UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON D. C. 20555

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

SUPPORTING AMENDMENT NO. 20 TO FACILITY OPERATING LICENSE NO. DPR-72

FLORIDA POWER CORPORATION, ET AL

CRYSTAL RIVER UNIT NO. 3 NUCLEAR GENERATING PLANT

DOCKET NO. 50-302

Introduction

By application dated September 1, 1977, as replaced by application dated May 25, 1979, the Florida Power Corporation (FPC or the licensee) proposed changes to Specification 3.6.2.2, Spray Additive System, of the Technical Specifications of Crystal River Unit 3 Nuclear Generating Plant (CR-3). The licensee proposed a reduction in the acceptable concentration limits of sodium hydroxide in Tank BST-2 in the Chemical Additive System (CAS) of the CR-3 Reactor Building Spray System (RBSS). The licensee proposes to change the acceptable range of sodium hydroxide concentrations in Tank BST-2 from between 21.2 to 22.3 weight percent to between 10.5 to 12.0 weight percent. The range of acceptable values of the volume of sodium hydroxide in Tank BST-2 is not being changed.

Condition 2.C.(4) of the CR-3 operating license required the licensee to isolate the sodium thiosulfate tank and its contents from the RBSS CAS until permanent modifications to the CAS were submitted to NRC for review and approval. This is discussed in Supplement No. 3 dated December 1976 to the Safety Evaluation (SE) dated July 1974. The isolation of Tank BST-1 from the CAS and the deletion of specifications on this tank were reviewed and approved in the SE dated January 4, 1979. The proposed reduction in sodium hydroxide concentration limits for Tank BST-2 implement the licensee's permanent modifications to the CAS.

Evaluation

We have reviewed and evaluated the data provided by the licensee on the CR-3 RBSS in his letters dated September 1, 1977 and May 25, 1979. By letter dated May 25, 1979, the licensee showed that the pH of the CR-3 RBSS injection spray and recirculation (sump) spray water was between 7.9 and 11 and the potential consequences of the postulated loss of coolant accident (LOCA) were calculated to be less than the exposure guidelines of 10 CFR Part 100. The concentrations of sodium hydroxide in the CAS used in the licensee's calculations are the values proposed in the licensee's letter dated May 25, 1979.

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On the basis of the data he has provided in his letter dated May 25, 1979, the licensee states that the CR-3 RBSS is adequate to assure acceptable spray water chemistry and potential consequences of the postulated LOCA which are less than the exposure guidelines of 10 CFR Part 100.

To show there is adequate assurance that sufficient sodium hydroxide will be added by gravity to the RBSS during a LOCA, the licensee has provided data from tests of the CAS. The licensee ran a series of measured drawdowns of the Borated Water Storage Tank, Tank BST-1 and Tank BST-2. These tests were made during the startup and test program of CR-3 in 1975 when Tank BST-1 was not isolated from the RBSS and contained sodium thiosulfate. After these water tests were performed, four spring-loaded stop check valves were replaced with conventional spring check valves and the CAS was retested. The tests were run pumping water from the tanks into the fuel transfer canal. These tests were compared to calculations made by the GAI computer program "Thermal Hydraulic Analysis." Comparison of the results are given in references (1) and (2). We conclude, based on these comparisons, that the computer program can accurately predict the performance of the CAS in the RBSS and can be used to determine the adequacy of the RBSS to maintain acceptable spray water pH.

Because the minimum pH of the RBSS spray water is less than 8.5, the evaluation of the CR-3 RBSS in Supplement No. 3 dated December 1976 of the SE dated July 1974 is no longer valid as it concerns (1) the RBSS spray water pH during the LOCA and (2) the potential consequences of the postulated LOCA. Our evaluation of the CR-3 RBSS during the LOCA concerning the above two items, based on the latest data on the CR-3 RBSS supplied by the licensee, is below. In addition, the evaluation in Supplement No. 3 above did not include the potential consequences due to leakage from safeguards equipment outside containment. This equipment outside containment, Decay Heat Removal and RBSS spray pumps and piping, circulates potentially highly radioactive water from the containment sump back to containment. Leakage from these systems outside containment will contribute to the potential consequences of the postulated LOCA. The potential consequences given in this evaluation will include a contribution from this pathway.

The requirements on post-accident spray water chemistry are discussed in Standard Review Plan (SRP) 6.5.2. The pH of the RBSS spray water during injection and recirculation should be between 8.5 and 11.0. As given in the Tables in the licensee's May25, 1979 letter, the pH of the RBSS spray during the LOCA is between 7.9 and 11.0. This includes the case of failure of one of the two valves at Tank BST-2 and all of the sodium hydroxide from the tank entering one of two operating RBSS trains which results in the maximum pH in the spray. For the most restrictive single active failure in the RBSS, in terms of the potential consequences of the postulated LOCA, the loss of a spray pump, the minimum pH of the RBSS spray is 8.1.

The minimum pH of the RBSS spray water is below 8.5 because the maximum pH was not allowed to be greater than 11.0. The requirement that the maximum spray water pH must be less than 11.0 is more important than the requirement that the minimum pH should be 8.5 or greater. Keeping the spray water pH no greater than 11 will prevent caustic stress corrosion cracking and degradation of the RBSS piping during a LOCA. Keeping the spray water pH no less than 8.5 will inhibit chloride stress corrosion cracking and degradation of the RBSS piping and will provide maximum spray effectiveness at preventing radioiodines released to the containment atmosphere during a LOCA from being released outside to the environment. Allowing the spray water pH to be less than 8.5 will reduce the effectiveness of the spray water to remove radioiodine from the containment atmosphere and to retain this radioiodine in the water. However, with the pH of the RBSS spray water above 7, the water will still inhibit chloride stress corrosion cracking in the RBSS piping and will still remove radioiodine from the containment atmosphere and retain it in the water. The effectivness of the spray to remove radioiodines from the containment atmosphere and retain it in the water and, thus, to reduce the potential consequences of the postulated LOCA increases rapidly with pH between 7 and 8.5.

We have calculated the potential consequences of the postulated LOCA at CR-3 with the proposed changes to the RBSS CAS. This is for a minimum RBSS spray water pH of 8. The potential consequences and the assumptions made to calculate them are given in Table 1 and Table 2, respectively. The potential consequences of the postulated LOCA are well within the exposure guidelines of 10 CFR Part 100. The potential consequences include a contribution due to leakage from safeguard equipment located outside containment. This contribution to potential consequences had not been included in previous evaluations of the postulated LOCA; however, the licensee does have specifications limiting the maximum acceptable leakage from this equipment outside containment. Compliance with Specification 4.5.2.e.5 (Decay Heat Removal System) and 4.6.2.1.b (RBSS) provide assurance that the leakage rates assumed for the two systems during the postulated LOCA will not be exceeded. Because the potential consequences of the postulated LOCA are within the exposure guidelines of 10 CFR Part 100, the potential consequences are acceptable and the proposed Specification 3.6.2.2 is acceptable as written.

Moderator Dilution

Based on an operating experience it had been determined that inadvertent injection of the contents of BST-2 into the reactor coolant system must be considered as a potential moderator dilution accident. Currently procedural restrictions are imposed to preclude this accident while the issue is being reviewed. However, during review of the spray additive system discussed above, it was determined that the potential for boron dilution by this means existed at times during Mode 4 operation with the decay heat system lined up for recirculation.

By letter dated July 3, 1979, the licensee proposed a Technical Specification change which would require a shutdown margin of $\geq 2.2\% \Delta k/k$ instead of $\geq 1.0\% \Delta k/k$ during Mode 4. This requirement was also proposed for mode 5 for consistency of operation. In support of this change the licensee presented an analysis which demonstrates that with this shutdown margin the operator has at least 15 minutes to take action before the reactor core could become critical. This meets the current criteria in Standard Review Plan 15.4.6.

We have reviewed the licensee's analysis and proposed changes to the Technical Specifications and find them acceptable.

Environmental Considerations

We have determined that the amendment does not authorize a change in effluent types, an increase in total amounts of effluents or an increase in power level and therefore will not result in any significant environmental impact. Having made this determination, we have further concluded that the amendment involves an action which is insignificant from the standpoint of environmental impact and, pursuant to 10 CFR 51.5(d)(4), that an environmental impact statement or negative declaration and environmental impact appraisal need not be prepared in connection with the issuance of this amendment.

Conclusion

We conclude on the basis of the above considerations that the proposed changes to Specification 3.6.2.2 of the CR-3 Technical Specifications is acceptable as written.

We also have concluded, based on the considerations above, that: (1) because the amendment does not involve a significant increase in the probability or consequences of accidents previously considered and does not involve a significant decrease in a safety margin, the amendment does not involve a significant hazards consideration, (2) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, and (3) such activities will be conducted in compliance with the Commission's regulations and the issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public.

References:

1. Ely, R. F. Jr., "Borated Water Storage Tank Drawdown Transient Analysis, Revision 1," for Crystal River Unit 3 Nuclear Generating Plant, Florida Power Corporation, 30 January 1976.

2. Ely, R. F. Jr., "Hydraulic Analysis of Piping Networks Using PIPF Computer Program," Topical Report GAI-TR-105, December, 1976.

Dated: July 3, 1979

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TABLE 1

POTENTIAL OFFSITE DOSES OF THE POSTULATED LOSS-OF-COOLANT ACCIDENT

Accident	Two Hour Exclusion Boundary (1340 Meters)		Course of Accidents Low Population Zone (8047 Meters)	
	Thyroid (Rem)	Whole Body (Rem)	Thyroid (Rem)	Whole Body (Rem)
Loss of Coolant				
Leakage thru containment	150.	3.0	27.	0.7
Leakage outside containment	4.8	.012	4.1	.004
Post-LOCA Hydrogen Purge Dose	-	-	<1	<1

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TABLE 2

ASSUMPTIONS FOR THE POSTULATED LOSS-OF-COOLANT ACCIDENT

Hydrogen Purge Dose Analysis

Using Regulatory Guide 1.7 assumptions, the licensee has calculated a hydrogen purge dose of approximately 0.1 Rem at the Low Population Zone. Our independent calculations are in substantial agreement with this incremental dose.

Loss-of-Coolant Accident

Regulatory Guide 1.4, Revision 2, 1974

Power (MWt)	2544
Containment Volume (ft^3)	2×10^6
Volume In Sump (lbs.)	3.8×10^6
Distribution of Radioiodines (%)	
elemental	91
organic	4
particulate	5

Through Containment Leakage

Design Containment Leak Rate (%/day)	
0 - 24 hours	0.25
24 hours	0.125
Spray fall height (ft)	96
Spray flow rate (gpm)	1500
Spray reduction limits	
elemental iodine	50
Partition Coefficient	
elemental iodine	1600 (pH=8)
Spray Removal rates (hrs)	
elemental iodine	7.05
organic iodine	0.0
particulate iodine	0.45
Unsprayed region (%)	25.

TABLE 2 (Cont'd)

Leakage Outside Containment (gph)	
Reactor Building Spray System	12
Decay Heat Removal System	12
Charcoal Filter Efficiency (%)	
elemental iodine	90
organic iodine	70
particulate iodine	90
Percent of Iodine Released (%)	10
Start of Recirculation After LOCA (Hr)	0.67
Atmospheric Dispersion Factors (sec/m^3)	
0 - 2 hours (1340 meters)	2.2×10^{-4}
0 - 8 hours (8047 meters)	1.0×10^{-5}
8 - 24 hours	6.8×10^{-6}
24 - 96 hours	2.8×10^{-6}
96 - 720 hours	7.5×10^{-7}