NPE-88/05

REACTIVITY CONTROL SYSTEMS

3/4.1.5 STANDBY LIQUID CONTROL SYSTEM

LIMITING CONDITION FOR OPERATION

3.1.5 Two standby liquid control system subsystems shall be OPERABLE.

APPLICABILITY: OPERATIONAL CONDITIONS 1, 2 and 5*.

ACTION:

a. In OPERATIONAL CONDITION 1 or 2:

except for the condition covered in ACTION a.3,

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.

INSERT A

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.

SURVEILLANCE REQUIREMENTS

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

a. At least once per 24 hours by verifying that;

INSERT B

1. The temperature of the sodium pentaborate solution is ~~within the limits of figure 3.1.5-1.~~

INSERT C

2. The available volume of sodium pentaborate solution is ~~greater than or equal to 4530 gallons.~~

INSERT D

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.~~

INSERT B

*With any control rod withdrawn.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

INSERT A Page 3/4 1-18

3. 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 normal operation limits of Figures 3.1.5-1 and 3.1.5-2 within 72 hours. Otherwise, declare both standby liquid control system subsystems inoperable and be in at least HOT SHUTDOWN within the next 12 hours.

INSERT B Page 3/4 1-18

greater than or equal to 75°F and less than or equal to 130°F.

INSERT C Page 3/4 1-18

within the limits of Figure 3.1.5-2.

INSERT D Page 3/4 1-18

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

NPE-88/05

REACTIVITY CONTROL SYSTEMS

SURVEILLANCE REQUIREMENTS (Continued)

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 5800 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.

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.

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.

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.

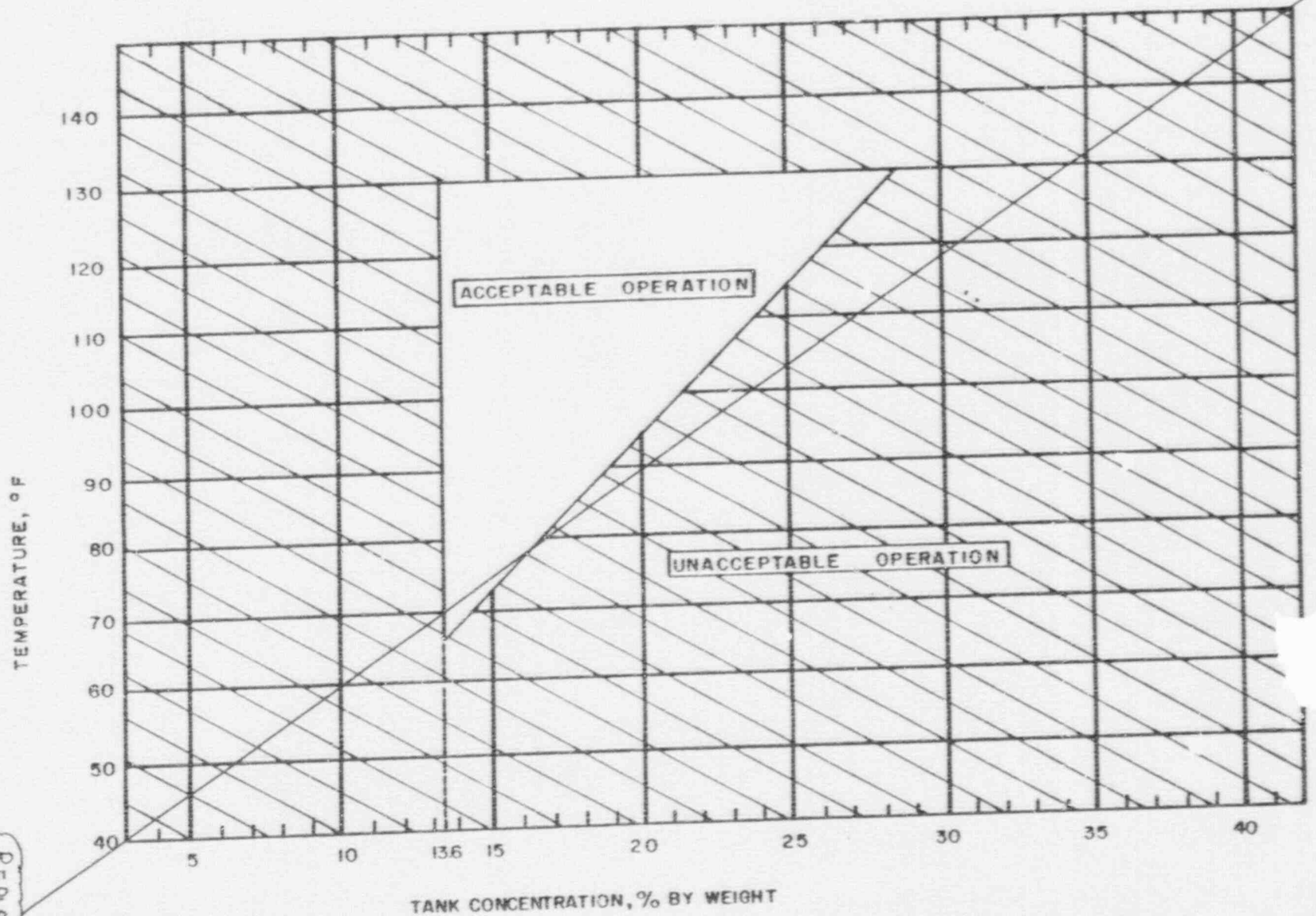
---

*This test shall also be performed anytime water or boron is added to the solution or when the solution temperature drops below ~~the limit of Figure 3.1.5-1.~~ the suction piping temperature is 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.

below 75°F

NPE-88/05



REPLACE ENTIRE FIGURE

FIGURE 3.1.5-1 SODIUM PENTABORATE SOLUTION TEMPERATURE/CONCENTRATION REQUIREMENTS

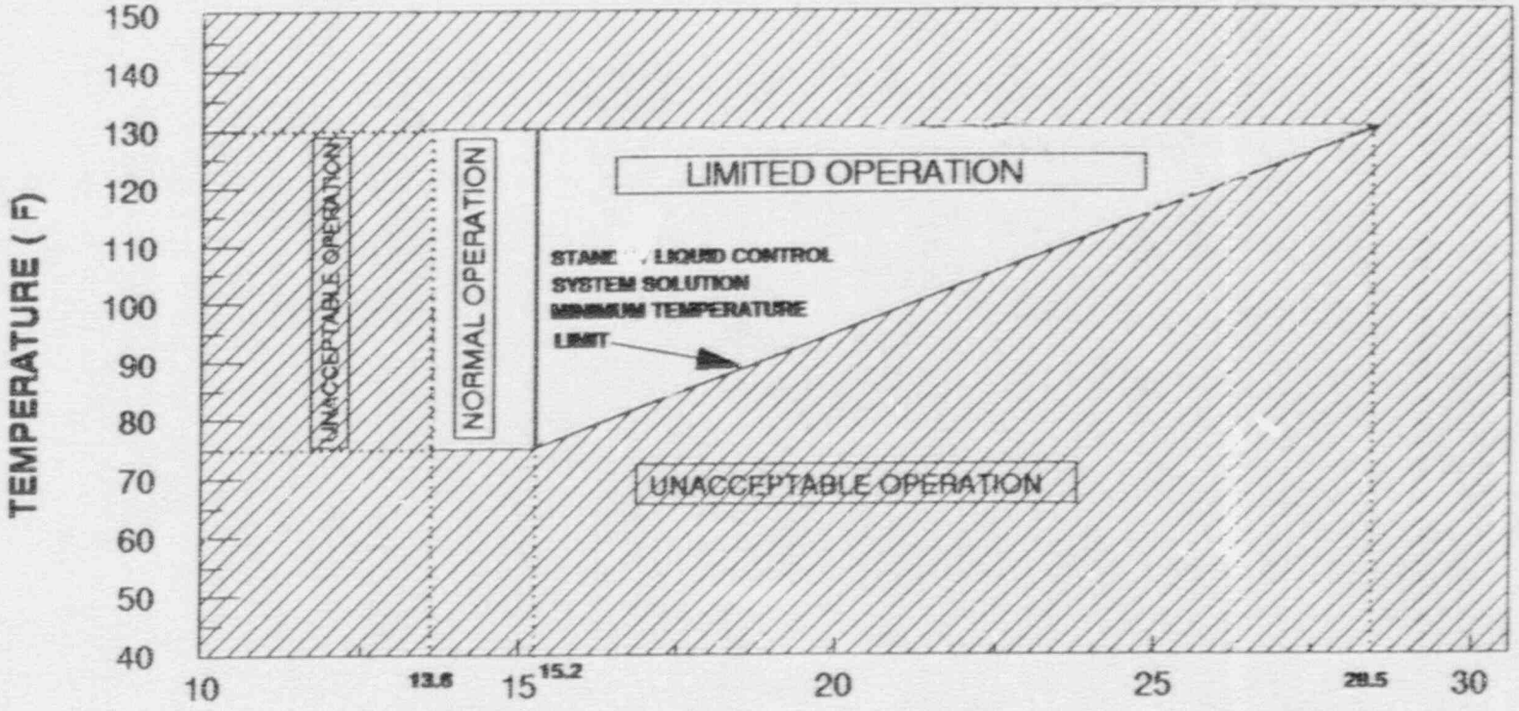


FIGURE 3.1.5-1

SODIUM PENTABORATE SOLUTION TEMPERATURE/CONCENTRATION REQUIREMENTS

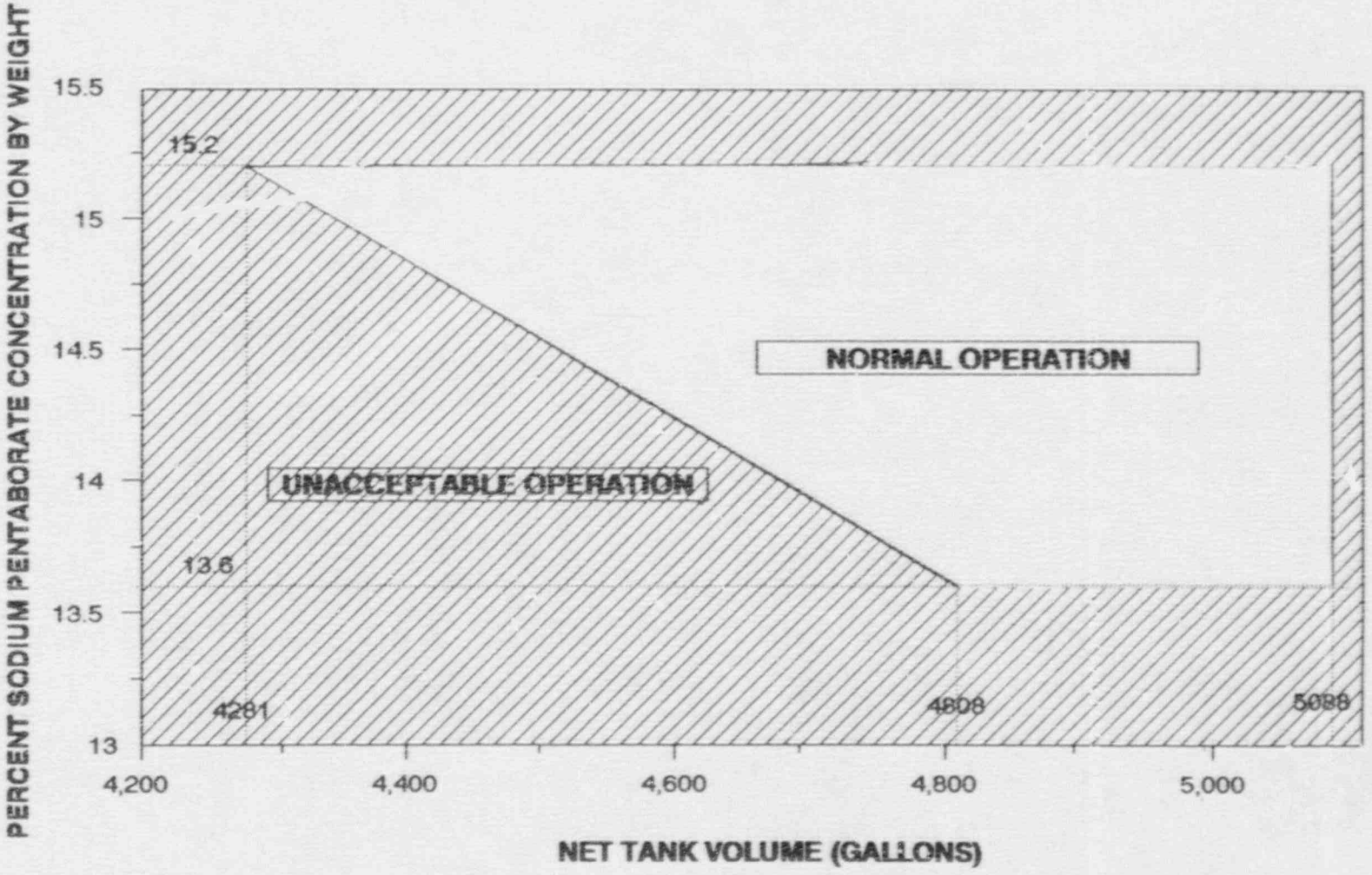


FIGURE 3.1.5-2

SODIUM PENTABORATE SOLUTION CONCENTRATION/AVAILABLE VOLUME REQUIREMENTS

BASES

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 (Reference 1) 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 baseline analysis of the rod drop accident is presented in Section 15.4 of the FSAR and the techniques of the analysis are presented in Reference 1. Analyses applicable to the current cycle are addressed in the appropriate cycle-specific documentation.

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

INSERT A

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. ~~A minimum available quantity of 4630 gallons of sodium pentaborate solution containing a minimum of 5800 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. The temperature requirement is necessary to ensure that the sodium pentaborate remains in solution.

INSERT B

INSERT C

1. C.J. Paone, "Banked Position Withdrawal Sequence," GE Topical Report, NEDO-21231, January 1977.

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.

INSERT C to Page B 3/4 1-4

The sodium pentaborate solution volumes specified in ACTION a.3 and Figure 3.1.5-2 are based on a 90°F nominal sodium pentaborate solution temperature.

STANDBY LIQUID CONTROL SYSTEM (Continued)

With redundant pumps and explosive injection valves and with a highly reliable control rod scram system, operation of the reactor is permitted to continue for short periods of time with the system inoperable or for longer periods of time with one of the redundant components inoperable.

Relief valves are provided on the SLCS pump discharge piping to protect the SLCS pump and piping from overpressure conditions. Testing of the relief valve setpoint and verifying that the relief valve does not open during steady state operation of the SLCS pumps demonstrates OPERABILITY of the relief valve. The relief valves are ASME Class 2 valves and, as such, have a ± 3% tolerance in the opening pressure from the set pressure, per the ASME Code (Section III - Division 1 Subsection NC-7614.2(b), 1974 Edition).

Surveillance requirements are established on a frequency that assures a high reliability of the system. Once the solution is established, boron concentration will not vary unless more boron or water is added, thus a check on the temperature and volume once each 24 hours assures that the solution is available for use. INSERT A

Replacement of the explosive charges in the valves at regular intervals will assure that these valves will not fail because of deterioration of the charges.

Compliance with the NRC ATWS Rule 10CFR50.62 has been demonstrated by means of the equivalent control capacity concept using the plant specific minimum parameters. This concept requires that each boiling water reactor must have a standby liquid control system with a minimum flow capacity and boron content equivalent in control capacity to 86 gpm for 13% weight sodium pentaborate solution (natural boron enrichment) used for the 251-inch diameter reactor vessel studied in NEDE-24222, Reference 2. The described minimum system parameters (82.4 gpm, 13.6% weight with natural boron enrichment) provides an equivalent control capacity to the 10CFR 50.62 requirement. The techniques of the analysis are presented in a licensing topical report NEDE-31096-P, Reference 3.

Only one subsystem is needed to fulfill the system design basis, and two subsystems are needed to fulfill ATWS rule requirements. An SLCS subsystem consists of the storage tank, one divisional pump, explosive type valve, and associated controls, and other valves, piping, instrumentation, and controls necessary to prepare and inject neutron absorbing solution into the reactor.

---

2. "Assessment of BWR Mitigation of ATWS, Volume II," NEDE-24222, December 1979.

3. L. B. Claasen et al., "Anticipated Transients Without Scram, Response to NRC ATWS Rule 10CFR50.62," G. E. Licensing Topical Report prepared for the BWR Owners' Group, NEDE-31096-P, December 1985.

INSERT A to Page B 3/4 1-4a

Temperature surveillance requirements are established on a frequency that assures a high probability that the solution temperature remains above the saturation temperature as illustrated by Figure 3.1.5-1. More frequent surveillance is required when operating in the "Limited Operation" region of Figure 3.1.5-1 because of decreased margin to saturation.