchanger 2B is equipped with a vacuum breaker to mitigate water hammer loads in the event that the piping becomes drained in a fire event. Air for the vacuum breakers is drawn from outside to prevent release of secondary containment atmosphere to the environment.

Each common discharge is equipped with a radiation monitor. Drain and fill connections are provided on the service-water side of the RHR heat exchangers in order to drain or fill the heat exchangers.

The piping and valves from the heat exchanger inlet check valve to the discharge motor-operated globe valve are designed for 450 psig at 350°F, with the remainder of the supply piping and the Reactor Building discharge piping designed for 185 psig at 150°F. The yard discharge piping is designed for 80 psig at 150°F. The portion of piping from the discharge motor-operated globe valves to the point where the individual discharge lines form a common header is designed for 185 psig at 350°F.

Redundant RHRSW sump pumps are located within a 195 cu. ft. sump pit in rooms A, B, C, and D of the intake pumping station. Each sump pump is designed to remove 300 gpm of water at a total design head of 20 feet. The sump pumps are safety related and protect essential equipment in the pump rooms from damage due to flooding of the intake station pump rooms as a result of local maximum 1-hour rainfall.

10.9.4 Safety Evaluation

Power for the RHR service water pumps is provided by the four 4160-V shutdown boards (two pumps per board) in Units 1 and 2 and four 4160-V shutdown boards in Unit 3 (one pump per board). Each shutdown board is supplied by its individual standby diesel generator in the event of failure of the Normal Auxiliary Power System.

Two RHR service water pumps (A3 and C3) provide direct feed to the EECW north header and are powered from the shutdown boards in Unit 3. Another pair (B3 and D3) provide direct feed to the EECW south header and are powered from the shutdown boards in Units 1 and 2. One RHR service water pump (A2, B2, C2, and D2) on each RHR service water header is powered from the shutdown boards in Units 1 and 2. The other service water pumps on the B and D headers (B1 and D1) are powered from Unit 3 shutdown boards. The other service water pumps on the A and C headers (A1 and C1) are powered from Units 1 and 2 shutdown boards.

The RHR service water pumps are deck-mounted on the intake structure in an accessible location so that maintenance may be performed under emergency conditions. They will remain operable under flood conditions to about El. 578, which is approximately 6 feet above the maximum possible flood level of El. 572.5. The pumps are designed to operate in severe wind and weather such as during tornadoes. The pumps are widely dispersed and physically separated into groups of three on the intake deck to prevent common damage from one or more missiles.

The RHR Service Water System is designed as a Class I system for withstanding the specified earthquake loadings (see Appendix C). The air intake piping for the RHRSW vacuum breakers (portions between the vacuum breakers and the Secondary Containment penetrations) is seismic Class II. The system piping and equipment are designed, installed, and tested in accordance with USAS B31.1.0, Section 1, 1967 edition with the exception of the RHRSW Pumps, which are designed and constructed in accordance with ASME Section III, Class 3 (non-stamped), 1974 Edition through 1974 Winter Addenda.

For power uprated units, the analyzed RHRSW effluent temperature from the RHR heat exchanger is greater than analyzed for the non-power uprated condition. In order to maintain the same value for post LOCA peak suppression pool temperature as calculated prior to the power uprate, the reactor power level will be limited when the RHRSW input (Wheeler Lake) temperature is above the technical specifications specified value.

10.9.5 Inspection and Testing

The RHR service water pumps and piping are tested periodically to verify operability. The system is tested during initial startup to simulate breach of Wheeler Dam. The flow through each heat exchanger is measured for compliance with the specifications. After testing or use, the heat exchangers are left filled and the motor-operated valve downstream of the heat exchangers is closed.

The RHR service water system piping and components are monitored by routine inspections, general housekeeping practices, and system operability testing which maintains system leakage to an as-low-as-possible level.