DSAR-9.8

Auxiliary Systems

Raw Water System

Rev 2

Safety Classification: **Safety**

Usage Level: **Information**

Change No.:	EC 69788
Reason for Change:	This section is being updated to align with Permanently Defueled Technical Specifications.
Preparer:	J. Dolton
Owner:	Design Engineering

Table of Contents

List of Tables

List of Figures

The following figures are controlled drawings and can be viewed and printed from the listed aperture card.

9.8 Raw Water System

9.8.1 Design Bases

The raw water system was designed to provide a cooling medium for the component cooling water system. The system is rated for the maximum duty requirements that may occur during defueled operation. The heat transferred to the raw water is discharged to the river. The river water temperature can vary between 32°F in winter to a maximum of 90°F in summer (Ref. 9.7.6.2.1).

The system was designed and constructed to seismic Class I standards (see Appendix F).

9.8.2 System Description

Four raw water pumps are installed in the intake structure pump house to provide screened river water to the component cooling heat exchangers. Motor driven traveling screens are installed ahead of the pump suction. The debris and refuse picked up by the traveling screens are removed through the trash trough.

The pump discharge piping is arranged as two headers which are interconnected and valved at the pumps and in the auxiliary building. Each header was designed to accommodate sufficient flow to the component cooling heat exchangers to support normal modes of plant operation. Consequently, raw water system design bounds defueled plant operation requirements. System pressures, flows and valve positions are displayed in the control room. Water level instrumentation in the intake structure will alarm in the control room if water from any source should endanger the raw water pumps. A majority of the system operational and control functions can be performed from the control room. The flow diagram is shown in P&ID 11405-M-100.

In the unlikely event of a complete failure of the component cooling water system, raw water direct cooling capability exists for the following equipment:

- Raw water direct cooling of the shutdown cooling heat exchangers.
- Raw water direct cooling may be used for the control room A/C waterside economizers.
- Raw water may be utilized for direct cooling of the low pressure safety injection pumps.

Raw water direct cooling is utilized via normally hand-jacked, locked-closed valves.

Raw water direct cooling will not be available when the raw water system is out of service for maintenance. This condition is acceptable due to the short outage duration, close attention to the fuel pool heatup rate, and the availability of makeup water sources

The two raw water lines between the intake structure and the auxiliary building are buried in separate trenches. At the point where raw water piping enters a building, the detail shown in Figure 9.8-2 is employed. The outside guard pipe absorbs forces imposed by the soil in the event of an earthquake. During an earthquake, differential movement between the auxiliary building and the surrounding earth occurs, since the building is connected to bedrock via piles. The process pipe can flex inside the guard pipe, where it is free of soil reactions, enough to absorb the movement between the building and the surrounding earth.

9.8.3 System Components

The design and operating design characteristics of the major raw water system components are shown in Table 9.8-1.

Table 9.8-1 - Raw Water System Design Data

Raw Water Pumps, Item No.'s AC-10A, 10B, 10C and 10D

Number Installed	4
Type	Vertical, Mixed Flow

Pump characteristics:	Flow, gpm per pump	TDH, ft
Nominal Flow and TDH	5325	118
Design Pressure	150 psig	
Design Temperature	150 °F	
Materials of Construction:		
Bowl	AISI 4330 or approved equivalent	
Impeller	AISI 4330 heat treated or approved equivalent	
Shaft	Type 410 stainless steel	

Piping

Design pressure	150 psig
Design temperature	500 °F
Code	USAS B31.7 1968, Class II/Class III and B31.1 1967
Material	Seamless ASTM A106, predominantly. Some high-wear spool pieces are ASTM A312 Grade TP304 or TP304L. See Raw Water P&IDs for details.

Raw Water Strainers, Item No.'s AC-12A and AC-12B

Number Installed	2
Type	20", Model A, Self Cleaning

Strainer Characteristics

Design Pressure	150 psig
Design Temperature	150 °F
Materials of Construction:	
Body	Cast Iron
Drum	Cast Iron
Shaft	Steel
Media	316 SS w/ 1/8" perforations

9.8.4 System Operation

9.8.4.1 Normal Operation

The system is remotely operated from the control room. Raw water flow is normally maintained through at least one in service component cooling heat exchanger. The number of component cooling heat exchangers in service (i.e., having both raw water and component cooling water flow through them) during defueled plant operation is a function of river temperature and the amount of cooling capability needed.

9.8.5 Design Evaluation

The raw water system was designed to provide sufficient flow and head capability to maintain the component cooling water at a maximum return temperature of 110°F during normal plant operation. Due to substantially reduced heat loads that are cooled by raw water in the defueled plant condition, the raw water system design bounds all possible defueled plant heat loads.

The raw water system is capable of providing alternate cooling of the SFP through the shutdown cooling heat exchangers if the CCW system is not available.

9.8.6 Availability and Reliability

The system piping between the intake structure and the auxiliary building was designed as a two 20 inch header system. The discharge piping from the four pumps is manifolded, valved and instrumented to permit operation or isolation of any pump. Sufficient flow is available, under any normal mode of operation, even if one of the two supply headers should rupture. Redundant pumping capacity is provided.

To ensure system integrity in the event of an earthquake, each 20 inch header is encased in a 28 inch cast-in-concrete guard pipe in the south wall of the auxiliary building.

The emergency diesel-generators ensure a power supply if the off-site power is interrupted and either generator operates sufficient equipment to provide defueled plant cooling.

Air accumulators inside the intake structure provide instrument air to operate the raw water system valves in the intake structure even upon failure of the Instrument Air system. The air-operated raw water strainer backflush valves (HCV-2805A/B), however, do not have air accumulators. These valves fail to the open position upon loss of instrument air.

Water level instrumentation in the intake structure will alarm in the control room if water from any source should endanger the raw water pumps.

Protection for the raw water pumps and their drives against floods is provided at three elevations as indicated on Figure 9.8-1. The pumps are permanently protected against any water level up to elevation 1,007.5 feet by the Class I concrete substructure of the intake building. See Section 2.7 for additional information. Protection against the 1,009.3 foot and 1,014 foot floods (discussed below) is provided by gasketed steel closures at exterior doorway openings and the screen wash discharge trough. The water level inside the intake cells can be controlled by closing the exterior sluice gates and throttling the intake cell flood water inlet valves and/or varying the raw water pump output to remove the inlet flow. Flood water isolation valves are available to isolate a failed open flood water inlet valve if required.

The flood water inlet and isolation valves, attached piping, and immediate components remain functional for a flood following a seismic event (Reference 9.8.8.3, DSAR Section 2.7).

The reinforced concrete perimeter walls of the intake structure extend to elevation 1,014.5 feet. However, above 1,007.5 feet MSL, the walls are designed only for the hydrostatic load from a 1,014 foot flood.

For further information on flood protection, see Section 2.7

The intake structure is a massive concrete building set just back of the harbor line of the river. The noses of all of the intake or recirculation channels are armored with anchored steel plates. The threat of collision from boat or barge traffic traveling downstream has been reduced by the installation of a sheet pile wall upstream of the intake structure. This wall eliminates the protrusion of the structure into the river channel on the upstream side. Any blow that could be struck by such a vessel would be a glancing one at worst on the armored wall noses and any damage to the structure itself is considered unlikely. Even a flood or storm driven barge which might strike the intake structure could not conceivably block flow sufficiently in the three sections of the structure to decrease the flow from the raw water pumps. The intake structure consists of three bays separated by concrete walls perpendicular to the river; two cells contain one raw water pump each and one cell contains two. Flow through each cell is independent of the other two, and the raw water pumps are located 35 feet back from the river.

There are three types of icing conditions which have been encountered. The three types of ice that can be potentially encountered at the station are frazil ice, floating block ice, and complete freeze over of the river.

Frazil ice it the most severe, which occurs at the beginning of ice formation on the river. Testing and Operating Experience has shown that frazil ice grows horizontally but not downward.

Floating block ice occurs when portions of the rivers surface have frozen, but still have the ability to float freely with the river current.

During very severe weather, the river may freeze completely over but, the flow of water beneath the ice is sufficient to supply water for the raw water pumps.

In low intake flow conditions, as currently being experienced during decommissioning activities, partial blockage at the top surface of the river may occur due to ice conditions described above, but the ice will not completely block flow into the intake structure. Reference FC07384 “River Level Required to Maintain RW/CW Pump Minimum Submergence.”

The Corps of Engineers adjusts winter releases from Gavins Point as necessary to accommodate the needs of all Missouri River water users. Normally, the water level is maintained higher than 983.0 feet. Although agreement between OPPD and the Corps of Engineers to maintain minimum river water levels has not been formalized, the Corps of Engineers does cooperate with OPPD in these matters and would provide additional flow from upstream dams if such conditions would be impending. The time required for severe ice blockage of the river to occur extends into many hours and the weather conditions which would cause blockage would be evident over a period of a few days. Even lower river water levels would not be detrimental to plant safety since the minimum submergence level (MSL) on the raw water pumps is 976 feet 9 inches or more than six feet below the controlled minimum river water level.

At low river levels, debris and/or ice on the traveling screens and/or trash racks can cause significant head loss potentially reducing intake cell levels below the raw water pump MSL. The levels of the river and the intake cells are monitored by plant instrumentation.

An evaluation has been performed of the flooding consequences of a postulated pipe failure involving a system in or above the raw water pump rooms (fire protection, raw water, screen wash). Since these are not high-energy systems (pressure <275 psig and temperature <200°F), the "postulated pipe failure" is a through-wall pipe crack, with the crack size being half the pipe diameter in length and half the pipe thickness in width. The evaluation shows that for any single postulated pipe failure, ample time is available to implement operator actions to isolate the leak before the raw water pump room water level reaches the raw water pump motors.

In the unlikely event all raw water pumps are unavailable, cooling water can be obtained from the fire protection system and its diesel or electric driven fire pumps to provide some base load cooling until raw water can be restored. This system interconnection would be made between the raw water/component cooling water heat exchangers and local fire hose cabinets. Operator actions required for this interconnection are included in one of the plant's abnormal operating procedures.

9.8.7 Tests and Inspections

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

Prior to startup, the system was tested with regard to flow paths, flow capacity, heat transfer capability and mechanical operability. The pumps and valves were tested for conformance to design specifications. Pressure, temperature and flow indicating and controlling instruments were calibrated and checked for operability.

The equipment is accessible for inspection and maintenance.

9.8.8 General References

9.8.8.1 Safety Evaluation by the Office of Nuclear Reactor Regulation supporting Amendment No. 282 to Renewed Facility Operating License No. DPR-40, June 30, 2015 (NRC-15-058)