FLORIDA POWER CORPORATION
CRYSTAL RIVER UNIT 3
DOCKET NO. 50-302/LICENSE NO. DPR-72
TECHNICAL SPECIFICATION CHANGE REQUEST NO. 203, REVISION 1
FIRST SPAN IGA OTSG EDDY CURRENT INDICATION DISPOSITION

LICENSE DOCUMENT INVOLVED: Technical Specifications (TS)

PORTIONS: Technical Specification 3.4.12
Technical Specification 5.6.2.10
Technical Specification 5.7.2.c

DESCRIPTION OF REQUEST:

This request proposes a strategy for dispositioning Inter-granular Attack (IGA) indications in tubes within the first span of the Once Through Steam Generators (OTSGs). The strategy adds acceptance criteria based upon the indications' morphology, bobbin coil amplitude, and axial and circumferential dimensions. The proposed strategy is described below. This addition is necessary because the current technical specifications do not address IGA flaws located in the first span of tubes in the OTSGs. This disposition strategy has been qualified for use through the tube pull efforts conducted previously at CR-3 and used as the basis for the technical specification change request.

First span indications with a bobbin coil amplitude greater than 1.5 volts will be repaired or plugged. First span indications with a bobbin coil amplitude less than or equal to 1.5 volts will undergo an initial motorized rotating pancake coil (MRPC) inspection to determine the morphology of the indication. Indications exhibiting a volumetric morphology will undergo an MRPC sizing evaluation to determine the axial and circumferential extent. First span volumetric (IGA) indications with all of the following characteristics will remain in service:

a bobbin coil amplitude $\leq$ 1.5 volts; and

axial extent $\leq$ 0.25 inches; and

circumferential extent $\leq$ 0.6 inches.

Tubes with first span IGA indications which exceed any one of the above criteria will be repaired or removed from service. Following an initial MRPC examination of first span IGA indications with a bobbin coil amplitude $\leq$ 1.5 volts, subsequent MRPC examination is not required unless the bobbin coil amplitude has increased by a value of $\geq$ 0.3 volts from the previous inspection.

The following specific changes to the Technical Specifications are proposed to address the criteria described above.

A. 3.4.12 Item d, page 3.4-22; Reduce allowed primary to secondary LEAKAGE through steam generators such that this LCO would read as follows:

150 gpd primary to secondary LEAKAGE through any one steam generator (OTSG).

B. 5.6.2.10.2, page 5.0-14, above the NOTE; propose to add the words "bobbin coil" prior to "sample inspection" such that this sentence would read as follows:

The results of each bobbin coil sample inspection shall be classified into one of the following three categories:

C. 5.6.2.10.2, page 5.0-14, Note modifying category definition; propose to insert criteria reflective of growth in a first span IGA indication. The proposed Note would read as follows:

In all inspections, previously degraded tubes whose degradation has not been spanned by a sleeve must exhibit a significant increase in the applicable imperfection size measurement (≥ +0.3V bobbin coil amplitude increase for first span IGA indications or >10% further wall penetration for all other imperfections) to be included in the below percentage calculations.

D. 5.6.2.10.4.a.2, page 5.0-16, second sentence; Re-word imperfection criteria to address first span IGA such that this item would read as follows:

Imperfection means an exception to the dimensions, finish, or contour of a tube from that required by fabrication drawings or specifications. Any indication below all degraded tube criteria specified in item 4 below may be considered as imperfections.

E. 5.6.2.10.4.a.4, page 5.0-16; Add IGA criteria equating to a degraded tube such that this item would read as follows:

Degraded Tube means a tube containing a first span IGA indication with a bobbin coil amplitude ≥ 0.75 V, an axial extent of ≥ 0.13 inches, or a circumferential extent of ≥ 0.3 inches, or other imperfections ≥ 20% of the nominal wall thickness caused by degradation except where all such degradation has been spanned by the installation of a sleeve.

F. 5.6.2.10.4.a, add page 5.0-16A, new vocabulary term; Add new vocabulary term for first span IGA indication as 5.6.2.10.4.a.7 such that the TS would read as follows:

First span IGA indication means a bobbin coil indication located between the lower tubesheet secondary face and the first tube support plate confirmed by MRPC to have a volumetric morphology.

G. 5.6.2.10.4.a.7 and 8 on added page 5.0-16A, and 5.6.2.10.4.a.9, page 5.0-17; Renumber definitions to reflect insertion of new first span IGA indication vocabulary term.

H. 5.6.2.10.4.a.7, renumbered to 5.6.2.10.4.a.8, on added page 5.0-16A; Add first span IGA criteria equating to the plugging/ sleeving limit such that this definition would read as follows:

Plugging/Sleeving Limit means the extent of degradation at or beyond which the tube shall be restored to serviceability by the installation of a sleeve or removed from service because it may become unserviceable prior to the next inspection. The limit for first span IGA indications is a bobbin coil amplitude of 1.5 V or an axial extent of 0.25 inches, or a

circumferential extent of 0.6 inches. The limit for indications other than first span IGA is equal to 40% of the nominal tube or sleeve wall thickness. No more than five thousand sleeves may be installed in each OTSG.

I. 5.7.2.c.2, page 5.0-29; Add reporting requirements for first span IGA indications including a requirement to notify the NRC prior to MODE 4 and change the reporting time-frame from 12 months to 90 days. Add a new item 3 to address inspection in the first span of the OTSG and re-number item 5.7.2.c.3 to 5.7.2.c.4. Create new page 5.0-29A. This section would read as follows:

Following each inservice inspection of steam generator (OTSG) tubes, the NRC shall be notified of the following prior to plant ascension into MODE 4:

1. Number of tubes plugged and sleeved,

2. Crack-like indications in the first span,

3. An assessment of growth for first span IGA indications, and

4. Results of in-situ pressure testing, if performed.

The complete results of the OTSG tube inservice inspection shall be submitted to the NRC within 90 days following the completion of the inspection. The report shall include:

1. Number and extent of tubes inspected,

2. Location and percent of wall thickness penetration for each other indication of an imperfection,

3. Location, bobbin coil amplitude, and axial and circumferential extent (if determined) for each first span IGA indication, and

4. Identification of tubes plugged and tubes sleeved.

Results of OTSG tube inspections that fall into Category C-3 shall be reported to the NRC prior to resumption of plant operation. This report shall provide a description of investigations conducted to determine cause of the tube degradation and corrective measures taken to prevent recurrence.

REASON FOR REQUEST:

Current OTSG TS inspection acceptance criteria are depth-based or percent through-wall (TW) criteria. TS specify the plugging/sleeving limit (i.e., repair limit) used as the criterion for removing steam generator tubes from service to be an imperfection depth equal to or greater than 40% of the nominal wall thickness. This criterion is based on a structural evaluation of a simplified model of tubes with uniform wall thinning. However, based upon CR-3 pulled tube examination results, the degradation observed in the CR-3 pulled tubes has a substantially different morphology than the model used to develop the current limit.

During previous eddy current inspections, a significant number of small volume indications were identified in the first span of the OTSGs. Due to the small signal amplitude associated with these indications, they can not be accurately sized by conventional bobbin coil phase angle. Therefore, FPC chose to develop supplemental methods to disposition these small volume IGA indications located in the first span of the OTSGs. Two tube pull campaigns have supported the development of these criteria. FPC has determined that the proposed disposition strategy described in this request is more accurate than the TW criterion currently in the TS.

This proposal is being supplemented as Revision 1 to address concerns raised by the NRC during their review.

EVALUATION OF REQUEST:

The approach used by FPC to evaluate the proposed disposition strategy is consistent with Regulatory Guide (RG) 1.121 and with that taken in past FPC submittals on this subject. Attachment 1 to Revision 0 of this TSCRN contains the basis for the proposed first span, small volume eddy current indication disposition strategy. This basis document has been developed from an analysis provided previously and reflects additional knowledge and experience gained by FPC as a result of Refuel Outage 9 (9R), the 9R tube pull, and various industry and Owners Group initiatives which have occurred since those first submittals. The evaluation presented in the basis document and referred to below demonstrates the adequacy of the proposed disposition strategy. FPC considers the essential elements for demonstrating the acceptability of the proposed approach to be:

Structural Adequacy of the Tubing

Section 4.2 of the basis document discusses the relationship between burst pressure and the proposed dimensional extent limits. It also discusses the results of a structural analysis performed by MPR and Associates Inc. and the subsequent review of this initial analysis performed by Packer Engineering. The structural analysis calculates the maximum allowable tube wall degradation for all damage mechanisms and defect geometries postulated for CR-3 OTSG tubing.

Section 4.3 provides a discussion of field data relative to the structural limit. This section extensively discusses burst testing results of the 1992 and 1994 pulled tubes and evaluates burst pressure data for IGA and wear mechanisms respectively. This evaluation concludes the proposed structural limits provide considerable margin above the RG 1.121 allowable values for steam generator tube degradation.

Growth Rate of Tube Indications at CR-3

Section 4.5 documents the results of three independent reviews to assess the growth rate of indications present in the CR-3 OTSGs. The studies, performed by the EPRI NDE Center, Babcock and Wilcox Nuclear Technologies (BWNT), and Packer Engineering, Inc. Each concluded there to be little or no growth for the period of time examined. The proposed strategy includes a mechanism (Section 4.5) which ensures this conclusion is validated during future inspections.

Non-destructive Examination (NDE) Considerations in Morphology Determination

Section 3 assesses the ability of MRPC to accurately identify the morphology of low volume eddy current indications. This section also discusses the results of

a regression analysis of volumetric degradation dimensional data which shows a direct relationship between bobbin coil signal amplitude and volume for a given indication. This section also demonstrates the conservatism of the MRPC measurement technique discontinuity as applied to determining volumetric morphology dimensional extents.

Conservatism of Signal Amplitude and Dimensional Plugging Limits

Sections 4.2 and 5.2 provide the basis for the originally proposed bobbin coil amplitude (voltage)-based limits of 0.9 and 2.5 volts and for the dimensional-based limits of 0.33 inches axial extent and 0.6 inches circumferential extent. This revision is more conservative in proposing no volumetric threshold below which MRPC examination will not be performed. The 1.5 V limit and axial extent of 0.25 inches are consistent with our past inspections. The axial and circumferential limits selected within the range of interest ($\leq$ 1.5 volts) reduce the significance of TW sizing since, the limits were developed assuming a 100% through-wall defect. CR-3's operating experience demonstrates there is a low probability for this to happen.

Leakage Considerations

Section 5 addresses primary to secondary leakage with a defense-in-depth approach that includes an NDE repair limit for leakage designed to ensure a minimum tube wall thickness is maintained for all tubes. This approach is tailored toward ensuring no leakage under worst-case accident conditions.

SHOLLY EVALUATION OF REQUEST:

Florida Power Corporation has reviewed the requirements of 10CFR50.92 as they relate to the proposed method for dispositioning first span, IGA OTSG tube eddy current indications and determined that the proposed change does not involve a significant hazards consideration. In support of this conclusion the following analysis was provided with the original proposal:

1. The proposed change will not significantly increase the probability or consequences of an accident previously evaluated. The relevant accidents are excessive leakage or steam generator tube rupture (as a consequence of MSLB or otherwise).

   RG 1.121 establishes a standard method for demonstrating structural integrity under worse-than-DBE conditions. The existing TS is based on this RG. The first span, IGA disposition strategy continues to rely on this guidance. Current TW sizing techniques would allow defects greater than the current TS limit of 40 % to remain in service since these techniques do not accurately measure percent wall penetration for small volume indications. The proposed disposition strategy based on measurable eddy current parameters of voltage, axial extent, and circumferential extent has been shown to provide a higher confidence that unacceptable flaws are removed from service. Therefore, the probability of a Steam Generator Tube Rupture (SGTR) is not increased and may well be decreased by implementation of this S/N disposition strategy.

   The probability of OTSG tube leakage during normal operation or accident conditions is not adversely affected by the proposed first span IGA disposition strategy. Operating history indicates essentially no primary to secondary leakage through the OTSG tubes at CR-3. Growth rate studies imply this trend could be expected to continue. However, for conservatism the OTSG leakage limit has been reduced from 1 gallon per minute through all OTSGs to 150 gallons per day through any one OTSG. This change is consistent with the guidance provided in Generic Letter 95-05. Small volume indications which might leak during worse-case FWLB conditions are addressed in the RG 1.121 evaluation. The disposition strategy ensures these indications are removed from service as part of the inservice inspection. Once detected, the proposed criteria are at least as effective in determining those indications which should be removed from service as are the existing TS limits.

   The first span IGA disposition strategy is an integral part of an overall effort to better address these and similar phenomena in OTSGs.

2. The proposed change will not create the possibility of a new or different kind of accident from any accident previously evaluated.

   The key "new or different" accidents addressed in this and similar proposals is the potential for MSLB-induced multiple SGTR or excessive primary-to-secondary leakage during such events. While these events are addressed in CR-3 Emergency Operating Procedures (EOPs), they are beyond those licensed for the facility.

However, as noted above, the probability of a MSLB-induced multiple SGTR is reduced by more effective screening and plugging/sleeving criteria. The probability of detection and identification of tubes which should be removed from service is maintained or improved by the first span IGA disposition strategy. The likelihood of adverse effects from plugging sound tubes is reduced. The operation of the OTSG or related structures, systems or components is otherwise unaffected.

3. The proposed change will not involve a significant reduction to any margin of safety.

The margins of safety defined in RG 1.121, including the required pressure used in the structural analysis, are retained. The probability of detecting degradation is unchanged since bobbin coil methods will continue to be the primary means of initial detection. The probability of leakage remains acceptably small. The proposed first span IGA disposition strategy is an enhancement to the inservice inspection of OTSG tubing that will provide a higher level of confidence that tubes exceeding the allowable limits are repaired while sound tubes are left in service. Based upon results of the various growth rate studies, the probability of an accident at the end of cycle is essentially the same as the beginning.

REVISED ITS PAGES

3.4 REACTOR COOLANT SYSTEM (RCS)

3.4.12 RCS Operational LEAKAGE

LCO 3.4.12 RCS operational LEAKAGE shall be limited to:

a. No pressure boundary LEAKAGE;

b. 1 gpm unidentified LEAKAGE;

c. 10 gpm identified LEAKAGE; and

d. 150 gpd of primary-to-secondary LEAKAGE through any one steam generator (OTSG).

Two OTSGs shall be OPERABLE.

APPLICABILITY: MODES 1, 2, 3, and 4.

ACTIONS

CONDITION	REQUIRED ACTION		COMPLETION TIME
A. RCS LEAKAGE not within limits for reasons other than pressure boundary LEAKAGE.	A.1	Reduce LEAKAGE to within limits.	4 hours
B. Required Action and associated Completion Time not met. OR Pressure boundary LEAKAGE exists.	B.1 AND B.2	Be in MODE 3. Be in MODE 5.	6 hours 36 hours

5.6 Procedures, Programs and Manuals (continued)

5.6.2.10 Steam Generator (OTSG) Tube Surveillance Program

Each OTSG shall be demonstrated OPERABLE by performance of the following augmented inservice inspection program.

1. Each OTSG shall be determined OPERABLE during shutdown by selecting and inspecting at least the minimum number of OTSGs specified in Table 5.6.2-1.

2. The OTSG tube minimum sample size, inspection result classification, and the corresponding action required shall be as specified in Table 5.6.2-2. The inservice inspection of OTSG tubes shall be performed at the frequencies specified in Specification 5.6.2.10.3 and the inspected tubes shall be verified acceptable per the acceptance criteria of Specification 5.6.2.10.4. The tubes selected for each inservice inspection shall include at least 3% of the total number of tubes in all OTSGs. The tubes selected for these inspections shall be selected on a random basis except:

   a. Where experience in similar plants with similar water chemistry indicates critical areas to be inspected, then at least % of the tubes inspected shall be from these critical areas.

   b. The first inservice inspection (subsequent to the preservice inspection) of each OTSG shall include:

      1. All nonplugged tubes that previously had detectable wall penetrations (>20%), and

      2. Tubes in those areas where experience has indicated potential problems.

   c. The second and third inservice inspections may be less than a full tube inspection by concentrating (selecting at least 50% of the tubes to be inspected) the inspection on those areas of the tube sheet array and on those portions of the tubes where tubes with imperfections were previously found.

   d. Tubes in specific limited areas which are distinguished by unique operating conditions or physical construction may be excluded from random samples if all such tubes

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5.6 Procedures, Programs and Manuals

5.6.2.10 OTSG Tube Surveillance Program (continued)

in the specific area of an OTSG are inspected with the inspection result classification and the corresponding action required as specified in Table 5.6.2-3. No credit will be taken for these tubes in meeting minimum sample size requirements. Degraded or defective tubes found in these areas will not be considered in determining the inspection results category as long as the mode of degradation is unique to that area and not random in nature.

The results of each bobbin coil sample inspection shall be classified into one of the following three categories:

----------NOTE----------
In all inspections, previously degraded tubes whose degradation has not been spanned by a sleeve must exhibit significant increase in the applicable imperfection size measurement ($\geq$ +0.3V bobbin coil amplitude increase for first span IGA indications or >10% further wall penetration for all other imperfections) to be included in the below percentage calculations.

Category	Inspection Results
C-1	Less than 5% of the total tubes inspected are degraded tubes and none of the inspected tubes are defective.
C-2	One or more tubes, but not more than 1% of the total tubes inspected are defective, or between 5% and 10% of the total tubes inspected are degraded tubes.
C-3	More than 10% of the total tubes inspected are degraded tubes or more than 1% of the inspected tubes are defective.

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5.6 Procedures, Programs and Manuals

5.6.2.10 OTSG Tube Surveillance Program (continued)

3. The above-required inservice inspections of OTSG tubes shall be performed at the following frequencies:

   a. Inservice inspections shall be performed at intervals of not less than 12 nor more than 24 calendar months after the previous inspection. If two consecutive inspections following service under all volatile treatment (AVT) conditions, not including the preservice inspection, result in all inspection results falling into the C-1 category, or if two consecutive inspections demonstrate that previously observed degradation has not continued and no additional degradation has occurred, the inspection interval may be extended to a maximum of once per 40 months.

   b. If the inservice inspection of an OTSG, conducted in accordance with Table 5.6.2-2 or Table 5.6.2-3 requires a third sample inspection whose results fall in Category C-3, the inspection frequency shall be reduced to at least once per 20 months. The reduction in inspection frequency shall apply until a subsequent inspection demonstrates that a third sample inspection is not required.

   c. Additional unscheduled inservice inspections shall be performed on each OTSG in accordance with the first sample inspection specified in Table 5.6.2-2 or Table 5.6.2-3 during the shutdown subsequent to any of the following conditions:

      1. Primary-to-secondary tube leaks (not including leaks originating from tube-to-tube sheet welds) in excess of the limits of Specification 3.4.12,

      2. A seismic occurrence greater than the Operating Basis Earthquake,

      3. A loss-of-coolant accident requiring actuation of the engineered safeguards, or

      4. A main steam line or feedwater line break.

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5.6 Procedures, Programs and Manuals

5.6.2.10 OTSG Tube Surveillance Program (continued)

4. Acceptance criteria:

a. Vocabulary as used in this Specification:

1. Tubing or Tube means that portion of the tube or sleeve which forms the primary system to secondary system pressure boundary.

2. Imperfection means an exception to the dimensions, finish or contour of a tube from that required by fabrication drawings or specifications. Any indication below all degraded tube criteria specified in item 4 below may be considered as imperfections.

3. Degradation means a service-induced cracking, wastage, wear, or general corrosion occurring on either inside or outside of a tube.

4. Degraded Tube means a tube containing a first span IGA indication with a bobbin coil amplitude $\geq$ 0.75V or $\geq$ 0.13 inches axial extent or $\geq$ 0.3 inches circumferential extent or imperfections $\geq$ 20% of the nominal wall thickness caused by degradation except where all such degradation has been spanned by the installation of a sleeve.

5. % Degradation means the percentage of the tube wall thickness affected or removed by degradation.

6. Defect means an imperfection of such severity that it exceeds the plugging/sleeving limit except where the imperfection has been spanned by the installation of a sleeve. A tube containing a defect in its pressure boundary is defective. Any tube which does not permit the passage of the eddy-current inspection probe shall be deemed a defective tube.

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5.6 Procedures, Programs and Manuals

5.6.2.10 OTSG Tube Surveillance Program (continued)

7. First span Inter-granular Attack (IGA) indications mean a bobbin coil indication located between the lower tubesheet secondary face and the first tube support plate confirmed by MRPC to have a volumetric morphology.

8. Plugging/Sleeving Limit means the extent of degradation beyond which the tube shall be restored to serviceability by the installation of a sleeve or removed from service because it may become unserviceable prior to the next inspection. The limit for first span IGA indications is a bobbin coil amplitude of 1.5V or an axial extent of 0.25 inches or a circumferential extent of 0.6 inches. The limit for indications other than first span IGA is 40% of the nominal tube or sleeve wall thickness. No more than five thousand sleeves may be installed in each OTSG.

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5.7 Reporting Requirements

5.7.2 Special Reports (continued)

The following Special Reports shall be submitted:

a. When a Special Report is required by Condition B or F of LCO 3.3.17, "Post Accident Monitoring (PAM) Instrumentation," a report shall be submitted within the following 14 days. The report shall outline the preplanned alternate method of monitoring, the cause of the inoperability, and the plans and schedule for restoring the instrumentation channels of the Function to OPERABLE status.

b. Any abnormal degradation of the containment structure detected during the tests required by the Containment Tendon Surveillance Program shall be reported to the NRC within 30 days. The report shall include a description of the tendon condition, the condition of the concrete (especially at tendon anchorages), the inspection procedures, the tolerances on cracking, and the corrective action taken.

c. Following each inservice inspection of steam generator (OTSG) tubes, the NRC shall be notified of the following prior to ascension into MODE 4:

1. Number of tubes plugged and sleeved

2 Crack-like indications in the first span

3. An assessment of growth in the first span indications

4. Results of in-situ pressure testing, if performed.

The complete results of the OTSG tube inservice inspection shall be submitted to the NRC within 90 days following the completion of the inspection. The report shall include:

1. Number and extent of tubes inspected,

2. Location and percent of wall-thickness penetration for each indication of an imperfection,

3. Location, bobbin coil amplitude, and axial and circumferential extent (if determined) for each first span IGA indication, and

4. Identification of tubes plugged and tubes sleeved.

5.7 Reporting Requirements

5.7.2 Special Reports (continued)

Results of OTSG tube inspections that fall into Category C-3 shall be reported to the NRC prior to resumption of plant operation. This report shall provide a description of investigations conducted to determine cause of the tube degradation and corrective measures taken to prevent recurrence.