3.6 TURBINE CYCLE

Applicability

Applies to the operating status of the Main Steam and Auxiliary Feed Systems

Objective

To define the conditions required in the Main Steam System and Auxiliary Feed System for protection of the steam generator and to assure the capability to remove residual heat from the core during a loss of station power.

Specification

A. A unit's Reactor Coolant System temperature or pressure shall not exceed 350° F or 450 psig, respectively, or the reactor shall not be critical unless the five main steam line code safety valves associated with each steam generator in unisolated reactor coolant loops, are operable.

B. To assure residual heat removal capabilities, the following conditions shall be met prior to the commencement of any unit operation that would establish reactor coolant system conditions of 350°F and 450 psig which would preclude operation of the Residual Heal Removal System.

1. Two motor driven auxiliary feedwater pumps shall be operable and one of three auxiliary feedwater pumps for the opposite unit shall be operable.

2. A minimum of 96,000 gal of water shall be available in the tornado missile protected condensate storage tank to supply emergency water to the auxiliary feedwater pump suctions. A minimum of 60,000 gal of water shall be available in the tornado protected condensate storage tank of the opposite unit to supply emergency water to the auxiliary feedwater pump suction of that unit.

3. All main steam line code safety valves, associated with steam generators in unisolated reactor coolant loops, shall be operable.

C. Prior to reactor power exceeding 10%, the steam driven auxiliary feedwater pump shall be operable.

D. System piping, valves, and control board indication required for the operation of the components enumerated in Specification B. 1, 2, 3, and C shall be operable.

E. The iodine - 131 activity in the secondary side of any steam generator, in an unisolated reactor coolant loop, shall not exceed 9 curies.

F. With one auxiliary feedwater pump inoperable, restore at least three auxiliary feedwater pumps (two motor driven feedwater pumps and one steam driven feedwater pump) to operable status within 72 hours or be in hot shutdown within the next 12 hours.

G. The requirements of Specification B-2 above may be modified to allow utilization of protected condensate storage tank water with the auxiliary steam generator feed pumps provided the water level is maintained above 60,000 gallons, sufficient replenishment water is available in the 300,000 gallon condensate storage tank, and replenishment of the protected condensate storage tank is commenced within two hours after the cessation of protected condensate storage tank water consumption.

Basis

A reactor which has been shutdown from power requires removal of core residual heat. While reactor coolant temperature or pressure is greater than 350°F or 450 psig, respectively, residual heat removal requirements are normally satisfied by steam bypass to the condenser. If the condenser is unavailable, steam can be released to the atmosphere through the safety valves, power operated relief valves, or the 4 inch decay heat release line.

The capability to supply feedwater to the generators is normally provided by the operation of the Condensate and Feedwater Systems. In the event of complete loss of electrical power to the station, residual heat removal would continue to be assured by the availability of either the steam driven auxiliary feedwater pump or one of the motor driven auxiliary feedwater pumps and the 100,000 gallon condensate storage tank. In the event of a fire which would render the auxiliary feedwater pumps inoperable, residual heat removal would continue to be assured by the availability of either the steam driven auxiliary feedwater pump or one of the motor driven auxiliary feedwater pumps from the opposite unit.

A minimum of 92,000 gallons of water in the 110,000 gallon condensate tank is sufficient for 8 hours of residual heat removal following a reactor trip and loss of all off-site electrical power. If the protected condensate storage tank level is reduced to 60,000 gallons, the immediately available replenishment water in the 300,000 gallon condensate tank can be gravity-feed to the protected tank if required for residual heat removal. An alternate supply of feedwater to the auxiliary feedwater pump suctions is also available from the Fire Protection System Main in the auxiliary feedwater pump cubicle.

The five main steam code safety valves associated with each steam generator have a total combined capacity of 3,725,575 pounds per hour at their individual set pressure; the total combined capacity of all fifteen main steam code safety valves is 11,176,725 pounds per hour. The ultimate power rating steam flow is 11,167,923 pounds per hour. The combined capacity of the safety valves required by Specification 3.6 always exceeds the total steam flow corresponding to the maximum steady-state power than can be obtained during one, two or three reactor coolant loop operation.

The availability of the auxiliary feedwater pumps, the protected condensate storage tank, and the main steam line safety valves adequately assures that sufficient residual heat removal capability will be available when required.

The limit on steam generator secondary side iodine - 131 activity is based on limiting inhalation thyroid does at the site boundary to 1.5 rem after a postulated accident that would result in the release of the entire contents of a unit's steam generators to the atmosphere. In this accident, with the halogen inventories in the steam generator being at equilibrium values, I-131 would contribute 75 percent of the resultant thyroid dose at the site boundary;

the remaining 25 percent of the dose is from other isotopes of iodine. In the analysis, one-tenth of the contained iodine is assumed to reach the site boundary, making allowance for plate out and retention in water droplets.

The inhalation thyroid dose at the site boundary is given by:

$$\text{Dose (Rem)} = \frac{(C)\ (\chi/Q)\ (D_\infty/A)\ (B.R.)}{(.75)\ (P.F.)}$$

where: C = steam generator I-131 activity (curies)

$\chi/Q = 8.14 \times 10^{-4}$ sec/m^3

$D_\infty/A = 1.48 \times 10^{6}$ rem/Ci for I-131

B. R. = breathing rate, 3.47×10^{-4} m^3/sec. from TID 14844

P.F. = plating factor, 10

Assuming the postulated accident, the resultant thyroid dose is 1.5 rem. The steam generator's specific iodine - 131 activity limit is calculated by dividing the total activity limit of 9 curies by the water volume of a steam generator. At full power, with a steam generator water volume of 47.6 M^3, the specific iodine - 131 limit would be .18 µCi/cc; at zero power, with a steam generator water volume of 101 M^3, the specific iodine - 131 limit would be .089 µCi/cc.

References

FSAR Section 4	Reactor Coolant System
FSAR Section 9.3	Residual Heat Removal System
FSAR Section 10.3.1	Main Steam System
FSAR Section 10.3.2	Auxiliary Steam System
FSAR Section 10.3.5	Auxiliary Feedwater Pumps
FSAR Section 10.3.8	Vent and Drain Systems
FSAR Section 14.3.2.5	Environmental Effects of a Steam Line Break

4.8 AUXILIARY FEEDWATER SYSTEM

Applicability

Applies to periodic testing requirements of the Auxiliary Feedwater System.

Objective

To verify the operability of the auxiliary steam generator feedwater pumps and their ability to respond properly when required.

Specification

A. Tests and Frequency

1. Each motor driven auxiliary steam generator feedwater pump shall be flow tested for at least 15 minutes on a monthly basis to demonstrate its operability.

2. The turbine driven auxiliary steam generator feedwater pump shall be flow tested for at least 15 minutes on a monthly basis to demonstrate its operability.

3. The auxiliary steam generator feedwater pump discharge valves shall be exercised on a monthly basis.

4a. Within 72 hours prior to temperature and pressure exceeding 350°F and 450 psig respectively, the motor driven auxiliary feedwater pumps shall be flow tested from the 110,000 gallon above ground condensate storage tank to the steam generators.

4b. Within 72 hours after achieving reactor criticality, the steam turbine driven auxiliary feedwater pump shall be flow tested from the 110,000 gallon above ground condensate storage tank to the steam generators.

5. During periods of extended reactor shutdown, the testing requirements of Specification A. 1, 2, and 3 may be modified as follows:

   a. Only one of the three auxiliary steam generator feedwater pumps shall be flow tested for at least 15 minutes on a monthly basis to demonstrate its operability provided the required components are tested prior to startup.

   b. The auxiliary steam generator feedwater pump discharge valves of the pump tested in 5a shall be exercisedon a monthly basis provided all the discharge valves are tested prior to startup.

B. Acceptance Criteria

These tests, except the system flow test, shall be considered satisfactory if control board indication and subsequent visual observation of the equipment demonstrate that all components have operated and sequenced properly.

The system flow test shall be considered satisfactory if the control board indication demonstrates that flow paths exist to each steam generator.

Basis

On a monthly basis the auxiliary steam generator feedwater pumps will be tested to demonstrate their operability by recirculation to the 110,000 Gallon Condensate Storage Tank.

The capacity of any one of the three feedwater pumps in conjunction with the water inventory of the steam generators is capable of maintaining the plant in a safe condition and sufficient to cool the unit down.

Proper functioning of the steam turbine admission valve and the ability of the feedwater pumps to start will demonstrate the integrity of the system. Verification of correct operation can be made both from instrumentation within the Main Control Room and direct visual observation of the pumps.

References

FSAR Section 10.3.1 Main Steam System

FSAR Section 10.3.2 Auxiliary Steam System