4.11 Main Steam Lines, Feedwater Piping, and Drains

4.11.1 Power Generation Objective

The power generation objective of the main steamlines is to conduct steam from the reactor vessel through the primary containment to the steam turbine. The power generation objective of the feedwater lines is to provide a piping path for delivery of water through the primary containment to the reactor vessel.

4.11.2 Safety Design Basis

1. The main steam and feedwater lines shall be designed to accommodate operational stresses, such as internal pressures, without a failure which could lead to a release of radioactivity in excess of the guideline values in 10 CFR 50.67.

2. The main steam and feedwater lines within the primary containment shall be designed to withstand the effects of an earthquake without a failure which could lead to a release of radioactivity in excess of the guideline values in 10 CFR 50.67.

4.11.3 Power Generation Design Basis

1. The main steam and feedwater lines shall be designed to allow inservice testing and inspections.

2. The main steam lines shall be designed to conduct steam from the reactor vessel over the full range of reactor power operation.

3. The feedwater piping shall be designed to conduct water to the reactor vessel over the full range of reactor power operation.

4.11.4 Description

The feedwater piping is designed to conduct water from sources outside the primary containment to the reactor vessel. The general requirements of the feedwater system are covered in Subsection 7.10, "Feedwater Control System," and 11.8, "Condensate and Reactor Feedwater Systems." All main steam and feedwater piping are classified according to service and location. A diagram of the feedwater piping is shown in Figure 4.11-1.

The main steam piping is designed to conduct steam from the reactor vessel through the primary containment to the steam turbine. Four steam lines are utilized between the reactor and the turbine. The use of these multiple lines permits turbine stop valve and main steam isolation valve tests during plant operation with a minimum amount of load reduction. To fully achieve this objective, the four steam lines are connected to a header upstream of the turbine stop valves. This header placement also ensures that the turbine bypass system is connected to the used steam lines and not to idle lines. A diagram of the main steam piping is shown in Figures 4.5-1, 4.5-2, and 4.5-3 of Subsection 4.5, "Main Steam Line Flow Restrictors."

Acoustic vibration suppressors are installed in 6-inch blind-flanged branch lines on the main steam piping in the drywell to minimize accoustic loading on the steam dryer and other components. The suppressor locations are shown in Figures 4.5-1 and 11.1-1e for Unit 1, Figures 4.5-2 and 11.1-1a for Unit 2, and Figures 4.5-3 and 11.1-1c for Unit 3.

Design and construction of pressure retaining piping and components of the Main Steam System and Feedwater System were initially in accordance with the requirements of USAS B31.1.0, 1967 Edition, as supplemented by the requirements of the applicable GE design and procurement specifications, which were implemented in lieu of the outdated B31 Nuclear Code Cases-N2, N7, N9, and N10. Quality control methods were used during the fabrication and assembly of main steam and feedwater piping to ensure that the design specifications were met.

A drain line is connected to the low points of each main steam line, both inside and outside the drywell. Both sets of drains are connected to a header and are connected by valving to permit drainage to the main condenser hotwell. A vent line is provided around the final valve to the condenser hotwell to permit continuous draining of the steam line low points. The inside steam line drains slope downward from the steam line low point to the orifice outside the drywell. The drain line from the orifice to the condenser hotwell slopes down to the main condenser. An additional drain is provided from the low point of the drains to clean-radwaste to permit purging the lines for maintenance. During operations only the outside drain valve is open allowing continuous drainage to the condenser through the orifice.

The inside and outside steam line drains are capable of being utilized to equalize pressure across the main steam isolation valves prior to restart following a steam line isolation. Assuming all steam line isolation valves have closed and the steam lines outside the drywell have been depressurized, the isolation valves outside the drywell are opened first; the drain lines are then used to warm up and pressurize the outside steam lines. Finally, the main steam isolation valves inside the drywell are opened.

Feedwater line breaks are isolated on the vessel inlet side by closure of the check valves. The break continues to be fed by feedwater until low level in the reactor vessel is detected and the low level instrumentation actuates the main steam isolation valves and the valves then close. Temperature sensors are strategically located in the steam tunnel near the feedwater lines in order to sense any rise in ambient temperature. These sensors also initiate closure of the main steam isolation valves if the ambient temperature in the steam tunnel rises too high.

4.11.5 Safety Evaluation

Differential pressures on reactor internals under the assumed accident conditions of a ruptured steam line are limited by both the utilization of flow restrictors and the utilization of four main steam lines. Main steam and feedwater piping are designed in accordance with the USAS B31.1.0, 1967 edition, Code for Power Piping which describes the primary and secondary allowable stresses associated with the main steam and feedwater piping. Design of piping in accordance with these requirements ensures the meeting of safety design basis 1. Safety design basis 2 is met by design of main steam and feedwater piping from the pressure vessel to the outside isolation valve to Class I specifications in accordance with the loading criteria of Appendix C.

4.11.6 Inspection and Testing

Prior to initial operation, the main steam and feedwater piping were inspected and tested in accordance with USAS B31.1.0, 1967 edition and the applicable GE design and procurement specifications, which were implemented in lieu of the outdated B31 Nuclear Code Cases-N2, N7, N9 and N10. Inservice inspection is considered in the design of the main steam and feedwater piping. This consideration assures adequate working space and access for inspection of selected components. Access requirements for inservice inspection are in accordance with the requirements of APED-5450, "Design Provisions for Inservice Inspection." Subsection 4.12 describes the inservice inspection and testing program.