William J. Cahill, Jr.
Vice President

Regulatory File Cy.

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October 10, 1975

RE: Indian Point Unit No. 3
Docket No. 50-286

Mr. D. B. Vassallo, Chief
Light Water Reactors
Project Branch 1-1
Division of Reactor Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Vassallo:

This submittal completes our response to your April 24, 1975 letter in which you requested additional information on three items in order to complete your review of the Indian Point Unit No. 3 core cooling system.

Item 1 of your letter requested that an additional cold leg guillotine break in the pump discharge piping (C_D=0.8) be analyzed. This break analysis was submitted as part of Supplement 30 to the Indian Point Unit No. 3 FSAR (Appendix 14C) in May 1975.

Item 2 of your letter specifically requested that a discussion be provided of the possibility of high levels of boric acid concentration in the core region due to continuous evaporation processes in the core region during the post-LOCA, long term core cooling period. A discussion of this subject which is provided as Attachment 1 to this letter, considers breaks in both hot and cold legs, provides a description of the analyses to justify the proposed procedures, provides the basis for initiation of hot leg recirculation at 24 hours after a LOCA, discusses single failures which could effect the recirculation capability, considers the effects of chemical additives in the sump water on the solubility of boric acid and references Westinghouse generic reports on long term core cooling-boron considerations as transmitted to the NRC by Westinghouse letters CLC-NS-309 and JOC-NS-364 dated April 1, 1975 and July 23, 1975 respectively, which consider the full spectrum of break sizes in both the hot and cold legs.

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Item 3 of your letter requested procedures that would enable the operator to prevent a high level boric acid concentration from occurring during the post-LOCA long term cooling period. Procedures are being prepared and will be available prior to plant heatup to assure plant operation in accordance with the discussion in Attachment 1. These procedures will provide for the initiation of hot leg recirculation at 24 hours after the postulated LOCA in the following fashion:

(a) For one hi-head safety injection train, 2 of the 4 cold leg injection lines will be closed and then the single hot leg injection line opened. This procedure is then repeated for the other hi-head safety injection train.

(b) All hi-head safety injection pumps will be started.

(c) Operation of the low head safety injection pumps will be continued.

A copy of these procedures will be available on-site prior to plant heatup for your inspectors to review.

Very truly yours,

William J. Cahill, Jr.
Vice President

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ATTACHMENT 1

INDIAN POINT UNIT NO. 3

BORON CONSIDERATIONS - LONG TERM CORE COOLING

DESCRIPTION AND ANALYSIS OF THE GENERAL PHENOMENA

Discussed in the Westinghouse Reports entitled "Long Term Core Cooling-Boron Considerations" (transmitted to the NRC by W Letter CLC-NS-309 dated April 1, 1975, C.L. Caso to T. Novak) and "Hot Leg Recirculation Period" (transmitted to the NRC by W Letter JOC-NS-364 dated July 23, 1975, J.O. Cermak to T. Novak).

These reports re-emphasize the adequacy of the current Westinghouse ECCS Design Concept in addressing long term core cooling needs.

Evaluation of IP-3 RCS Cold Leg Break

An analysis was performed similar to the conservative analysis presented in Table 1 of "Long Term Core Cooling - Boron Considerations" (Ref: CLC-NS-309) using Indian Point Unit 3 parameters. A comparison between the parameters used for the generic 4-loop case and the Indian Point case is presented in Table A below:

TABLE A

	W Generic Report 4-Loop Plant	Indian Point 3
Core Power MWt	3425	3025
Total Sump Inventory (lbm)	3.6×10^6	3.6×10^6
Initial ppm Boron in System	2000	2050
Effective Vessel Volume (ft^3)	1154	1154
Weight Percent Boric Acid in Vessel at 24 hours	27.2	26.8

The effective vessel volume used in the analysis includes the core and upper plenum (to the bottom of the HL nozzles) volumes. The method of analysis used here is identical to that used for Table 1 of "Long Term Core Cooling - Boron Considerations". (Ref: CLC-NS-309). Note that 1.4% margin is calculated for the Indian Point plant compared to the solubility limit of 28.2% in Figure 1 of the W Report (Ref: CLC-NS-309). At a calculated boric acid concentration below 28.2 weight %, the appropriate time for the initiation of hot leg injection would be 24 hours.

Indian Point Unit 3 has the capability to inject into two hot legs. In addition, injection is maintained to two of four cold legs, even after the changeover to hot leg recirculation is accomplished. If a single failure is assumed to occur in one hot leg injection line, then the remaining hot leg injection line will provide flow (∿250 gpm) through the core and out the cold leg break. Although the core boiling may not be fully suppressed following the 24-hour switchover with a hot leg injection flow of ~250 gpm, the boron buildup is arrested after hot leg injection is initiated. This is because the total mass of flow entering the top of the core (SI injected into hot leg + amount of core steam flow condensed in the hot leg) acts to dilute the boric acid in the core retarding the boric acid concentration buildup due to steam boiloff. In other words, 33.3 lbm/sec (250 gpm) of SI flow is being injected into the hot leg. The steam boiloff rate at this time is 16.4 lbm/sec. The injected SI flow of 33.3 lbm/sec will condense about 3 lbm/sec of the steam boiloff, leaving a net steam boiloff of 13.4 lbm/sec. The total SI flow + condensate that will enter the core is 36.3 lbm/sec, which is greater than the steam boiloff of 16.4 lbm/sec. Therefore, the boric acid concentration in the core will decrease, insuring that the solubility limit is not exceeded for Indian Point Unit 3.

Evaluation of IP-3 RCS Hot Leg Break

Cold leg flow from the cold leg injection point through the core and out the hot leg break quickly establishes a subcooled flowpath through the core and eliminates the possibility of a buildup in boric acid concentration.

After hot leg injection is initiated at the 24-hour switchover time, some cold leg injection continues, so that the hot leg break at no time would pose a problem in regard to boric acid buildup.

Summary

In summary, for Indian Point Unit 3 the 24-hour switchover time to go to hot leg injection for the spectrum of cold leg and hot leg breaks is sufficient to prevent exceeding the boric acid solubility limit (28.2% @ 212°F).

Discussion of Single Failure

Hot leg recirculation for the Indian Point Unit 3 plant is directed to two of the four hot legs. Cold leg recirculation is maintained simultaneously via 4 of the 8 cold leg injection lines. There is no single failure which could defeat all recirculation flow. There are, however, some single failures which, in combination with a hot leg break, could defeat all hot leg recirculation, i.e., (a) loss of one power train or failure of one valve to operate which would result in the inability to open one hot leg line, and (b) passive failure of one hot leg line or one SI header which would result in the unavailability of one hot leg line. As noted above, however, for a hot leg break, hot leg recirculation is not required, as cold leg injection and cold leg recirculation is maintained even after changeover to hot leg recirculation to furnish a direct flow path for cooling the core.

As the only means by which all hot leg recirculation capability could be lost is a hot leg break plus a single failure and as hot leg recirculation is not required for a hot leg break, it is concluded that this postulated condition does not present a problem.

Other single failures have previously been evaluated and are discussed in Section 6 of the FSAR.

Effects of Chemical Additives

For IP-3, the only chemical additive to the sump water is sodium hydroxide, as mixed in the containment spray, for fission product iodine removal from the containment post accident environment. Adjustment of ph also utilizes sodium hydroxide as an additive. The effects of this additive to the sump water are evaluated in the IP-3 FSAR, Appendix 6D.