3.4 STEAM AND POWER CONVERSION SYSTEM

Applicability

Applies to the turbine cycle components for removal of reactor decay heat.

Objective

To specify minimum conditions of the turbine cycle equipment necessary to assure the capability to remove decay heat from the reactor core.

Specifications

3.4.1 The reactor shall not be heated, above 280F unless the following conditions are met:

1. Capability to remove a decay load of 5% full reactor power by at least one of the following means:

   a. A condensate pump and a main feedwater (MFW) pump, using turbine by-pass valve.

   b. A condensate pump and the auxiliary feedwater (AFW) pump using turbine by-pass valve.

2. Fourteen of the steam system safety valves are operable.

3. A minimum of 16.3 ft. (107,000 gallons) of water is available in the condensate storage tank.

4. Both emergency feedwater (EFW) pumps and both EFW block valves are capable of automatic actuation, or a dedicated operator is available for their operation.*

5. Both main steam block valves and both main feedwater isolation valves are operable.

6. The emergency feedwater valves associated with Specification 3.4.1.4 shall be operable.

3.4.2 The Steam Line Break Instrumentation and Control System (SLBIC) shall be operable when main steam pressure exceeds 100 psig greater than the SLBIC actuation setpoint and shall be set to actuate at a value between 575 psig and 805 psig.

*One train of EFW may be removed from the control-grade automatic actuation mode for purposes of surveillance testing of the automatic actuation circuitry for a period not to exceed one (1) hour per test without invoking the reporting requirements of Specification 6.12.3.

Bases

The feedwater flow required to remove decay heat corresponding to 5% full power with saturated steam at 1065 psia (lowest setting of steam safety valve) as a function of feedwater temperature is:

Feedwater Temperature	Flow
60	758
90	777
120	799
140	814

The feedwater system and the turbine bypass system are normally used for decay heat removal and cooldown above 280F. Feedwater makeup is supplied by operation of a condensate pump and either a main or the auxiliary feedwater pump.

In the incredible event of loss of all AC power, feedwater is supplied by the turbine driven emergency feedwater pump which takes suction from the condensate storage tank. Decay heat is removed from a steam generator by steam relief through the atmospheric dump valves or safety valves. Fourteen of the steam system safety valves will relieve the necessary amount of steam for rated reactor power.

The minimum amount of water in the condensate storage tank would be adequate for about 4.5 hours of operation. This is based on the estimate of the average emergency flow to a steam generator being 390 gpm. This operation time with the volume of water specified would not be reached, since the decay heat removal system would be brought into operation within 4 hours or less.

If the turbine driven emergency feedwater pump has not been verified to be operable within 3 months prior to heatup, its operability will be verified upon reaching hot shutdown conditions.

The SLBIC System is designed to isolate the steam generators to assure that only one steam generator will experience uncontrolled blowdown following a steam line break. Normal steam line operating pressures are approximately 900 psig at all power levels, thus operability above 100 psig greater than the SLBIC actuation setpoint with actuation between 575 psig and 805 psig is appropriate. The setpoint is based on severe transients in the main steam lines resulting in rapid pressure decays as well as smaller overcooling events in which high setpoints within the allowable range will reduce the RCS shrinkage occurring and thus the potential for loss of pressurizer fluid inventory.

The control-grade EFW automatic actuation system is required per NUREG-0578 to assure that EFW will be available when necessary. This control-grade system is fully testable, but only at the risk of cold EFW reaching a hot steam generator during operation. To reduce the risk of this, and the subsequent transient, the EFW train to be tested may be removed from the automatic actuation mode if the other train is operable by automatic action, and the train to be tested is still operable is the manual mode.

References

FSAR, Section 10

for protective action from a digital ESAS subsystem will not cause that subsystem to trip. The fact that a module has been removed will be continuously annunciated to the operator. The redundant digital subsystem is still sufficient to indicate complete ESAS action.

The testing schemes of both the RPS and ESAS enable complete system testing while the reactor is operating. Each channel is cable of being testing independently so that operation of individual channels may be evaluated.

Reactor trips on loss of all main feedwater and on turbine trips will sense the start of a loss of OTSG heat sink and actuate earlier than other trip signals. This early actuation will provide a lower peak RC pressure during the initial over pressurization following a loss of feedwater or turbine trip event. The LOFW trip may be bypassed up to 10% to allow sufficient margin for bringing the MFW pumps into use at approximately 7%. The Turbine Trip trip may be bypassed up to 20% to allow sufficent margin for bringing the turbine on line at approximately 15%.

The Automatic Closure and Isolation System (ACI) is designed to close the Decay Heat Removal System (DHRS) return line isolation valves when the Reactor Coolant (RCS) pressure exceeds a selected fraction of the DHRS design pressure or when core flooding system isolation valves are opened. The ACI is designed to permit manual operation of the DHRS return line isolation valves when permissive conditions exist. In addition, the ACI is designed to disallow manual operation of the valves when permissive conditions do not exist.

Power is normally supplied to the control rod drive mechanisms from two separate parallel 480 volt sources. Redundant trip devices are employed in each of these sources. If any one of these trip devices fails in the untripped state, on-line repairs to the failed device, when practical, will be made and the remaining trip devices will be tested. Four hours is ample time to test the remaining trip devices and, in many cases, make on-line repairs.

The Steam Line Break Instrumentation and Control System (SLBIC) is designed to automatically close the Main Steam Block valves and the Main Feedwater Isolation valves upon loss of pressure in either of the two main steam lines.

The SLBIC is also designed to be reset from its trip position only when the system is shut down or the Main Steam line pressure is at or below 50 psig greater than the actuation setpoint.

The Degraded Voltage Monitoring relay settings are based on the short term starting voltage protection as well as long term running voltage protection. The 4.16 KV undervoltage relay setpoints are based on the allowable starting voltage plus maximum system voltage drops to the motor terminals, which allows approximately 78% of motor rated voltage at the motor terminals. The 460V unvervoltage relay setpoint is based on long term motor voltage requirements plus the maximum feeder voltage drop allowance resulting in a 92% setting of motor rated voltage.

The OPERABILITY of the accident monitoring instrumentation ensures that sufficient information is available on selected plant parameters to monitor and assess these variables during and following an accident. This capability is consistent with the recommendations of Regulatory Guide 1.97, "Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Plant Conditions During and Following an Accident," December 1975 and NUREG-0578, "TMI-2 Lessons Learned Task Force Status Report and Short-Term Recommendations."

REFERENCE

FSAR, Section 7.1