Progress Energy

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SERIAL: BSEP 03-0035
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U.S. Nuclear Regulatory Commission
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Washington, DC 20555-0001

BRUNSWICK STEAM ELECTRIC PLANT, UNIT NOS. 1 AND 2
DOCKET NOS. 50-325 AND 50-324/LICENSE NOS. DPR-71 AND DPR-62
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION REGARDING TECHNICAL SPECIFICATION 3.1.7, "STANDBY LIQUID CONTROL SYSTEM" SODIUM PENTABORATE SOLUTION REQUIREMENTS
(NRC TAC NOS. MB5680 AND MB5681)

Ladies and Gentlemen:

On July 24, 2002 (i.e., Serial: BSEP 02-0124), Progress Energy Carolinas, Inc. requested a revision to the Technical Specifications for the Brunswick Steam Electric Plant (BSEP), Unit Nos. 1 and 2. The proposed license amendments revise Technical Specification Section 3.1.7, "Standby Liquid Control (SLC) System," to reflect modifications being made to the system as a result of transition to the GE14 fuel design. To support this transition, the required in-vessel boron concentration, supplied by the SLC system, is being raised from 660 ppm natural boron to a concentration equivalent to 720 ppm natural boron. This will be accomplished by use of sodium pentaborate solution enriched with the Boron-10 isotope. On February 4, 2003, the NRC provided an electronic version of a request for additional information (RAI) concerning the SLC amendment request. The response to this RAI is included in Enclosure 1.

Enclosure 2 contains updated typed technical specification pages associated with this amendment request. An editorial change has been made to the label of the x-axis in Figure 3.1.7-1, "Sodium Pentaborate Solution Volume Versus Concentration Requirements," for each unit. The figure submitted in BSEP 02-0124 labeled the x-axis as "Gross Volume of Solution In Tank." The enclosed figures correctly label the x-axis as "Net Volume of Solution In Tank." Progress Energy Carolinas, Inc. has determined that this correction does not affect the bases for concluding that the proposed amendments do not involve a Significant Hazards Consideration. As such, the 10 CFR 50.92 Evaluation, provided in the July 24, 2002, submittal and published in the Federal Register (i.e., 67 FR 53984, dated August 20, 2002) remains valid.

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Please refer any questions regarding this submittal to Mr. Edward T. O'Neil, Manager - Support Services, at (910) 457-3512.

Sincerely,

John S. Keenan

John S. Keenan

MAT/mat

Enclosures:

1. Response to Request for Additional Information
2. Typed Technical Specification Pages – Units 1 and 2

John S. Keenan, having been first duly sworn, did depose and say that the information contained herein is true and correct to the best of his information, knowledge and belief; and the sources of his information are officers, employees, and agents of Carolina Power & Light Company.

Dean S. Mason

Notary (Seal)

My commission expires: August 29, 2004

cc:

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Response to Request for Additional Information

Background

On July 24, 2002 (i.e., Serial: BSEP 02-0124), Progress Energy Carolinas, Inc. requested a revision to the Technical Specifications (TSs) for the Brunswick Steam Electric Plant (BSEP), Unit Nos. 1 and 2. The proposed license amendments revise Technical Specification Section 3.1.7, "Standby Liquid Control (SLC) System," to reflect modifications being made to the system as a result of transition to the GE14 fuel design. To support this transition, the required in-vessel boron concentration, supplied by the SLC system, is being raised from 660 ppm natural boron to a concentration equivalent to 720 ppm natural boron. This will be accomplished by use of sodium pentaborate solution enriched with the Boron-10 isotope. On February 4, 2003, the NRC provided an electronic version of a request for additional information (RAI) concerning the SLC amendment request. The response to this RAI follows.

NRC Question 1a

The ATWS equivalency equation is based on the SLC pumps' design flow rate. The amendment request cites NEDE-31096-P-A, which states that the use of the design flow rate is more reasonable than the TS minimum flow rate. However, the ability of the SLC pumps to achieve the TS minimum flow rate is verified during performance of SR 3.1.7.6.

Please, state if according to your SR testing, the BSEP pumps can achieve the design flow rate of 43 gpm as oppose to 41.2 gpm specified in the TS.

Response to NRC Question 1a

Topical Report NEDE-31096-P-A, "Anticipated Transients Without Scram, Response to NRC ATWS Rule, 10 CFR 50.62," page 1-7 states:

> . . . the use of the design flow rate (as verified by vendor test) is more reasonable for calculation purposes than using a Technical Specification minimum value that may be several gpm lower than the design value.

Historical vendor test data sheets documented 43 gpm as the flow rate for the SLC pumps at six different test pressures. All design information for the SLC pumps shows that they are rated at 43 gpm. Recent test data for surveillances was also reviewed. When corrected for actual fluid density and conservatively adjusted for possible instrument uncertainty, all four SLC pumps are currently delivering greater than 43.5 gpm. Surveillance Requirement (SR) 3.1.7.6 is a practical demonstration of pump performance. Due to variations in SLC solution density during testing, the indicated flow may be less than actual flow by 1 to 2 gpm with the current configuration.

NRC Question 1b

State if BSEP will satisfy the equivalency equation, using the TS flow rate of 41.2. State if BSEP will meet the equivalency equation if two SLC pumps are injecting.

Response to NRC Question 1b

In response to 10 CFR 50.62, Progress Energy Carolinas, Inc. modified the BSEP SLC system to operate both SLC pumps simultaneously. The proposed amendment does not alter the two pump operation of the SLC system and BSEP will take no action that prevents operation of both pumps. With two SLC pumps injecting, the system flow rate will greatly exceed the 43 gpm required to meet the equivalency equation.

The use of sodium pentaborate enriched with the Boron-10 isotope will allow the BSEP Probabilistic Safety Assessment (PSA) success criteria for meeting Anticipated Transients Without Scram (ATWS) requirements to be revised from the current two SLC pump/squib valve criteria to a single SLC pump/squib valve criteria. Since ATWS requirements, as described in NEDE-31096-P-A, specify use of the pump design values, the 43 gpm flow rate was used in the equivalency equation. If a 41.2 gpm flow rate for one pump operation is used, equivalency is not met.

NRC Question 1c

Explain what other actions can be taken to meet the equivalency equation using the TS SLC pump flow rate. Is it feasible to increase the Boron-10 enrichment above 47% atom percent or the concentration in order to meet the equivalency equation using the TS flow rate.

Response to NRC Question 1c

Progress Energy Carolinas, Inc. believes that the amendment, as proposed, ensures that the equivalency equation is met. As stated above, the BSEP SLC system operates both SLC pumps simultaneously to satisfy 10 CFR 50.62 requirements.

The 47% enrichment was selected to satisfy 10 CFR 50.62 requirements. The 8.5% minimum allowed concentration was selected to eliminate reliance on piping heat trace equipment. The response to NRC Question 2 provides additional details regarding the scope of planned modifications. Increasing the minimum concentration to 9.0% would either: (1) reduce the concentration operating range of 2%, which is considered to be the minimum practical operating band, or (2) increase the maximum allowed concentration to 11%. Increasing the maximum concentration from 10.5% to 11% would increase the associated temperature requirement from 51 °F to 54 °F. With a minimum historical area temperature of 57 °F, the reduction in margin for temperature concerns would be undesirable.

NRC Question 1d

State if the BSEP equivalency determination is currently based on design flow rates or total SLC flow rate based on the actual TS values.

Response to NRC Question 1d

The current BSEP equivalency determination is based on two pumps operating to ensure 66 gpm, total flow. This was established in NEDC-30858, "Brunswick Units 1 & 2 ATWS Assessment," December 1984. The 66 gpm total flow requirement is based on comparing the reference mass of water of 628,262 pounds, under normal conditions, for the 251-inch diameter reference plant to 485,468 pounds of water for BSEP, a 218-inch diameter plant. This report compared the 66 gpm requirement to the 86 gpm design capacity of both pumps operating together. The current BSEP equivalency determination in NEDC-30858 is not based on the 41.2 gpm per pump Technical Specification SR.

NRC Question 2

State if other changes (e.g. configuration, SLC relief valve upgrade) would be performed on the SLC system? The revised Figure 3.1.7-2 indicates the minimum required boron solution temperature changes from approximately 65 F to 35 F. Therefore, state if CP&L plans to remove the heat tracing?

Response to NRC Question 2

The following constitute the primary, non-Technical Specification changes being made to the SLC system as a result of the planned modification.

1. The SLC system piping heat tracing is being removed as a result of the planned modification. SLC system piping heat tracing was installed to allow higher boron solution concentrations to be used without any crystallization problems. However, maintaining heat trace for the duration of the winter months requires a significant effort. It also relies on the active protection provided by thermostats and the passive protection provided by insulated pipes. Eliminating reliance on piping heat trace is a significant reliability improvement for the SLC system.

   The local thermocouples used for piping temperature verifications will not be removed and the existing Technical Specification surveillances associated with piping temperature verifications are maintained. The temperature requirements will be based on the actual solution chemical concentration and will range from 35 °F to 51 °F. Although building temperatures below 57 °F are not expected, BSEP has administrative provisions for placing temporary area heaters in service if needed. Also, tank concentration can be easily reduced by adding water to the tank. These provisions ensure that the SLC system can be maintained operable even if building temperatures drop lower than expected.

2. The SLC pump discharge relief valves are being replaced and the setpoint increased by 50 psig. The new relief valves were selected to improve reliability with respect to Inservice Testing (IST) setpoint verifications. The setpoint change improves margins and is being implemented in response to NRC Information Notice 2001-13, "Inadequate Standby Liquid Control System Relief Valve Margin."

3. The SLC system test provisions are being improved. Test connections are being added. These changes will reduce the amount of surplus solution that is removed from the storage tank and discarded during testing. These new provisions have no impact on design basis operation of the system or effectiveness of surveillances.

4. Instrumentation is being recalibrated to reflect the new solution density, the new tank level requirements, and a reduction in the standby tank temperature requirements.

NRC Question 3

The amendment request states that the 720 ppm is based on GE14 equilibrium core calculation. Although the BSEP Units are transitioning to GE14 fuel, there are GE13 fuel loaded in the core and operating at higher power. Explain why the GE14 equilibrium core calculations bounds cold shutdown concentration based on core-specific (GE13 and GE14 at uprated power level) configuration and conditions. Explain if GE13 equilibrium core calculations based on the uprated conditions were performed and will be bounded by the GE14 core calculations.

Response to NRC Question 3

The 720 ppm boron concentration is calculated to ensure cold shutdown following an ATWS. It provides for adequate shutdown with an equilibrium core of GE14 fuel, allowing some additional margin to provide for actual variations in future reload designs. Power uprate calculations using an equilibrium core of GE13 fuel are not useful, because they would not bound the BSEP cores, as designed, containing GE14 fuel. The required cold shutdown concentration is directly proportional to the reactivity of the core. The GE14 fuel bundle design contains significantly more uranium than the GE13 design and tends to be more reactive than the GE13 design (i.e., at similar enrichments) at cold conditions. The increasing core fraction of GE14 fuel is the driving force to increase the cold shutdown boron concentration from 660 ppm to 720 ppm. Therefore, an equilibrium core of GE14 fuel is more limiting than a partial core of GE14 fuel. The reload design process calculates, for each specific reload core design, and documents in Section 5 of the Supplemental Reload Licensing Report, the shutdown margin for the core as designed with the assumed boron concentration (e.g., 660 ppm or 720 ppm). Thus, the bounding nature of the equilibrium GE14 core assumption in the power uprate calculations is confirmed for the actual core designs prior to refueling.

NRC Question 4

The amendment states that the current cold shutdown concentration is expected to remain bounding for the up coming cycles and for currently planned future core designs. CP&L submitted amendment requesting operation at the higher MELLLA+ rod line. Explain, if CP&L performed preliminary calculations to determine if the required cold shutdown ppm may change, based on the MELLLA+ core design changes (e.g. higher enrichment, more high powered bundles etc.).

Response to NRC Question 4

The core shutdown requirements for upcoming cycles (i.e., including Maximum Extended Load Line Limit Analysis Plus (MELLLA+) cores) could be met with a value above 660 ppm but below the 720 ppm. The 720 ppm value was selected to maintain sufficient margin such that no future Technical Specification changes are expected.

NRC Question 5

The BSEP ATWS analysis-of-record assumed the hot shutdown boron concentration would be injected at specified time. In general, GE uses a generic HSBC and determines when the reactor will reach the HSBC. The staff would like to discuss the assumptions made in the BSEP ATWS analysis of-record (revisit some issues discussed previously in audit and BSEP EPU RAI 5-11) and the ATWS mitigation strategy as defined in the BSEP ATWS EOPs. Please, provide the BSEP ATWS EOP Sections or contingency that address HSBC, and the ATWS mitigation strategies.

Response to NRC Question 5

The Emergency Operating Procedures (EOPs) for BSEP Unit 1 and 2 have been developed consistent with Boiling Water Reactor (BWR) Emergency Procedure Guidelines (i.e., Boiling Water Reactor Owners' Group NEDO-31331). The BSEP EOPs include the following Operator actions as part of its ATWS control strategy:

a. Terminate feedwater flow,

b. Initiate the SLC system,

c. Start the Residual Heat Removal (RHR) system in the pool cooling mode,

d. Maintain reactor pressure vessel (RPV) water level above Minimum Steam Cooling Water Level and two feet below the feedwater spargers.

An NRC Safety Evaluation Report, dated June 6, 1996, for the proposed modifications to the BWR Emergency Procedure Guidelines, Revision 4, concluded that it is acceptable to control water level between Minimum Steam Cooling Water Level and two feet below the feedwater spargers. This mitigation strategy has been incorporated into the BSEP Unit 1 and 2 EOPs.

The instability event for BSEP remains consistent with currently evaluated conditions, since the BSEP response to the key driving parameters is similar, and plant operating conditions are not significantly affected by this modification. Therefore, the mitigation actions, i.e., reducing of water level and injecting of boron, are also evaluated for conditions which are acceptable as compared to the generic ATWS instability mitigation analysis in NEDO-32164, "Mitigation of BWR Core Thermal-Hydraulic Instabilities in ATWS."

The only effect the proposed SLC modification has on the response to an ATWS is a change in the timing for injection of Hot Shutdown Boron Concentration (HSBC). The start timing of SLC initiation is unchanged. Prior to the modification, HSBC is achieved approximately 20 minutes after injection starts. If the actual 86 gpm flow is assumed, the injection requires only 15 minutes. After the modification, HSBC will be achieved in approximately 20 minutes assuming 43 gpm injection from one SLC pump or in approximately 10 minutes assuming 86 gpm injection from both SLC pumps.

The BSEP ATWS analysis of record demonstrates that the time for HSBC injection is not excessive based on maintaining the peak suppression pool temperature less than or equal to 207.7 °F (i.e., the calculated peak suppression pool temperature for a design basis loss-of-coolant accident). For the limiting ATWS event (i.e., Main Steam Isolation Valve closure), the results were found to have substantial margin, with a peak suppression pool temperature of 195.5 °F under extended power uprate conditions and 197.5 °F under MELLLA+ conditions. Evaluations performed in support of MELLLA+ demonstrate that the suppression pool heatup rate, prior to reaching HSBC, is slightly less than 2 °F/minute. Based on the existing temperature margin of 10.2 °F (i.e., 207.7 °F – 197.5 °F = 10.2 °F) and heatup rate of 2 °F/minute, it is concluded that an additional 5 minutes of injection to reach HSBC would be acceptable. A SLC injection rate of only 35 gpm is required to achieve HSBC in 25 minutes (i.e., a 5 minutes increase from 20 minutes). Since a single SLC pump has a 43 gpm design flow rate, substantial margin remains with respect to the HSBC injection time.

NRC Question 6

Discuss the impact of the proposed SLC modifications on Net Positive Suction Head (NPSH) and vortexing.

Response to NRC Question 6

The proposed SLC system modification results in a slight improvement in available NPSH margin and has no impact on the potential for vortexing.

When used for injection, SLC will be operated until solution level reaches 0% indicated or tank zero which is at approximately the same elevation as the pump suction. Therefore, atmospheric pressure (i.e., P_a = 14.7 psi) provides the positive contribution to the available NPSH (NPSHA) with no credit for any static head (i.e., $h_s = 0$). The terms that reduce NPSHA are fluid absolute vapor pressure, P_v, piping friction losses, h_f, and pump acceleration head, h_a. The modification will reduce the fluid specific gravity from a limiting value of 1.08 down to a limiting value of 1.05. Reducing the specific gravity does not reduce h_s since it is assumed to be zero. Reducing the specific gravity reduces the acceleration head term, h_a, by 0.2 psi at the limiting conditions. No other terms are affected. The end result of the modification is that NPSHA is improved from 5.8 to 6.0 psi where the required NPSH is 4.0 psi.

As discussed above, when used for injection, SLC will be operated until level reaches 0% indicated or tank zero. The modification does not affect the level at which pump operation is secured. Therefore, the modification does not affect the potential for vortexing. However, the potential for vortexing at this elevation was considered. Tank zero is approximately 1 inch above the top of the flush mounted suction nozzle located on the side of the tank. Based on industry papers and site review, this is adequate to preclude air entrainment.

Typed Technical Specification Pages – Units 1 and 2

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.1.7.2	Verify temperature of sodium pentaborate solution is within the limits of Figure 3.1.7-2.	24 hours
SR 3.1.7.3	Verify temperature of pump suction and discharge piping up to the SLC injection valves is within the limits of Figure 3.1.7-2.	24 hours
SR 3.1.7.4	Verify continuity of explosive charge.	31 days
SR 3.1.7.5	Verify the concentration of boron in solution is within the limits of Figure 3.1.7-1.	31 days AND Once within 24 hours after water or boron is added to solution AND Once within 24 hours after solution temperature is restored within the limits of Figure 3.1.7-2

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.1.7.6	Verify each pump develops a flow rate ≥ 41.2 gpm at a discharge pressure ≥ 1190 psig.	In accordance with the Inservice Testing Program
SR 3.1.7.7	Verify flow through one SLC subsystem from pump into reactor pressure vessel.	24 months on a STAGGERED TEST BASIS
SR 3.1.7.8	Verify sodium pentaborate enrichment is ≥ 47 atom percent B-10.	Prior to addition to SLC tank

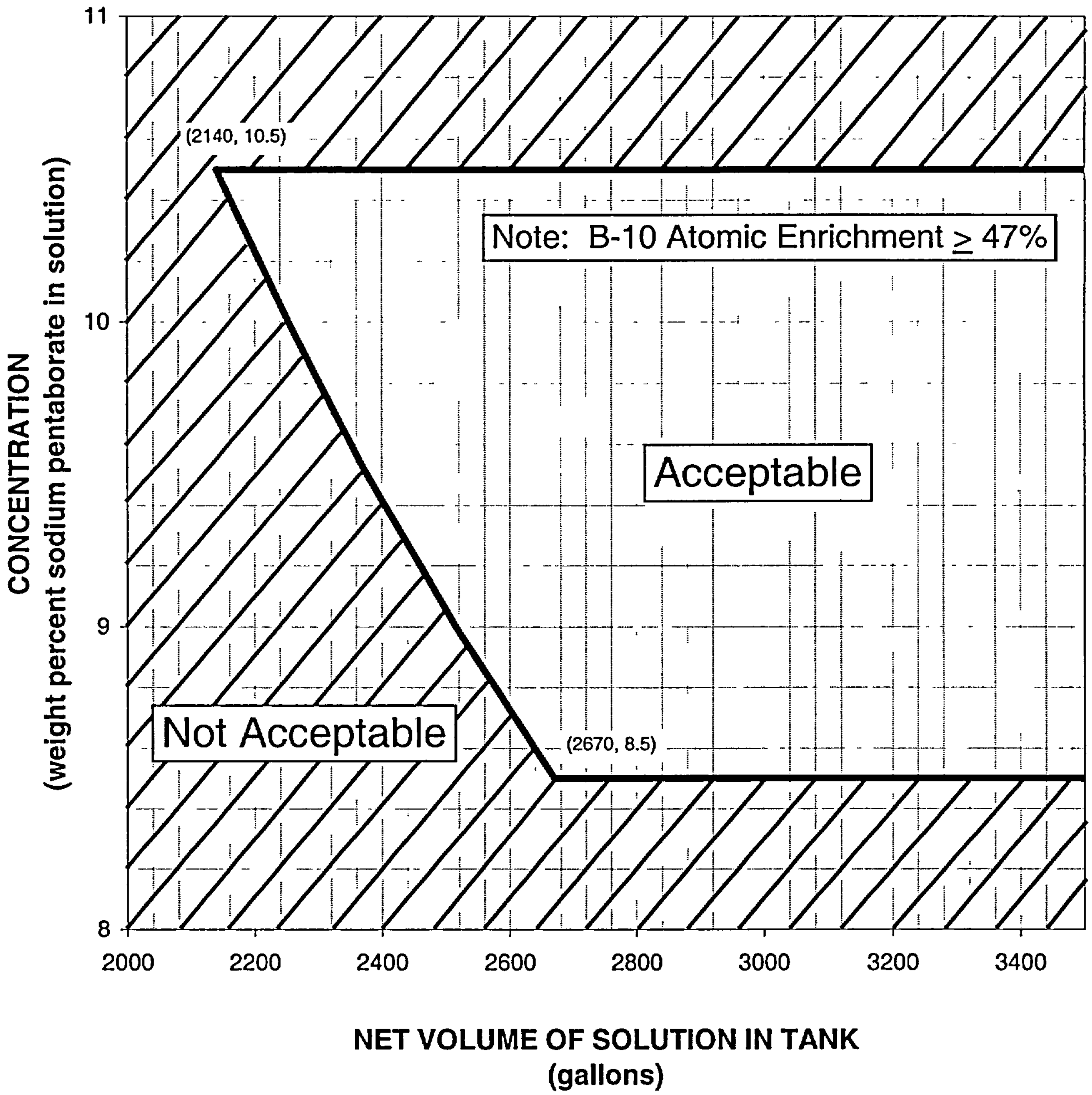

Figure 3.1.7-1 (page 1 of 1)
Sodium Pentaborate Solution Volume
Versus Concentration Requirements

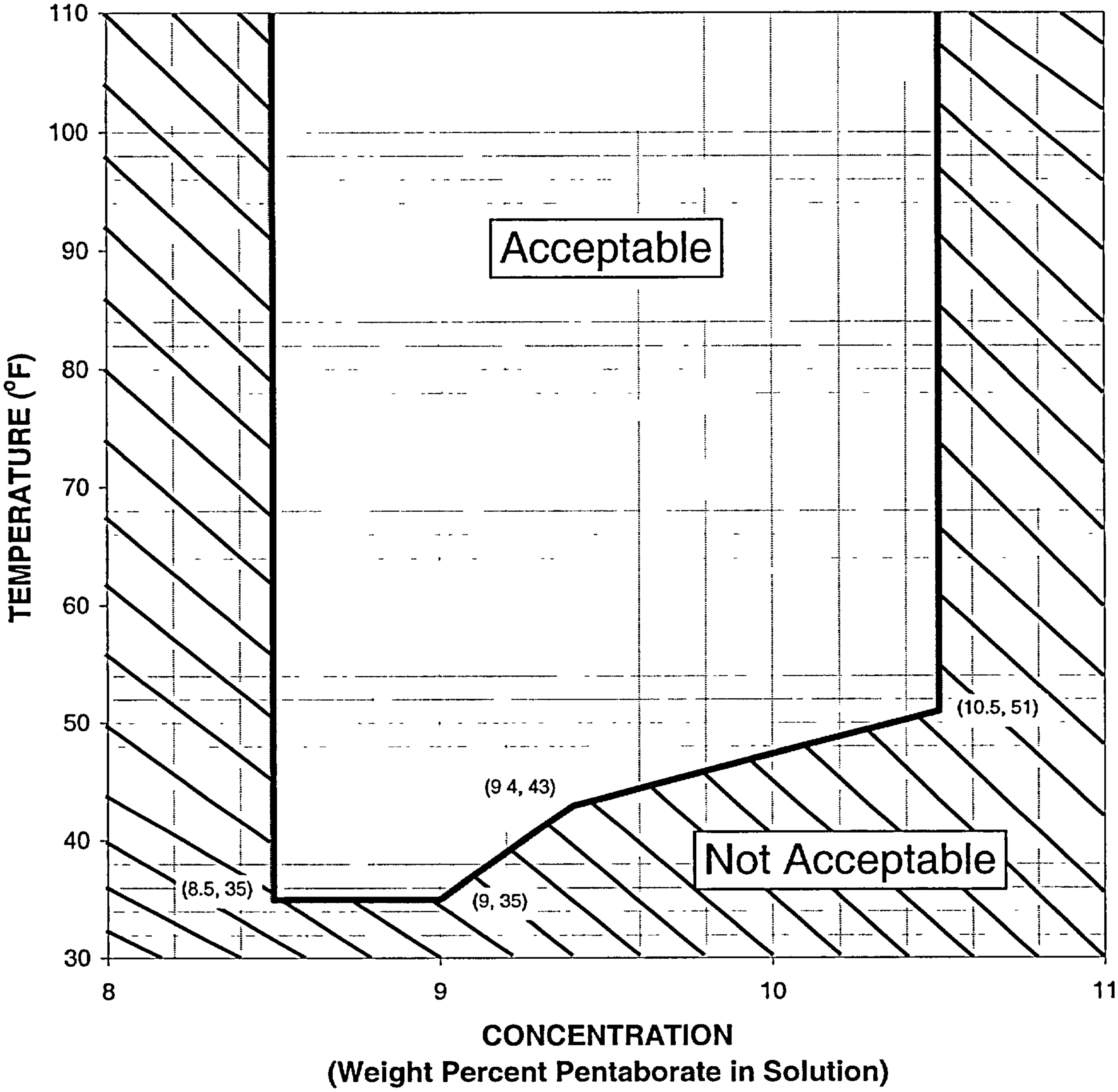

Figure 3.1.7-2 (page 1 of 1)
Sodium Pentaborate Solution Temperature
Versus Concentration Requirements

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.1.7.2	Verify temperature of sodium pentaborate solution is within the limits of Figure 3.1.7-2.	24 hours
SR 3.1.7.3	Verify temperature of pump suction and discharge piping up to the SLC injection valves is within the limits of Figure 3.1.7-2.	24 hours
SR 3.1.7.4	Verify continuity of explosive charge.	31 days
SR 3.1.7.5	Verify the concentration of boron in solution is within the limits of Figure 3.1.7-1.	31 days AND Once within 24 hours after water or boron is added to solution AND Once within 24 hours after solution temperature is restored within the limits of Figure 3.1.7-2

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.1.7.6	Verify each pump develops a flow rate $\geq$ 41.2 gpm at a discharge pressure $\geq$ 1190 psig.	In accordance with the Inservice Testing Program
SR 3.1.7.7	Verify flow through one SLC subsystem from pump into reactor pressure vessel.	24 months on a STAGGERED TEST BASIS
SR 3.1.7.8	Verify sodium pentaborate enrichment is $\geq$ 47 atom percent B-10.	Prior to addition to SLC tank

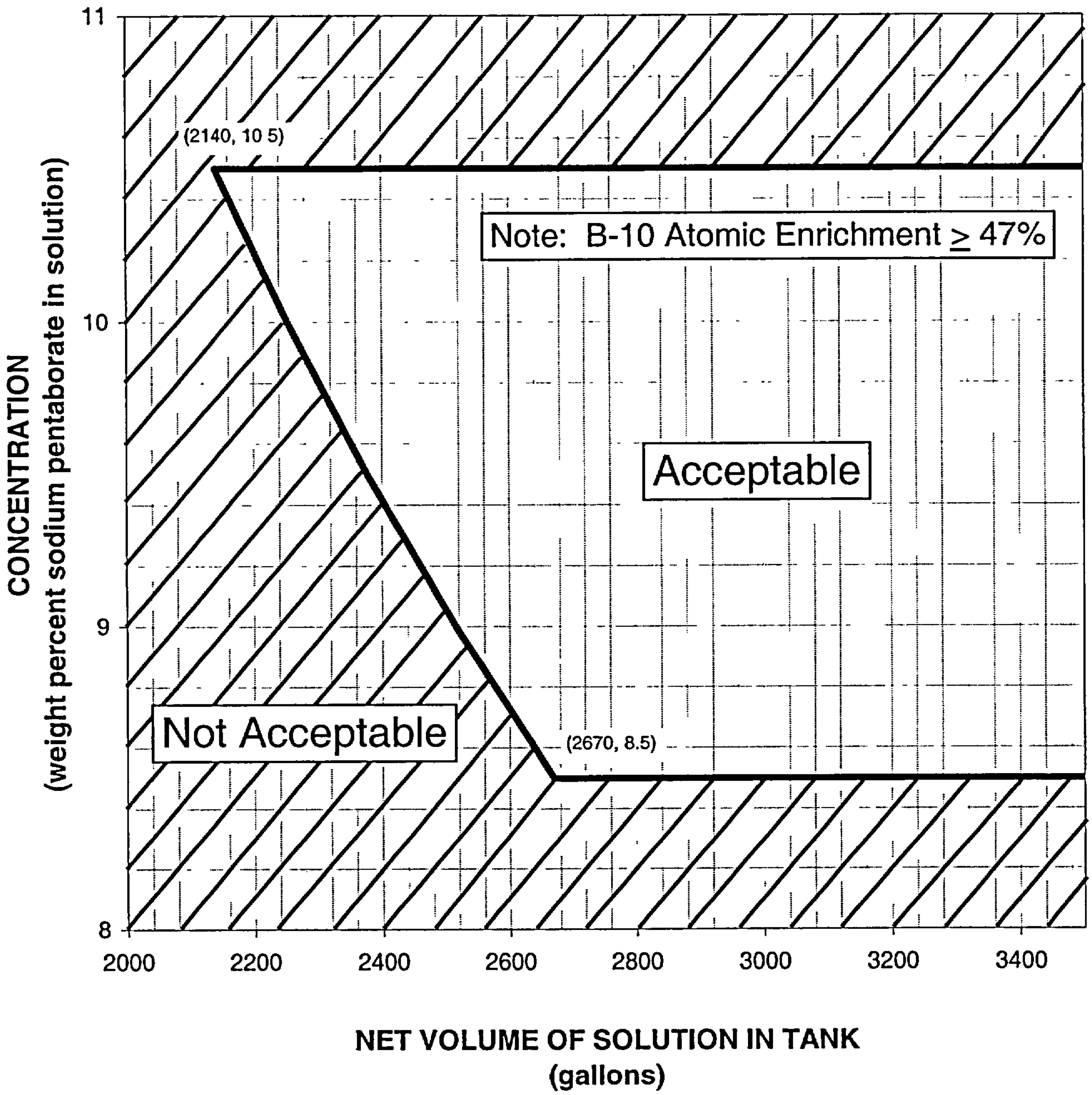

Figure 3.1.7-1 (page 1 of 1)
Sodium Pentaborate Solution Volume
Versus Concentration Requirements

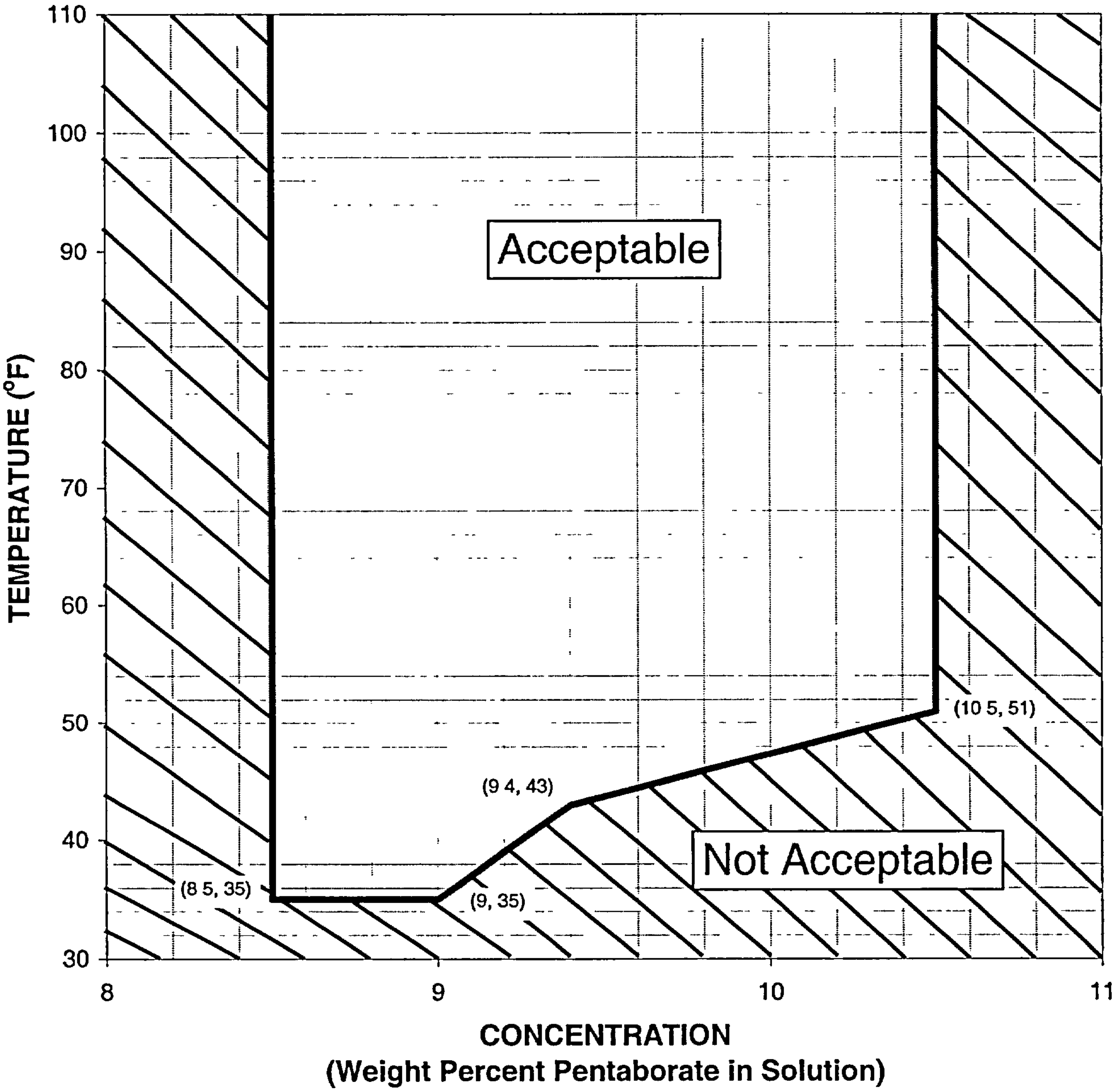

Figure 3.1.7-2 (page 1 of 1)
Sodium Pentaborate Solution Temperature
Versus Concentration Requirements