## 3.2 MAKEUP AND PURIFICATION AND CHEMICAL ADDITION SYSTEMS

### Applicability

Applies to the operational status of the makeup and purification and the chemical addition systems.

### Objective

To provide for adequate boration under all operating conditions to assure ability to bring the reactor to a cold shutdown condition.

### Specification

The reactor shall not be critical unless the following conditions are met:

3.2.1 Two makeup and purification pumps are operable except as specified in 3.3.2. Specification 3.0.1 applies.

3.2.2 A source of concentrated boric acid solution, in addition to the borated water storage tank, is available and operable. This can be either:

a. The boric acid mix tank containing at least the equivalent of the volume and boron concentration specified in the Core Operating Limits Report as boric acid solution with a temperature of at least 10°F above the crystallization temperature. System piping and valves necessary to establish a flow path from the tank to the makeup and purification system shall also be operable and shall have at least the same temperature requirement as the boric acid mix tank. One associated boric acid pump shall be operable.

b. A reclaimed boric acid storage tank containing at least the equivalent of the volume and boron concentration specified in the Core Operating Limits Report as boric acid solution with a temperature of at least 10°F above the crystallization temperature. System piping and valves necessary to establish a flow path from the tank to the makeup and purification system shall also be operable and shall have at least the same temperature requirement as the reclaimed boric acid tank. One associated reclaimed boric acid pump shall be operable.

c. With neither the boric acid mix tank nor the reclaimed boric acid storage tank OPERABLE, restore one source to OPERABLE status within 72 hours or be in at least HOT SHUTDOWN within the next 6 hours and borated to a SHUTDOWN MARGIN equivalent to 1% delta k/k at 200°F; restore a concentrated boric acid source to OPERABLE status within the next 7 days or be in COLD SHUTDOWN within the next 30 hours.



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Bases

The makeup and purification system (Reference 1), and the chemical addition and sampling systems (Reference 2) provide control of the reactor coolant boron concentration. This is normally accomplished by using any of the three makeup and purification pumps in series with a boric acid pump associated with the boric acid mix tank or a reclaimed boric acid pump associated with a reclaimed boric acid storage tank. The alternate method of boration will be the use of the makeup and purification pumps taking suction directly from the borated water storage tank (Reference 3).

The quantity of boric acid in storage from any of the three above mentioned sources is sufficient to borate the reactor coolant system to a one percent subcritical margin in the cold condition at the worst time in core life with a stuck control rod assembly. The minimum volume and boron concentration determined for each of the three sources mentioned above by cycle specific analyses will satisfy this requirement. Technical Specification 3.2 assures that at least two of these supplies are available whenever the reactor is critical so that a single failure will not prevent boration to a cold condition. The minimum volumes of boric acid solution include the boron necessary to account for xenon decay.

The primary method of adding boron to the reactor coolant system is to pump the concentrated boric acid solution into the makeup tank using either the 10 gpm boric acid pumps or the 30 gpm reclaimed boric acid pumps. The alternative method of addition is to inject boric acid from the borated water storage tank using the makeup and purification pumps. Either method is capable of injecting the required boron volume to the reactor coolant system at a rate sufficient to account for all transient xenon effects even if only one pump is available (i.e. one 10 gpm boric acid pump for the primary method or one makeup and purification pump for the alternative BWST method).

Concentration of boron in the boric acid mix tank or a reclaimed boric acid storage tank may be higher than the concentration which would crystallize at ambient conditions. For this reason, the boric acid mix tank is provided with an immersion electric heating element and the reclaimed boric acid tanks are provided with low pressure steam heating jackets to maintain the temperature of their contents well above (10°F or more) the crystallization temperature of the boric acid solution contained in them. Both types of heaters are controlled by temperature sensors immersed in the solution contained in the tanks. Further, all piping, pumps and valves associated with the boric acid mix tank and the reclaimed boric acid storage tanks to transport boric acid solution from them to the makeup and purification system are provided with redundant electrical heat tracing to ensure that the boric acid solution will be maintained 10°F or more above its crystallization temperature. The electrical heat tracing is controlled by the temperature of the external surfaces of the piping systems. Once in the makeup and purification system, the boric acid solution is sufficiently well mixed and diluted so that normal system temperatures assure boric acid solubility.

References

(1) UFSAR, Section 9.1 - "Makeup and Purification System"
(2) UFSAR, Section 9.2 - "Chemical Addition and Sampling Systems"
(3) UFSAR, Figures 6.0-1, 6.0-2 - Simplified ECCS Diagrams