

10.3 MAIN STEAM SUPPLY SYSTEM

The main steam supply system for this BWR cycle extends from the outermost containment isolation valve up to but not including the turbine stop valves and includes connected piping of 2-1/2 inches nominal diameter or larger up to and including the first valve that is either normally closed or is capable of automatic closure during all modes of reactor operation.

10.3.1 DESIGN BASES

The main steam supply system has no safety-related function and is designed to:

- 1) Deliver the required steam flow from the reactor to the turbine generator, at rated temperature and pressure, over the full range of operation from turbine warm up to valves wide open (VWO).
- 2) Provide motive steam to the steam jet air ejectors.
- 3) Provide steam for the steam seal evaporator and driving steam for reactor feed pump turbines.
- 4) Provide steam for the off gas recombiner.
- 5) Bypass reactor steam to the condensers during startup and any time the quantity of steam produced by the reactor is more than is required by the turbine generator.

10.3.2 DESCRIPTION

The design pressure/temperature rating of the main steam piping is 1230 psig at 585°F. The piping is designed and tested according to ASME Section III, Class 2, and is fabricated of seamless carbon steel (the 24 inch lines are SA106 Grade C, all other sizes are either SA106 Grade B or an alloy steel that provides increased resistance to erosion/corrosion).

There are four 24 inch nominal main steamlines supplying steam to the turbine generator. Each line is provided with a drain downstream of the outermost containment isolation valve. The drains are routed to the condenser through a common 3 inch header. The main steam line drain can be used to process leakage from the outboard Main Steam Isolation Valves (MSIV). The Isolated Condenser Treatment Method (ICTM) routes leakage past MSIVs to the main condenser utilizing the main steam drain lines as a pathway. In the condenser, volumetric dilution and plate-out hold up fission products until eventual release to the environment through the low pressure turbine seals. The design of the ICTM is such that 300 scfh of total MSIV leakage can be processed with the resulting radiological dose consequences bounded by the DBA-LOCA dose analysis (see Section 6.7). Additional leakage above 300 scfh can be processed by this with a corresponding fractional increase in offsite and control room doses. Each main steamline is also provided with low point drains consisting of a drip leg which, under normal operation, collects moisture and drains it to the condenser through a normally open valve and a restricting orifice. Each drip pot is provided with high and low level switches which operate another motorized drain valve that is normally closed and is installed in parallel to the

normally open valve described above. On high level the level switch opens the motorized valve and drains the moisture directly to the condenser. When the level in the drip leg has been lowered sufficiently the low level switch closes the valve.

Pressure equalizing lines, 24 inch nominal size, branch from each main steamline and connect to a 24 inch nominal header which ties into the bypass valve chest through two 18 inch nominal lines. The 24 inch header is provided with a drip pot similar to that described for the main steamlines. The main steam supply to the reactor feed pump turbines originates from this 24 inch header.

See Dwgs. M-101, Sh. 1, M-101, Sh. 2 and M-101, Sh. 3 for details of the above description. For details of piping downstream of the turbine stop and control valves see Section 10.2.

During normal plant operation the turbine control valves and bypass valves are controlled by one of two pressure regulators furnished by the turbine vendor. These two regulators receive the pressure signals from two essentially identical pressure transmitters which are installed in an averaging manifold connected across all four of the main steamlines in accordance with the turbine vendor's instructions. The regulator with the lowest set point will be the controlling regulator until it fails, then the other regulator which is biased approximately 3 psi higher will take over. A pressure transmitter is installed in one of the main steam lines, the readings from which are recorded in the control room.

10.3.3 EVALUATION

The main steamlines (MSL) from the outer isolation valves up to and including the turbine stop valves and all branch lines 2-1/2 inches in diameter and larger, up to and including the first valve (including their restraints) are designed by the use of an appropriate dynamic seismic-system analysis to withstand the Operating Bases Earthquake (OBE) and Safe Shutdown Earthquake (SSE) design loads in combination with other appropriate loads, within the limits specified for Class 2 pipe in the ASME Section III. The mathematical model for the dynamic seismic analyses of the MSL and branch line piping includes the turbine stop valves and piping beyond the stop valves including the piping to the turbine casing. The dynamic input loads for design of the main steamlines are derived from a time history model analysis or an equivalent method, as described in Section 3.9, of the Containment, Reactor Building, Turbine Building and turbine pedestal. The Turbine Building, housing the main steamlines, may undergo some plastic deformation under the SSE, however, the plastic deformation is limited to a ductility factor of 2 and an elastic multi-degree-of-freedom system analysis is used to determine the input to the main steamlines. The stress allowable and associated deformation limits for piping are in accordance with ASME Section III, Class 2 requirements for the OBE and SSE loading combinations. The main steamline supporting structures (those portions of the Turbine Building) are such that the main steamlines and their supports can maintain their integrity within the ASME Section III, Class 2 requirements under the Seismic Category I loading conditions. The pipe supports for the main steamline meet the requirements of ASME Section III 1971 Edition through winter 1972 Addenda, for materials, fabrication and inspection.

Between the outermost isolation valves and the turbine stop valves the four main steamlines are routed within the confines of a tunnel. Temperature elements are located at each end of this tunnel and the readings from these are fed into a temperature differential switch. The purpose of these temperature elements is to detect a failure of any of the main steamlines. This would

be indicated by an increase in the temperature differential which would be sensed and an alarm initiated.

For details of the analysis of postulated high energy lines failure refer to Section 3.6.

10.3.4 INSPECTION AND TESTING REQUIREMENTS

The main steamlines outboard of the outermost MSIV are fabricated, examined and tested in accordance with the ASME Boiler and Pressure Vessel Code, Section III, Class 2.

The main turbine stop valves are tested as described in FSAR Section 10.2.3.6 at the frequency specified in the Technical Requirements Manual. Similarly each bypass valve is tested in accordance with the Technical Specifications. The preoperational and inservice inspection of the main steamlines is described in Section 6.6. The preoperational and inservice inspection of the steamline isolation valves is described in Subsection 5.2.4. The system was preoperationally tested in accordance with the requirements of Chapter 14.

10.3.5 WATER CHEMISTRY (PWR)

Not applicable

10.3.6 STEAM AND FEEDWATER SYSTEM MATERIALS (NON-NSSS)

10.3.6.1 Fracture Toughness

The ASME Class 2 main steam and feedwater piping was not impact tested. The ASME Class 1 main steam piping was covered by Subsection 5.2.3.3.1. The ASME Class 1 feedwater piping was impact tested in accordance with article NB-2000. The penetrations of these lines through the primary containment, from the isolation valves outside the containment, were charpy, V-notch, or drop weight tested (See Subsection 3.1.2.5.2).

10.3.6.2 Material Selection and Fabrication

- 1) Materials used in the main steam and feedwater systems are listed in Appendix I to Section III of the ASME Code. Materials for Class 1 main steam piping are covered by Subsection 5.2.3. Material for Class 1 feedwater piping is SA-333gr6. Material for Class 2 main steam and feedwater piping is SA-155 KC70, SA-106 gr B or C, and A335 gr P22 material that provides increased resistance to erosion/corrosion.
- 2) With the exception of certain 1 sensing lines, there are no austenitic stainless steel piping components in this system.
- 3) The cleaning and handling Class 2 and 3 components will be performed in accordance with cleanliness Specification 8850-M-167 which complies with the requirements of Regulatory Guide 1.37, March 16, 1973 and ANSI N45.2.1-73.

- 4) There is no low alloy steel in these systems.
- 5) Exceptions to Regulatory Guide 1.71 are described in Section 3.13.