11.9 CONDENSATE STORAGE AND TRANSFER SYSTEMS

11.9.1 Power Generation Objective

The power generation objectives of the Condensate Storage and Transfer Systems are to deliver condensate to other systems at the flow rates and pressures required, and to receive inputs of water of condensate quality from other systems.

11.9.2 Power Generation Design Basis

The Condensate Storage System, including the supply-return headers, shall be capable of supplying makeup water to the hotwells of the main condensers, and water to the suctions of the control rod drive pumps and the condensate transfer pumps; for test purposes, to the headers in the basement of each Reactor Building which supply the core spray, RHR, RCIC, and HPCI pumps.

1. The Condensate Storage System, including headers, shall be capable of receiving inputs of water from the Radioactive Liquid Waste System, condenser hotwell high-level reject water, and water returned during tests of the RCIC and HPCI pumps.

2. The Condensate Transfer System shall provide water under pressure for such purposes as backwashing filters and demineralizers, makeup to the spent-fuel pools, cooling water flow for dry cask annulus flushing, annulus quenching, alternate cooling operations, decontamination of reactor well, dryer-separator pit, and spent fuel shipping cask.

3. The Condensate Transfer System shall be capable of transferring water from one condensate storage tank to another.

4. The Condensate Storage System shall provide a reserve supply of condensate to serve as the preferred source of water for the operation of the HPCI and RCIC Systems.

5. The Condensate Storage System, including the associated supply-return headers, shall be sized such that while it is supplying normal requirements for condensate at maximum demand, the system shall be capable of supplying the added demand created by a design basis accident.

11.9.3 System Description

Flow diagrams of the Condensate Storage and Transfer Systems are shown in Figures 11.9-1b sheets 1, 2, and 3.

11.9.3.1 Condensate Storage System

Condensate normally meeting the quality requirements given in Table 11.9-1 is stored in three 375,000-gallon tanks. The tanks are located out-of-doors. They are constructed of steel, and are painted inside with a phenolic-epoxy protective coating. Makeup water is supplied from demineralized water storage.

Two supply return lines per unit, one 20 inches (steel on Unit 1, aluminum on Units 2 and 3), and one 24 inches (aluminum) in diameter, interconnect the storage tanks and lead to the Turbine Building, from which branch lines lead to points of use. The 20-inch lines terminate in standpipes within the tanks. These standpipes prevent the level in the individual tanks from being drawn below the 135,000-gallon level via the 20-inch pipe. The 24-inch header terminates in a 20-inch line near the bottom of the tanks. The valves between the tanks and the 20- and 24-inch lines are normally closed to prevent crossload, resulting in a unitized system.

The 20-inch line normally supplies water for non safety related uses. The line connects directly to the condensate transfer pump suctions and to the condenser hotwells for makeup. The transfer pumps supply water to the following:

Condensate, cleanup, and fuel pool filter-demineralizers for backwashing,

Reactor Building operating floor for cooling water flow during dry cask annulus flushing, annulus quenching, alternate cooling operations, decontaminating spent-fuel shipping casks and walls of reactor wells and dryer-separator pits, and for
makeup to the fuel pools,

RHR and core spray systems flush and fill, and

Floor drain and waste filters and waste demineralizer for backwashing.

The 20-inch line receives return flows from HPCI and RCIC pump tests. The 24-inch line receives return flow from the high-level reject from the condenser hotwells. The latter includes water drained from the reactor well and dryer-separator pit following the refueling, and reactor water released via the Reactor Water Cleanup System during startup.

The 24-inch supply-return header, which has access to the entire volume of the storage tanks, is lined up to supply water to the condensate header in the basement of each Reactor Building, which, in turn, is the primary supply of water to the HPCI and RCIC pumps. The 24-inch supply-return header also provides water to the control rod drive pumps.

Water recovered in the radwaste system is returned to condensate storage via the Unit 1 20-inch line.

The three storage tanks and the two supply-return headers for each unit are not designed to Class I seismic requirements.

The condensate ring header and branch lines from the ring header that supply condensate to the RHR, CS, HPCI, and RCIC Systems are designed to seismic Class I requirements.

In addition to the three tanks described above, two 500,000-gallon condensate storage tanks are available for the storage of condensate or for the storage of torus and reactor vessel cavity water during outages.

11.9.3.2 Condensate Transfer System

The Condensate Transfer System includes two centrifugal pumps rated at 1,000 gpm each at 200 feet head. A 10,000-gallon head tank is connected into the pump discharge line. The tank is located on the roof of the Reactor Building, approximately 150 feet above the pump. Normally, one pump is used at a time. The transfer system operates such that small quantities of water are supplied from the head tank, while larger quantities are supplied by the operating pump. The head tank sets the system pressure. When large quantities of water are required, the head tank is valved off from the rest of the system, and both pumps are placed on manual operation.

If one of the condensate storage tanks is to be taken out of service, the water in it can be transferred to the other storage tanks, using the transfer pumps. Valves are set so that the 20-inch supply-return header is connected to the bottom of the tank to be emptied. The valves in the 24-inch supply-return header are closed to the tank being emptied and open to the tanks being filled. The transfer pump is set to take suction via the 20-inch line and discharge through the 24-inch line. Should an accident occur during the transfer, all of the water in the tanks being filled, and some in the tank being emptied, is available to the safety related systems. The only operator action required is to open the valve in the 24-inch line and to stop the transfer pumps before the suction is lost from the tank being emptied.

11.9.3.3 Instrumentation and Controls

Figure 11.9-2 is a control diagram of the systems. Instruments and controls for the condensate storage tanks and the condensate transfer pumps are located in the Unit 1 control room. Included on the Unit 1 panel 9-22 are the following:

Level indicator for each of the three condensate storage tanks,

Control switch for each of the six motor-operated valves in the two supply-return headers, with position-indicating lights,

Control switch for each of the two condensate transfer pumps, with status lights, and

Control switch for air-operated valve which isolates the condensate head tank from the condensate transfer pump discharge line, with position-indicating lights.

Annunciators mounted on the Unit 1 Main Control Room panel 9-22 are actuated by the following signals:

High level in a condensate storage tank,
Low level in a condensate storage tank,
High-high level in condensate head tank, and
Low-low level in condensate head tank.

The high-level alarm on the condensate storage tank, located just below the overflow, informs the operator that inputs to the tanks must be stopped to avoid overflow. The low-level alarm is located just above the 135,000-gallon level, and informs the operator that the level is approaching the point at which outflow into the 20-inch header will cease.

Controls on the condensate head tank start the selected condensate transfer pump at low-tank level, and stop the pump at high level. Should the demand exceed the capacity of one pump, the alternate pump is started at low-low level. Simultaneously, the low-low level alarm is actuated. Should the cutoff switch at the high level fail to stop the pump, the second cutoff switch at the high-high level stops it. The high-high level alarm is actuated simultaneously.

In addition to the Unit 1 controls and indications, level indicators are locally mounted on each of the condensate storage tanks. Unit specific condensate storage tank level indications and annunciators are located on the Units 2 and 3 Main Control Room panels 9-6.

11.9.4 Power Generation Evaluation

The Condensate Storage and Transfer System, as described in paragraph 11.9.3, is capable of meeting the requirements listed under paragraph 11.9.2.

The Condensate Storage System is designed such that each of the three storage tanks contains a reserve supply of 135,000 gallons. The only normal water requirements drawn from the reserve volume consists of an essentially continuous flow requirement for control rod drive cooling water and short-term flow requirements

for periodic testing of the HPCI and RCIC System pumps. The control rod drive cooling water is a minor demand of approximately 65 gpm per operating BFN unit. The periodic testing of the HPCI and RCIC System pumps is normally in a closed-loop flow path which returns the water to the Condensate Storage System. Therefore, periodic testing of the HPCI and RCIC System pumps does not reduce the amount of water in the reserve volume.

Standard operating practice is to maintain a reserve of 135,000 gallons per operating reactor. This reserve is the preferred source of cooling water for any kind of accident condition that requires operation of the HPCI and RCIC pumps to supply water to the reactor. If the tanks or headers were destroyed, as by an earthquake or tornado, the HPCI pumps would automatically take suction from the pressure suppression chamber. This action is initiated by redundant level switches located in the line leading from the supply-return headers to the header in the Reactor Building basement. The switches respond to a low-level signal which indicates that the 24-inch supply-return header is not delivering water. The basement header contains sufficient water to supply the pumps while the transfer to the pressure suppression chamber is being made.

Only one tank normally supplies water to each unit. However, if it becomes necessary to remove a condensate storage tank on one unit from service, one of the other unit's condensate storage tanks can furnish the needed water by opening the appropriate valves separating the three-unit supply and return lines. It is possible to provide all the water for all three units from one unit's tank by opening all the valves.

If it becomes necessary to remove all three storage tanks from service, the plant will be shut down.

The 20- and 24-inch supply-return headers are of adequate size that, while carrying maximum normal flows, they can accommodate the added flows occasioned by an accident on one of the units and provide adequate NPSH to the safety related system pumps. When both lines are in service, maximum normal flows include tests of safety related pumps.

11.9.5 Inspection and Testing

The condensate storage tanks are inspected at appropriate intervals to ascertain the condition of the protective coating, and routine inspection and maintenance are performed on valves, pumps, and piping. No special tests of the Condensate Storage and Transfer System are required.