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SUBJECT: Submits response to NRC request for addl info re GL 95-03,
 "Circumferential Cracking of SG Tubes."

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December 11, 1995

L-95-318
10 CFR 50.4

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

RE: St. Lucie Units 1 and 2
Docket Nos. 50-335 and 50-389
Supplemental Information
Generic Letter 95-03

The additional information and clarifications requested by NRC letter dated September 19, 1995 are attached. This information supplements the original Florida Power and Light Company (FPL) response to Generic Letter 95-03, *Circumferential Cracking of Steam Generator Tubes*, for St. Lucie Units 1 and 2 which was submitted by FPL letter, L-95-174, dated June 23, 1995.

This Generic Letter provided notification of recent Steam Generator tube inspection findings at Maine Yankee and discusses the safety significance of these findings. Licensees were requested to confirm plans to implement the recommended actions and submit a written response. The response was to include a safety assessment justifying continued operation based on the evaluations performed and a summary of the plans and schedules for the next inspections.

Please contact us if there are any questions about this submittal.

Very truly yours,

D. A. Sager
Vice President
St. Lucie Plant

DAS/GRM

cc: Stewart D. Ebnetter, Regional Administrator, Region II, USNRC
Senior Resident Inspector, USNRC, St. Lucie Plant

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St. Lucie Units 1 and 2
Docket Nos. 50-335 and 50-389
Supplemental Information
Generic Letter 95-03

L-95-318

RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION

GENERIC LETTER 95-03

CIRCUMFERENTIAL CRACKING OF STEAM GENERATOR TUBES

NRC REQUEST 1

The following areas have been identified as being susceptible to circumferential cracking:

- a. Expansion transition circumferential cracking
- b. Small radius U-bend circumferential cracking
- c. Dented location (including dented TSP) circumferential cracking
- d. Sleeve joint circumferential cracking

In your response, areas b, c, and d, were not specifically addressed for both units although it was indicated that circumferential cracking has also been observed at tube support plate intersections and in the U-bend of a retired Combustion Engineering steam generator. In addition, recirculating steam generators designed by another vendor have experienced circumferential cracking in the U-bend portion of tubes with small radius U-bends and at dented locations. Please submit the information requested in Generic Letter (GL) 95-03 per the guidance contained in the GL for this area (and any other area susceptible to circumferential cracking). The staff realizes that some of the above areas may not have been addressed since they may not be applicable to your plant; however, the staff requests that you clarify this (e.g., no sleeves are installed; therefore, the plant is not susceptible to sleeve joint circumferential cracking).

FPL RESPONSE

AREA D - St. Lucie Units 1 and 2 do not contain sleeves of any design. Therefore, area d above, is not discussed further herein.

AREAS A, B & C - Additional information relative to GL 95-03 is provided below for areas a, b and c. The following sections update our original response for the actions and information requested.

GL 95-03 REQUESTED ACTION 1 -

AREA B - With respect to retired Combustion Engineering (CE) SGs, industry operating experience shows that there were no occurrences of circumferential cracking in small radius U-bends (area b above). There were several occurrences in retired SGs of circumferential cracking in 90° bends (10 inch radius bends) at or adjacent to diagonal supports and in horizontal runs at or adjacent to vertical supports; these have been described as cracks in the bend region.

Our review of recent industry operating experience shows that all circumferential cracks to date in active CE steam generators are located at the top of the tubesheet with no reported circumferential indications in the upper part of the tube bundles, including tight radius U-bends. This observation is based on the fact that several CE plants have conducted MRPC inspections in tight radius U-bends without detecting any circumferential cracks.

AREAS A & C - With respect to area a and c above, FPL has completed extensive MRPC inspections of tube expansion transitions, and has completed sampling with MRPC inspections for dented tube locations during recent inspections at St. Lucie Units 1 and 2. FPL has recently completed the end of Cycle 8 inspection for St. Lucie Unit 2. This inspection included (1) full length bobbin coil inspection of all active tubes, (2) MRPC inspection for all active hot leg tube expansion transitions, (3) MRPC inspection for 20% of active cold leg tube expansion transitions in the sludge pile regions and (4) MRPC inspection of hot and cold leg dented tube support intersections. No circumferential cracks were detected during the end of Cycle 8 inspections for St. Lucie Unit 2. The end of Cycle 8 inspections completed exceed the planned scope provided in FPL's response to GL 95-03 (FPL Letter L-95-174, June 23, 1995).

GL 95-03 REQUESTED ACTION 2 -

AREAS A & C - Our safety assessment justifying continued operation until the next steam generator tube inspection includes consideration for all areas susceptible to circumferential cracking. As stated in our initial response, L-95-174 dated June 23, 1995, FPL has completed extensive MRPC inspections of tube expansion transitions, and has completed sampling with MRPC inspections for dented tube locations during recent inspections at St. Lucie Units 1 and 2.

AREAS B & D - Further, no circumferential cracking has been reported in small radius U-bends (area b) and no sleeves of any design are installed at St. Lucie Unit 1 and 2. All active small radius U-bends have been inspected in each of the past three inservice inspections using bobbin coil techniques. There are no manufacturing or operational conditions related to small radius U-bends at St. Lucie Unit 1 and 2, or in other CE SGs, which require additional inspections for this area.

GL 95-03 REQUESTED ACTION 3 -

AREAS A & D - Plans for the next SG inspection at St. Lucie Units 1 and 2, provided in our initial response to GL 95-03 (FPL letter L-95-174, dated June 23, 1995), adequately address areas a and d above.

AREA B - These plans currently include inspection of all active small radius U-bends (area b) using bobbin coil techniques, with MRPC techniques to further characterize indications as required. There are no manufacturing or operational conditions related to small radius U-bends at St. Lucie Units 1 and 2, or other CE SGs, which require additional inspections for this area.

AREA C - With respect to area c above, all circumferential cracks to date in active CE SGs have been located at the top of the tubesheet with no reported circumferential indications in the upper part of the tube bundle. However, FPL plans will be modified to complete MRPC inspections for a minimum 20% sample of dented hot leg tube support locations in at least one SG. As discussed above, end of Cycle 8 inspections recently completed for St. Lucie Unit 2, provided such additional MRPC inspections for circumferential cracking at dented locations and, therefore, fulfills this commitment for St. Lucie Unit 2.

GL 95-03 REQUESTED INFORMATION ITEM 1 -

AREA B - Our safety assessment justifying continued operation (based on Requested Actions 1 & 2 above) provided in our initial response addresses all areas susceptible to circumferential cracking. Additionally, no circumferential cracking has been reported in small radius U-bends for CE SGs, which includes St. Lucie Units 1 and 2. Further, there are no manufacturing or operational conditions related to small radius U-bends at St. Lucie Unit 1 and 2, or in other CE SGs, which would require additional inspections for this area.

GL 95-03 REQUESTED INFORMATION ITEM 2 - Our summary of inspection plans developed in accordance with Requested Action 3 of GL 95-03, and the schedule for the next planned inspection, are provided in FPL Letter L-95-174 dated June 23, 1995. FPL has recently completed the end of Cycle 8 inspection for St. Lucie Unit 2. This inspection included (1) full length bobbin coil inspection of all active tubes, (2) MRPC inspection for all active hot leg tube expansion transitions, (3) MRPC inspection for 20% of active cold leg tube expansion transitions in the sludge pile regions and (4) MRPC inspection of hot and cold leg dented tube support

intersections. No circumferential cracks were detected during the end of Cycle 8 inspections for St. Lucie Unit 2. The end of Cycle 8 inspections exceed the planned scope provided in FPL's response to GL 95-03. FPL plans for the end of Cycle 13 inspection at St. Lucie Unit 1, will be modified to include MRPC inspections for a minimum 20% sample of dented hot leg tube support locations in at least one SG. Currently plans include inspection of all active small radius U-bends using bobbin coil techniques, with MRPC techniques to further characterize indications as required.

NRC REQUEST 2

In your response, it was indicated that between 7% and 14% of the total hot leg dented tube support plate intersections were inspected at St. Lucie Unit 1. Discuss the criteria used for determining which dents were examined. If a dent voltage threshold is used for such a determination, provide the calibration procedure used (i.e., 4.0 volts on 4-20% through-wall ASME holes at 550/130 mix).

FPL RESPONSE

The criteria used for determining which dents will be examined utilizes a dent voltage threshold. The calibration procedure sets voltage equal to 5 volts on 4-20% ASME flat bottom holes using a 400/100 Kilohertz Mix. Larger dents receive priority for inspection since greater residual stress associated with these dents may contribute to circumferential cracking earlier than at non-dented locations, or at locations with smaller dents.

NRC REQUEST 3

In your response you indicated that the circumferential cracks identified at St. Lucie were identified early in their lifetimes and were not of sufficient size to threaten mid-cycle leakage. Please indicate how tubes with circumferential indications were dispositioned during the previous inspection outage. For the tubes identified to have circumferential cracks at St. Lucie 1 and 2 during the prior inspection, provide your assessment of the structural integrity of these tubes (i.e., were they capable of withstanding the pressure loadings of Regulatory Guide 1.121).

FPL RESPONSE

All tubes with circumferential indications at St. Lucie Unit 1 and 2 were stabilized and removed from service in the outage in which they were detected.

Available industry data provided by utility owners groups and NSSS vendors for circumferential cracks examined metallurgically or in-situ pressure tested indicate that structural limits have not been violated. NRC Information Notice (IN) 95-40, Supplemental Information To Generic Letter 95-03, *Circumferential Cracking of Steam Generator Tubes*, discusses sizing techniques used to size circumferential cracks at Maine Yankee Atomic Power Station. NRC IN 95-40 indicates that nondestructive examination data cannot distinguish ligaments of sound material when segmented cracks are present, and that nondestructive examination data are conservative in that the tubes are most likely more structurally sound than estimated by the eddy current examination. Inspection results for circumferential cracks detected at St. Lucie Units 1 and 2 have been qualitatively compared with inspection results for circumferential cracks that have been examined metallurgically or in-situ pressure tested at several plants. Such sizing techniques indicate that circumferential cracks at St. Lucie Units 1 and 2 are being detected at levels which were not sufficient to challenge structural integrity.

NRC REQUEST 4

During the Maine Yankee outage in July/August 1994, several weaknesses were identified in their eddy current program as detailed in NRC Information Notice 94-88, *Inservice Inspection Deficiencies Result in Severely Degraded Steam Generator Tubes*. In Information Notice 94-88, the staff observed that several circumferential indications could be traced back to earlier inspections when the data was reanalyzed using terrain plots. These terrain plots had not been generated as part of the original field analysis for these tubes. For the rotating pancake coil (RPC) examinations performed at your plant at locations susceptible to circumferential cracking during the previous inspection (i.e., previous inspection per your Generic Letter 95-03 response), discuss the extent to which terrain plots were used to analyze the eddy current data. If terrain plots were not routinely used at locations susceptible to circumferential cracking, discuss whether or not the RPC eddy current data has been reanalyzed using terrain mapping of the data. If terrain plots were not routinely used during the outage and your data has not been reanalyzed with



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terrain mapping of the data, discuss your basis for not reanalyzing your previous RPC data in light of the findings at Maine Yankee.

Discuss whether terrain plots will be used to analyze the RPC eddy current data at locations susceptible to circumferential cracking during your next steam generator tube inspection (i.e., the next inspection per your Generic Letter 95-03 response).

FPL RESPONSE

Terrain plots were routinely used for analysis of RPC data at locations susceptible to circumferential cracking during each of the two previous inspections at St. Lucie Unit 1. Terrain plots were also routinely used during the end of Cycle 7 inspection at St. Lucie Unit 2, which was the first extensive inspection of areas subject to circumferential cracking. FPL has recently completed the end of Cycle 8 inspection for St. Lucie Unit 2. This inspection included (1) full length bobbin coil inspection of all active tubes, (2) MRPC inspection for all active hot leg tube expansion transitions, (3) MRPC inspection for 20% of active cold leg tube expansion transitions in the sludge pile regions and (4) MRPC inspection of hot and cold leg dented tube support intersections. No circumferential cracks were detected during the end of Cycle 8 inspections for St. Lucie Unit 2. The end of Cycle 8 inspections completed exceed the planned scope provided in FPL's initial response to GL 95-03 (FPL Letter L-95-174, June 23, 1995).

Terrain plots will continue to be routinely used for analysis of MRPC data at locations susceptible to circumferential cracking during future inspections at St. Lucie Units 1 & 2.