## TECHNICAL SPECIFICATIONS - FIGURES

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(3) Protection Against Low Temperature Overpressurization

The following limiting conditions shall be applied during scheduled heatups and cooldowns. Disabling of the HPSI pumps need not be required if the RCS is vented through at least a 0.94 square inch or larger vent.

Whenever the reactor coolant system cold leg temperature is below 350°F, at least one (1) HPSI pump shall be disabled.

Whenever the reactor coolant system cold leg temperature is below 320°F, at least two (2) HPSI pumps shall be disabled.

Whenever the reactor coolant system cold leg temperature is below 270°F, all three (3) HPSI pumps shall be disabled.

In the event that no charging pumps are operable when the reactor coolant system cold leg temperature is below 270°F, a single HPSI pump may be made operable and utilized for boric acid injection to the core, with flow rate restricted to no greater than 120 gpm.

(4) Trisodium Phosphate (TSP)

During operating Modes 1 and 2, the TSP baskets shall contain a volume of active TSP that is within the area of acceptable operation shown in Figure 2-3.

a. With the above TSP requirements not within limits, the TSP shall be restored within 72 hours.

b. With Specification 2.3(4)a required action and completion time not met, the plant shall be in hot shutdown within the next 6 hours and cold shutdown within the following 36 hours.

Basis

The normal procedure for starting the reactor is to first heat the reactor coolant to near operating temperature by running the reactor coolant pumps. The reactor is then made critical. The energy stored in the reactor coolant during the approach to criticality is substantially equal to that during power operation and therefore all engineered safety features and auxiliary cooling systems are required to be fully operable.

## 2.0 LIMITING CONDITIONS FOR OPERATION
### 2.3 Emergency Core Cooling System (Continued)

With respect to the core cooling function, there is functional redundancy over most of the range of break sizes.[3][4]

The LOCA analysis confirms adequate core cooling for the break spectrum up to and including the 32 inch double-ended break assuming the safety injection capability which most adversely affects accident consequences and are defined as follows. The entire contents of all four safety injection tanks are assumed to be available for emergency core cooling, but the contents of one of the tanks is assumed to be lost through the reactor coolant system. In addition, of the three high-pressure safety injection pumps and the two low-pressure safety injection pumps, for both large break analysis and small break analysis it is assumed that one high pressure pump and one low pressure pump operate (5); and also that 25% of their combined discharge rate is lost from the reactor coolant system out of the break. The transient hot spot fuel clad temperatures for the break sizes considered are shown in USAR Section 14.

The restriction on HPSI pump operability at low temperatures, in combination with the PORV setpoints ensure that the reactor vessel pressure-temperature limits would not be exceeded in the case of an inadvertent actuation of the operable HPSI and charging pumps.

Removal of the reactor vessel head, one pressurizer safety valve, or one PORV provides sufficient expansion volume to limit any of the design basis pressure transients. Thus, no additional relief capacity is required.

Technical Specification 2.2(1) specifies that, when fuel is in the reactor, at least one flow path shall be provided for boric acid injection to the core. Should boric acid injection become necessary, and no charging pumps are operable, operation of a single HPSI pump would provide the required flow path. The HPSI pump flow rate must be restricted to that of three charging pumps in order to minimize the consequences of a mass addition transient while at low temperatures.

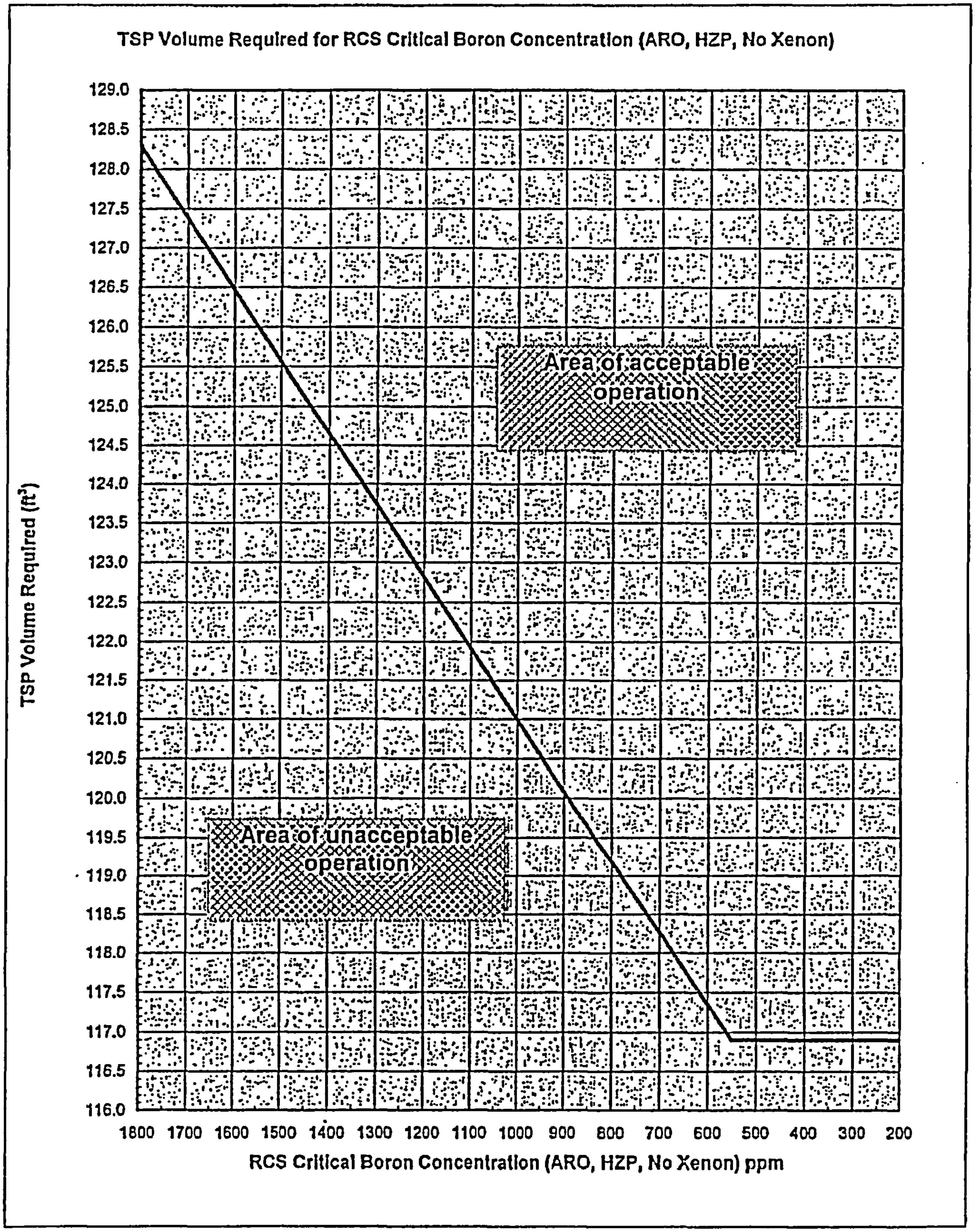
Trisodium Phosphate (TSP) is required to adjust the pH of the recirculation water to ≥ 7.0 after a loss of coolant accident (LOCA). This pH value is necessary to prevent significant amounts of iodine, released from fuel failures and dissolved in the recirculation water, from converting to a volatile form and evolving into the containment atmosphere. Higher levels of airborne iodine in containment may increase the releases of radionuclides and the consequences of the accident. A pH of ≥ 7.0 is also necessary to prevent stress corrosion cracking (SCC) of austenitic stainless steel components in containment. SCC increases the probability of failure of components.

The hydrated form (45-57% moisture) of TSP is used because of the high humidity in the containment building during normal operation. Since the TSP is hydrated, it is less likely to absorb large amounts of water from the humid atmosphere and will undergo less physical and chemical change than the anhydrous form of TSP.

Radiation levels in containment following a LOCA may cause the generation of hydrochloric and nitric acids from radiolysis of cable insulation and sump water. TSP will neutralize these acids.

The required amount of TSP is represented in a volume quantity converted from the Reference 7 mass quantity using the manufactured density. Verification of this amount during surveillance testing utilizes the measured volume.

Figure 2-3


TSP Volume Required for RCS Critical Boron Concentration (ARO, HZP, No Xenon)
TSP Volume Required (ft³)
129.0
128.5
128.0
127.5
127.0
126.5
126.0
125.5
125.0
124.5
124.0
123.5
123.0
122.5
122.0
121.5
121.0
120.5
120.0
119.5
119.0
118.5
118.0
117.5
117.0
116.5
116.0
Area of acceptable operation
Area of unacceptable operation
1800 1700 1600 1500 1400 1300 1200 1100 1000 900 800 700 600 500 400 300 200
RCS Critical Boron Concentration (ARO, HZP, No Xenon) ppm

3.0 <u>SURVEILLANCE REQUIREMENTS</u>
3.6 Safety Injection and Containment Cooling Systems Tests (continued)

(ii) Verifying that the trisodium phosphate (TSP) baskets contain a volume of granular TSP that is within the area of acceptable operation of Figure 2-3.

(ii) Verifying that a sample from the TSP baskets provides adequate pH upward adjustment of the recirculation water.

3.0 SURVEILLANCE REQUIREMENTS
3.6 Safety Injection and Containment Cooling Systems Tests (Continued)

Operation of the system for 10 hours every month will demonstrate operability of the filters and adsorbers system and remove excessive moisture build-up on the adsorbers.

Demonstration of the automatic initiation capability will assure system availability.

Periodic determination of the volume of TSP in containment must be performed due to the possibility of leaking valves and components in the containment building that could cause dissolution of the TSP during normal operation.

A refueling frequency shall be utilized to visually determine that the volume of TSP contained in the TSP baskets is within the area of acceptable operation based on the TSP volume required by Figure 2-3. A measured value or the Technical Data Book (TDB) II, "Reactivity Curves" may be used to obtain a hot zero power (HZP) critical boron concentration (CBC). The "as found" volume of TSP must be within the area of acceptable operation of Figure 2-3 using this HZP CBC value. Prior to exiting the refueling outage, another visual TSP volume determination is performed to ensure that the "as-left" volume of TSP contained in the baskets is ≥ 128.3 $ft^3$. This requirement ensures that there is an adequate quantity of TSP to adjust the pH of the post-LOCA sump solution to a value ≥ 7.0 for HZP CBC up to 1800 ppm.

The periodic pH verification is also required on a refueling frequency. Operating experience has shown this surveillance frequency acceptable due to margin in the volume of TSP placed in the containment building.

An "as left" representative sample of 1.78 -1.81 grams of TSP from one of the baskets in containment is submerged in 0.99-1.01 liters of water at a boron concentration of 2439 - 2459 ppm (equivalent to a RCS boron concentration of 1800 ppm - Figure 2-3). At a standard temperature of 115-125°F, without agitation, the solution should be left to stand for 4 hours. The liquid is then decanted and mixed, the temperature adjusted to 75 - 79°F and the pH measured. At this point the pH must be ≥ 7.0. The representative sample weight is based on the minimum required TSP weight at the beginning of cycle of 6,800 $lbs_m$ which, at a manufactured density of at least 53.0 $lb_m/ft^3$ corresponds to the minimum volume of 128.3 $ft^3$, and maximum possible post-LOCA sump volume of 397,183 gallons, normalized to buffer a 1.0 liter sample.

3.0 SURVEILLANCE REQUIREMENTS
3.6 Safety Injection and Containment Cooling Systems Tests (Continued)

Testing of the "as found" condition must be performed to ensure the solubility and buffering ability of the TSP after exposure to the containment environment. The "as found" test is performed in the same manner as the "as left" test. However, a different sample size and boron concentration is used based on the end of cycle HZP CBC. The representative sample size, boron concentration of sample water, minimum required TSP weight, and minimum volume of TSP are all a function of the end of cycle HZP CBC as specified in EA-FC-03-041. The "as found" volume of TSP corresponds to the maximum possible boron concentration corresponding to the maximum possible post-LOCA sump volume of 397,183 gallons, normalized to a buffer a 1.0 liter sample.

The boron concentration of the test water is representative of the maximum possible boron concentration corresponding to the maximum possible post-LOCA sump volume. The post-LOCA sump volume originates from the Reactor Coolant System (RCS), the Safety Injection Refueling Water Tank (SIRWT), the Safety Injection Tanks (SITs) and the Boric Acid Storage Tanks (BASTs). The maximum post-LOCA sump boron concentration is based on a cumulative boron concentration in the RCS, SIRWT, SITs and BASTs of 2449 ppm at beginning of cycle (HZP CBC = 1800 ppm) and 2333 ppm at end of cycle (HZP CBC $\leq$ 550 ppm). These values are based on the SIRWT and SITs at 2350 ppm and the BASTs at 4.5 wt. % boron. Agitation of the test solution is prohibited, since an adequate standard for agitation intensity cannot be specified. The test time of 4 hours is necessary to allow time for the dissolved TSP to naturally diffuse through the sample solution. In the post-LOCA containment sump, rapid mixing would occur, significantly decreasing the actual amount of time before the required pH is achieved. This would ensure achieving a pH $\geq$ 7.0 by the onset of recirculation after a LOCA.

References

(1) USAR, Section 6.2
(2) USAR, Section 6.3
(3) USAR, Section 14.16
(4) USAR, Section 6.4
(5) EA-FC-03-041, 10/14/03, "Minimum Trisodium Phosphate (TSP) Volume Required in Containment Sump as a Function of RCS Critical Boron Concentration (ARO, HZP, No Xenon)"