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SUBJECT: Forwards supplemental info re SG tube insp for Unit 1.

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Florida Power & Light Company, P.O. Box 128, Fort Pierce, FL 34954-0128

May 14, 1996

L-96-129
10 CFR 50.4

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

RE: St. Lucie Unit 1
Docket No. 50-335
Supplemental Information
Steam Generator Tube Inspection

During a telephone conversation on May 7, 1996, the NRC staff identified several concerns with respect to the structural and leak integrity of steam generator tube indications identified by Florida Power and Light Company (FPL), in the sludge pile, at eggcrate supports, and at drilled tube support plates. Several of these concerns were identified as a result of a meeting with NRC on April 22, 1996, when FPL discussed, in part, the steam generator tube integrity program for St. Lucie Unit 1. The information requested during the phone call is attached.

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

Very truly yours,

W. H. Bohlke
Vice President
St. Lucie Plant

WHB/GRM

Attachment

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

A001

I. For indications at the eggcrate support plates and in the sludge pile:

NRC REQUEST 1.

For the planned in-situ pressure testing of the most significant flaws, provide information on the adjustments to the test pressure to account for (1) temperature differences between operating conditions and the test, (2) material properties, and (3) locked tube support plate conditions.

Provide the criteria to be used for selecting the tubes to be in-situ pressure tested, the number of tubes that will be tested, and the procedure for the test (e.g., with or without a reinforcing bladder). Due to NRC staff concerns regarding the ability to depth size these types of indications, provide the basis for concluding that you will select the tubes with the most significant flaws.

FPL RESPONSE

FPL will use in-situ pressure testing to verify the structural adequacy of the most significant eddy current test (ECT) indications at drilled support plate, free span, eggcrates and sludge pile locations.

FPL will initially conduct in-situ pressure testing without a burst bladder to assess leakage integrity. Leakage, if observed, will be measured at normal operating differential pressure and at higher pressures. If leakage exceeds makeup capacity, the burst bladder will then be installed to achieve the desired test pressures.

Tube selection for in-situ pressure testing will be conducted by lead ECT data analysis and engineering personnel. Selection criteria will be based on review of ECT data for a variety of flaw characteristics including length, maximum depth, average depth, voltage (amplitude), location, potential for tube support lock-up, number of flaws in a tube, and flaw growth rate. Due to the variety of flaw characteristics involved, analytical judgment and evaluation experience is required for assessing the severity of flaws indications.

Selection of flaw indications for in-situ pressure testing will be based on bobbin coil inspection techniques that are qualified for detection and depth sizing of intergranular attack/stress corrosion cracking (IGA/SCC) at eggcrate supports, free span and sludge pile locations. Candidate indications will also be inspected with MRPC techniques to assess the flaw characteristics discussed above. Candidate indications for in-situ pressure testing at drilled support plate locations will also be inspected by bobbin coil and MRPC techniques. Selection of candidate indications at drilled support plate locations will rely on a combination of depth and voltage information as well as the other flaw characteristics discussed above.

Adjustments to in-situ test pressure will include a 13% increase for temperature based on burst testing of 3/4 inch by 0.048 inch Alloy 600 tube samples at operating and room temperatures. Test pressure for circumferential flaws at the tube expansion transition will also be increased by 8.5% for locked support plate conditions based on a 40 inch span between the tubesheet and the first eggcrate support. The adjusted pressures are:

Flaw Orientation	ADJUSTED NOP D/P	ADJUSTED 1.4 x SLB D/P	ADJUSTED 3 x NOP D/P
Axial	1622 psi	3955 psi	4865 psi
Circumferential	1744 psi	4253 psi	5231 psi

NOP D/P Tube differential pressure at normal operating system pressures. NOP D/P = 1435 psi.

SLB D/P Tube differential pressure during Steam line break. SLB D/P = 2500 psi.

In-situ pressure testing of flawed steam generator tubing is becoming a relatively common industry practice. Industry experience with in-situ pressure testing has been positive in terms of assuring that adequate structural margins exist. FPL will use field proven equipment and experienced personnel for in-situ pressure testing. Between 10 and 20 of the most significant indications from all locations (eggcrate, sludge pile, drilled support plate, or free span) will be in-situ

pressure tested. In-situ pressure test results are expected to demonstrate that conservative margins for structural integrity are provided utilizing the ECT depth sizing techniques.

NRC REQUEST 2.

Given the staff concerns regarding the depth sizing technique, provide a discussion of the feasibility of, and any plans you have, for performing helium leak testing to confirm that no through-wall cracks are present. This action would provide supporting information that indications sized less than 100% through-wall are in fact less than 100% through-wall provided no leakage was detected for these tubes. This test also has the potential to permit the identification of the source of any primary-to-secondary leakage observed during the last cycle (e.g., if leakage is attributed to a plug, this test may provide additional confidence that all the leakage is from the plug).

FPL RESPONSE

FPL has reviewed helium leak detection efforts with a leak detection vendor and several utilities. The majority of leak detection efforts with helium have been for leakage in excess of 50 gallons per day (gpd). Leakage at St. Lucie Unit 1 is estimated at 2-4 gpd. The use of helium leak testing for leakage which is less than 5 gpd is extremely limited and is not expected to be effective. Also, helium testing is not expected to identify leakage through a perforated tube which contains a leaking tube plug due to the column of water which is typically present above the plug. Further, the difficulty in maintaining a positive pressure with helium on the secondary system makes this test difficult to implement.

The FPL approach includes extensive inspections, in-situ pressure testing and improved on-line leakage monitoring at St. Lucie Unit 1. FPL believes that helium leak testing will provide little or no benefit beyond the information and insight provided by the other techniques being employed.

NRC REQUEST 3.

Provide your plans and schedule for performing an estimate of the conditional probability of burst given a main steam line

break given the number of indications, the maximum growth rate observed, and the eddy current uncertainties.

FPL RESPONSE

FPL will perform a calculation for the probability of tube burst based on the APTECH Engineering model of the Palo Verde Steam generator. This calculation will evaluate the as-left condition of the St. Lucie Unit 1 steam generators and project the end of the next cycle conditions based on the number of indications, growth rates and eddy current uncertainties for all locations in the steam generator. The calculation of tube burst probability will be submitted approximately 6 months after start up from the current refueling outage (SL1-14).

NRC REQUEST 4.

Provide your criteria for determining whether or not a mid-cycle inspection is necessary as a result of eddy current testing, in-situ pressure testing, helium leak testing, and conditional probability of burst (e.g., 1E-2), as appropriate.

FPL RESPONSE

The ECT inspection data for all locations in the steam generator will be the basis for the assessment of the need for a mid-cycle inspection. The factors considered will include in-situ pressure test results and the probability of burst calculation conservatively estimated based on ECT examination results. A calculated probability of tube burst substantially greater than $1X10^{-2}$ will be considered as input to the need for a mid-cycle inspection.

NRC REQUEST 5.

Provide your plans with respect to notifying the staff if any indication would not be able to withstand the loading specified in Draft Regulatory Guide 1.121. This should address reporting indications whose length exceeds the critical length assuming a 100% through-wall flaw and indications whose depth exceeds the critical depth assuming an infinitely long flaw.

FPL RESPONSE

FPL will inform the NRC project manager for St. Lucie Units 1 and 2, via telephone, of the progress of the inspections after they are approximately 50%, 75% and 100% complete. FPL will discuss the general state of the inspection, the number and size of the indications and candidate indications for in-situ pressure testing. The NRC project manager was updated by phone on 5/13/96 at approximately 25% completion. Results from the in-situ pressure tests will be provided, via telephone, within 24 hours of completion of the in-situ test program.

NRC REQUEST 6.

Discuss your plans with respect to submitting a summary of the inspection results and the above mentioned helium and in-situ pressure test results.

FPL RESPONSE

Results from the eddy current inspections will be submitted as part of the special report required by Technical Specification 4.4.5.5.b. The results from the in-situ pressure testing will be submitted within 10 days of completion of the in-situ test program.

II. For indications at the drilled hole tube support plates which you plan to size and leave in service:

NRC REQUEST a.

Discuss the qualification data to support the ability to size the types of indications that will remain in service (e.g., volumetric indications). Include the tube pull data or other test data that confirms that the morphology of the qualification data is consistent with the morphology of the indications in the field.

FPL RESPONSE

Qualification data for detection and sizing of IGA/SCC indications at drilled support plates using bobbin coil inspection techniques has been provided to the NRC via the Electric Power Research Institute (EPRI) as part of EPRI NP-6201, Revision 4, *PWR Steam Generator Tube Examination Guidelines*. The data demonstrates that the bobbin coil technique exceeds the detection requirements of EPRI NP-6201, Appendix H with a probability of detection (POD) of 80% at a 90% confidence level for flaws penetrating 40% through wall. However, bobbin coil techniques failed to meet the sizing requirements since they resulted in a root mean square error (RMSE) of 29% (Appendix H requires less than or equal to 25% RMSE).

FPL has considered two repair options for eddy current indications at the 9th and 10th drilled support plates. Option 1 relies on bobbin coil techniques for detection, and requires MRPC examination of all flaw indications reported. All indications which are crack-like by MRPC examination will be removed from service. Non-crack MRPC indications will be sized using the EPRI bobbin coil technique (RMSE = 29%). Indications 40% or greater through wall, or indications with >10% growth, since the prior inspection will be removed from service.

Option 2 also relies on bobbin coil techniques for detection, and requires MRPC examination of all flaw indications reported. However, this option requires that all indications which are confirmed by MRPC examination be removed from service.

FPL considers option 2 excessively conservative. Therefore, our current plan is to use Option 1 above and to in-situ pressure test the most significant drilled support plate indications to demonstrate that adequate structural margins exist for flaws which will remain inservice in these regions.

The Staff also requested that FPL discuss our plans for sizing IGA/SCC indications which are located in free span regions. Our current plan is to apply Option 1, as discussed above for

drilled support plate indications, for indications located in the free span regions.

Tubes removed in 1985 provide a full range of intergranular modes of attack from patches of IGA to discrete cracks. Depth sizing using post mortem eddy current calibration curves have resulted in 10 years of operation without significant inservice leakage. Based on extensive prior inspections, FPL has a through understanding of the extent of degradation in the St. Lucie steam generators. FPL expects that changes in corrosion morphology or increases in growth rate would have resulted in substantial inservice leakage if eddy current sizing criteria were nonconservative. General eddy current response has remained constant since 1984, with the only changes being an increase in the number of affected locations. Consistency in eddy current response and lack of significant operational leakage provide assurance that corrosion morphology is being adequately monitored.

NRC REQUEST b.

Address the comments/questions listed above for eggcrate support and sludge pile indications (items 1 through 6), as appropriate.

FPL RESPONSE

The response to questions 1-6 for eggcrate and sludge pile indications include the responses for drilled support plate indications.