Florida Power
CORPORATION

August 30, 1988
3F0888-21

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

Subject: Crystal River Unit 3
Docket No. 50-302
Operating Licensing No. DPR-72
Response To NRC Bulletin 88-08:
Thermal Stresses In Piping Connected To RCS

Dear Sir:

Florida Power Corporation (FPC) is submitting the following information as its response to Bulletin 88-08 and its two supplements.

In January 1982, Crystal River Unit 3 (CR-3) had a failure in its normal makeup nozzle. The Emergency Core Cooling System (ECCS) piping failure at Farley 2, and the Make-Up/ High Pressure Injection (MU/HPI) line failure at Crystal River Unit 3 were both brought on by high cycle thermal fatigue. Similarity between the two failures would appear to end at this point, owing to the dissimilar nozzle arrangement. Farley's arrangement features an elbow while CR3 utilizes a straight run protected by a thermal sleeve. The solution path taken by FPC and the B&W Owners Group parallels the action items outlined in Bulletin 88-08. FPC letter dated April 30, 1982 (3F0482-34) documents the failure mechanism and actions taken to repair the safe-end region components.

Following the failure of the MU/HPI nozzle safe end welds at CR-3, a metallurgical examination concluded that a degraded or inadequate contact expansion of the associated thermal sleeve was the principle, contributing factor in the safe-end weld thermal fatigue failure. Flow induced vibration caused a loose thermal sleeve to rotate, allowing circulation of primary coolant between the thermal sleeve and nozzle body. The thermal sleeves on the other three nozzles were intact, undamaged and properly rolled. Nondestructive testing (radiography, dye penetrant, ultrasonic) of these nozzles did not reveal any flaws induced by thermal fatigue.

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Once the failure mechanism was understood, the nozzle assemblies were modified. The thermal sleeve in the MU/HPI nozzle was replaced with a slightly longer sleeve (+1.5"). The added length was necessary to facilitate installation. The check valve just upstream of each nozzle was relocated five inches further upstream, and all thermal sleeves were rerolled to improve and expand nozzle contact. Following the repair effort, a finite element analysis qualified the revised configuration for service based on the original design code (USAS B31.7, June 1968).

Actual operating data was collected on the MU/HPI nozzle assembly using thermocouples, strain gages, and accelerometers. Data was collected across the full spectrum of expected flow conditions, from full emergency flow down to a minimum of 1.5gpm. Throughout testing, the temperature profiles at each cross sectional plane did not indicate the presence of hot spots or flow stratification. Static and dynamic strains measured at the safe end to HPI piping interface were well below allowable limits. Since the flow characteristics and temperature distribution downstream of the modified nozzle is acceptable at a flow rate of only 1.5gpm, FPC is confident that a lesser flow rate, such as that resulting from upstream valve leakage, will not compromise the integrity of the assembly.

The nozzles are now part of an augmented inservice inspection plan. Nondestructive testing (radiography) is used to confirm nozzle and thermal sleeve integrity during selected refueling outages. The radiography was last performed during Refuel V (1985).

FPC considers the testing and analysis performed on the dual function MU/HPI nozzle as part of our 1982 repair program to be more than sufficient to qualify the HPI "only" nozzles for any minor valve leakage. The redesign, testing, analysis and surveillance of the nozzles parallels the actions requested in Bulletin 88-08. This letter completes the action requested by Action Item 1 and Reporting Requirement 1.

Sincerely,

Rolf C. Widell, Director
Nuclear Operations Site Support

RCW/JWT/kdr

xc: Regional Administrator, Region II

Senior Resident Inspector

STATE OF FLORIDA

COUNTY OF PINELLAS

Rolf C. Widell states that he is the Director, Nuclear Operations Site Support for Florida Power Corporation; that he is authorized on the part of said company to sign and file with the Nuclear Regulatory Commission the information attached hereto; and that all such statements made and matters set forth therein are true and correct to the best of his knowledge, information, and belief.

R. C. Widell

Rolf C. Widell, Director
Nuclear Operations Site Support

Subscribed and sworn to before me, a Notary Public in and for the State and County above named, this 30th day of August, 1988.

Sheryl D. Roberson

Notary Public

Notary Public, State of Florida at Large,

My Commission Expires: NOTARY PUBLIC STATE OF FLORIDA MY COMMISSION EXP. JULY 22,1989 BONDED THRU GENERAL INS. UND.