LIST OF FIGURES

Amendment No. 14, 22, 43, 64, 72, 74, 88, 98, 113

3.4 LIMITING CONDITIONS FOR OPERATION

3.4 STANDBY LIQUID CONTROL SYSTEM

Applicability:

Applies to the operating status of the Standby Liquid Control System.

Objective:

To assure the availability of a system with the capability to shut down the reactor and maintain the shutdown condition without control rods.

Specifications

A. Normal Operation

During periods when fuel is in the reactor and prior to startup from a cold condition, the Standby Liquid Control System shall be operable except as specified in 3.4.B below. This system need not be operable when the reactor is in the cold condition, all rods are fully inserted and Specification 3.3.A is met.

4.4 SURVEILLANCE REQUIREMENTS

4.4 STANDBY LIQUID CONTROL SYSTEM

Applicability:

Applies to the periodic testing requirements for the Standby Liquid Control System.

Objective

To verify the operability of the Standby Liquid Control System.

Specification:

A. Normal Operation

The operability of the Standby Liquid Control System shall be verified by performance of the following tests:

1. At least once per month -

   Demineralized water shall be recycled to the test tank. Pump minimum flow rate of 50 gpm shall be verified against a system head of $\geq$ 1,275 psig.

2. At least once during each operating cycle

   Manually initiate the system, except the explosive valves and

3.4 (Cont'd)

C. Sodium Pentaborate Solution

The standby liquid control solution tank shall contain a boron bearing solution with a minimum enrichment of 34.7 atom percent of B-10 that satisfies the volume-concentration requirements of Fig. 3.4-1 at all times when the Standby Liquid Control System is required to be operable and the solution temperature including that in the pump suction piping shall not be less than the temperature presented in Fig. 3.4-2. Tank heater and the heat tracing system shall be operable whenever the SLCS is required in order to maintain solution temperature in accordance with Fig. 3.4-2.

D. If specifications 3.4.A through C are not met, the reactor shall be in the cold condition within 24 hours.

4.4 (Cont'd)

C. Sodium Pentaborate Solution

The availability of the proper boron bearing solution shall be verified by performance of the following tests:

1. At least once per month -

Boron concentration shall be determined. In addition, the boron concentration shall be determined any time water or enriched sodium pentaborate is added or if the solution temperature drops below the limits specified by Fig. 3.4-2.

2. At least once per day -

Solution volume and the solution temperature shall be checked.

3. At least once per operating cycle -

a. The temperature and level elements shall be calibrated.

b. Enrichment of B-10 (in atom percent) shall be checked.

3.4 and 4.4 BASES

A. Normal Operation

The design objective of the Standby Liquid Control System is to bring the reactor from full power to cold, xenon-free shutdown assuming that no control rods can be inserted. To do this, the Standby Liquid Control System is designed to inject a quantity of boron which produces a minimum concentration equivalent to 660 ppm of natural boron in the reactor core. Six hundred and sixty ppm boron concentration in the reactor core is required to bring the reactor from full power to a subcritical condition considering:

- o the reactivity insertion due to temperature decrease caused by changing water density,
- o decay of xenon poisoning
- o uncertainties and biases in the analyses and
- o 25% margin for potentially imperfect mixing of the sodium pentaborate solution in the reactor water.

The design basis of the SLCS requires that injection be completed in a time period no less than 23 minutes and no greater than 125 minutes. The upper time limit (125 min) for complete injection of the sodium pentaborate solution was selected to override the rate of reactivity insertion due to cooldown of the reactor following the xenon poison peak. The lower time limit (23 min) is based on the need to allow adequate mixing, so the boron does not circulate in uneven concentrations that could cause local power fluctuations.

The technical specifications assure that the minimum injecting time for the SLC System is 44 minutes and maximum injection time 96 minutes, thus meeting the plant design basis. In addition to meeting its original design basis, the system must also satisfy the Anticipated Transient Without Scram (ATWS) Rule, 10 CFR 50.62 paragraph (c) (4).

The ATWS Rule requires a minimum flow capacity and boron content equivalent in control capacity to 86 gallons per minute of 13 weight percent sodium pentaborate solution. The "equivalent in control capacity" wording was clarified in Generic Letter 85-03. Equivalence can be obtained by increasing the flow, boron concentration, or boron enrichment. For the FitzPatrick plant, the rule is met by using boron enriched to 34.7 atom percent boron-10 and a pumping rate of 50 gpm. The method used to show equivalence with 10 CFR 50.62 is described in NEDE - 31096 - P-A :

$$E/19.8 \times C/13 \times M251/M \times Q/86 \geq 1$$

where

E = boron enrichment = 34.7 atom %
Q = SLCS flow rate = 50 gpm
M = mass of water in reactor vessel and recirculation system at hot rated condition 491,700 lbs. for FitzPatrick plant
M251 = mass of water in vessel and recirculation system at hot rated condition (628,300 lbs.) for 251 - inch diameter vessel plant
C = sodium pentaborate solution concentration (weight percent) greater than or equal to 10 percent

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ATWS requirements are satisfied at all concentrations above 10 weight percent for a minimum enrichment of 34.7 atom percent of B-10.

Figure 3.4-1 shows the permissible region of operation on a sodium pentaborate solution volume versus concentration graph. This curve was developed for 34.7% enriched B-10 and a pumping rate of 50 gpm. Each point on this curve provides a minimum of 660 ppm of equivalent natural boron in the reactor vessel upon injection of SLC solution. At a solution volume of 2200 gallons, a weight concentration of 13% sodium pentaborate, enriched to 34.7% boron-10 is needed to meet shutdown requirements. The maximum storage volume of the solution is 4780 gallons which is the net overflow volume in the SLC tank.

Boron concentration, isotopic enrichment of boron-10, solution temperature, and volume are checked on a frequency adequate to assure a high reliability of operation of the system should it ever be required. Experience with pump operability indicates that monthly testing is adequate to detect if failures have occurred.

The only practical time to test the Standby Liquid Control System is during a refueling outage and by initiation from local stations. Components of the system are checked periodically as described above and make a functional test of the entire system on a frequency of more than once each refueling outage unnecessary. A test of explosive charges from one manufacturing batch is made to assure that the charges are satisfactory. A continuous check of the firing circuit continuity is provided by pilot lights in the control room.

The relief valves in the Standby Liquid Control System protect the system piping and positive displacement pumps, which are nominally designed for 1,500 psig, from overpressure. The pressure relief valves discharge back to the standby liquid control pump suction line.

B. Operation with Inoperable Components

Only one of two standby liquid control pumping circuits is needed for operation. If one circuit is inoperable, there is no immediate threat to shutdown capability, and reactor operation may continue during repairs. Assurance that the remaining system will perform its function and that reliability is good is obtained by demonstrating pump operation in the operable circuit at least daily.

C. Sodium Pentaborate Solution

To guard against precipitation, the solution, including that in the pump suction piping, is kept at least 10°F above saturation temperature. Figure 3.4-2 shows the saturation temperature including 10°F margin as a function of sodium pentaborate solution concentration. Tank heater and heat tracing system are provided to assure compliance with this requirement. The set points for the automatic actuation of the tank heater and heat tracing system are established based on the solution concentration. Temperature and liquid level alarms for the system annunciate in the control room. Pump operability is checked on a frequency to assure a high reliability of operation of the system should it ever be required.

Once the solution is prepared, boron concentration does not vary, unless more enriched sodium pentaborate or more water is added. Level indications and alarms indicate whether the solution volume has changed which might indicate a possible solution concentration change. The test interval has been established considering these factors.

Boron enrichment (B-10 atom percent) does not vary with the addition of enriched sodium pentaborate material or water to the SLC tank provided 34.7% enriched (B-10 atom percent) is added. Therefore, a check once per operating cycle is adequate to ensure proper enrichment.

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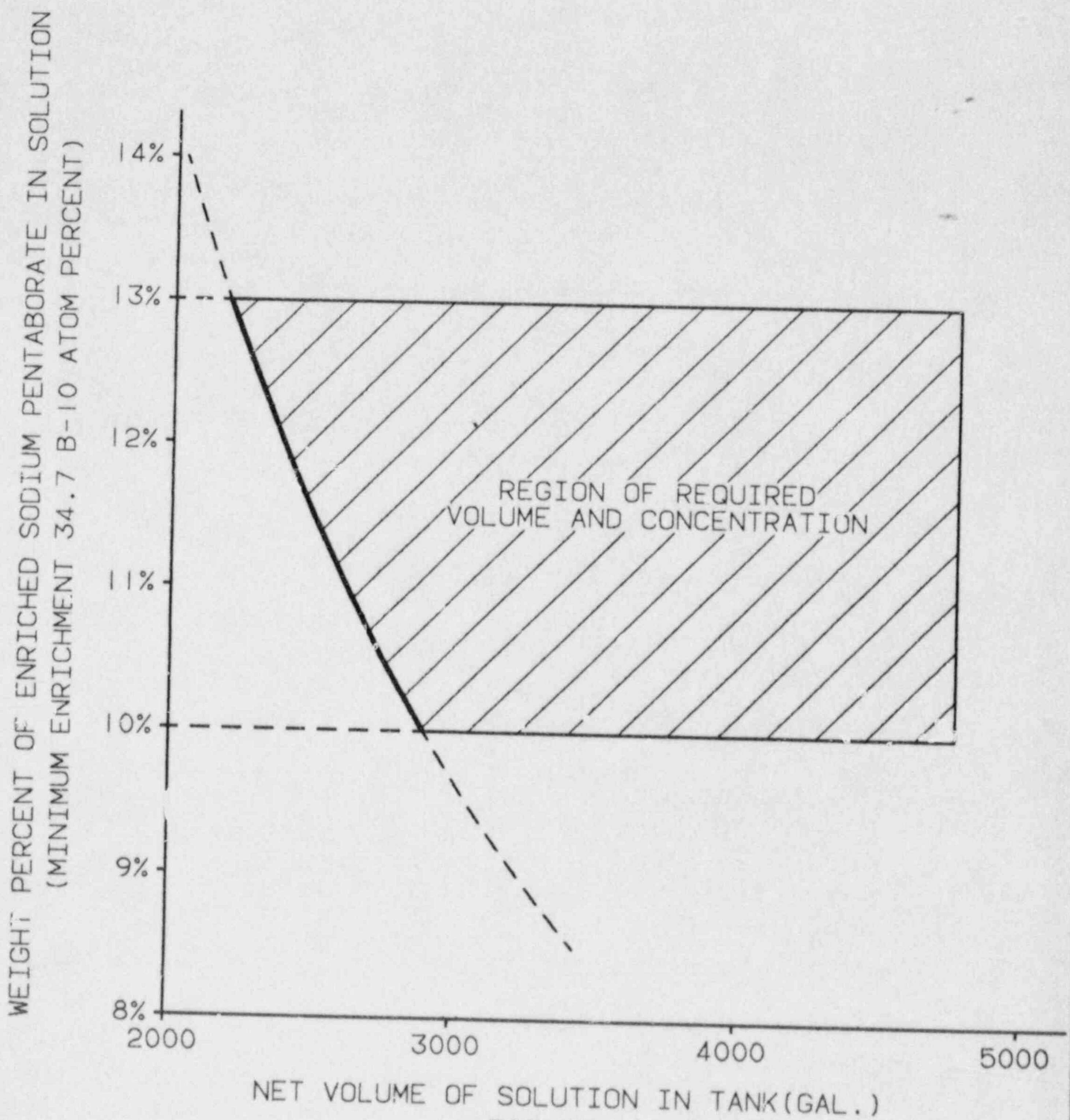

FIG.3.4-1
SODIUM PENTABORATE SOLUTION(MINIMUM 34.7 B-10 ATOM% ENRICHED)
VOLUME CONCENTRATION REQUIREMENTS.

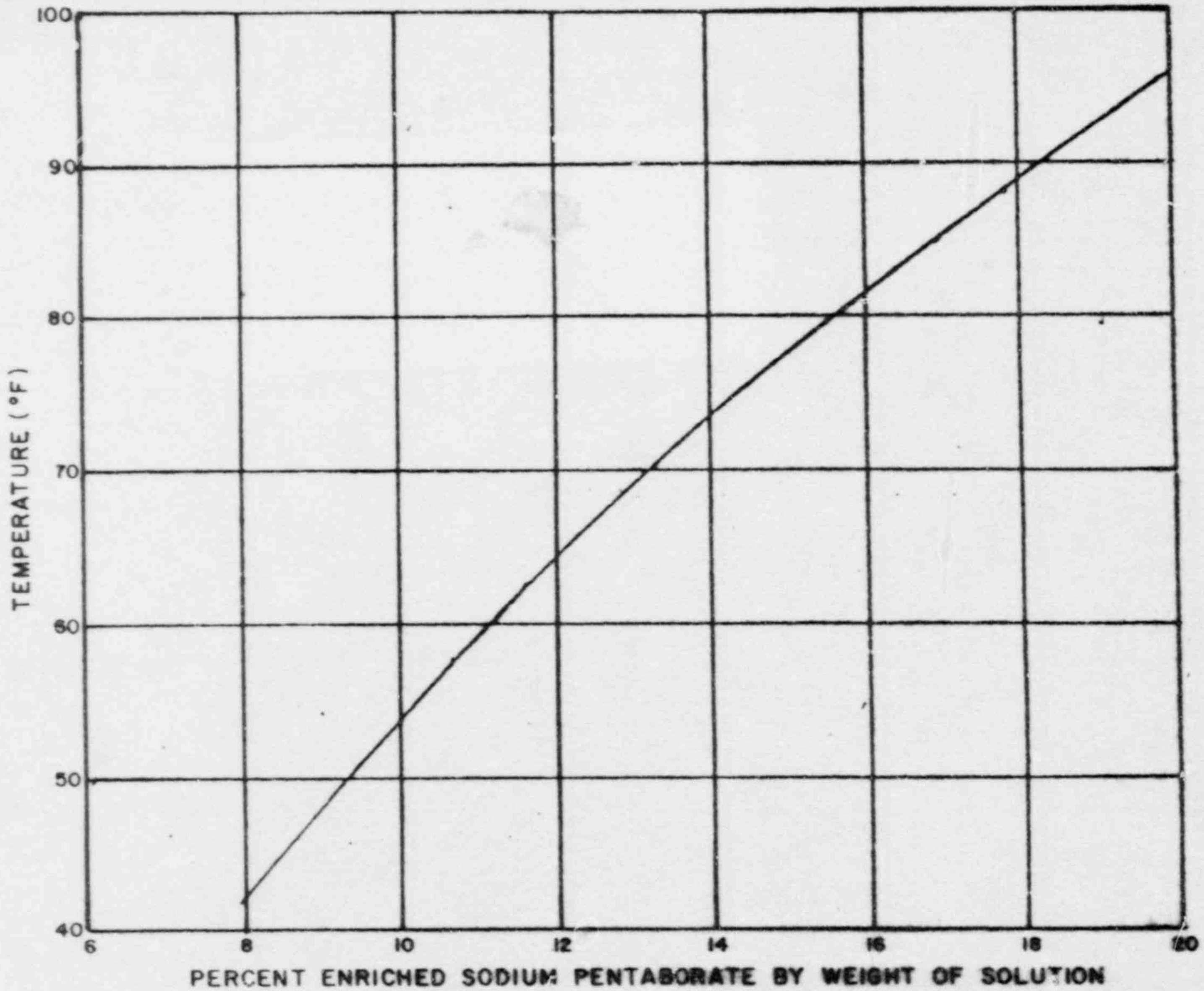

FIG. 3.4-2

SATURATION TEMPERATURE OF ENRICHED SODIUM PENTABORATE SOLUTION
(INCLUDES 10°F MARGIN)

ATTACHMENT II
TO
JPN-88-

SAFETY EVALUATION FOR
PROPOSED TECHNICAL SPECIFICATION
CHANGES REGARDING STANDBY LIQUID CONTROL SYSTEM
(JPTS-88-08)

NEW YORK POWER AUTHORITY
JAMES A. FITZPATRICK NUCLEAR POWER PLANT
DOCKET NO. 50-333
DPR-59

I. DESCRIPTION OF THE PROPOSED CHANGES

The proposed changes to the James A. FitzPatrick Technical Specifications revise Sections 3.4 and 4.4 and their associated Bases:

(a) On page vii, the titles of Figures 3.4-1 and 3.4-2 are revised.

(b) On page 105, in Specification 4.4.A.1, the flow rate is changed from 39 to 50 gpm.

(c) On page 107, in Specification 3.4.C, the phrase, "with a minimum enrichment of 34.7 atom percent of B-10," is added. Also, the phrase "tank heaters" is replaced with "tank heater and the heat tracing system."

(d) On page 107, in Specification 4.4.C.1, the word "boron" is replaced with "enriched sodium pentaborate."

(e) Specification 4.4.C.3 is revised on page 107. It reads:

3. At least once per operating cycle -

a. The temperature and level elements shall be calibrated.

b. Enrichment of B-10 (in atom percent) shall be checked.

(f) On pages 108, 109, and new page 109a, the Bases have been rewritten for clarity and to reflect the change from 600 ppm of natural boron to 660 ppm of equivalent natural boron and the changes resulting from application of Anticipated Transient Without Scram (ATWS) requirements.

(g) On page 110, replace Fig. 3.4-1, "Sodium Pentaborate Solution Volume - Concentration Requirements" with new Fig. 3.4-1, "Sodium Pentaborate Solution 34.7 Atom % Enriched Volume Concentration Requirements." This figure is revised to indicate the changes in the region required for volume and concentration of enriched sodium pentaborate solution.

(h) On page 111, replace Fig. 3.4-2, "Saturation Temperature of Sodium Pentaborate Solution", with new Fig. 3.4-2, "Saturation Temperature of Enriched Sodium Pentaborate Solution (Includes 10^{O}F Margin)."

II. PURPOSE OF THE PROPOSED CHANGE

10 CFR 50.62 paragraph (c) (4) requires that:

> "Each boiling water reactor must have a standby liquid control system (SLCS) with a minimum flow capacity and boron content equivalent in control capacity to 86 gallons per minute of 13 weight percent sodium pentaborate solution."

This requirement is intended to provide prompt injection of negative reactivity in the event of an ATWS event. This equivalency will be obtained at the FitzPatrick plant by changing to a SLC solution which is enriched to 34.7 atom percent boron - 10 (B10).

In addition to meeting 10 CFR 50.62 requirements, to permit an increase in reload enrichment and energy content in future core design reloads, the final in-vessel boron concentration following injection of standby liquid control solution is being increased from 600 ppm of natural boron to 660 ppm of equivalent natural boron.

III. IMPACT OF THE PROPOSED CHANGE

The ATWS Rule (10 CFR 50.62) requires that the SLCS has a minimum equivalent control capacity of 86 gallons per minute (gpm) of 13 weight percent sodium pentaborate solution.

NRC Generic Letter 85-03 clarifies "equivalent control capacity." It can be provided by increasing flow rate, boron concentration, or B-10 enrichment. The 86 gallons per minute and 13 weight percent sodium pentaborate were values used in NEDE-24222, "Assessment of BWR Mitigation of ATWS, Volumes I and II," December 1979, for BWR/4, BWR/5, and BWR/6 plants with a 251 inch vessel inside diameter. Different values are applicable to the FitzPatrick plant because inside vessel diameter is 218 inches. The existing SLCS is required to pump 39 gpm into the reactor vessel but has a tested capability of 52 gpm with either of the two pumps. The new required flow rate will be 50 gpm minimum. The existing tank solution is typically 13 weight percent sodium pentaborate with natural boron. Natural boron is 19.8 atom percent B-10 isotope. B-10 is the isotope which provides the necessary negative reactivity to shutdown the reactor if the SLCS is actuated. For the FitzPatrick plant the rule will be met by increasing B-10 enrichment and taking credit for 50 gpm pumping capacity. The modified tank solution will typically contain an 11.5 weight percent sodium pentaborate made up from boron enriched to 34.7 atom percent B-10 isotope. That this provides the required "equivalent control capacity" was verified by a calculation performed in accordance with NRC's "Safety Evaluation of Topical Report (NEDE-31096-P) "Anticipated Transient Without Scram; Response to ATWS Rule, 10 CFR 50.62" which was attached to NRC letter to NYPA, "ATWS Rule (10 CFR 50.62): Plant Specific Reviews", dated January 8, 1987. This change increases the negative reactivity insertion of the SLCS.

Furthermore, the final in-vessel boron concentration following injection of standby liquid control solution is being increased from 600 ppm of natural boron to 660 ppm of equivalent natural boron. The additional margin permits increases in reload enrichment and energy content in future reload core designs. Actual shutdown margin for reload cores is determined during the reload core design and analysis process and must meet appropriate design and licensing criteria.

The existing (unmodified) SLCS typically has a 13 weight percent sodium pentaborate solution which requires heat tracing to ensure that the solution temperature stays above the boron precipitation temperature of 58^{o}F. The new tank solution will be typically 11.5 weight percent concentration which has a precipitation temperature of 52^{o}F. Since the minimum room temperature for the SLCS is 65^{o}F, this concentration reduces the need for the tank heater and the heat tracing system, thus increasing system reliability and enhancing the overall safety for the system. The setpoints for the tank heater and heat tracing system will be reduced consistent with the new precipitation temperature.

The SLCS, including the SLC Tank, is a seismic Category I design. The change in tank contents will not affect that design. The new solution is slightly less dense due to the reduction in sodium pentaborate weight percent concentration. This difference is in the conservative direction but is small and not really significant.

IV. EVALUATION OF SIGNIFICANT HAZARDS CONSIDERATION

Operation of the FitzPatrick plant in accordance with the proposed amendment would not involve a significant hazards consideration as stated in 10 CFR 50.92, since it would not:

1. Involve a significant increase in the probability or consequences of an accident previously evaluated. The change involves an increase in B-10 enrichment in the solution in the SLC Tank and an increase in required pumping capacity. Although the modification involves decreasing the concentration of sodium pentaborate in the SLC Tank, the increased enrichment of B-10 and increased solution pumping rate result in an overall increase in the injection rate of B-10 isotope into the reactor vessel. As a result of the increased amount of B-10 isotope in the SLC tank, the final in-vessel boron concentration following injection of SLC solution is being increased from 600 ppm of natural boron to 660 ppm of equivalent natural boron. The increased boron concentration in the reactor vessel will allow future core reloads to utilize higher energy content fuel without decreasing present shutdown margin. Furthermore, operation of the SLCS with the proposed changes will merely provide a backup to other safety related systems in accordance with 10 CFR 50.62 requirements. Also, the reduced need for a tank heater and the heat tracing system contributes to the overall reliability of the system.

2. Create the possibility of a new or different kind of accident from any accident previously evaluated. The ATWS changes proposed and the accompanying plant modifications only serve as backups to already existing safety-related systems. The proposed changes will ensure that the SLCS is maintained such that it is capable of fulfilling the operability requirements of 10 CFR 50.62. As stated above, the proposed changes increase the shutdown margin in the unlikely event that SLCS should be needed to shut down the reactor. No new or different kinds of accidents result from improving the effectiveness of the SLCS.

3. Involve a significant reduction in a margin of safety. On the contrary, this change increases the negative reactivity inserted by the SLCS, and, therefore, enhances the safety margin for the plant. The proposed changes are in accordance with the requirements of 10 CFR 50.62, and provide additional assurance that the SLCS is capable of safely shutting down the plant in the unlikely event that its use is required. SLCS operability does not decrease the margin of safety. since it serves as backup to other safety-related systems.

V. IMPLEMENTATION OF THE PROPOSED CHANGE

Implementation of the proposed changes will not impact the ALARA or Fire Protection programs at the FitzPatrick plant, nor will the changes impact the environment.

VI. CONCLUSION

The change, as proposed, does not constitute an unreviewed safety question as defined in 10 CFR 50.59. That is, it:

a. will not change the probability nor the consequences of an accident or malfunction of equipment important to safety as previously evaluated in the Safety Analysis Report;

b. will not increase the possibility of an accident or malfunction of a type different from any previously evaluated in the Safety Analysis Report;

c. will not reduce the margin of safety as defined in the basis for any Technical Specification;

d. does not constitute an unreviewed safety question; and

e. involves no significant hazards consideration, as defined in 10 CFR 50.92.

VII. REFERENCES

1. James A. FitzPatrick Nuclear Power Plant Updated Final Safety Analysis Report, Sections 3.9.3, 3.9.4, 14.5.11.

2. James A. FitzPatrick Nuclear Power Plant Safety Evaluation Report (SER).