ATTACHMENT III TO IPN-91-044

INDIAN POINT 3

MINIMUM RWST BORON CONCENTRATION AND RELATED CHANGES SAFETY EVALUATION

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INDIAN POINT UNIT 3

MINIMUM RWST BORON CONCENTRATION AND RELATED CHANGES

SAFETY EVALUATION

December 1991

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INDIAN POINT UNIT 3

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SAFETY EVALUATION

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WESTINGHOUSE NUCLEAR SAFETY EVALUATION CHECKLIST

1) NUCLEAR PLANT: Indian Point Unit 3

2) SUBJECT: Minimum RWST Boron Concentration and Related Changes

3) The written safety evaluation of the revised procedure, design change or modification required by 10 CFR 50.59 has been prepared to the extent required and is attached. If a safety evaluation is not required or is incomplete for any reason, explain on Page 2.

   Parts A and B of this Safety Evaluation CheckList are to be completed only on the basis of the safety evaluation performed.

   CHECKLIST - PART A

   (3.1) Yes _X_ No ___ A change to the plant as described in the FSAR?
   (3.2) Yes ___ No _X_ A change to procedures as described in the FSAR?
   (3.3) Yes ___ No _X_ A test or experiment not described in the FSAR?
   (3.4) Yes _X_ No ___ A change to the plant technical specifications? (Appendix A to the Operating License)

4) CHECKLIST - PART B (Justification for Part B answers must be included on Page 2.)

   (4.1) Yes ___ No _X_ Will the probability of an accident previously evaluated in the FSAR be increased?
   (4.2) Yes ___ No _X_ Will the consequences of an accident previously evaluated in the FSAR be increased?
   (4.3) Yes ___ No _X_ May the possibility of an accident which is different than any already evaluated in the FSAR be created?
   (4.4) Yes ___ No _X_ Will the probability of a malfunction of equipment important to safety previously evaluated in the FSAR be increased?
   (4.5) Yes ___ No _X_ Will the consequences of a malfunction of equipment important to safety previously evaluated in the FSAR be increased?
   (4.6) Yes ___ No _X_ May the possibility of a malfunction of equipment important to safety different than any already evaluated in the FSAR be created?
   (4.7) Yes ___ No _X_ Will the margin of safety as defined in the bases to any technical specification be reduced?

If the answers to any of the above questions are unknown, indicate under 5) REMARKS and explain below.

If the answer to any of the above questions in 4) cannot be answered in the negative, based on written safety evaluation, the change cannot be approved without an application for license amendment submitted to the NRC pursuant to 10CFR50.90

5) REMARKS:

The answers given in Sections 3 and 4 of the Safety Evaluation Check List are based on the attached Safety Evaluation.

The subject change in the minimum RWST boron concentration represents a change to the IP3 Technical Specifications, and will be accompanied by associated additions and changes to related technical specifications. Therefore, implementation of these changes cannot be made without prior NRC approval, and 10 CFR 50.59 requires an application for amendment to the IP3 license pursuant to the regulations of 10 CFR 50.90. Furthermore, a No Significant Hazards evaluation is required per the regulations of 10 CFR 50.92. This report supports the requirement for a written safety evaluation, and explicitly addresses the regulatory screening criteria of both 10 CFR 50.59 (section 4.0) and 10 CFR 50.92 (section 5.0).

FOR FSAR UPDATE

Section:________ Page(s):________ Table(s):________ Figure(s):________

Reason for/Description of Change: NOT APPLICABLE

NUCLEAR SAFETY APPROVAL LADDER

Prepared By: J. J. DeBlasio Date: 12-13-91
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MINIMUM RWST BORON CONCENTRATION AND RELATED CHANGES

SAFETY EVALUATION

1.0 BACKGROUND

The purpose of this safety evaluation is to demonstrate that a change in the Indian Point Unit 3 (IP3) minimum Refueling Water Storage Tank (RWST) boron concentration technical specification from 2000 ppm to 2400 ppm, along with associated additions and changes to related technical specifications, will not adversely affect safe plant operation.

The change in the IP3 minimum RWST boron concentration from 2000 ppm to 2400 ppm is necessary to support 24 month operating cycles that the New York Power Authority (NYPA) will institute beginning with Cycle 9. The change will ensure that the core remains in a subcritical state during emergency and refueling conditions for 24 month operating cycles.

Other related technical specification changes will be made stemming from the subject change to the minimum RWST boron concentration. All the related technical specification changes are:

1. ADDITIONS

   a. Maximum RWST Boron Concentration of 2600 ppm.
   b. Maximum Spray Additive Tank (SAT) NaOH Concentration of 38% by weight (wt%).
   c. Maximum Accumulator Boron Concentration of 2600 ppm. (minimum concentration of 2000 ppm will not change)

2. REVISIONS

   a. Minimum RWST Boron 2400 ppm.
   b. Minimum SAT NaOH Concentration of 35 wt%.
   c. Maximum Accumulator Liquid Volume of 815 ft3. (revised range will be 775 ft3 - 815 ft3)
   d. Minimum Boric Acid Storage System Volume of 6100 gallons.

The change to the SAT NaOH concentration range was made to effect pH control. The change in the accumulator volume was made to provide increased operating margin. The change to the minimum Boric Acid Storage System volume from 5000 gpm to 6100 gpm was made consistent with the change to the minimum RWST boron concentration in order to comply with the IP3 technical specifications which require that the quantity of boric acid in storage in both the RWST and Boric Acid Storage System be sufficient to borate the reactor coolant in order to reach cold shutdown at any time during core life.

This safety evaluation was based on consideration of the subject changes with respect to Loss-of-Coolant Accident (LOCA) Analyses, non-LOCA Transient Analyses, LOCA Forces, Containment Integrity, Instrumentation and Control Systems, Technical Specifications, Mechanical and Fluid Systems, Emergency Operating Procedures (EOPs), Steam Generator Tube Rupture Analysis, and Risk Assessment. Based on this consideration, the LOCA Analyses, non-LOCA Analyses, Radiological & Hydrogen Generation Analyses, Instrumentation and Control Systems, Mechanical and Fluid Systems, EOPs, and Technical Specifications areas were potentially affected by the subject changes. Therefore, this evaluation was limited to these areas.

The principal conclusion of this safety evaluation is that the change to the IP3 minimum RWST boron concentration from 2000 ppm to 2400 ppm, along with associated additions and changes to other related technical specifications, will neither represent an Unreviewed Safety Question nor involve Significant Hazards Consideration and, therefore, will not adversely affect safe plant operation.

2.0 LICENSING BASIS

This evaluation was performed in accordance with the regulations set forth in Title 10 of the Code of Federal Regulations, Part 50 (10 CFR 50.59). This regulation allows the holder of a license authorizing operation of a nuclear power facility the capacity to make changes to plant and/or procedures, and conduct tests or experiments not described in the Final Safety Analysis Report (FSAR) without prior Nuclear Regulatory Commission (NRC) approval provided that such activities would involve neither an Unreviewed Safety Question nor changes to the plant technical specification. Furthermore, the licensee is obligated to maintain a record of such activities to the extent that they affect the FSAR. 10 CFR 50.59 stipulates that this record include a written safety evaluation which provides the basis for the determination that the subject activity will not adversely affect safe plant operation.

The subject change in the minimum RWST boron concentration represents a change to the IP3 Technical Specifications, and will be accompanied by associated additions and changes to related technical specifications. Therefore, implementation of these changes cannot be made without prior NRC approval, and 10 CFR 50.59 requires an application for amendment to the IP3 license pursuant to the regulations of 10 CFR 50.90. Furthermore, a No Significant Hazards evaluation is required per the regulations of 10 CFR 50.92. This report supports the requirement for a written safety evaluation, and explicitly addresses the regulatory screening criteria of both 10 CFR 50.59 (section 4.0) and 10 CFR 50.92 (section 5.0).

The determinations by this safety evaluation that the subject changes to the IP3 technical specifications will neither represent an Unreviewed Safety Question, nor involve Significant Hazards Consideration were made based on individual evaluations performed according to the following pertinent licensing basis acceptance criteria:

(a) LOCA Analyses

The LOCA Analyses safety evaluation demonstrates compliance with the Peak Clad Temperature (PCT) limit of 2200°F as specified in 10 CFR 50.46 b(1), and was performed consistent with the requirements of 10 CFR 50, Appendix K. The analyses also demonstrate compliance with other 10 CFR 50.46 criteria paraphrased as follows:

- The total cladding oxidation must be less that 17% of the total cladding thickness prior to oxidation.
- The total hydrogen generated must be less than 1% of the hypothetical amount that would be generated if all the cladding were to react with water or steam.
- The core must remain amenable to cooling.
- The core temperature must be maintained acceptably low, and decay heat must be removed for the period of time required by long-lived radioactivity remaining in the core.

The first three criteria are addressed by the Large Break LOCA (LBLOCA) and Small Break LOCA (SBLOCA) evaluations, the fourth criterion is addressed in the LOCA Hydraulic Forces evaluation, and the fifth criterion is addressed in the Post-LOCA Long Term Core Cooling and Hot Leg Switchover calculations.

(b) Non-LOCA Transients

The non-LOCA safety evaluation demonstrates that the assumptions used in the potentially affected calculations remain valid, and that the minimum Departure from Nucleate Boiling Ratio (DNBR) will not violate the current limit value.

(c) Radiological Consequences

The Radiological Consequences safety evaluation demonstrates that the calculated accident doses are within 300 rem to the thyroid based on consideration of plant design and plant site characteristics consistent with the requirements of 10 CFR 100.11.

(d) Post-LOCA Hydrogen Generation

The Post-LOCA Hydrogen Generation safety evaluation demonstrates that the hydrogen concentration inside containment following a LOCA will be less than 4.0% by volume as defined in Section 14.3.7 of the IP3 FSAR. This ensures that the hydrogen concentration will be limited and so preclude explosive levels.

(e) Equipment Integrity and Operability

The Mechanical and Fluid Systems safety evaluation demonstrates that the integrity and operability of potentially affected equipment and systems will be maintained.

3.0 SAFETY EVALUATIONS

3.1 LOCA Evaluation

Large Break Loss-of-Coolant Accident

The IP3 Large Break LOCA (LBLOCA) licensing basis analysis of record was performed with the 1981 LOCA Evaluation Model with BASH. The analysis resulted in a PCT of 1978°F for a double-ended cold leg guillotine break with a discharge coefficient of 0.4, and has since been supplemented by a number of safety evaluations. Though penalties associated with these evaluations, and penalties associated with several Potential Issues have increased the LBLOCA PCT, margin is still maintained to the 2200°F the regulatory limit.

The LBLOCA evaluation model does not depend on the presence of boron in the safety injection water as a mechanism for core shutdown. The time of shutdown is based on the formation of voids within the reactor core during the blowdown portion of the transient. The kinetics model in the LBLOCA computer codes tracks the level of voiding in the core and predicts the time of shutdown based on the amount of negative reactivity inserted into the core as a result of the voiding. Credit is neither taken for the control rods (which are assumed to fail to insert) nor the boron in the safety injection water. Only the post-LOCA long term criticality calculation accounts for the boron concentration in the system.

NYPA requested that Westinghouse use an accumulator volume range of 775-815 ft^3 in all the analyses (reference 7). The LBLOCA analysis of record, however, was based on a range of 775-800 ft^3. An evaluation had been performed in support of Cycle 7 for this change in accumulator maximum volume but was never implemented into the plant technical specifications. A 15°F penalty had been calculated for LBLOCA and will now be added to the current PCT rackup to account for a maximum accumulator volume of 815 ft^3. The assessed PCT then increases by this amount, but margin is maintained to the 2200°F limit.

On this basis, the change in the minimum RWST boron concentration along with the other associated technical specification changes will have no effect on the LBLOCA analysis results, and thus ensuring LBLOCA PCT margin to the 2200°F limit.

Small Break Loss-of-Coolant Accident

The IP3 Small Break LOCA (SBLOCA) licensing basis analysis of record for IP3 was performed using the NRC approved NOTRUMP Evaluation Model. This analysis resulted in a PCT of 1711°F for a 6 inch diameter cold leg break (limiting break size) and has been supplemented by several safety evaluations. Though penalties associated with these evaluations and associated Potential Issues have increased the PCT, margin is maintained to the 2200°F regulatory limit.

As with the LBLOCA evaluation model, the SBLOCA model does not take credit for the boron concentration of the safety injection water. In the SBLOCA analyses, core shutdown is accomplished by insertion of the control rods after the appropriate delay times. Only in the long term is the boron concentration of the system water inventory modeled with respect to maintaining core subcriticality. Therefore, the change in the minimum RWST boron concentration will have no adverse effect on the results of the IP3 SBLOCA analysis.

LOCA Hydraulic Forces

The blowdown hydraulic forcing functions resulting from a postulated LBLOCA are considered in Chapter 14.3.4 of the IP3 FSAR. That section addresses the effects of a pipe rupture on the Reactor Coolant System (RCS) and serves as a basis for the core and reactor internals integrity analyses.

The peak loads generated on the reactor vessel as a result of a LBLOCA typically occur between 10 and 500 milliseconds after event initiation, and subside well before 1 second. Since the forces would peak and subside well before the earliest possible injection of water from the RWST, there is no effect on the LOCA Hydraulic Forces analysis as a result of the change in RWST boron concentration.

Post-LOCA Long Term Core Cooling

The Westinghouse licensing position for satisfying the requirements of 10 CFR 50.46 Section (b) Item (5), "Long-Term Cooling", is defined in WCAP-8339. The Westinghouse commitment is that the reactor will be maintained in a shutdown state by ECCS borated water. Since credit is not taken for the control rods in LBLOCA analyses, the ECCS water provided by the RWST and accumulators must contain enough boron, when combined with other borated and non-borated sources of water, to maintain the core subcritical in the long term following a LOCA.

For each cycle of operation, the ability of the ECCS system to maintain the core subcritical following a LOCA is reevaluated. The calculation of expected post-LOCA sump boron concentration is checked to determine if any of the pertinent parameters, such as water volumes and boron concentrations, have changed since the last cycle. The objective of the calculation is to conservatively determine the anticipated sump boron concentration by minimizing or maximizing RCS component boron concentrations and water volumes appropriately. The calculated sump boron conditions are then compared to the subcriticality requirements of the new core design.

As stated above, the calculation to determine the anticipated post-LOCA sump boron concentration is dependent on total RCS component volumes and boron concentrations. Thus, the change in the RWST boron concentration will have a significant effect on the results of this calculation.

Westinghouse has recalculated the post-LOCA containment sump boron concentration versus pre-trip RCS boron concentration curve for IP3 based on the new RWST boron concentration. This calculation was based upon key assumptions that were provided to Westinghouse by NYPA and are as follows (reference 7):

Minimum RWST Boron Conc. = 2400 ppm
Minimum Accumulator Boron Conc. = 2000 ppm
RWST Volume = 314,245 gallons
BIT Volume of 900 gallons
Minimum Accumulator Volume = 775 ft^3

Also, the following three different cases were considered with regard to the modeling of the Boron Injection Tank (BIT): 1) BIT functional at 0 ppm Boron Concentration, 2) BIT Removed, and 3) BIT functional at the Tech Spec minimum boron concentration. The most limiting case was found to be the BIT functional at 0 ppm boron concentration.

Based on the expected Cycle 9 core design and the new post-LOCA sump concentration curve, Westinghouse has verified that sufficient boron will be available in the containment sump following a LOCA to maintain the core subcritical.

<u>Hot Leg Switchover to Prevent Boron Precipitation</u>

Hot leg recirculation switchover time is determined for inclusion in a plant's EOPs and is calculated to ensure that boron precipitation will not occur in the core as a result of post-LOCA boiling. The time at which hot leg switchover occurs is dependent on core power history and RCS component water volumes and boron concentrations.

The input for this calculation is similar to that of the Post-LOCA Long Term Core Cooling calculation, except that the boron concentrations are maximized for conservatism. Westinghouse has recalculated the hot leg switchover time for IP3 based, in part, on the following assumptions.

RWST Maximum Boron Conc. = 2600 ppm
Accumulator Maximum Boron Conc. = 2600 ppm
RCS Boron Conc. = 2400 ppm
RWST Volume = 314,245 Gallons
Maximum Accumulator Volume = 815 ft^3
BIT Volume = 900 gallons

As in the post-LOCA Long Term Core Cooling Calculation, three different cases were considered with respect to the modeling of the BIT. These three cases are as follows:

1) BIT Functional at Maximum Tech Spec Boron Conc.,(22,735 ppm)
2) BIT Functional at 0 ppm Boron
3) BIT Removed

The hot-leg switchover times calculated for these three cases are given below in Table 3-1.

TABLE 3-1

Hot-Leg Switchover Times for INT

BIT Case	Switchover Time (hours)
1	8.20
2	8.47
3	8.46

Please note that Case 1 resulted in the shortest hot-leg switchover time and is, therefore the most conservative case. Unless Westinghouse receives verification from NYPA that the BIT is either removed or is at 0 ppm boron concentration, the time calculated for Case 1 shall be the limiting hot-leg switchover time applied to IP3.

Note that the switchover times given above are much shorter than the previously recognized switchover time of 21 hours. Several factors are responsible for this difference. The first and most important is that the latest Westinghouse model for calculating hot-leg switchover times was utilized in this evaluation. This model has consistently predicted shorter switchover times for the various plants for which it has been used. Another important contributor to the shorter switchover time is the boron concentration increases of the RWST and accumulator. The increase to 2600 ppm maximum boron concentration for both the RWST and the accumulators has a significant effect on the hot leg switchover time. These two items are predominantly responsible for the shorter switchover time.

Another requirement of hot leg switchover calculation is that the boiloff rate in the core must be matched by safety injection flow at the time of hot leg switchover, for both LBLOCA and SBLOCA. For a LBLOCA, the total flow into the core is based on the available SI pump flow estimated from pre-operational tests and has been compared to the boiloff rate in the core at the hot leg switchover time for both cold leg and hot leg injection. Because the flow rates were found to be greater than the boiloff rate, the requirement for LBLOCA is met.

For SBLOCA, the requirement is that the total recirculation flow in hot leg mode with one hot leg line spilling must be greater than the boiloff rate. For this calculation, the RCS is assumed to be at the steam generator secondary side safety valve setpoint. Westinghouse has calculated the SBLOCA safety injection flows in hot leg mode. The flows calculated were found to be greater than or equal to the boiloff rate at the MSSV setpoint pressure at the hot leg switchover time. Therefore, the SBLOCA hot leg switchover requirement is met for IP3.

This evaluation also considered whether the cold leg sump recirculation flows might be different than those assumed during the injection phase of the LOCA accident analyses. It was determined that the cold leg sump recirculation flow will be no different that the cold leg injection mode flow when the safety injection pumps are operating at the same performance capability. Since both the SBLOCA and LBLOCA transients analyses were ended assuming injection mode flows, the switch from injection mode to cold leg sump recirculation mode will not result in any additional core uncovery.

3.2 Non-LOCA Transient Evaluation

The increase in the RWST and accumulator boron concentrations, accumulator volume and the change in NaOH concentration in the SAT does not adversely impact the conclusions of the various non-LOCA safety analyses for IP3.

The RWST provides borated coolant for safety injection flow required in steamline break events as a source of negative reactivity to offset increases in core reactivity due to reactivity feedback effects associated with the transient cooldown. However, since a lower SI boron concentration adds conservatism to the analyses, increasing the RWST boron concentration would only provide a benefit for those steamline break events that receive SI.

Changes in the accumulator boron concentration can potentially affect the steamline break events if RCS pressure were to drop below the point at which accumulator injection will occur. However, since minimum accumulator boron concentrations are conservatively assumed in the analyses, increases to the accumulator boron concentration will provide a benefit for those steamline break events severe enough to decrease the RCS pressure low enough to initiate accumulator injection.

3.3 Radiological Evaluation

The affect of the change in the minimum RWST boron concentration, along with the other related technical specification changes, on the spray and sump solution pH values is that the spray pH will be in the range of 9.0 to 10.0 (as opposed to the FSAR range of 9.3 to 9.6 from FSAR Table 6A-1). The minimum sump pH will be 7.9 instead of the current FSAR value of 8.3 (FSAR page 6A-9). However, all pertinent licensing basis limits have been met.

Iodine Removal by Containment Spray

The minimum spray pH decreases from 9.3 to 9.0. The maximum spray pH increases from 9.6 to 10.0. The removal of iodine from the containment atmosphere by sprays is enhanced by higher levels of alkalinity. Hence, the increase in the maximum spray pH would benefit iodine removal. Although the minimum spray pH stated in FSAR Appendix 6A, Section 4.2 is 9.3, the current calculation of the design basis case iodine removal coefficient was based on a pH of 9.0 (FSAR Table 6A-1). Thus, there is no adverse affect on iodine removal due to the change in the spray pH range.

Iodine Retention in the Sump Solution

The reduction in the sump solution pH has been evaluated for its affect on iodine retention in the sump. The current licensing basis assumes a sump temperature of 150°F for the determination of the iodine partition coefficient. With a sump temperature of 150°F and the sump solution pH reduced to 7.9, the necessary partition coefficient to assure a decontamination factor (DF) of 100, as is assumed for the dose analysis, cannot be met. However, following a LBLOCA the sump solution temperature would be in excess of 212°F for a number of hours. Since the conversion of iodine from the volatile I_2 form to other non-volatile forms takes place to a greater extent at elevated temperatures, and since there is no reversion to the I_2 form as a result of declining temperatures, the basis for the determination of the partition coefficient was changed from 150 to 212°F. Using 212°F, the partition coefficient was determined to be 9000 which is more than the 5000 required to support a DF of 100 (FSAR currently specifies a partition of 4000). Thus, there is no adverse affect on iodine retention in the sump solution due to the reduction in minimum equilibrium sump solution pH.

Post-LOCA Hydrogen Production

The analysis in Section 14.3.7 of the IP3 FSAR assumes that hydrogen is produced in the post-LOCA containment environment due to the corrosion of aluminum, radiolytic decomposition of the core cooling solution, and the reaction of the zirconium fuel cladding with steam. However, only the aluminum corrosion would be affected by the pH of the spray and sump solution.

By inspection of FSAR Table 6D-4, the aluminum corrosion rate design curve (Figure 6D-8) bounds corrosion rates for pH between 9 and 9.3, which is consistent with the mininimum spray pH of 9.3 specified in FSAR Appendix 6A.

Thus, the design basis aluminum corrosion rate curve is considered to be based on minimum spray pH rather than the maximum spray pH. The recalculated minimum spray pH is 9.0, and is within the applicable range of the current design basis aluminum corrosion rate curve.

The FSAR does not address the potential affect of the maximum spray pH on aluminum corrosion. However, since the recalculated maximim pH is slightly greater than the current FSAR value (9.6 vs. 10.0) the affect will be addressed here. First of all, the high pH injection spray persists for less than 1 hour. After this time, sump solution, which will have a pH no greater than approximately 8.3, is recirculated through the containment spray headers. FSAR Figure 6D-9 shows that the aluminum corrosion rate rapidly decreases with decreasing pH. The FSAR analysis assumes a constant pH of approximately 9.3. Thus, basing long-term corrosion on a pH of 9.3 is conservative. Secondly, because the production of hydrogen is evaluated out to 100 days post-LOCA, a change in corrosion rate during only the first hour would have a negligible effect on the aggregate production of hydrogen over the duration of the accident.

Finally, there is substantial margin in the FSAR analysis. Specifically, the original FSAR analysis considered 140 lb_m of aluminum paint with a surface of 18,000 ft^2. The paint has subsequently been eliminated from containment with the replacement of the steam generators during the Cycle 6/7 outage (footnote on Table 14.3-43). The hydrogen analyis was not revised to reflect this aluminum inventory reduction. The aluminum corrosion rate is directly proportional to the exposed surface area. Refering to FSAR Table 14.3-43, the eliminated paint accounts for approximately 63% of the total surface area. Hence, the hydrogen production rate, specifically during the first hour, would be decreased by approximately 63% from that currently shown in the FSAR (this decrease would not be applicable to times beyond approximately one hour because the paint would likely be totally consumed during the first hour). Based on the above arguements, there would be no adverse affect on post-LOCA hydrogen production due to aluminum corrosion resulting from an increase in the injection spray maximum pH.

3.5 Equipment Integrity and Operability Evaluation

With respect to 10 CFR50.49, as it applies to chemistry conditions during design basis accidents as well as normal operations, the proposed change in RWST boron concentration and changes to the other associated technical specifications will have no affect on equipment which would be in contact with liquid concentrations affected by this change. The proposed change in boron concentration will affect accident chemistry conditions very early and for brief duration during a LOCA in containment. Neither, the IP3 FSAR nor the Equipment Qualification (EQ) program requirements (reference 9) state explicit requirements with respect to equipment potentially affected by the changes. Furthermore, there are no technical specification requirements in the EQ or instrumentation areas which would be affected.

The RWST provides borated water to the refueling canal, three charging pumps, three safety injection pumps, two residual heat removal pumps and two containment spray pumps for normal and accident conditions. The immediate effect of changing the minimum boron concentration in the RWST from a nominal 2000 ppm to a range of 2400 ppm to 2600 ppm will be a decrease in the pH of the liquid. To assess the magnitude of this decrease, pH values of boric acid solutions containing 2000, 2300 and 2600 ppm at 40, 77, and 125°F were computed (reference 1). These values are listed in Table 3-4. The lowest and highest temperatures chosen, 40°F and 125°F, represent the range the RWST is expected to experience, while 77°F represents the temperature which the RWST liquid exhibits most of the time.

Table 3-4 pH of RWST Liquid

Boron (ppm)	pH at 40°F	pH at 77°F	pH at 125°F
2000	4.57	4.57	4.59
2300	4.49	4.49	4.52
2600	4.41	4.42	4.48

An inspection of Table 3-4 indicates that an increase in the RWST boron concentration of 600 ppm, i.e., from 2000 to 2600 ppm, will result in a pH decrease at 77°F from 4.57 to 4.42 (0.15 units).

This minimal pH change does not cause any concern regarding the integrity of the RWST material or any other stainless steel surfaces at IP3 that may come into contact with the RWST liquid within the above temperature range.

Structural carbon steel surfaces in containment are protected by paint against corrosion. Boric acid does not interact with the paint. Wherever there are unprotected carbon steel surfaces, some corrosion would be expected to take place in the moist air of the containment. If the unprotected surfaces would receive a spray of RWST or accumulator liquid containing as much as 2600 ppm boron, a slightly lower pH of the spray will not affect the corrosion rate of carbon steel since the pH of the above liquids would be within a range where corrosion rates are nearly independent of pH. Furthermore, at constant pH, the corrosion rate of carbon steel by boric acid is less than that by a strong acid. Based on these reasons, it is the judgement of Westinghouse that a slight pH decrease of the RWST and accumulator liquids, resulting from the proposed increase in boron concentration, will not adversely affect the unprotected (unpainted) carbon steel surfaces in the IP3 containment.

The increase in boric acid concentration is not expected to affect the corrosion of exposed carbon steel surfaces which are inspected consistent with Generic Letter 88-05.

Various other NSSS components, including piping, would be exposed to the RWST liquid during post-LOCA injection. A boron concentration of 2600 ppm is within the range of 2000 - 4000 ppm that is specified in Table 1-5 Rev. 4 of the Westinghouse Standard Information Package, entitled "Refueling Water Storage Tank" (reference 10). Therefore, the integrity of all equipment in the Nuclear Steam Supply System and support systems, including piping, will not be adversely affected by the increased boron concentration and associated technical specification changes.

With regard to any potential for boron precipitation, the solubility of boric acid at 40°F, 77°F, and 125°F, taken from the pertinent literature, is about 5590 ppm, 9500 ppm, and 18,530 ppm, respectively. Therefore, 2600 ppm will remain soluble at temperatures that the IP3 RWST liquid may experience.

4.0 ASSESSMENT OF NO UNREVIEWED SAFETY QUESTION

The safety significance of the change to the IP3 minimum RWST boron concentration technical specification along with other related technical specification changes, has been evaluated per the criteria of 10 CFR 50.59, and does not represent an unreviewed safety question based on the following answers to specific related questions:

4.1 Will the probability of an accident previously evaluated in the FSAR be increased?

No. The RWST boron concentration is not related to the initiation of any given accident analysis. Therefore, the subject change in the IP3 minimum RWST boron concentration, along with the other related technical specification changes will not adversely affect the RWST material or any other stainless steel surfaces that may come in contact with the RWST fluid. These changes are not expected to affect the phenomenon of Primary Water Stress Corrosion Cracking (PWSCC). Although these changes represent changes to the IP3 Technical Specifications, the integrity and operability of the RWST and other potentially affected NSSS components will not be challenged. The changes do not result in a condition where the design, material and construction standards of such components that were applicable prior to the changes are altered. Therefore, the probability of an accident previously evaluated in the FSAR will not be increased.

4.2 <u>Will the consequences of an accident previously evaluated in the FSAR be increased?</u>

No. As stated in section 3.0, the proposed changes have no adverse affect on radiological consequences, and all other safety analysis criteria are still met. In particular, these changes will not adversely affect iodine removal from the post-LOCA containment atmosphere, and will not adversely affect iodine retention in the sump solution due to the reduction in minimum equilibrium sump solution pH. As such, the calculated doses remain within 300 rem thyroid as required by 10 CFR 100.11.

Also it has been determined that the changes,will not adversely affect post-LOCA hydrogen generation since hydrogen concentrations will remain below the 4.0 vol.% limit (thuse precluding explosive hydrogen concentrations).

Therefore, the consequences of an accident previously evaluated in the FSAR.

4.3 <u>May the possibility of an accident which is different than any already evaluated in the FSAR be created?</u>

No. While the changes affect post-LOCA iodine removal and retention and hydrogen production, these functions are associated with accident mitigation and do not affect accident initiation or the probability of occurrence. Furthermore, the affects on iodine removal and retention do not result in any pertinent safety limits being exceeded.

The subject changes do not invalidate any of the IP3 accident analyses results or conclusions. All of the safety analyses acceptance criteria continue to be met.

The changes do not cause the initiation of any accident nor create any new failure mechanisms. Although technical specifications changes are required, the integrity of the RWST and other potentially affected NSSS components is not challenged. The changes do not result in a condition where the design, material and construction standards of the RWST and other potentially affected NSSS components that were applicable prior to the technical specification change are altered.

Therefore, the subject changes will not increase the possibility of an accident which is different than any already evaluated in the FSAR.

4.4 Will the probability of a malfunction of equipment important to safety previously evaluated in the FSAR be increased?

No. Requirements placed upon the containment spray and the containment hydrogen control systems are not adversely affected by the proposed changes. Also, the changes do not prevent operation of the reactor protection system or any other safety-related component/system from being able to function properly. The subject changes neither involve introducing any new equipment, nor create any new failure modes for existing safety-related equipment. Although technical specifications changes are required, the integrity of the RWST and other potentially affected NSSS equipment is not challenged. The modifications do not result in a condition where the design, material and construction standards of the RWST and other potentially affected NSSS equipment that were applicable prior to the technical specification changes are altered. Therefore, the probability of a malfunction of equipment important to safety previously evaluated in the FSAR is not increased.

4.5 Will the consequences of a malfunction of equipment important to safety previously evaluated in the FSAR be increased?

No. The function of the containment spray and hydrogen control systems is unchanged from that currently described in the FSAR. The requirements placed upon the containment spray and the containment hydrogen control systems are not adversely affected by the proposed changes. The changes do not result in response to accident scenarios being different than that postulated in the FSAR. The changes do not involve introducing any new equipment, nor do they create any new failure modes for existing equipment. Therefore the consequences of a malfunction of equipment important to safety previously evaluated in the FSAR will not be increased.

4.6 May the possibility of a malfunction of equipment important to safety different than any already evaluated in the FSAR be created?

No. The function of the containment spray and hydrogen control systems is unchanged from that currently described in the FSAR. The requirements placed upon the containment spray and the containment hydrogen control systems are not adversely affected by the proposed changes. No new equipment is introduced as a result of the subject changes, nor has the possibility of a malfunction of existing equipment important to safety different than already evaluated in the FSAR been created. The changes do not affect the ability of the RWST and other potentially affected NSSS components to perform their intended functions, nor does it create failure modes that could adversely impact safety-related equipment. Therefore, the possibility of a malfunction of equipment important to safety different from that already evaluated in the FSAR will not be created.

4.7 Will the margin of safety as defined in the bases to any technical specification be reduced?

No. The proposed changes include the concentration of boron in the RWST, accumulators, and BAST, and the NaOH concentration in the SAT. Though these changes affect the pH of the containment spray and sump solution, there are no adverse affects on radiological consequences or hydrogen production. The bases for IP3 technical specification 3.3 states "The minimum RWST boron concentration ensures that the reactor core will remain subcritical during long term recirculation with all control rods fully withdrawn following a postulated LBLOCA".

Furthermore, the changes do not invalidate any of the IP3 non-LOCA safety analysis results or conclusions, and all of the non-LOCA safety analysis acceptance criteria continue to be met.

The margin of safety associated with the licensing basis LBLOCA and SBLOCA analyses is not reduced as a result of the proposed changes. Since adequate margin to the specified acceptance limit of 2200° F has been maintained, no degradation in the margin of safety to the design failure point (fuel melt) has been calculated.

The changes will not significantly effect the operation of the RWST or related RCS components. Although the changes do require a change to the IP3 technical specifications, they do not reduce the margin of safety as described in the bases to any technical specification.

5.0 NO SIGNIFICANT HAZARDS DETERMINATION

The safety significance of the change to the IP3 minimum RWST concentration technical specification, along with other related technical specifications, has been evaluated per the criteria of 10 CFR 50.92, and does not involve Significant Hazards Consideration based on the following answers to specific related questions:

1) Will the probability or consequences of an accident previously evaluated be increased significantly?

   No. The evaluation of the proposed changes to the IP3 technical specification indicates that the changes will not adversely affect the RWST material or any other stainless steel surface that may come in contact with the RWST fluid. The changes will not result in a condition where the design, material and construction standards of the RWST and other potentially affected NSSS components that were applicable prior to the technical specification changes, are altered. The changes are not expected to affect the phenomenon of PWSCC.

The injection of refueling water and NaOH solution into containment post-accident is a safety-related function designed to mitigate the consequences of the accident. The availability of this equipment is unrelated to accident initiation.

The previously analyzed consequences of potential excessive corrosion have not been increased, nor has the probability of such postulated events been increased. Therefore, the probability and consequences of an accident are not affected by the technical specification changes.

The probability and consequences of the non-LOCA accidents previously evaluated do not change due to the fact that the RWST boron concentration is not used as an input in the current IP3 licensing basis non-LOCA transient analyses. Further, it has been determined that, following a LBLOCA, iodine removal from the containment atmosphere by sprays, iodine retention in the sump solution and the generation of hydrogen within the containment are not adversely affected by the proposed changes. Thus, the validity of the conclusions of the previously evaluated accidents are not challenged by the change in RWST boron concentration or the SAT NaOH concentration.

With regard to the consequences of an accident previously evaluated, it was determined that the SBLOCA and LBLOCA PCT will remain below the 2200°F limit. Since the PCTs will remain below 2200°F, the radiological releases will not be adversely affected.

2) Will the possibility of a new or different kind of accident from any accident previously evaluated be created?

No. The subject changes will not cause the initiation of any accident nor create any new credible limiting single failure. The changes do not result in any event previously deemed as incredible being made credible. The changes do not result in a condition where the design, material and construction standards of the RWST and other potentially affected NSSS components, that were applicable prior to the changes, are altered. No new modes of operation are proposed for either the refueling water or spray additive. The refueling water and spray additive will function exactly as currently described in the IP3 FSAR. The change in boron concentration will not create any new type of credible LOCA accident in that RCS component boron concentrations are already modeled in LOCA accidents currently analyzed.

3) Will a significant reduction in a Margin of Safety be involved?

No. The subject changes will not significantly affect the operation of the RWST or related RCS components. Therefore, the changes to subsections 3.2.B.3, 3.3.A.1.a, 3.3.A.3.a, 3.3.A.3.c, and 3.3.B.1.a of the IP3 Technical Specification will not reduce margin of safety.

The changes do not invalidate any of the IP3 non-LOCA safety analysis results or conclusions. All of the non-LOCA safety analysis acceptance criteria continue to be met.

Iodine retention in the sump solution is not adversely affected by the proposed changes. Thus, the radiological consequences of the LOCA are not affected and remain appropriately within the 10 CFR 100 dose acceptance criteria. Furthermore, there is no adverse affect on hydrogen production in containment post-LOCA which is maintained below the limit of 4.0 vol. %.

The basis for this conclusion is that this change will not change the SBLOCA or LBLOCA PCTs above the acceptance limit of 2200°F as defined in 10 CFR 50.46 . Since adequate margin is maintained to the limit, no degradation in the margin of safety to the design failure point (fuel melt) has been calculated. Also, the hot leg switchover requirement is met for LBLOCA and SBLOCA.

Therefore, the subject changes will not involve a significant reduction in margin of safety.

6.0 <u>CONCLUSIONS</u>

Based on the results of this safety evaluation and, specifically, on the responses to the 10 CFR 50.59 and 10 CFR 50.92 screening criteria, it has been determined that the subject change in the IP3 minimum RWST boron concentration technical specification, along with other related technical specification changes, will neither involve an Unreviewed Safety Question nor Significant Hazards Consideration. Therefore, the changes will not adversely affect safe plant operation.

7.0 REFERENCES

1. Letter: NSD-MWR-1380 (Rev. 1) from Chemistry Systems to J. S. Galembush, 9/16/91.

2. Letter: ET-NSL-TSOS-91-1038 "Preliminary Tech Spec Mark Ups for Indian Point Unit 3 RWST Boron Concentration Increase", 9/19/91.

3. Letter: ET-NSA-SAII-91-311 "Safety Evaluation of Increased RWST Boron Concentration at Indian Point Unit 3", 9/19/91.

4. Letter: ET-NSL-ICSL-91-232 "Impact for Instrumentation and Control", 9/20/91.

5. Davidson, S. L. (Ed), et al., "Westinghouse Reload Safety Evaluation Methodology," WCAP-9273-NP-A, July 1985

6. 89IN*-G-0018, February 20, 1989, "New York Power Authority, Indian Point Unit 3, Boron Dilution Interim Operating Procedure," R. G. Creighton

7. Letter from NYPA- REC:91-140, 8/14/91, "New Technical Specification Limits for Indian Point Unit 3".

8. Indian Point Unit 3 UPDATED FSAR

9. Letter from NYPA- REC:91-151, 9/4/91, EQ and Dose information.

10. Letter from NYPA- REC-91-222, 12/9/91, BAST minimum volume.