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3/4.1.5 STANDBY LIQUID CONTROL SYSTEM

LIMITING CONDITION FOR OPERATION

3.1.5 ~~Two~~ The standby liquid control system subsystems shall be OPERABLE as follows:

INSERT A

APPLICABILITY: OPERATIONAL CONDITIONS 1, 2, 3#, 4#, 5# and 5*.

ACTION:

a. In OPERATIONAL CONDITION 1 or 2:

1. With one system subsystem inoperable, restore the inoperable subsystem to OPERABLE status within 7 days or be in at least HOT SHUTDOWN within the next 12 hours.
2. With both standby liquid control system subsystems inoperable, restore at least one subsystem to OPERABLE status within 8 hours or be in at least HOT SHUTDOWN within the next 12 hours.

b. In OPERATIONAL CONDITION 5*:

1. With one system subsystem inoperable, restore the inoperable subsystem to OPERABLE status within 30 days or insert all insertable control rods within the next hour.
2. With both standby liquid control system subsystems inoperable, insert all insertable control rods within one hour.

INSERT B

SURVEILLANCE REQUIREMENTS

4.1.5 Each standby liquid control system subsystem shall be demonstrated OPERABLE:

a. At least once per 24 hours in OPERATIONAL CONDITIONS 1, 2 and 5* by verifying that;

1. The temperature of the sodium pentaborate solution is ~~within the limits of Figure 3.1.5-1.~~ greater than or equal to 75°F and less than or equal to 130°F.
2. The available volume of sodium pentaborate solution is ~~greater than or equal to 4530 gallons.~~ within the limits of Figure 3.1.5-2.

INSERT C

3. The heat tracing ~~circuit~~ is OPERABLE by determining the temperature of the pump suction piping is ~~within the limits of Figure 3.1.5-1.~~ greater than or equal to 75°F and less than or equal to 130°F.

INSERT D

*With any control rod withdrawn. Not applicable to control rods removed per Specification 3.9.10.1 or 3.9.10.2.

INSERT E

INSERT A Page 3/4 1-18

a. In OPERATIONAL CONDITIONS 1, 2 AND 5*:

1. Two subsystems, and

b. In OPERATIONAL CONDITIONS 3#, 4# AND 5#:

1. At least one division of heat tracing circuitry on the pumps suction piping.

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c. In OPERATIONAL CONDITIONS 1, 2, 3#, 4#, 5# and 5*:

1. With no heat tracing OPERABLE, restore at least one division of heat tracing circuitry to OPERABLE status, and

2. If the pumps suction piping temperature decreases to less than 75°F, declare both standby liquid control system subsystems inoperable and perform Surveillance Requirement 4.1.5.e.3 before declaring a standby liquid control system subsystem OPERABLE.

3. The provisions of Specification 3.0.4 are not applicable in OPERATIONAL CONDITIONS 3, 4, and 5.

d. In OPERATIONAL CONDITIONS 1 AND 2:

1. With the sodium pentaborate concentration greater than 15.2 weight percent and the net tank volume greater than or equal to 4281 gallons and less than or equal to 5088 gallons, verify the sodium pentaborate solution temperature to be greater than or equal to the standby liquid control system solution minimum temperature limit of Figure 3.1.5-1 once per 4 hours and restore the sodium pentaborate solution to within the limits of Figures 3.1.5-1 and 3.1.5-2 within 72 hours.

2. Otherwise, declare both standby liquid control system subsystems inoperable and be in at least HOT SHUTDOWN within the next 12 hours.

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that power is available to at least one division of heat tracing circuitry and

INSERT D Page 3/4 1-18

b. At least once per 24 hours in OPERATIONAL CONDITIONS 3#, 4# and 5# by verifying the heat tracing is OPERABLE by determining that power is available to at least one division of heat tracing circuitry and the temperature of the pumps suction piping is greater than or equal to 75°F and less that or equal to 130°F.

With sodium pentaborate solution in the standby liquid control system storage tank.

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(c) ~~b.~~ At least once per 31 days by;

1. Starting both pumps and recirculating demineralized water to the test tank.

2. Verifying the continuity of the explosive charge.

3. Determining that ~~the available weight of sodium pentaborate is greater than or equal to 5000 lbs and~~ the concentration of boron in solution is within the limits of Figure 3.1.5-~~1~~ (2) by chemical analysis.*

4. Verifying that each valve, manual, power operated or automatic, in the flow path that is not locked, sealed, or otherwise secured in position, is in its correct position.

(d) ~~c.~~ Demonstrating that, when tested pursuant to Specification 4.0.5, the minimum flow requirement of 41.2 gpm at a pressure of greater than or equal to 1300 psig is met, without actuation of the pump relief valve.

(e) ~~d.~~ At least once per 18 months during shutdown by;

1. Initiating one of the standby liquid control system subsystems, including an explosive valve, and verifying that a flow path from the pumps to the reactor pressure vessel is available by pumping demineralized water into the reactor vessel. The replacement charge for the explosive valve shall be from the same manufactured batch as the one fired or from another batch which has been certified by having one of that batch successfully fired. Both system subsystems shall be tested in 36 months.

2. Demonstrating that the pump relief valve opens within 3% of the system design pressure and verifying that the relief valve does not actuate during recirculation to the test tank.

3. ~~**~~Demonstrating that all heat traced piping between the storage tank and the reactor vessel is unblocked by pumping from the storage tank to the test tank and then draining and flushing the piping with demineralized water. [INSERT F]

4. Demonstrating that the storage tank heater is OPERABLE by verifying the expected temperature rise for the sodium pentaborate solution in the storage tank after the heater is energized.

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*This test shall also be performed anytime water or b[illegible]is added to the solution or when the solution temperature drops below ~~the limit of Figure 3.1.5-1.~~ 75°F

~~**This test shall also be performed whenever both heat tracing circuits have been found to be inoperable and may be performed by any series of sequential, overlapping or total flow path steps such that the entire flow path is included.~~

This test may be performed by any series of sequential, overlapping or total flow path steps such that the entire flow path is included.

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REPLACE ENTIRE FIGURE

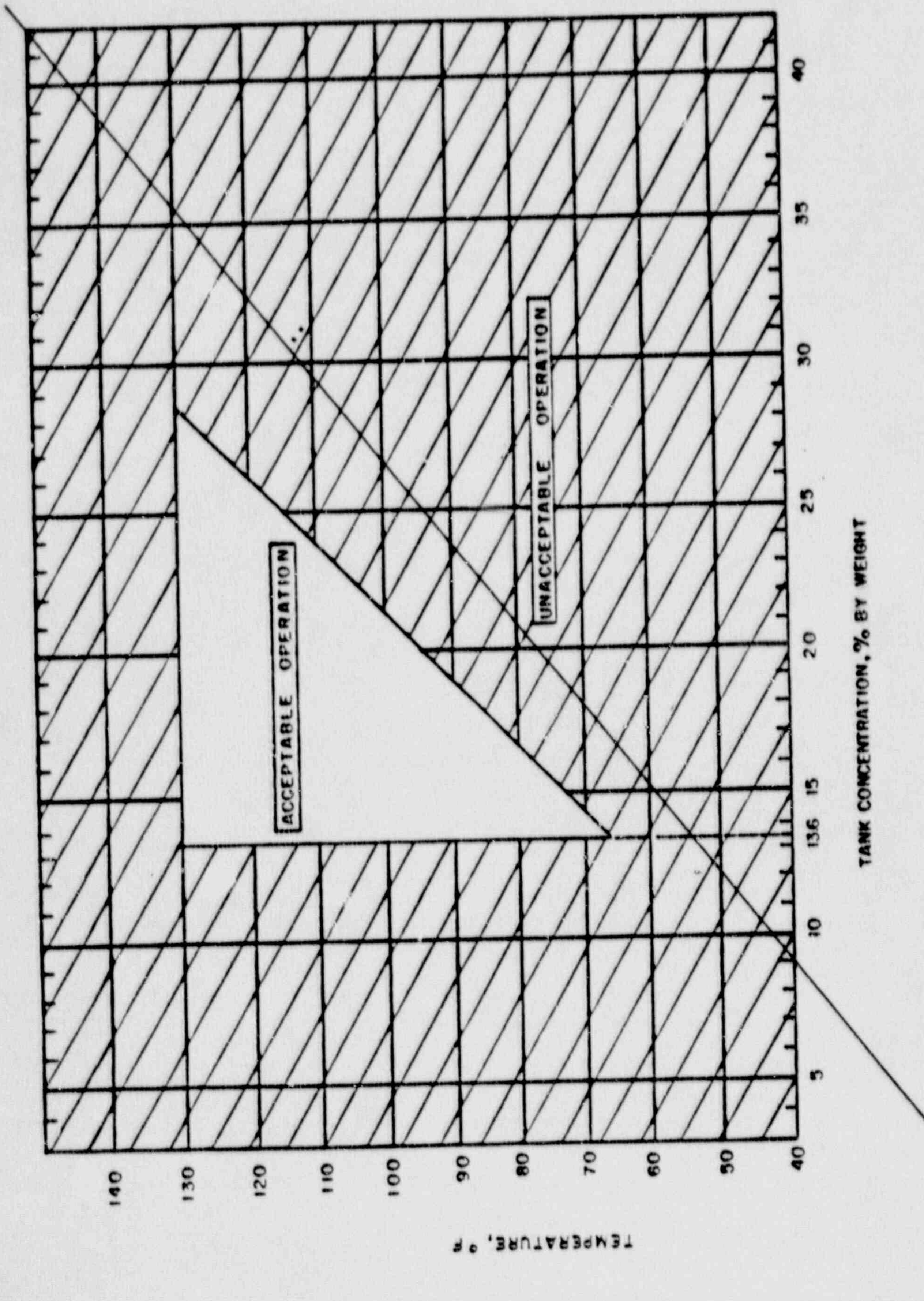

FIGURE 3.1.5-1 SODIUM PENTABORATE SOLUTION TEMPERATURE/CONCENTRATION REQUIREMENTS

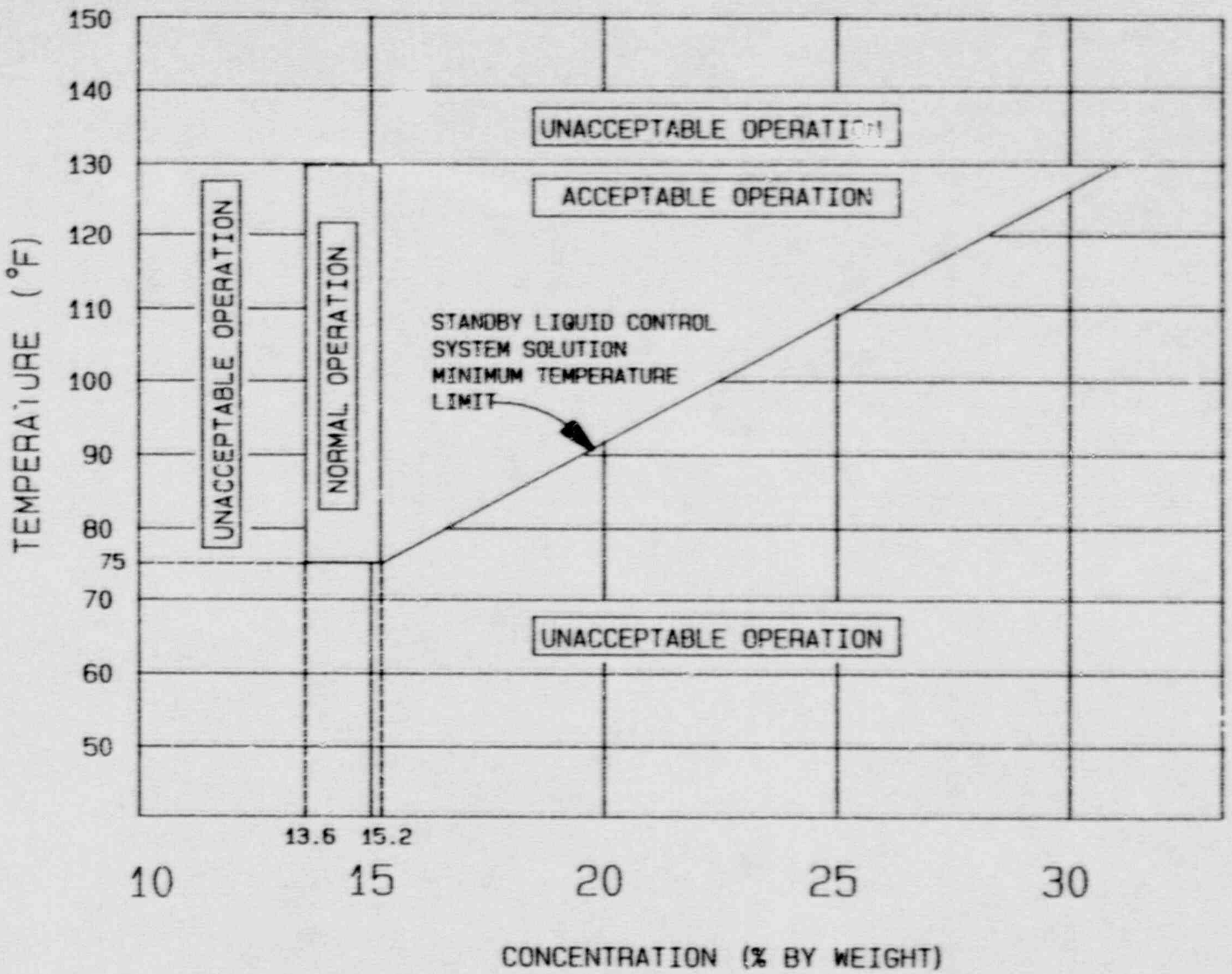

FIGURE 3.1.5-1

SODIUM PENTABORATE SOLUTION TEMPERATURE/CONCENTRATION REQUIREMENTS

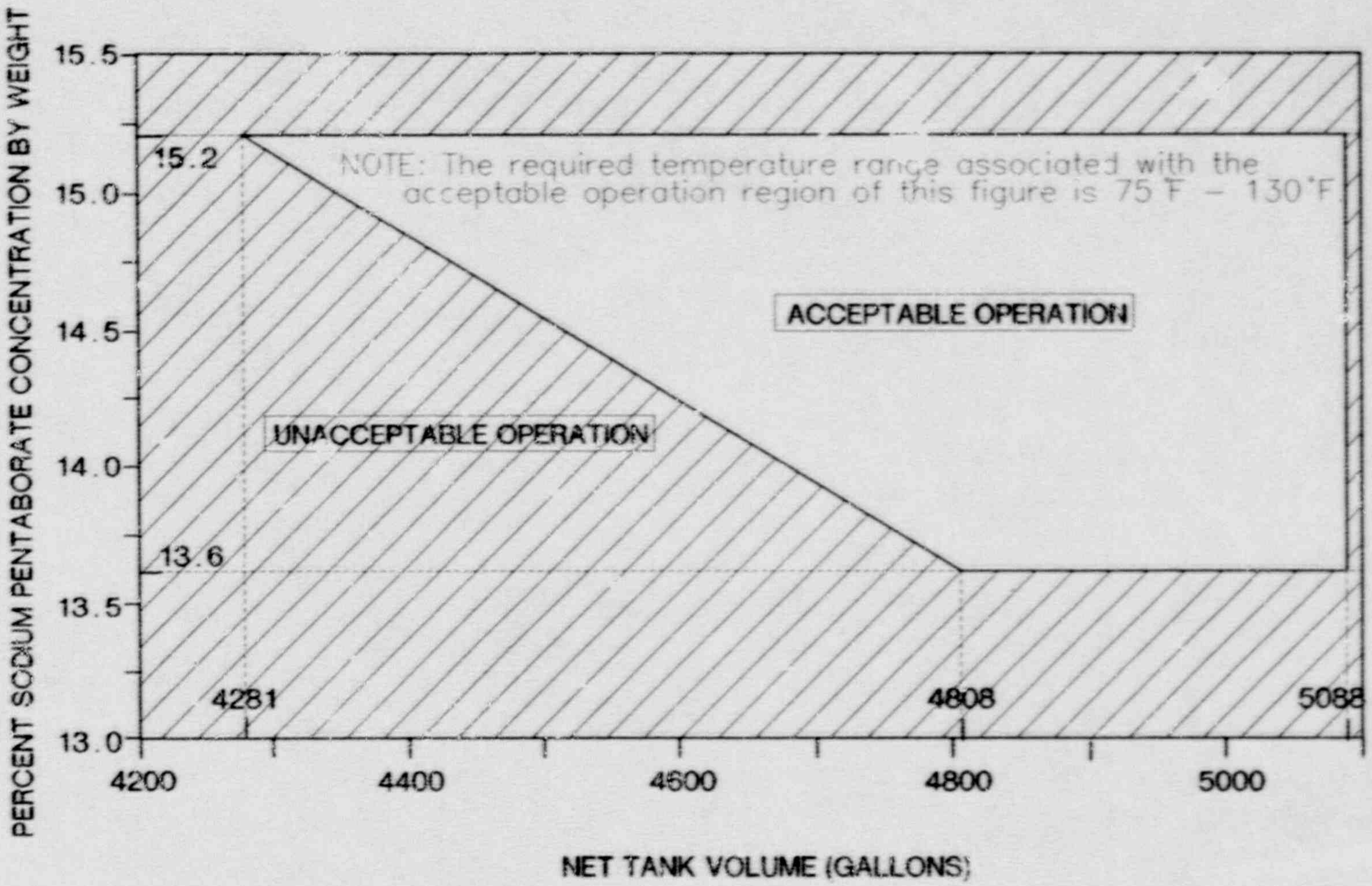

FIGURE 3.1.5-2

SODIUM PENTABORATE SOLUTION CONCENTRATION/AVAILABLE VOLUME REQUIREMENTS

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CONTROL ROD PROGRAM CONTROLS (Continued)

The RPCS provides automatic supervision to assure that out-of-sequence rods will not be withdrawn or inserted. A rod is out of sequence if it does not meet the criteria of the Banked Position Withdrawal Sequence as described in the FSAR. The RPCS function is allowed to be bypassed in the Rod Action Control System (RACS) if necessary, for example, to insert an inoperable control rod, return an out-of-sequence control rod to the proper in-sequence position or move an in-sequence control rod to another in-sequence position. The requirement that a second qualified individual verify such bypassing and positioning of control rods ensures that the bases for RPCS limitations are not exceeded. In addition, if THERMAL POWER is below the low power setpoint, additional restrictions are provided when bypassing control rods to ensure operation at all times within the basis of the control rod drop accident analysis.

The analysis of the rod drop accident is presented in Section 15.4 of the FSAR and the techniques of the analysis are presented in a topical report, Reference 1, and two supplements, References 2 and 3.

The RPCS is also designed to automatically prevent fuel damage in the event of erroneous rod withdrawal from locations of high power density during higher power operation.

A dual channel system is provided that, above the low power setpoint, restricts the withdrawal distances of all non-peripheral control rods. This restriction is greatest at highest power levels.

3/4.1.5 STANDBY LIQUID CONTROL SYSTEM

The standby liquid control system provides a backup capability for bringing the reactor from full power to a cold, xenon-free shutdown, assuming that the withdrawn control rods remain fixed in the rated power pattern. To meet this objective it is necessary to inject a quantity of boron which produces a concentration of 660 ppm in the reactor core in approximately 90 to 120 minutes. INSERT A ~~A minimum available quantity of 4630 gallons of sodium pentaborate solution containing a minimum of 5500 lbs. of sodium pentaborate is required to meet a shutdown requirement of 3%.~~ There is an additional allowance of 165 ppm in the reactor core to account for imperfect mixing and leakage. The time requirement was selected to override the reactivity insertion rate due to cooldown following the xenon poison peak and the required pumping rate is 41.2 gpm. The minimum storage volume of ~~the solution~~ is established to allow for the portion below the pump suction that cannot be inserted. INSERT B The temperature requirement is necessary to ensure that ~~the sodium pentaborate~~ Figure 3.1.5-2 remains in solution.

1. C. J. Paone, R. C. Stirn and J. A. Woolley, "Rod Drop Accident Analysis for Large BWR's," G. E. Topical Report NEDO-10527, March 1972

2. C. J. Paone, R. C. Stirn and R. M. Young, Supplement 1 to NEDO-10527, July 1972

3. J. M. Haun, C. J. Paone and R. C. Stirn, Addendum 2, "Exposed Cores," Supplement 2 to NEDO-10527, January 1973

INSERT A to Page B 3/4 1-4

To meet the 3% shutdown requirement, the minimum required solution concentration at the design volume of 4530 gallons is 14.4 weight percent. In order to establish this minimum concentration, it is necessary to have a minimum weight of 5803 pounds of sodium pentaborate.

INSERT B to Page B 3/4 1-4

The sodium pentaborate solution is required to be maintained above the minimum required concentration and below the maximum allowable concentration on Figure 3.1.5-2.

SERI RESPONSES TO THE JULY 21, 1989 AND
SEPTEMBER 29, 1989 NRC QUESTIONS

NRC Question No. 1

Will the tank overflow if the temperature increases from 75°F to 130°F?

SERI Response

The specific gravity of sodium pentaborate solution depends primarily on the solution concentration. Assume solution concentration is constant with respect to temperature and therefore, volumetric changes will be based on density changes of water with respect to temperature.

Tank ID = 108.0 in = 9.0 ft (Reference 1)

Tank volume per foot = 63.62 ft^3/ft = 475.8 gal/ft

High Alarm = 10'-9 7/8" = 10.82 ft = 688.6 ft^3 = 5151.1 gal*
(Reference 2)

The specific volume of water at 75°F, V_{75} = 0.01607 ft^3/lbm

The mass of water in the tank at the high level alarm at 75°F is:

$$\frac{(688.6\ ft^3)}{(0.01607\ ft^3/lbm)} = 42,850\ lbm$$

The specific volume of water at 130° is V_{130} = 0.01625 ft^3/lbm
(Reference 3)

The volume of 42,850 lbm of water at 130°F is:

$$(42,850\ lbm) \times (0.01625\ ft^3/lbm) = 696.3\ ft^3 = 5208.7\ gal$$

The volume increase is, therefore, 7.7 ft^3 or 57.6 gal

The level increase is 0.12 ft or about 1-1/2 inches

This corresponds to a level of 10.94 ft or 10'-11 3/8"

This level is 4 5/8" below the bottom of the tank overflow at 11'-4"

Therefore, as demonstrated by the results of the above calculation, the tank will not overflow if the temperature increases from 75°F to 130°F.

References:

1. GE Drawing 767E164 Rev. 7
2. Level Setting Diagram J-1603 Rev. 2
3. Thermodynamic Properties of Steam, Keenan and Keyes

* This volume is the total tank volume and includes the volume below instrument level zero at 6.125" above the tank bottom.

NRC Question No. 2

How is the SLCS suction piping temperature measured? How are the measurements recorded? If the temperature drops below 75°F, how do we assure that the solution hasn't solidified?

SERI Response

The heat tracing provided for the SLCS pump suction piping consists of two independent subsystems. Each subsystem is supplied power from an independent power source. The primary subsystem heat tapes energize when the piping temperature reaches 85°F, decreasing. The backup heat tapes energize when the piping temperature reaches 80°F, decreasing. Both heat trace subsystem control panels are provided with "Power Available" lights, and power indicating LEDs on each control module.

The SLCS suction piping temperature is currently measured with a handheld pyrometer at four locations once every 24 hours, in all OPERATIONAL CONDITIONS. The measurements are recorded in the operator daily logs. The power indicating lights for the heat tracing circuits and controllers are also currently checked once per 24 hours, in all OPERATIONAL CONDITIONS. The results of heat tracing checks are presently recorded on the auxiliary building rounds sheets. These will be moved to the operator daily logs (Technical Specification readings) upon approval of the proposed Specification.

Existing Technical Specification Surveillance 4.1.5.d.3 provides the corrective action required in the event the pump suction piping temperature drops below 75°F. This surveillance requires that all heat traced piping between the storage tank and the reactor vessel be verified unblocked by pumping from the storage tank to the test tank.

This surveillance frequency and corrective action are consistent with the SLCS surveillance requirements in the BWR Owners Group Improved BWR Technical Specifications (NEDC-31681).

NRC Question No. 3

Provide additional information on tank heater design and how it assures adequate mixing.

SERI Response

The SLCS storage tank uses an operating heater for maintaining the minimum required solution temperature (electric immersion type rated at 10 kw, 480 V, 3-phase, located approximately 8.9" above the tank bottom). In addition to the operating heater, a mixing heater is used for the initial mixing of the tank contents during chemical addition (electric immersion type rated at 40 kw, 480V, 3-phase, located approximately at tank azimuth 270 degrees and 8.1" above the tank bottom).

The operating heater is controlled automatically using a temperature indicating controller (TIC) with a temperature element (TE) located in a thermowell at approximately tank azimuth 330 degrees and 7.4" above the tank bottom. This instrumentation maintains the solution temperature between 85°F and 95°F. The TE location provides a conservative temperature measurement such that operation of the heater would not cause the TIC to short-cycle the heater. In addition to this instrumentation, a temperature switch (TS) is located in a thermowell immediately below the TE approximately 2.4" above the tank bottom. In conjunction with a remote trip unit, this TS provides a control room alarm if the tank solution temperature, measured at one of the coldest locations in the tank, falls to 80°F or lower.

The mixing heater is controlled manually using a local handswitch to aid in solution mixing during chemical addition. The electrical rating of this heater is sized to ensure complete dissolution and mixing of the sodium pentaborate solution. In addition to the mixing heater, the tank is provided with a sparger along the tank bottom for solution mixing using either air or makeup water as needed.