B 06/13/78

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DOCDATE: 06/08/78
DATE RCVD: 06/12/78

DOCTYPE: LETTER NOTARIZED: YES

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LTR 3 ENCL 40

SUBJECT:
FORWARDING REVISED RESPONSE TO QUESTIONS 6, 7, & 8 ORIGINALL SUBMITTED ON 06/02/78 CONCERNING LONG TERM REPAIR SCHEME THAT WOULD BE IMPLEMENTED ON THE "B" OTSG DURING THE REFUELING OUTAGE FOLLOWING COMPLETION OF THE FIRST FUEL CYCLE... NOTARIZED 06/08/78

PLANT NAME: CRYSTAL RIVER #3

REVIEWER INITIAL: XJM
DISTRIBUTOR INITIAL: DL

***************** DISTRIBUTION OF THIS MATERIAL IS AS FOLLOWS *****************

GENERAL DISTRIBUTION FOR AFTER ISSUANCE OF OPERATING LICENSE.
(DISTRIBUTION CODE A001)

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DISTRIBUTION: LTR 40 ENCL 39
SIZE: 3P+4P

CONTROL NBR: ~~781640005~~ MK GI

*********************************** THE END ***********************************

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Florida Power
CORPORATION

June 8, 1978

Mr. Robert W. Reid, Chief
Operating Reactors Branch #4
Division of Operating Reactors
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: Crystal River Unit #3
Docket No. 50-302
Operating License #DPR-72

Dear Sir:

On June 2, 1978 we submitted responses to questions contained in Enclosure 2 of your letter of May 2, 1978.

Since submitting this information, we have had further internal discussions pertaining to our response to questions 6, 7 and 8 and believe that clarification to our response to these questions is necessary.

Attached is a revised response to questions 6, 7, and 8 collectively. We request that this information be used in lieu of the response contained in our June 2, 1978 letter to questions 6, 7 and 8. This revision is required to correctly relay our position to you. Our June 2 submittal contained information which indicated that the "long term repair scheme" would be implemented on the "B" OTSG during the refueling outage following completion of the first fuel cycle. We have made no decision yet to implement the long term repair and feel that it would be imprudent to make that decision at this time. We are confident that there are no safety implications involved with continued operation of CR-3 due to OTSG concerns at this time and prefer to delay a decision as to the long term repair implementation until a later date.

In addition, our June 2 submittal contained a paragraph with the heading Calculations as part of the response to questions 6, 7 and 8. This information is not relevant and has been deleted from the attached, corrected response. We request that this information in our June 2 submittal be disregarded. We believe there is no reason to assume tube-to-tubesheet leakage paths at this time as the OTSG has been leak tested and there is no mechanism to induce weld failures for the remainder of the first fuel cycle.

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General Office 3201 Thirty-fourth Street South • P.O. Box 14042, St. Petersburg, Florida 33733 • 813—866-5151

We apologize for any inconvenience this may cause you or your staff and appreciate your consideration of our request.

Very truly yours,

FLORIDA POWER CORPORATION

A. J. Ormston

A. J. Ormston
Vice President

AJO/hw 3/9a

Attachments - 1
File: 3-0-3-a-3

STATE OF FLORIDA

COUNTY OF PINELLAS

A. J. Ormston, Vice President for Florida Power Corporation, states 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.

A. J. Ormston

A. J. Ormston

Subscribed and sworn to before me, a Notary Public in and for the State and County above-named, this 8th day of June, 1978.

Notary Public

Notary Public, State of Florida at Large,
My Commission Expires: July 25, 1980

Revised response to Questions 6, 7 and 8 of Enclosure 2 of May 2, 1978 letter.

Questions 6, 7, 8 are answered in unison as they all pertain to Once-through-Steam Generators (OTSG's). The answer takes the form of an updated status of the OTSG test and repair program.

Question 6 - Describe the damage to the steam generator tubesheets and steam generator tubes.

Question 7 - Describe your plans to repair the damaged components of the steam generators including the procedures for rewelding grinding or milling, testing, and inspection.

Question 8 - Provide the results of the inspections, tests, and repairs discussed above.

Answer:

B&W has concluded that continued operation of CR III "B" OTSG for a short period (1 year or less) does not represent a safety problem. The damage has been limited to tube ends and weld deposited Inconel. The strength of the tube-to-tubesheet joint to resist an accident event has not been reduced since the "hard" tube roll strength capacity has been determined independent of the seal weld. The seal weld minimum leak path has not been decreased below minimum ASME code requirements for a seal weld, the seal capabilities of the weld for the short term have only been effected in the areas of low cycle fatigue and stress corrosion cracking. Low cycle fatigue is not considered a safety problem since only plant heat-ups and cooldowns affect this property. Failures of this nature will only cause plant shutdowns for repair when the leakage exceeds plant limitations. Stress corrosion cracking is a long term phenomenom requiring incubation periods longer than the anticipated time to the next refueling. Again failures of this nature result only in plant shutdowns for weld repairs when leakage exceeds plant limitations.

Background:

The structural attachment of the tube to the tubesheet is at the primary side of the tubesheet. The 56 foot long, 5/8" O.D. tubes extend from the primary sides of the upper and lower tubesheets, through the two foot thick tubesheets, and through 15 support plates spaced three to four feet apart. The attachment to the tubesheet consists of a "hard" roll expansion approximately 1 inch into the tubesheet measured from the tube-to-tubesheet fillet seal weld on the tubesheet primary face.

A high quality automatic machine fillet weld at the tubesheet primary face provides the primary-to-secondary side seal. This is an Inconel weld between the Inconel tube and Inconel clad (5/16" thick) tubesheet.

Loads that are imposed on the tube-to-tubesheet joint are primarily axial loads due to thermal differentials and pressure fluctuations (pulses). Lateral loads and their resulting moments applied by secondary side conditions are attenuated within the 23 inches of tubesheet before reaching the 1 inch "hard" tube roll.

Damage

Damage to the tube and extending above the tube-to-tubesheet weld, the weld itself, and clad has been varied. The tube-to-tubesheet damage has been classified into the following categories:

Class I (55% of the tubes)

Impact or roll over of tube ends may exist on the O.D. or I.D. Deformed material does not include weld metal.

Class II (6% of the tubes)

Partially separated chip (sliver); may exist with Class 1, III, or IV damage.

Class III (26% of the tubes)

Minor weld damage extending into the upper 1/3 of weld metal.

Class IV (17% of the tubes)

Damage to the tube ends and weld metal is excess of Class III. (Above percentages exceed 100% since Class II can exist with Class I, III, & IV).

Tests

A ten tube mock-up of the damage was prepared at B&W fabrication facilities. The mock-up damage was made by beating the tubes with a ballpeen hammer. The damage mock-up includes the worst damage observed at the site. Hardness traverses across the damaged tube ends, welds, and into the clad showed the effects of significant cold working. The highest of the 250 readings were mostly in the high 300's (Knoop hardness scale) with three readings exceeding 400. Normal readings for Inconel weld metal may range as high as 200. The high hardness readings indicate increased yield and ultimate strengths, potentially increased resistance to high cycle fatigue failure, decreased resistance to low cycle fatigue failure, and decreased resistance to stress corrosion cracking.

The minimum leak path (normally the weld throat of the tube-to-sheet fillet weld) of the mock-up damage was measured. Measurements were made per procedures used to inspect daily product quality control samples of shop production welds (stage micrometer at approximately 15 x power). The minimum measured leak path was .051 inches compared to minimum tube wall thickness of 0.032 inches.

Tests of the roll joint showed a minimum strength of 2500 pounds axial tube load to initiate relative motion with the tubesheet. The m..imum load to completely free the tube from the tubesheet was 4520 lbs. The minimum tube yield strength based on the specified minimum yield stress of 35,000 psi is 2200 lbs. The tests were performed on samples that were expanded, welded, and stress relieved per standard B&W fabrication procedures. The welds were removed in their entirety prior to performing the tube pulling tests.

Repair

Repair of the steam generator has been separated into two phases: a short term repair and a long term repair. The short term is presently underway and consists of:

Video Inspection & Cat. Tubes
Locate Leaks & Identify
Install Dome Shielding & J Leg Screens
Repair Leaks, NDE Repairs, & Dress Tubes
Remove Shielding
100% Free Path Check
Clean Obstructed Tubes & E/C
Explosive Plug & Leak Test
100% Free Path Check OTSG-A
Remove Screens & Close Up OTSGs

The video inspections and cataloging of damage has been completed and the results reported above. All tube-to-tubesheet welds have been inspected and no leaks have been found.

Leak testing was performed by pressurizing the partially filled secondary side with helium and inspecting each weld individually with a mass spectrometer capable of detecting a 10^{-8} cc/sec leak. The dome shielding has been installed and the tube ends dressed with hand held tools. The remaining items of the short term repair have yet to be completed.

The following long term repair may be performed at a future date:

Dome Decon Prep.
Install Decon Equip. Bladders
Decontaminate Dome
Setup Machine Carriage
Machine/Spot Face Tubes (57%/43%)
Deburr Tube Ends & Vacuum
Clean Spot Face as Necessary
Roll Expand as Necessary
Remove Mach. Carriage
Setup & Preheat Tubesheet
Install/Setup Weld Carriage
Weld Spot Face Tubes (2800)
Video Inspect Welds
Clean for Pt Inspection

Remote machines to support the long term repair are presently being designed and fabricated. Prior to installation at the site, all remotely controlled machinery will be proven in mock-ups.

Conclusion

Based on the above assessment the structural capacity of the tube-to-sheet joint has not been degraded because of the "hard" roll capacity to continue to carry axial tube loads greater than the tube yield strength and the attenuation of lateral tube loads up through the 2 foot thick tubesheet. Therefore, the damage sustained by the OTSG will not have a detrimental effect on its safe operation over the time remaining on this fuel cycle. Further analyses will be performed and operating experience gained during the remainder of the first fuel cycle. The need for implementation of the long term repair scheme is not clear at the present time. This decision will be made and justified prior to startup following the first refueling outage.

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