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SUBJECT: Forwards comprehensive,composite white paper on evolution of final configuration for safety injection pump B,per commitment made at 920131 meeting w/NRC on technical & mgt issues associated w/safety injection sys.

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H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2
DOCKET NO. 50-261/LICENSE NO. DPR-23
FINAL CONFIGURATION FOR SAFETY INJECTION PUMP B

Gentlemen:

The purpose of this letter is to provide to the NRC a comprehensive, composite "White Paper" on the evolution of the final configuration for Safety Injection (SI) Pump B at the H. B. Robinson Steam Electric Plant, Unit No. 2 (HBR2). Carolina Power & Light Company (CP&L) committed to the preparation and submittal of this "White Paper" at the close of a January 31, 1992 meeting with the NRC on technical and management issues associated with the SI system.

This submittal should now close all issues related to SI Pump B design configuration. As previously committed, and restated during the above-referenced meeting, CP&L will continue to keep the NRC advised of the schedule for the restoration of SI Pump C, now pending receipt of new pump casings.

If you have any questions, please contact Mr. R. W. Prunty at (919) 546-7318.

Yours very truly,

David C. McCarthy

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CP&L White Paper

Final Configuration for Safety Injection Pump B
at H. B. Robinson Steam Electric Plant, Unit No. 2

Purpose:

The purpose of this "White Paper" is to summarize the events and decision processes which ultimately resulted in Safety Injection (SI) Pump B at the H. B. Robinson Steam Electric Plant, Unit No. 2 (HBR2) being configured as a standby maintenance pump, capable of automatically starting when properly aligned to the respective emergency bus in the place of SI Pump A or C when either is out of service (i.e., for maintenance).

Preamble:

The original SI system design for several of the early vintage plants (H. B. Robinson 2, Ginna, Turkey Point 3 & 4 and Indian Point 2 & 3) required only one of two SI pumps to satisfy the minimum safeguards flow requirements. Three pumps were, however, incorporated into the original designs of these plants, with the third pump considered an installed spare. However, after completing the preliminary safety analyses for these plants, subsequent results indicated that additional safeguards flow was required to provide a faster change in reactivity to mitigate certain transients.

The most cost-effective solution to this problem at the time was to automatically start the spare pump instead of changing the pump/fluid system design. While Westinghouse electrical design engineers were aware of the complicated electric scheme that this pump arrangement would require, they believed that implementation was possible, considering prevailing separation and independence criteria. From this, the concept of a "swing pump" - a pump capable of being automatically powered from either of the two divisions of the electrical distribution system according to a prescribed logic - was devised.

This feature was uniquely licensed on Ginna and HBR2. The Atomic Energy Commission (AEC), the predecessor of today's Nuclear Regulatory Commission (NRC), specifically questioned CP&L on a particular single failure aspect of this design. CP&L's response was incorporated into the original FSAR, Volume 4, Section VII, Responses to AEC Questions September 17, 1969, Question V E. Additionally, the AEC's Safety Evaluation of HBR2, dated May 18, 1970, approved a licensed power level of 2200 megawatts thermal based on a predicted peak clad temperature (PCT) of 2280°F resulting from a previously approved analytical model and an emergency core cooling system design which included the swing pump concept.

Since the time of original license, there have been numerous analytical changes to PCT which have resulted from 10CFR requirements (implementation of new 10CFR50.46 and Appendix K rule in 1974), power uprate to 2300 megawatts thermal in 1979 and intervening core model and design changes from cycle to cycle.

Background:

In January 1988, as the result of NRC questions on the automatic transfer logic of SI Pump B, Carolina Power & Light Company (CP&L) identified several single-failure vulnerabilities which could have rendered two of the three SI pumps at HBR2 inoperable, in violation of design basis and Technical Specifications. The plant was shut down, and a modification was initiated to eliminate the initial single-failure vulnerabilities.

In February 1988, modification M-947, "SI Pump Availability Upgrade," changed the power supply breaker alignment to SI Pump B (among several other changes) but did not change the basic auto-start, auto-transfer feature. While this modification resolved most of the single-failure concerns, there remained one scenario whereby the emergency bus became degraded but did not trip (such as may result from an intermediate failure of the emergency diesel generator (EDG) voltage regulator or speed control governor). Consequently, later in February 1988, modification M-951, "SI Pump B Deletion of Auto Start," was developed to resolve this scenario, as well as the other automatic transfer vulnerabilities. This modification completely removed the automatic start feature of SI Pump B, leaving it as an operator-controlled, manual-start pump only. The accompanying safety analysis addressed the effect of the operator manually loading SI Pump B onto the EDG during a Loss of Coolant Accident (LOCA), as opposed to the automatic loading after the EDG output breaker closes, as follows:

a) The EDG purchase specification required the capability of starting a 900 HP load block at any time as long as the machine rating was not exceeded (SI Pump B is nameplate rated at 350 HP).

b) The SI pump would be manually started in a controlled manner after the EDG had stabilized versus being automatically sequenced with other loads.

c) A formal EDG loading evaluation was already in progress by the Nuclear Engineering Department (NED) and load changes would be factored into that evaluation.

It should be noted that the total connected equipment load on the EDG was unchanged by this modification. Essentially, only the timing and method of pump start was changed.

Since modification M-951 reduced from three to two the number of automatically started and load-sequenced SI pumps, a Technical Specification (TS) change from the NRC was required. Therefore, an emergency TS change request was submitted in late February 1988 following a series of meetings and telephone calls with the NRC. Based on initial analysis results, the maximum power level was restricted to approximately 60 percent. On March 7, 1988 License Amendment No. 115, authorizing the change, was approved, and modification M-951 was implemented.

It was originally anticipated that additional, more detailed analyses would justify a power level of approximately 80 percent, and that design and operational changes would be required to restore power to 100 percent. However, with only analytical model input assumption refinements, a return to full power was ultimately justified. A second emergency TS change request was then submitted in early May 1988. However, the NRC disagreed with CP&L's assessment that there had not been a significant reduction in the margin of safety and thus required a full 30-day notice in the Federal Register. As a result, CP&L continued evaluating both design and operational potential changes to allow an earlier return to power. Ultimately, however, all other courses of action had a greater regulatory or technical uncertainty; and thus the original request was issued by the NRC on June 20, 1988 as License Amendment No. 119 after the full notice period. HBR2 was returned to full power shortly thereafter.

During this same time period, as previously mentioned, NED was performing a detailed loading analysis of the EDG. This effort was the result of an issue raised during the NRC's Electrical Safety System Functional Inspection (SSFI) in early 1987. The issue was the capability of the EDG to carry the required loads during a LOCA sequence. Since no such analysis could be produced from the original design documentation, a short-term evaluation was performed by NED and plant Operations personnel in 1987 which confirmed the adequacy of the EDG. This evaluation considered the loading of all three SI pumps, which was the design basis at the time. As part of long-term resolution and per the Design Basis Reconstitution effort, CP&L committed to a more comprehensive load study. It was this effort which was in progress during the evolution of the SI system design. Another factor in the EDG load study was the incorporation of additional HVAC electrical loads resulting from the Control Room Habitability modification, which was to be installed during Refueling Outage No. 12 (RO12) in late 1988.

This additional Control Room HVAC load, coupled with ongoing discussions related to operator responses to Emergency Operating Procedures and restarting operator discretionary loads that were initially automatically load shed (such as instrument air compressors and Auxiliary Building HVAC loads), challenged the ongoing EDG load study; and in fact, the load study was temporarily stopped in July 1988 to resolve concerns. A multi-path electrical distribution system decision logic was then created to systematically evaluate and integrate the various options into the most comprehensive, cost-effective solution. The third SI Pump was recognized by the logic as a viable electrical load, even though no credit could be taken for it in the thermal-hydraulic accident analyses. While the decision logic was still being evaluated, before any final results had been obtained or conclusions reached, CP&L decided to completely remove SI Pump B from its augmented operator-controlled design feature. Thus, the design was revised in October 1988 by modification M-958, "Add Auto Start to B SI Pump." This modification restored the automatic start feature of the pump, but only when it had been properly aligned to take the place of SI Pump A or C when either had been taken out of service for maintenance. SI Pump B had now become a true standby maintenance pump. The safety analysis for this modification noted that SI flow and electrical load were not changed (per the accident analysis) and that no TS change was required. However, the description in the Updated Final Safety Analysis Report (UFSAR) would have to be revised. On December 30, 1988, CP&L formally notified the NRC of the final SI system configuration and provided a commitment to continue operability surveillance as required by the Inservice

Inspection Program on SI Pump B. The modification was installed during RO12 in the time frame of November 1988 through February 1989.

Analysis:

It was a combination of design, analytical and operational considerations that led to the final SI pump configuration. It had become clear that (1) no credit could be taken for SI Pump B in the accident analysis, even though it was available for manual loading, (2) the revised accident analysis showed that use of the third SI pump was not required to mitigate the effects of design basis accidents, and (3) the electrical margin of the EDGs was being reduced by the addition of HVAC loads and the potential for discretionary operator actions. Thus CP&L determined that the most prudent, cost-effective course of action to eliminate all single failure concerns, completely satisfy the accident analysis requirements and provide maximum electrical load management flexibility was to modify the SI pump configuration as described above.

It should be noted that this final configuration is consistent with that of CP&L's other Westinghouse plant and with several others in the industry. As previously discussed, the originally licensed design of three SI pumps had been revised from the initial design which required only two pumps; it was one of only two such designs so licensed by the NRC.

When the EDG load study resumed in December 1988, the final SI configuration had been established, and the modification work was proceeding. Thus, the removal of the manual-start capability from SI Pump B now became an input into the EDG load study. Even though some previous communications may have assumed that EDG capacity was insufficient to accommodate the third SI pump, the chronology clearly demonstrates that the detailed EDG load study had not progressed to the point of fully evaluating the third SI pump load. Due to the complexity and iterative nature of the study, it is not valid to simply add the SI Pump B load on the back end now and evaluate the results. Many operational and design decisions made much earlier in the process would have to be revisited and reworked. This would be a major effort, and there are no requirements or plans to do so.

As a further consideration, removal of the third SI pump from operator control also removed another operator decision point from the Emergency Operating Procedure (EOP) sequence, thus allowing more focused operator attention to those actions which are required for mitigation, restoration, and safe operation of the plant during a design basis event.

Conclusion:

The ultimate decision to employ SI Pump B as a standby maintenance pump was based on three overlapping considerations:

(1) By detailed accident analysis, the third SI pump is not required to mitigate the effects of a design basis LOCA in accordance with the criteria of 10CFR50.46 and Appendix K.

(2) The safety-train independent, two SI pump configuration unequivocally eliminates all the single-failure vulnerabilities associated with the starting, running, and transfer of the third, "swing" pump. This design configuration is consistent with the design of CP&L's other Westinghouse PWR and that of many other single-unit PWRs in the industry.

(3) The elimination of the potential for an additional operator-controlled electrical load (which could not be credited for accident mitigation) which would have to have been factored into the EDG load study, allowed for a much more prudent use of design and operational margin in the electrical distribution system.

This design is the best approach which satisfies the composite of regulatory, analytical, design, and operational considerations for the H. B. Robinson Plant.