11.3 MAIN CONDENSER SYSTEM

11.3.1 Power Generation Objective

The objective of the Main Condenser System is to provide a heat sink for the steam leaving the turbine-generator during power operation.

11.3.2 Power Generation Design Basis

The Main Condenser System shall be capable of providing an adequate heat sink for the turbine-generator at rated reactor vessel steam flow and at 105% rated steam flow.

11.3.3 System Description

The Main Condenser System consists of three deaerating, single-pass, single-pressure, radial flow type surface condensers with divided waterboxes. Each one-third-capacity condenser is located beneath one of the three low-pressure turbines with the tubes oriented transverse to the turbine-generator axis and is rigidly supported on a foundation. A rubber belt-type expansion joint is installed between the upper and lower steam inlet sections to permit movement resulting from the temperature changes of the equipment. Cross connections are provided for equalization of pressure between condenser shells. Two one-third-capacity low-pressure extraction feedwater heaters and a separate drain cooler are mounted in the neck of each condenser.

The design heat load for the main condensers is 8.825×10^9 Btu/hr which includes exhaust flow from three reactor feed pump turbines. Deaeration is provided to remove dissolved gases from the condensate, limiting oxygen content to approximately 0.005 cc per liter at any load during normal operation.

The condenser hotwells have sufficient condensate storage capacity to provide the quantity of condensate required of full-power turbine operation. Baffling in the hotwell is arranged to assure a retention time for condensate. This will permit decay of short-lived radioactive isotopes. The main condenser storage capacity has been evaluated to a 2-minute retention time and found to be acceptable for operation at 3952 MWt. As the 2-minutes retention time for decay of short-lived radioisotopes remains a conservative decay time, this remains acceptable for operation at 3952 MWt.

A circulating water temperature of 90°F, the condenser can accept 3,529,207 lb/hr of bypass steam flow based on approximately 21.3% of rated main steam flow at a maximum enthalpy of 1190.4 Btu/lb. Moreover, the turbine exhaust hood temperature will not exceed 175°F.

The Main Condenser System will produce a back pressure of 3.79 inches of mercury, absolute, when operating at rated turbine output. The condenser tubes are cleaned to keep the condenser operating at peak performance. The condensate leaving the system will have negligible dissolved gas concentrations.

SEACURE® tubes are used throughout Unit 1 condenser; Allegheny Ludlum's AL-6XN tubes are used throughout Unit 2 and Unit 3 condensers. The condenser shells, tube sheets, tube support plates, and waterboxes are constructed of carbon steel, ASTM A 285, Grade C.

The Condenser Circulating Water (CCW) system is provided with a chemical treatment system designed to reduce Main Condenser tube fouling and improve heat transfer.

The condenser maintains a negligible oxygen concentration in the effluent condensate by limiting subcooling and thereby limiting gas solubility. Steam jet air ejectors evacuate the noncondensible gases during normal operation. Mechanical vacuum pumps evacuate noncondensible gases during startup. Subsection 11.4 includes a description of the Main Condenser Gas Removal System.

The extraction steam and turbine drain piping located internal to the condensers are designed in accordance with USAS B31.1, 1967.

11.3.4 Inspection and Testing

The condenser may be tested for leaks by completely filling with water, by helium leak detection, or by other methods. Manways provide access to waterboxes, tube sheets, lower steam inlet section, shell, and hotwell for purposes of inspection, repair, or tube cleaning.