

15.3 LIMITING CONDITIONS FOR OPERATION

15.3.1 REACTOR COOLANT SYSTEM

Applicability

Applies to the operating status of the Reactor Coolant System.

Objective

To specify those limiting conditions for operation of the Reactor Coolant System which must be met to ensure safe reactor operation.

Specification

A. OPERATIONAL COMPONENTS

1. Coolant Pumps*

- a. When the reactor is critical, except for tests, at least one reactor coolant pump shall be in operation.
 - (1) Reactor power shall not be maintained above 3.5% of rated power unless both reactor coolant pumps are in operation.
 - (2) If either reactor coolant pump ceases operating, immediate power reduction shall be initiated under administrative control as necessary to reduce power to less than 3.5% of rated power.
 - (3) If both reactor coolant pumps cease operating and power is greater than 3.5% of rated power, but less than 10% of rated power, reactor shutdown will commence immediately and verify the reactor trip breakers are opened within one hour.
- b. When the reactor is subcritical and the average reactor coolant temperature is greater than 350°F, except for tests, at least one reactor coolant pump shall be in operation.
 - (1) Both reactor coolant pumps may be deenergized provided:
 - a. No operations are permitted that would cause dilution of the reactor coolant system boron concentration,
 - b. Core outlet temperature is maintained at least 10°F below saturation temperature, and
 - c. The reactor trip breakers are open.
- c. At least one reactor coolant pump or residual heat removal system shall be in operation when a reduction is made in the boron concentration of the reactor coolant.

2. Steam Generator*

- a. One steam generator shall be operable whenever the average reactor coolant temperature is above 350°F.

3. Components Required for Redundant Decay Heat Removal Capability*

- a. Reactor coolant temperature less than 350°F and greater than 140°F.
 - (1) At least two of the decay heat removal methods listed shall be operable.
 - (a) Reactor Coolant Loop A, its associated steam generator and either reactor coolant pump
 - (b) Reactor Coolant Loop B, its associated steam generator and either reactor coolant pump

* Applicable only when one or more fuel assemblies are in the reactor vessel.

- (c) Residual Heat Removal Loop (A)*
- (d) Residual Heat Removal Loop (B)*

- (2) If the conditions of specification (1) above cannot be met, corrective action to return a second decay heat removal method to operable status as soon as possible shall be initiated immediately.
- (4)(3) If no decay heat removal method is in operation, except as permitted by (4) below, all operations causing an increase in the reactor decay heat load or a reduction in reactor coolant system boron concentration shall be suspended. Corrective actions to return a decay heat removal method to operation shall be initiated immediately.
- (3)(4) At least one of the above decay heat removal methods shall be in operation, except when required to be secured for testing.
 - (a) All reactor coolant pumps and residual heat removal pumps may be deenergized for up to 1 hour in any 8 hour period provided:
 - (1) No operations are permitted that would cause dilution of reactor coolant system boron concentration, and
 - (2) Core outlet temperature is maintained at least 10°F below saturation temperature.
- b. Reactor Coolant Temperature Less Than 140°F
 - (1) Both residual heat removal loops shall be operable except as permitted in items (3) or (4) below.
 - (2) If no residual heat removal loop is in operation, all operations causing an increase in the reactor decay heat load or a reduction in reactor coolant system boron concentration shall be suspended. Corrective actions to return a decay heat removal method to operation shall be initiated immediately.
 - (3) One residual heat removal loop may be out of service when the reactor vessel head is removed and the refueling cavity flooded.
 - (4) One of the two residual heat removal loops may be temporarily out of service to meet surveillance requirements.

4. Pressurizer Safety Valves

- a. At least one pressurizer safety valve shall be operable whenever the reactor head is on the vessel.
- b. Both pressurizer safety valves shall be operable whenever the reactor is critical.

*Mechanical design provisions of the residual heat removal system afford the necessary flexibility to allow an operable residual heat removal loop to consist of the RHR pump from one loop coupled with the RHR heat exchanger from the other loop. Electrical design provisions of the residual heat removal system afford the necessary flexibility to allow the normal or emergency power source to be inoperable or tied together when the reactor coolant temperature is less than 200°F.

5. Pressurizer Power-Operated Relief Valves (PORV) and PORV Block Valves
 - a. Two PORVs and their associated block valves shall be operable.
 - (1) If a PORV is inoperable due to leakage in excess of that allowed in Specification 15.3.1.D, the PORV shall be restored to an operable condition within one hour or the associated block valve shall be closed.
 - (2) If a PORV is inoperable due to a channel functional test failure, the associated PORV control switch shall be placed and maintained in the closed position or the associated block valve shall be closed within one hour.
 - (3) If a PORV block valve is inoperable, the block valve shall be restored to an operable condition within one hour or the block valve shall be closed with power removed from the block valve; otherwise, the unit shall be in hot shutdown within the next six hours.
6. The pressurizer shall be operable with at least 100 KW of pressurizer heaters available and a water level greater than 10% and less than 95% during steady-state power operation. At least one bank of pressurizer heaters shall be supplied by an emergency bus power supply.
7. Reactor Coolant Gas Vent System

These Specifications are not applicable during cold or refueling shutdown conditions:

 - a. At least one Reactor Coolant Gas Vent System vent path to the pressurizer relief tank (PRT) or containment atmosphere shall be operable from each of the following locations:
 - (1) Reactor vessel head
 - (2) PressurizerEach vent path from these locations to the common header includes two closed valves in parallel powered from emergency buses. The common header vents to the PRT and the containment atmosphere each contain a closed valve powered from an emergency bus which provides series isolation.

- b. When unable to vent from the common header to the PRT or the containment atmosphere, reactor startup and/or power operations may continue provided that the series isolation valve in the inoperable vent path is maintained closed with power removed from the valve actuator.
- c. If a vent path from the reactor vessel head or the pressurizer to the common header becomes inoperable, reactor startup and/or power operations may continue provided that the paralleled isolation valves in the inoperable vent path from that location to the common header are maintained closed with power removed from the valve actuator. This does not necessitate removing power from the PRT or containment atmosphere isolation valves. The inoperable vent path shall be restored to operable status within thirty days, or the reactor shall be placed in hot shutdown within six hours and in cold shutdown within the following thirty hours.
- d. If the vent paths from both the reactor vessel head and the pressurizer to the common header are inoperable or the vent paths from the common header to both the PRT and the containment atmosphere are inoperable, then maintain all the inoperable vent path valves closed with power removed from the valve actuators of all the valves in the inoperable vent paths. Restore at least one of the vent paths from the reactor vessel head or pressurizer to the containment atmosphere or the PRT to operable status within 72 hours or be in hot shutdown within six hours and in cold shutdown within the following thirty hours.

Basis

When the boron concentration of the reactor coolant system is to be reduced, the process must be uniform to prevent sudden reactivity changes in the reactor. OMixing of the reactor coolant will be sufficient to maintain a uniform boron concentration if at least one reactor coolant pump or one residual heat removal pump is running while the change is taking place. The residual heat removal pump will circulate the primary system volume in approximately one-half hour. The pressurizer is of little concern because of the lower pressurizer volume and because pressurizer boron concentration normally will be higher than that of the rest of the reactor coolant.

Specification 15.3.1.A.1 requires that at least one reactor coolant pump must be operating whenever the average reactor coolant temperature is above 350°F unless the listed restrictions are established. This is required so that the FSAR zero power transients (rod withdrawal from subcritical and rod ejection) are addressed from conservative conditions. With the reactor subcritical, with required shutdown margin, and with the trip breakers open, a single rod ejection will not result in criticality being reached. With the reactor subcritical and the average reactor coolant temperature above 350°F, a single reactor coolant pump provides sufficient decay heat removal capability. Heat transfer analyses⁽¹⁾ show that reactor heat equivalent to 3.5% of the rated power can be removed with natural circulation only.

Items 15.3.1.A.1.a.(2) permits an orderly reduction in power if a reactor coolant pump is lost during operation between 3.5% and 50% of rated power.

Above 50% power, an automatic reactor trip will occur if either pump is lost. The power-to-flow ratio will be maintained equal to or less than 1.0, which ensures that the minimum DNB ratio increases at lower flow since the maximum enthalpy rise does not increase above its normal full-flow maximum value.⁽²⁾

Specification 15.3.1.A.3 provides limiting conditions for operation to ensure that redundancy in decay heat removal methods is provided. A single reactor coolant loop with its associated steam generator and a reactor coolant pump or a single residual heat removal loop provides sufficient heat removal capacity for removing the reactor core decay heat; however, single failure considerations require that at least two decay heat removal methods be available. Operability of a steam generator for decay heat removal includes two sources of water, water level indication in the steam generator, a vent path to atmosphere, and the Reactor Coolant System filled and vented so thermal convection cooling of the core is possible. If the steam generators are not available for decay heat removal, this Specification requires both residual heat removal loops to be operable unless the reactor system is in the refueling shutdown condition with the refueling cavity flooded and no operations in progress which could cause an increase in reactor decay heat load or a decrease in boron concentration. In this condition, the reactor vessel is essentially a fuel storage pool and removing a RHR loop from service provides conservative

conditions should operability problems develop in the other RHR loop. Also, one residual heat removal loop may be temporarily out of service due to surveillance testing, calibration, or inspection requirements. The surveillance procedures follow administrative controls which allow for timely restoration of the residual heat removal loop to service if required.

Additionally, with reactor coolant temperature between 350°F and 140°F, all operating decay heat removal pumps (either reactor coolant pumps or residual heat removal pumps) are allowed to be deenergized for a short time (1 hour) with the stipulation that boron dilution activities are not allowed and that core outlet temperature remain 10°F below saturation.

The operation of one reactor coolant pump or one RHR pump provides adequate flow to ensure mixing, prevent stratification and produce gradual reactivity changes during boron concentration reductions in the reactor coolant system. The reactivity change rate associated with boron reduction will, therefore, be within the capability of operator recognition and control.

Each of the pressurizer safety valves is designed to relieve 288,000 lbs per hour of saturated steam at setpoint. If no residual heat is removed by any of the means available, the amount of steam which could be generated at safety valve relief pressure would be less than half the valves' capacity. One valve, therefore, provide adequate defense against overpressurization. Below 350°F and 400 psig in the Reactor Coolant System, the residual heat removal system can remove decay heat and thereby control system temperature and pressure.

A PORV is defined as OPERABLE if leakage past the valve is less than that allowed in Specification 15.3.1.D and the PORV has met its most recent channel test as specified in Table 15.4.1-1. The PORVs operate to relieve, in a controlled manner, reactor coolant system pressure increases below the setting of the pressurizer safety valves. These PORVs have remotely operated block valves to provide a positive shutoff capability should a PORV become inoperable.

The requirement that 100 KW of pressurizer heaters and their associated controls be capable of being supplied electrical power from an emergency bus provides assurance that these heaters can be energized during a loss of offsite power condition to maintain pressure control and natural circulation at hot shutdown.

The requirement to have a reactor coolant system gas vent operable from the reactor vessel or the pressurizer steam space assures that non-condensable gases can be released from the Reactor Coolant System if necessary. The Reactor Coolant Gas Vent System (RCGVS) provides an orificed vent path from the pressurizer steam space and an orificed vent path from the reactor vessel. Both vent paths include two parallel solenoid-operated isolation valves which are powered from emergency buses and vent to a common header. From the common header, gases may be vented via separate lines, each with a single solenoid operated isolation valve powered from the emergency bus to the pressurizer relief tank or containment atmosphere. The orifice in these vent lines restricts leakage so that, in the event of a pipe break or isolation valve failure, makeup water for the leakage can be provided by a single coolant charging pump. If a RCGVS vent path from either the pressurizer or reactor vessel head is inoperable, Specification 15.3.1.A.7.c requires the remotely operable valves in that inoperable path to be shut with power removed. If a vent path from the common header to the pressurizer relief tank or containment atmosphere is inoperable, the isolation valve in that path must be shut but reactor operations may continue. If both vent paths to or both vent paths from the common header are inoperable, the RCGVS is inoperable and the steps in specification 15.3.1.A.7.d must be taken.

⁽¹⁾ FSAR Section 14.1.11.

⁽²⁾ FSAR Section 7.2.3.