Florida Power
CORPORATION

Crystal River Unit 3
Docket No. 50-302

October 4, 1990
3F1090-04

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555

Subject: Reactor Building Spray pH During Small Break LOCA

Reference:
A. FPC to NRC letter, dated June 4, 1990
B. FPC to NRC letter, dated June 15, 1990
C. NRC to FPC letter, dated June 21, 1990
D. NRC letter - Proposed Revision 2 to SRP Section 6.5.2 and Supporting Technical Documents, dated April 6, 1987

Dear Sir:

This letter provides Florida Power Corporation's (FPC) disposition of the Reactor Building (RB) spray pH concern identified during the resolution of the RB Flood Level issue. The RB spray pH issue is described in references A through C. The general background discusses the purposes of pH adjustment during LOCA events. This discussion is followed by a clear definition of the problem we have been addressing and the corrective actions we are taking. The remaining sections of the letter describe the safety implications of changes to the RB spray pH and our conclusion that the corrective actions are appropriate to resolve the problem.

GENERAL BACKGROUND

To handle the large iodine releases postulated for a large break LOCA (LBLOCA) and minimize the dose, some capability must be provided to remove elemental iodine from the RB atmosphere and contain it in the RB sump. The capacity of the RB sump water to retain iodine and, thereby, reduce doses is a function of the water's pH. The pH has a direct impact on the analysis of onsite and offsite dose consequences for loss of coolant accidents. The standard analytical assumption has been that the pH of the sump water must be basic. To assure that the iodine did not re-evolve due to a LBLOCA, dose analyses in a plant of CR-3's vintage assumed a final RB sump water pH of 8.5 to 11.0 which is in agreement with NRC recommended limits. Solutions with

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this pH range were assumed to be effective in retaining the elemental iodine while in the recirculation phase. The LBLOCA calculations performed for CR-3 assured that this range was met even assuming worst case single active failures.

PROBLEM DESCRIPTION

While evaluating the alternative resolution strategies to the RB Flood Level issue, FPC and B&W identified that the pH range of the RB spray for a small break LOCA (SBLOCA) may not be enveloped by existing LOCA analysis results. This results from system response to a SBLOCA creating different Borated Water Storage Tank (BWST) and Sodium Hydroxide (NaOH) Tank drawdown rates than those assumed in the LBLOCA analysis. This concern was first discussed in Reference A. Reference B advised the NRC that FPC was evaluating the reportability of the concern. The NRC noted in Reference C that a discussion of our resolution to the pH concern was necessary for closure.

The LOCA analyses assume simultaneous actuation of the High Pressure Injection (HPI) and Low Pressure Injection (LPI) functions of the emergency core cooling systems (ECCS) and the RB spray to evaluate the thermal-hydraulic performance of the reactor core and containment. The primary initial consequences of the LBLOCA are rapid depressurization of the reactor coolant system (RCS) and pressurization of the containment. A LBLOCA will actuate the HPI function at 1500 psig RCS pressure, the LPI function at 500 psig RCS pressure and the RB spray at a high RB pressure of 30 psig. These conditions are reached almost instantly during a LBLOCA.

The HPI, LPI and RB spray functions initially take suction from the BWST. The addition of NaOH to the RB spray is accomplished at CR-3 utilizing a passive, gravity feed connection to the BS pump suction path. The drawdown rates of borated water from the BWST and sodium hydroxide from the NaOH Tank are functions of the hydraulic conditions for each tank and produce the desired pH ranges. The rapid RCS depressurization of a LBLOCA was utilized to establish the design requirements for the NaOH addition system to ensure the pH range was met. Proper operation of the NaOH addition function during a LBLOCA was assured by considering the worst case single active failures expected to occur in the LPI and the BS systems. The HPI function is not assumed to play a part in mitigating a LBLOCA and has no significant, long term impact on the relative drawdown rates.

However, our SBLOCA analyses have shown that, depending upon the break size, a SBLOCA may actuate the HPI; but not actuate LPI or RB spray until some time after the break occurs. This scenario could create a difference in the relationship of the hydraulic heads on the BWST and NaOH Tank. Consequently, the drawdown rates and relative amounts of the boric acid and NaOH supplied to the RB spray could be different when it is actuated. Thus, any LOCA scenario which does not produce simultaneous drawdown could produce a RB spray pH higher than the current assumed pH range which leads to a concern for the degradation of equipment in the RB.

CORRECTIVE ACTIONS

FPC is implementing procedural changes in the Emergency Operating Procedures to require the control room operators to close the NaOH Tank outlet valves (BSV-11/BSV-12) in response to symptoms indicative of a SBLOCA. The procedures will advise the operators to verify, prior to closing the valves, that RCS pressure is remaining above 200 psig by monitoring existing RCS pressure instrumentation. This action will resolve the immediate concern and is acceptable for an interim corrective action since NaOH is only necessary to preclude the re-evolution of iodine during the recirculation phase for a LBLOCA. The procedural action will eliminate the possible high RB spray pH condition. The procedures have been revised and the licensed reactor operators have been trained on the procedure changes.

SAFETY ASSESSMENT OF CHANGES IN ASSUMED SPRAY pH FOR SBLOCAs

Regulatory Guide (RG) 1.4 requires dose analyses to assume the immediate release of significant iodine quantities into the containment atmosphere. These are 25% of the equilibrium radioactive iodine inventory developed from maximum full power operation of the core immediately available for leakage from the containment composed of 91% elemental iodine, 5% particulate iodine, and 4% organic iodides. In addition to the assumption that large quantities of iodine are released, the doses to the plant and the general public are calculated based on RG 1.4 assumptions that the leakage rate from the RB is to occur at 0.25% RB volume/day for 24 hours and half of that leakage rate after 24 hours.

Iodine releases of this magnitude cannot occur immediately and are expected to occur only during the Maximum Hypothetical Accident (a largely unmitigated design-basis LOCA), certainly not a SBLOCA. SBLOCAs will not create the potential (e.g extent of fuel damage) for iodine releases of the magnitude assumed for LBLOCAs. Further, SBLOCA analyses have shown that RB pressures will not reach those projected for a LBLOCA (55 psig). The differential pressure necessary to force RB leakage rates of this magnitude is not available. For instance, the TMI-2 accident caused substantial core damage to occur and released significant amounts of radionuclides from the fuel, but only a negligible amount of the iodine inventory was released to the environment and no metallic radionuclides are known to have been released. Consequently, the resulting dose from a SBLOCA will remain bounded by the LBLOCA.

Recent research, discussed in Reference D, also confirms that the release of fission products will not occur immediately upon the occurrence of a LOCA and the iodine removal rate of a plain boric acid spray is high enough to make a spray additive unnecessary. Based upon these research findings, the NRC in December 1988 published Revision 2 to the Standard Review Plan (SRP) Section 6.5.2, "Containment Spray As A Fission Product Cleanup System." In the revised SRP, the NRC permits the spraying of a plain boric acid solution during the initial injection phase when the spray solution is being drawn from the BWST. Since a plain boric acid spray could increase the potential for elemental iodine re-evolution and long-term stress corrosion, SRP

6.5.2 does contain a suggestion that the equilibrium sump solution pH be adjusted to above 7.0 by the time of the onset of the recirculation mode. One way this adjustment can be accomplished is by the use of tri-sodium phosphate (TSP-C) stored in baskets located in the reactor building lower levels, or other means. As shown by this research and based on the reduced source term and release potential, the enhanced removal and containment of iodine provided by the use of caustic additives is not necessary to demonstrate that the dose to the plant and general public resulting from a SBLOCA are acceptable and within appropriate limits.

The procedure change will not affect the ECCS functions to cool the reactor core. Further, the containment heat removal function of the BS System is maintained for all LOCA'S.

FPC has evaluated the effects of spray pH on the environmental qualification (EQ) of equipment in the RB. That equipment will not be degraded by exposure to a RB spray solution with a pH between the limits of 4.0 to 11.0 for 6 months or 11.0 to 12.5 for 19 minutes.

The Plant Review Committee has been briefed on this issue and concurs with the changes in procedures. The 10 CFR 50.59 evaluation has not identified any unreviewed safety questions.

CONCLUSION

The procedural change discussed above is an acceptable interim corrective action. However, the operator's burden is increased as a result of this requirement to isolate NaOH during SBLOCA conditions. Further, the use of NaOH at CR-3 has been proven to be a manpower intensive maintenance problem. The NaOH is a hazard to personnel and property from accidental spillage, and its use as a spray additive is no longer the only acceptable alternative for iodine control. Therefore, FPC is evaluating the most effective design for replacement of the NaOH spray additive. TSP-C installation appears to be the preferred method for spray pH control replacement.

Therefore, FPC concludes the following:

1. There is reasonable assurance that isolation of the NaOH tank only during a SBLOCA will provide adequate environmental and radiological protection for the spectrum of LOCAs.

2. Environmentally qualified equipment located in the RB sprayed with solutions in the expected pH ranges (4.0 to 11.0 for 6 months or 11.0 to 12.5 for 19 minutes) will not be unacceptably degraded.

CONCLUSION (Continued)

3. Installation of TSP-C baskets is the most appropriate permanent corrective action. Installation is currently scheduled for Refuel 8 (subject to material availability).

Sincerely,

P. M. Beard, Jr.
Senior Vice President
Nuclear Operations

PMB/KRW/JWT

cc: Regional Administrator, Region II
Senior Resident Inspector