CHAPTER 10

STEAM AND POWER CONVERSION

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CHAPTER 10

STEAM AND POWER CONVERSION

10.1 SUMMARY DESCRIPTION

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

10.1.3 COMBINED LICENSE INFORMATION ON EROSION-CORROSION MONITORING

Add the following text at the end of DCD Subsection 10.1.3.

10.1.3.1 Erosion-Corrosion Monitoring

STD COL 10.1-1 The flow accelerated corrosion (FAC) monitoring program analyzes, inspects, monitors and trends those nuclear power plant components that are potentially susceptible to erosion-corrosion damage such as carbon steel components that carry wet steam. In addition, the FAC monitoring program considers the information of Generic Letter 89-08, EPRI NSAC-202L-R3, and industry operating experience. The program requires a grid layout for obtaining consistent pipe thickness measurements when using Ultrasonic Test Techniques. The FAC program obtains actual thickness measurements for highly susceptible FAC locations for new lines as defined in EPRI NSAC-202L-R3 (Reference 201). At a minimum, a CHECWORKS type Pass 1 analysis is used for low and highly susceptible FAC locations and a CHECWORKS type Pass 2 analysis is used for highly susceptible FAC locations when Pass 1 analysis results warrant. To determine wear of piping and components where operating conditions are inconsistent or unknown, the guidance provided in EPRI NSAC-202L is used to determine wear rates.

10.1.3.1.1 Analysis

An industry-sponsored program is used to identify the most susceptible components and to evaluate the rate of wall thinning for components and piping potentially susceptible to FAC. Each susceptible component is tracked in a database and is inspected, based on susceptibility. Analytical methods utilize the results of plant-specific inspection data to develop plant-specific correction factors. This correction accounts for uncertainties in plant data, and for systematic discrepancies caused by plant operation. For each piping component, the analytical method predicts the wear rate, and the estimated time until it must be re-inspected, repaired, or replaced. Carbon steel piping (ASME III and B31.1) that is used for single or multi-phase high temperature flow are the most susceptible to erosion-corrosion damage and receive the most critical analysis.

10.1.3.1.2 Industry Experience

Review and incorporation of industry experience provides a valuable supplement to plant analysis. Industry experience is used to update the program by identifying susceptible components or piping features.

10.1.3.1.3 Inspections

Wall thickness measurements establish the extent of wear in a given component, provide data to help evaluate trends, and provide data to refine the predictive model. Components are inspected for wear using ultrasonic techniques (UT), radiography techniques (RT), or by visual observation. The initial inspections are used as a baseline for later inspections. Each subsequent inspection determines the wear rate for the piping and components and the need for inspection frequency adjustment for those components.

10.1.3.1.4 Training and Engineering Judgement

The FAC program is administered by both trained and experienced personnel. Task specific training is provided for plant personnel that implement the monitoring program. Specific non-destructive examination (NDE) is carried out by personnel qualified in the given NDE method. Inspection data is analyzed by engineers or other experienced personnel to determine the overall effect on the system or component.

10.1.3.1.5 Long-Term Strategy

This strategy focuses on reducing wear rates and performing inspections on the most susceptible locations.

10.1.3.2 Procedures

10.1.3.2.1 Generic Plant Procedure

The FAC monitoring program is governed by procedure. This procedure contains the following elements:

- A requirement to monitor and control FAC.
- Identification of the tasks to be performed and associated responsibilities.
- Identification of the position that has overall responsibility for the FAC monitoring program at each plant.
- Communication requirements between the coordinator and other departments that have responsibility for performing support tasks.
- Quality Assurance requirements.

- Identification of long-term goals and strategies for reducing high FAC wear rates.
- A method for evaluating plant performance against long-term goals.

10.1.3.2.2 Implementing Procedures

The FAC implementing procedures provide guidelines for controlling the major tasks. The plant procedures for major tasks are as follows:

- Identifying susceptible systems.
- Performing FAC analysis.
- Selecting and scheduling components for initial inspection.
- Performing inspections.
- Evaluating degraded components.
- Repairing and replacing components when necessary.
- Selecting and scheduling locations for the follow-on inspections.
- Collection and storage of inspections records.

10.1.3.3 Plant Chemistry

The responsibility for system chemistry is under the purview of the plant chemistry section. The plant chemistry section specifies chemical addition in accordance with plant procedures.

Add the following after DCD Subsection 10.1.3:

10.1.4 REFERENCES

201. EPRI NSAC-202L-R3, Recommendations for an Effective Flow-Accelerated Corrosion Program (NSAC-202L-R3), Electric Power Research Institute (EPRI) Technical Report 1011838, Palo Alto, CA, 2006.

10.2 TURBINE-GENERATOR

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

10.2.2 SYSTEM DESCRIPTION

Add the following sentence at the end of the second paragraph of DCD Subsection 10.2.2.

STD SUP 10.2-1 Subsection 3.5.1.3 addresses the probability of generation of a turbine missile for AP1000 plants in a side-by-side configuration.

Add the following statement at the end of DCD Subsection 10.2.2.

STD SUP 10.2-4 Preoperational and startup tests provide guidance to operations personnel to ensure the proper operability of the turbine generator system.

10.2.3 TURBINE ROTOR INTEGRITY

Add the following statement at the end of DCD Subsection 10.2.3.

STD SUP 10.2-5 Operations and maintenance procedures mitigate the following potential degradation mechanisms in the turbine rotor and buckets/blades: pitting, stress corrosion cracking, corrosion fatigue, low-cycle fatigue, erosion, and erosion-corrosion.

10.2.3.6 Maintenance and Inspection Program Plan

Add the following at the end of DCD Subsection 10.2.3.6.

STD SUP 10.2-3 The inservice inspection (ISI) program for the turbine assembly provides assurance that rotor flaws that lead to brittle fracture of a rotor are detected. The ISI program also coincides with the ISI schedule during shutdown, as required by the ASME Boiler and Pressure Vessel Code, Section XI, and includes complete inspection of all significant turbine components, such as couplings, coupling bolts, turbine shafts, low-pressure turbine blades, low-pressure rotors, and high-pressure rotors. This inspection consists of visual, surface, and volumetric examinations required by the code.

10.2.6 COMBINED LICENSE INFORMATION ON TURBINE MAINTENANCE AND INSPECTION

Replace the text in DCD Subsection 10.2.6 with the following:

STD COL 10.2-1

A turbine maintenance and inspection program will be submitted to the NRC staff for review prior to fuel load. The program will be consistent with the maintenance and inspection program plan activities and inspection intervals identified in DCD Subsection 10.2.3.6. Plant-specific turbine rotor test data and calculated toughness curves that support the material property assumptions in the turbine rotor analysis will be available for review after fabrication of the turbine and prior to fuel load.

10.3 MAIN STEAM SUPPLY SYSTEM

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

10.3.2.2.1 Main Steam Piping

Add the following at the end of DCD Subsection 10.3.2.2.1.

STD SUP 10.3-1 Operations and maintenance procedures include precautions, when appropriate, to minimize the potential for steam and water hammer, including:

- Prevention of rapid valve motion
- Process for avoiding introduction of voids into water-filled lines and components
- Proper filling and venting of water-filled lines and components
- Process for avoiding introduction of steam or heated water that can flash into water-filled lines and components
- Cautions for introduction of water into steam-filled lines or components
- Proper warmup of steam-filled lines
- Proper drainage of steam-filled lines
- The effects of valve alignments on line conditions

10.3.5.4 Chemical Addition

Add the following at the end of DCD Subsection 10.3.5.4.

STD SUP 10.3-2 Alkaline chemistry supports maintaining iodine compounds in their nonvolatile form. When iodine is in its elemental form, it is volatile and free to react with organic compounds to create organic iodine compounds, which are not assumed to remain in solution. It is noted that no significant level of organic compounds is expected in the secondary system. The secondary water chemistry, thus, does not directly impact the radioactive iodine partition coefficients.

10.3.6.2 Material Selection and Fabrication

Add the following at the end of DCD Subsection 10.3.6.2.

STD SUP 10.3-3 Appropriate operations and maintenance procedures provide the necessary controls during operation to minimize the susceptibility of components made of stainless steel and nickel-based materials to intergranular stress-corrosion cracking by controlling chemicals that are used on system components.

10.4 OTHER FEATURES OF STEAM AND POWER CONVERSION SYSTEM

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

10.4.2.2.1 General Description

Revise the first sentence of the third paragraph of DCD Subsection 10.4.2.2.1 to remove the brackets.

HAR CDI The circulating water system (CWS) provides the cooling water for the vacuum pump seal water heat exchangers.

10.4.2.2.2 Component Description

Revise the fourth sentence of the first paragraph of DCD Subsection 10.4.2.2.2 to remove the brackets.

HAR CDI Seal water flows through the shell side of the seal water heat exchangers, and circulating water flows through the tube side.

Subsection 10.4.5 is modified using full text incorporation to provide site specific information to replace the DCD conceptual design information (CDI).

DCD

10.4.5 CIRCULATING WATER SYSTEM

10.4.5.1 Design Basis

10.4.5.1.1 Safety Design Basis

The circulating water system (CWS) serves no safety-related function and therefore has no nuclear safety design basis.

10.4.5.1.2 Power Generation Design Basis

HAR CDI The circulating water system supplies cooling water to remove heat from the main condensers, the turbine building closed cooling water system (TCS) heat exchangers, and the condenser vacuum pump seal water heat exchangers, under varying conditions of power plant loading and design weather conditions.

DCD 10.4.5.2 System Description

10.4.5.2.1 General Description

Classification of components and equipment in the circulating water system is given in Section 3.2.

HAR COL 10.4-1 The circulating water system and cooling tower provide a heat sink for the waste heat exhausted from the steam turbine. Additional cooling is supplied from the CWS through a supply from the main header for the TCS heat exchangers and the condenser vacuum pump seal water heat exchangers. Site-specific CWS design data is provided in Table 10.4-201. Table 10.4-201 data replaces the conceptual design in DCD Table 10.4.5-1.

HAR CDI The circulating water systems consist of three 33-1/3 percent capacity circulating water pumps, one hyperbolic natural draft cooling tower, and the associated piping, valves and instrumentation. Figure 10.4-201 shows the circulating water system and the raw water (makeup water) system.

DCD Makeup water to the CWS is provided by the raw water system (RWS). In addition, water chemistry is controlled by a local chemical feed system.

10.4.5.2.2 Component Description

Circulating Water Pumps

DCD/HAR CDI The three circulating water pumps are vertical, wet pit, single-stage, mixed-flow pumps driven by electric motors. The pumps are mounted in an intake structure, which is connected to the cooling tower basin. Removable screens are provided in the circulating water pump intake structure for removal of debris that enters the cooling tower basin. The three pump discharge lines connect to a dual-pipe common header which connects to the two inlet water boxes of the condenser and may also supply cooling water to the TCS and condenser vacuum pump seal water heat exchangers. Each pump discharge line has a motor operated butterfly valve located between the pump discharge and the main header. This permits isolation of one pump for maintenance and allows two-pump operation.

Cooling Tower

HAR CDI The cooling tower for circulating water is a hyperbolic natural draft structure. Operation of the cooling tower, during conditions that are more restrictive than design conditions, may result in higher condenser back pressure.

The cooling tower has a basin which provides storage for the circulating water inventory and allows bypassing of the cooling tower during cold weather operations. This basin is connected to the intake of the circulating water pumps by a canal.

The closest edge of the cooling tower is located approximately 700 ft from the nearest safety-related structure to avoid potential interactions with the plant structures.

Routed to or near the natural draft cooling towers are the circulating water system piping, the raw water system piping, and the blowdown water line. Collapse of the natural draft cooling towers has the potential to rupture these pipes. Per DCD Subsection 3.4.1.1.1, failure of the cooling tower or the circulating water system piping under the yard could result in a potential flood source. However, as stated above, the cooling tower is located more than 700 feet from the closest safety-related structure and water from the cooling tower water basin would be carried by site grading away from safety-related structures. The circulating water system piping is routed north from the turbine building and then east to the cooling tower without passing near any safety-related structure. Water from a rupture of the circulating water piping also would be carried by site grading away from safety-related structures. The consequences of the failure in the yard of the circulating water piping is bounded by the failure of the circulating water piping in the turbine building described in DCD Subsections 3.4.1.1.1, 3.4.1.2.2.3 and 10.4.5.2.3. The circulating water system piping rupture bounds the rupture of the raw water system, piping and the blowdown water line. Per FSAR Table 10.4-201, the circulating water flow is greater than 530,000 gallons per minute. This bounds the raw water system flow rate (approximately 26,000 gallons per minute) or the blowdown flow (6000 gallons per minute per FSAR Subsection 10.4.5.2.2).

Cooling Tower Makeup and Blowdown

DCD The circulating water system makeup is provided by the raw water system.

HAR CDI The raw water pumps are located in the raw water pump house. The raw water system is discussed in Subsection 9.2.11. Makeup to and blowdown from the circulating water system is controlled by the makeup and blowdown control valves. This control scheme, along with the local chemical feed system, provides chemistry control in the circulating water in order to maintain a noncorrosive, nonscale-forming condition and limit biological growth in CWS components. The makeup water system for the circulating water cooling tower also provides makeup for the service water cooling tower, potable water system, fire protection system, and cycle makeup. Three 50% capacity makeup water pumps are provided and two 100% capacity ancillary makeup water pumps are provided for use when the circulating water system is not in operation. Self cleaning strainers are provided for the makeup pump discharges. The raw water distribution system is shown on Figure 10.4-202.

During operation a nominal blowdown flow of 6000 gpm is maintained for liquid waste dilution and to limit deposition of suspended solids in the blowdown discharge piping.

DCD **Piping and Valves**

HAR CDI The underground portions of the circulating water system piping are constructed of concrete pressure piping. The remainder is carbon steel, with an internal coating of a corrosion-resistant compound.

HAR COL 10.4-1 The primary drainage path for the condenser water boxes and tube bundles is via gravity to the cooling tower basins using the cooling tower bypass lines. As an alternate, condenser water box drain lines are provided that direct drainage to the turbine building sumps.

DCD Motor-operated butterfly valves are provided in each of the circulating water lines at their inlet to and exit from the condenser shell to allow isolation of portions of the condenser.

HAR CDI Control valves provide regulation of cooling tower blowdown and makeup.

DCD The circulating water system is designed to withstand the maximum operating discharge pressure of the circulating water pumps.

HAR CDI Piping includes the expansion joints, butterfly valves, condenser water boxes, and tube bundles.

HAR COL 10.4-1 The piping design pressure is 100 psig from the circulating water pump discharge to the pump discharge isolation valves. The piping design pressure from the circulating water pump discharge isolation valves, including the condenser and waterboxes, to the discharge to the cooling tower is 75 psig.

DCD **Circulating Water Chemical Injection**

Circulating water chemistry is maintained by a local chemical feed skid at the CWS cooling tower.

DCD/HAR CDI Circulating water system chemical feed equipment injects the required chemicals into the circulating water downstream at the CWS cooling tower basin area.

DCD This maintains a noncorrosive, nonscale-forming condition and limits the biological film formation that reduces the heat transfer rate in the condenser and the heat exchangers supplied by the circulating water system.

HAR COL 10.4-1 The specific chemicals used within the system are determined by the site water conditions and are discussed below.

DCD The chemicals can be divided into six categories based upon function: biocide, algaecide, pH adjuster, corrosion inhibitor, scale inhibitor, and a silt dispersant. The pH adjuster, corrosion inhibitor, scale inhibitor, and dispersant are metered into the system continuously or as required to maintain proper concentrations. The biocide application frequency may vary with seasons.

HAR COL 10.4-1

HAR COL 10.4-3

Sodium hypochlorite will be used as a biocide for the circulating water and potable water systems. The biocide application frequency may vary with the seasons. The Larson-Skold corrosivity index, for the makeup water from the Harris Lake, indicates that corrosion inhibitors will be required. Chemical solutions of phosphoric acid, zinc chloride, and Azole will be injected into the circulating water to control corrosion. A dispersant chemical will be injected to retain iron and solids in suspension. The corrosion inhibitors and dispersant are metered into the system continuously, or as required, to maintain proper concentrations. A Langelier Saturation Index of -2.1 to -0.74 is expected when operating at concentration ratios of 2.0 to 5.0, respectively.

DCD Addition of biocide and water treatment chemicals is performed by local chemical feed injection metering pumps and is adjusted as required.

HAR CDI Chemical concentrations are measured through analysis of grab samples from the CWS.

DCD Residual chlorine is measured to monitor the effectiveness of the biocide treatment.

HAR CDI Chemical injections are interlocked with each circulating water pump to prevent chemical injection when the circulating water pumps are not running.

DCD 10.4.5.2.3 System Operation

HAR CDI The three circulating water pumps take suction from the circulating water intake structure. They circulate the water, in parallel flow, through the TCS heat exchangers, the condenser vacuum pump seal water heat exchangers, and the tube side of the main condenser, and back through the piping discharge network to the cooling tower. The natural draft cooling tower cools the circulating water by discharging the water through a water distribution system furnished as part of the cooling tower. The water then falls through fill material to the basin beneath the tower and, in the process, rejects heat to the atmosphere. Provision is made during cold weather to direct a portion of the circulating water flow into freeze prevention spray headers on the periphery of the cooling tower. Air flowing through the peripheral spray is thus heated and allows de-icing in the central cooling tower spray baffles.

The flow to the cooling tower can be diverted directly to the basin, bypassing the cooling tower internals. This is accomplished by opening the bypass valve while operating one of the circulating water pumps. The bypass is normally used only during plant startup in cold weather or to maintain circulating water system temperature above 40°F, while operating at partial load during periods of cold weather.

DCD/HAR CDI The raw water system supplies makeup water to the cooling tower basin to replace water losses due to evaporation, wind drift, and blowdown. A separate connection is provided between the RWS and CWS to initially fill the CWS piping. This line connects to the CWS downstream of the CWS pump isolation valves.

DCD A condenser tube cleaning system is installed to clean the circulating water side of the main condenser tubes.

HAR CDI Blowdown from the circulating water system is taken from the discharge of the circulating water system pumps, and is discharged to the plant outfall.

DCD The circulating water system is used to supply cooling water to the main condenser to condense the steam exhausted from the main turbine.

DCD/HAR CDI If the circulating water pumps, the cooling tower, or the circulating water piping malfunctions, such that condenser backpressure rises above the maximum allowable value, the main condenser will no longer be able to adequately support unit operation.

DCD Cooldown of the reactor may be accomplished by using the power-operated atmospheric steam relief valves or safety valves rather than the turbine bypass system when the condenser is not available.

Passage of condensate from the main condenser into the circulating water system through a condenser tube leak is not possible during power generation operation, since the circulating water system operates at a greater pressure than the condenser.

DCD/HAR CDI Turbine building closed cooling water in the TCS heat exchangers is maintained at a higher pressure than the circulating water to prevent leakage of the circulating water into the closed cooling water system.

Cooling water to the condenser vacuum pump seal water heat exchangers is supplied from the circulating water system. Cooling water flow from the circulating water system is normally maintained through all four heat exchangers to facilitate placing the spare condenser vacuum pump in service.

DCD Isolation valves are provided for the condenser vacuum pump seal water heat exchanger cooling water supply lines to facilitate maintenance.

Small circulating water system leaks in the turbine building will drain into the waste water system. Large circulating water system leaks due to pipe failures will be indicated in the control room by a loss of vacuum in the condenser shell. The effects of flooding due to a circulating water system failure, such as the rupture of an expansion joint, will not result in detrimental effects on safety-related equipment since there is no safety-related equipment in the turbine building and the base slab of the turbine building is located at grade elevation. Water from a system rupture will run out of the building through a relief panel in the turbine building west wall before the level could rise high enough to cause damage. Site grading will carry the water away from safety-related buildings.

HAR CDI The cooling tower is positioned so that its collapse would have no potential to damage structures, systems, or components required for safe shutdown of the plant.

DCD

10.4.5.3 Safety Evaluation

The circulating water system has no safety-related function and therefore requires no nuclear safety evaluation.

10.4.5.4 Tests and Inspections

Components of the circulating water system are accessible as required for inspection during plant power generation.

HAR CDI

The circulating water pumps are tested in accordance with standards of the Hydraulic Institute.

DCD

Performance, hydrostatic, and leakage tests associated with preinstallation and preoperational testing are performed on the circulating water system. The system performance and structural and leaktight integrity of system components are demonstrated by continuous operation.

10.4.5.5 Instrumentation Applications

HAR CDI

Instrumentation provides indication of the open and closed positions of motor-operated butterfly valves in the circulating water piping. The motor-operated valve at each pump discharge is interlocked with the pump, so that the pump trips if the discharge valve fails to reach the full-open position shortly after starting the pump.

Local grab samples are used to periodically test the circulating water quality to limit harmful effects to the system piping and valves due to improper water chemistry.

Pressure indication is provided on the circulating water pump discharge lines.

DCD

A differential pressure transmitter is provided between one inlet and outlet branch to the condenser. This differential pressure transmitter is used to determine the frequency of operating the condenser tube cleaning system (CES).

DCD/HAR CDI

Temperature indication is supplied on the common CWS inlet header to the TCS heat exchanger trains. This temperature is also representative of the inlet cooling water temperature to the main condenser.

A flow element is provided on the common discharge line from the TCS heat exchangers to allow monitoring of the total flow through the TCS heat exchangers. Flow measurement for the raw water makeup to the cooling tower and for the cooling tower blowdown is also provided.

HAR CDI

Level instrumentation provided in the circulating water pump intake structure activates makeup flow from the RWS to the cooling tower basin, when required.

Level instrumentation also annunciates a low-water level in the pump structure, and a high-water level in the cooling tower basin.

HAR COL 10.4-1

The circulating water chemistry is controlled by cooling tower blowdown and chemical addition, to maintain the circulating water with an acceptable Langelier Index range. The system accomplishes this by regulating the blowdown valve. This regulation causes the tower basin water level to fluctuate. The fluctuation is sensed by a level controller which operates the makeup valve to cooling tower makeup.

DCD

The control approach is to allow the makeup water to concentrate naturally to its upper limit. Provisions are made to add chemicals for pH control.

DCD/HAR CDI

The cycles of concentration at which the cooling tower is operated is dependent on the quality of the cooling tower makeup water. Cooling tower blowdown is discharged to the reservoir, near the dam for the main reservoir.

DCD

Monitoring of the circulating water system is performed through the data display and processing system. Control functions are performed by the plant control system. Appropriate alarms and displays are available in the control room. See Chapter 7.

10.4.7.2.1 General Description

Replace the last sentence of the sixth paragraph of DCD Subsection 10.4.7.2.1 as follows.

HAR COL 10.4-2

The oxygen scavenger agent is hydrazine and the pH control agent is Morpholine. During shutdown conditions, carbohydrazide may be used in place of hydrazine.

STD SUP 10.4-2

Oxygen scavenging and ammoniating agents are selected and utilized for plant secondary water chemistry optimization following the guidance of NEI 97-06, “Steam Generator Program Guidelines” (Reference 201). The EPRI Pressurized Water Reactor Secondary Water Chemistry Guidelines are followed as described in NEI 97-06.

Add new paragraph at the end of the DCD Subsection 10.4.7.2.1:

STD SUP 10.4-1 Operations and maintenance procedures include precautions, when appropriate, to minimize the potential for steam and water hammer, including:

- Prevention of rapid valve motion
- Process for avoiding introduction of voids into water-filled lines and components
- Proper filling and venting of water-filled lines and components
- Process for avoiding introduction of steam or heated water that can flash into water-filled lines and components
- Cautions for introduction of water into steam-filled lines or components
- Proper warmup of steam-filled lines
- Proper drainage of steam-filled lines
- The effects of valve alignments on line conditions

10.4.12 COMBINED LICENSE INFORMATION

10.4.12.1 Circulating Water System

HAR COL 10.4-1 This COL Item is addressed in Subsections 10.4.5.2.1 and 10.4.5.2.2.

10.4.12.2 Condensate, Feedwater and Auxiliary Steam System Chemistry Control

HAR COL 10.4-2 This COL Item is addressed in Subsection 10.4.7.2.1.

10.4.12.3 Potable Water

HAR COL 10.4-3 This COL Item is addressed in Subsection 10.4.5.2.2.

10.4.13 REFERENCES

201. Nuclear Energy Institute, “Steam Generator Program Guidelines,” NEI 97-06, Revision 2, May 2005.

HAR COL 10.4-1

Table 10.4-201
Design Parameters for Major Circulating Water System Components

Circulating Water Pump	
Quantity	Three per unit
Flow rate (gal./min)	179,233
Natural Draft Cooling Tower	
Quantity	One per unit
Approach Temperature	13.7°F
Inlet temperature	119.6°F
Outlet temperature	90.7°F
Approximate Temperature range	28.9°F
Flow rate (gal./min)	531,100
Heat transfer (Btu/h)	7628×10^6
Wind velocity design (mph) Seismic design criteria per Uniform Building Code	123