15.3.4 STEAM AND POWER CONVERSION SYSTEM

Applicability

Applies to the operating status of steam and power conversion system.

Objective

To define conditions of the steam and power conversion system steam-relieving capacity. Auxiliary Feedwater System and Service Water System operation is necessary to ensure the capability to remove decay heat from the core.

Specification

A. When the reactor coolant is heated above 350°F the reactor shall not be taken critical unless the following conditions are met:

1. A minimum steam-relieving capability of eight (8) main steam safety valves available, except for low power physics testing.
2. Auxiliary Feedwater System
   a. Two Unit Operation - All four auxiliary feedwater pumps together with their associated flow paths and essential instrumentation shall be operable.

   b. Single Unit Operation - Both motor driven auxiliary feedwater pumps and the turbine driven auxiliary feedwater pump associated with that unit together with their associated flow paths and essential instrumentation shall be operable.

3. A minimum of 13,000 gallons of water per operating unit in the condensate storage tanks and an unlimited water supply from the lake via either leg of the plant Service Water System.

4. System piping and valves required to function during accident conditions directly associated with the above components operable.

5. Both atmospheric steam dump lines shall be operable. If either of the atmospheric steam dump lines is determined to be inoperable, restore the inoperable line to an operable status within 24 hours. If operability cannot be restored, be in hot shutdown within six hours and cold shutdown within 24 hours.

B. The iodine-131 activity on the secondary side of the steam generator shall not exceed 1.2 μCi/cc.

C. During power operation the requirements of 15.3.4.A.2.a and b may be modified to allow the following components to be inoperable for a specified time. If the system is not restored to meet the requirements of 15.3.4.A.2.a and b within the time period specified, the specified action must be taken. If the requirements of 15.3.4.A.2.a and b are not satisfied within an additional 48 hours, the appropriate reactor(s) shall be cooled down to less than 350°F.

1. Two Unit Operation - One of the four operable auxiliary feedwater pumps may be out-of-service for the below specified times. A turbine driven auxiliary feedwater pump may be out of service for up to 72 hours. If the turbine driven auxiliary feedwater pump cannot be restored to service within the 72 hour time period the associated reactor shall be in hot shutdown within the next 12 hours. A motor driven auxiliary feedwater pump may be out of service for up to 7 days. If the inoperable motor driven auxiliary feedwater pump cannot be restored to service within the 7 day time period both of the reactors shall be in hot shutdown within the next 12 hours.

2. Single Unit Operation - One of the three operable auxiliary feedwater pumps associated with a unit may be out-of-service for the below specified times. The turbine driven auxiliary feedwater pump may be out-of-service for up to 72 hours. If the turbine driven auxiliary feedwater pump cannot be restored to service within that 72 hour time period, the reactor shall be in hot shutdown within the next 12 hours. Either one of the two motor driven auxiliary feedwater pumps may be out-of-service for up to 7 days. If the motor driven auxiliary feedwater pump cannot be restored to service within that 7 day period the operating unit shall be in hot shutdown within the next 12 hours.

D. The crossover steam dump system shall be operable. If the crossover steam dump system is determined to be inoperable, reduce power to less than 480 MWe (gross) within 3 hours.

E. During power operation, at least one of the turbine overspeed protection systems that trip the turbine stop valves or shut the turbine governor valves shall be operable. If all three systems are determined to be inoperable, isolate the turbine from the steam supply within the next six hours.

F. Should one of the turbine stop valves or governor valves be declared inoperable, restore the inoperable valve to an operable status within 72 hours. If operability cannot be restored, perform one of the following actions:

1. Shut the affected valve within the next six hours.

2. Isolate the turbine from the steam supply with the next six hours.

Basis

A reactor shutdown from power requires removal of core decay heat. Immediate decay heat removal requirements are normally satisfied by the steam bypass to the condenser. Therefore, core decay heat can be continuously dissipated via the steam bypass to the condenser as feedwater in the steam generator is converted to steam by heat absorption. Normally, the capability to return feedwater flow to

the steam generators is provided by operation of the turbine cycle feedwater system.

The eight main steam safety valves have a total combined rated capability of 6,664,000 lbs/hr. The total full power steam flow is 6,620,000 lbs/hr, therefore eight (8) main steam safety valves will be able to relieve the total full-power steam flow if necessary.

In the unlikely event of complete loss of electrical power to the station, decay heat removal would continue to be assured for each unit by the availability of either the steam-driven auxiliary feedwater pump or one of the two motor-driven auxiliary steam generator feedwater pumps, and steam discharge to the atmosphere via the main steam safety valves or atmospheric relief valves. One motor-driven auxiliary feedwater pump can supply sufficient feedwater for removal of decay heat from a unit. The minimum amount of water in the condensate storage tanks ensures the ability to maintain each unit in a hot shutdown condition for at least one hour concurrent with a loss of all AC power.

An unlimited supply is available from the lake via either leg of the plant service water system for an indefinite time period.

Each of the AFW pumps possesses a low suction pressure trip that will protect it should a loss of feedwater occur. Additionally, should a steam generator tube rupture occur, the motor-operated steam admission valves for the turbine-driven AFW pumps serve as isolation boundaries for the affected steam generator.

The crossover steam dump system is designed to prevent the turbine from exceeding 132% of rated speed following a unit trip. The system is armed at approximately 430 MWe. The system receives input from, and is actuated when the turbine auxiliary governor and/or the Independent Overspeed Protection System (IOPS) senses an overspeed condition. The system consists of four pilot-operated dump valves, with only three valves being necessary to achieve the required overspeed protection. However, in order to meet single failure criteria, the crossover steam dump system shall be declared inoperable if any one of the four dump valves is declared inoperable.

In addition to the crossover steam dump system, there are three other systems that protect the turbine from an overspeed condition. The first feature is the mechanical overspeed trip mechanism which consists of an eccentric weight located in the turbine rotor extension shaft. The second feature uses the turbine auxiliary governor to sense turbine overspeed using the auxiliary speed tachometer. The third feature is IOPS. This system monitors turbine speed electrically and consists of three independent speed channels. The actuation of two of three channels will generate a trip signal. The mechanical overspeed trip mechanism and IOPS cause the turbine stop valves to trip and the turbine governor valves to shut, while the auxiliary governor causes only the governor valves to shut. A turbine stop valve shall be declared inoperable if it does not trip shut following a valid overspeed signal. A turbine governor valve shall be declared inoperable if it does not respond properly following a valid overspeed signal.

The atmospheric steam dump lines are required to be operable because they are relied upon, following a steam generator tube rupture coincident with a loss of A.C. power, to cool down the Reactor Coolant System to RHR entry conditions. An atmospheric steam dump line is considered operable if it is capable of providing the controlled relief of main steam flow necessary to perform the RCS cooldown. Isolating an atmospheric steam dump line does not render it inoperable if the line can be unisolated and the RCS can still be cooled down to RHR entry conditions, through local or remote operation, within the time period required by the applicable FSAR accident analyses.

For the purposes of determining a maximum allowable secondary coolant activity, the steam break accident is based on a postulated release of the contents of one steam generator to the atmosphere using a site boundary dose limit. The limiting dose for this accident results from iodine in the secondary coolant. I-131 is the dominant isotope because of its low MPC in air and because the other iodine isotopes have shorter half-lives and therefore cannot buildup to significant concentrations in the secondary coolant, given the limitations on primary system leak rate and activity. It is assumed that the accident occurs at zero load, which is when the maximum amount of water is contained in one steam generator. One tenth of the contained iodine is assumed to reach the site boundary, making allowance for plate-out and retention in water droplets. It is conservative to measure gross beta-gamma activity except when the gross activity exceeds or equals 1.2 μCi/cc. At this time the iodine-131 activity must be measured.

The maximum inhalation dose at the site boundary is then as follows:

$$\text{Dose (rem)} = \frac{C \times V}{10} \times B(t) \times \frac{\chi}{Q} \times DCF$$

where:

C = secondary coolant activity (1.2 μCi/cc = 1.2 Ci/m^3)

V = water volume in one steam generator (2821 ft^3 = 80 m^3)

B(t) = breathing rate (3.47 x 10^{-4} m^3/sec)

χ/Q = 3.0 x 10^{-4} sec/m^3 [4]

DCF = 1.48 x 10^6 rem/Ci I-131 inhaled

The resultant dose is slightly less than 1.5 rem.

References:
FSAR Section 10
FSAR Section 14

15.4.8 AUXILIARY FEEDWATER SYSTEM

Applicability

Applies to periodic testing requirements of the turbine-driven and motor-driven auxiliary feedwater pumps.

Objective

To verify the operability of the Auxiliary Feedwater System and its ability to respond properly when required.

Specification

1. a. Each motor driven auxiliary feedwater pump will be started quarterly.

   b. Each steam turbine driven auxiliary feedwater pump will be started quarterly provided steam is available. If the test comes due when not at power operation, the test shall be performed during the subsequent startup within 24 hours of entering power operation.

   c. The auxiliary feedwater pumps discharge valves and the service water supply valves on the suction side will be tested by operator action ~~monthly~~ quarterly.

2. These tests shall be considered satisfactory if control board indication and subsequent visual observation of the equipment demonstrate that all components have operated properly.

Basis

The quarterly testing of the auxiliary feedwater pumps will verify their operability. The quarterly test of the steam driven pumps will be a fast start test with no prior warmup. Proper functioning of the steam turbine admission valves and the start of the feedwater pumps ~~start~~ will demonstrate the integrity of the steam driven pumps. The ability to both

open and shut the turbine-driven AFW pump motor-operated steam admission valves will be demonstrated since these valves serve as isolation boundaries should a steam generator tube rupture occur. Verification of correct operation will be made both from instrumentation within the main control room and direct visual observation of the pumps.

Reference

FSAR - Sections 10.4 FSAR - Section 14.1.7 FSAR - Section 14.2.5