TABLE OF CONTENTS

CHAPTER 10.0

STEAM AND POWER CONVERSION SYSTEM

LIST OF TABLES

TABLE 10.3-4 has been deleted

10.4.5 CIRCULATING WATER SYSTEM

The Circulating Water System (CWS) includes equipment, exterior to the Standard Power Block, which supplies approximately 530,000 gpm of cooling water to the condenser. The CWS is shown schematically on Figure 9.2-1.

10.4.5.1 Design Bases

10.4.5.1.1 Safety Design Basis

The CWS serves no safety function and has no safety design basis.

10.4.5.1.2 Power Generation Design Basis

The CWS provides pumped circulation of approximately 530,000 gpm of cooling water to the unit. This flow is sufficient to remove heat at a rate of 7,860 million BTU/hr during maximum power operation with water entering the condenser at 95°F and leaving at 125°F. The cooling tower dissipates this heat by evaporation, cooling the water from 125°F to 95°F when the ambient air temperatures are 79°F wet bulb and 95°F dry bulb.

10.4.5.2 System Description

The CWS consists of three circulating water pumps, a pump suction pit, a 13 ft ID supply line to the power block, a 13 ft ID return line, a cooling tower, and ancillary valves, instruments and control. Three pumps are operated for full flow.

The circulating water pumps are single-stage, vertical, constant-speed, mixed-flow type. Each pump is equipped with a hydraulically operated butterfly valve on the discharge for isolation of the pump from the system. The valve is also programmed for quick closure in order to prevent reverse flow of water and pressure surge in the event of a pump trip. The pumps are symmetrically connected to the power block supply line. Water velocity in the 13 ft diameter supply line is approximately 8.9 fps. It is approximately 9.5 fps in the 13 ft return line because of the addition of 38,000 gpm of service water (See Section 9.2.1).

The pump suction pit under the pumphouse is connected to the cooling tower basin by an open flume which contains two sets of fixed screens. These screens, arranged in series, are provided at the inlet to the pump suction pit to remove airborne debris carried into the cooling tower basin. These screens are cleaned manually as required.

A natural draft cooling tower is used to dissipate heat rejected to the circulating and service water systems. The top of the hyperbolic-shaped concrete tower is 555 ft above grade (Elev. 845'-0" MSL) and is 250 ft in diameter at the outlet. The diameter of the tower at the inlet is 390 ft. The minimum diameter, which occurs at the throat 392 ft above grade, is 230 ft. Warm water enters the tower distribution system 45 ft above the basin normal water level.

The cooling tower basin is 428 ft in diameter and when filled to Normal Water Level (NWL), it contains a total of approximately 12 million gallons of water. Between NWL and Low Water Level (LWL), the lowest point at which circulating and service water pumps are operated, the basin contains approximately 7.8 million gallons of water. The 7'-3" variation in basin level from NWL down to LWL permits continued operation of the unit in the event of interruption of make-up water flow from the Water Treating Plant. One foot of basin wall free board above NWL is provided to contain the volume of water in residence in the cooling tower fill in the event of a trip of all three circulating water pumps.

In the pumphouse adjacent to the cooling tower basin, the floor of the circulating and service water pump suction basin is at El. 825'-6" MSL, and the service water pump suction basin is at El. 822'-0" MSL.

Blowdown from the cooling tower basin is used to limit the concentration of dissolved solids in the cooling water. Cooling tower blowdown is returned to the Missouri River. The rate of make-up flow to the cooling tower basin is controlled by water level in the cooling tower basin. Make-up flow is directed to the service water pump suction basin so that water of minimum dissolved solids concentration is passed through the plant heat exchangers to preclude deposition of carbonates. Service water, after passing through the plant heat exchangers is returned to the cooling tower via the CWS return line. Refer to Section 9.2.1 for details on the Service Water System.

The circulating/service water chemical control program may consist of the addition of chemicals for: copper corrosion control, pH control, scale control and biocides to control organic growth. Plant operating concentrations and feed rates of products are controlled per the plant National Pollutant Discharge Elimination System (NPDES) permit.

10.4.5.3 Safety Evaluation

The CWS is not a safety-related system. The cooling tower is located more than 600 ft. away from all ESF structures. The cooling tower structure has been designed to withstand the OBE.

10.4.5.4 Tests and Operation

All active components of the CWS are accessible for inspection during operation. Normal operational tests will be made, including tests of individual pump operation, system flow rate for design conditions, one pump failure, and the basin level control system.

10.4.5.5 Instrumentation Requirements

Instrumentation is provided on the main control board for monitoring the circulating water pumps. Status lights are included to indicate the pump motor starter condition. A variable cooling tower basin level indication is provided in the control room.

The circulating water pumps are individually equipped with hydraulically operated discharge isolation valves which are interlocked to open and close on pump start/stop signals. These valves are also programmed to close in approximately 5 seconds in the event of a trip of one or two pumps. This rapid closure prevents backflow through the pump(s) and consequent loss of flow through the main condenser and possible trip of the unit. If three pumps trip, the valves are to delay closure for 12 seconds before starting a two-phase Normal Closure mode closure. This three stage closure rate minimizes transient pressure surges in the piping system.