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Alan J. Harris
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W3F1-2005-0044

July 7, 2005

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

SUBJECT: Response to Request for Additional Information Related to Review of Refuel 12 Steam Generator Tube Inservice Inspection Reports
Waterford Steam Electric Station, Unit 3
Docket No. 50-382
License No. NPF-38

REFERENCES:
1. Entergy letter dated November 18, 2003, "Combined Category C-3 and 15-Day Special Report SR-03-002-00 on the 12th Refueling Outage Steam Generator Tube Inservice Inspection" (W3F1-2003-0089)
2. Entergy letter dated November 15, 2004, "12-Month Special Report SR-04-001-00 on the 12th Refueling Steam Generator Tube Inservice Inspection" " (W3F1-2004-0109)

Dear Sir or Madam:

In Reference 1, Entergy Operations, Inc. (Entergy) provided the number of tubes plugged in each Steam Generator (S/G) in refueling outage 12, as specified by Technical Specification (TS) 4.4.4.5.a, within 15 days following completion of S/G tube Inservice Inspection (ISI). In Reference 2, Entergy provided the complete eddy current test results for refueling outage 12, as specified by TS 4.4.4.5.b, within 12 months following the inspection. This report contained the number and extent of tubes inspected, the location and percent of wall-thickness penetration for each indication of an imperfection, and the identification of tubes plugged or sleeved.

On June 7, 2005 Entergy received an NRC request for additional information to support the review of the 12th Refueling Outage Steam Generator Tube Inservice Inspection. Entergy's response is contained in Attachment 1.

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There are no new commitments contained in this letter. If you have any questions or require additional information, please contact our R.L. Williams at (504) 739-6255 or R.C. O'Quinn at (504) 739-6387.

Sincerely,

for AJ Harris

A. J. Harris
Director, Nuclear Safety Assurance
Waterford Steam Electric Station, Unit 3

AJH/RLW

Attachment 1: Response to Request for Additional Information

cc: Dr. Bruce S. Mallett
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Attachment 1

To

W3F1-2005-0044

Response to Request for Additional Information

Response to Request for Additional Information

REFERENCES:
1. Entergy letter dated November 18, 2003 "Combined C-3 and 15-Day Special Report SR-03-002-00 on the 12th Refueling Outage Steam Generator Tube Inservice Inspection" (W3F1-2003-0089)
2. Entergy letter dated November 15, 2004 "12-Month Special Report SR-04-001-00 on the 12th Refueling Steam Generator Tube Inservice Inspection" (W3F1-2004-0109)
3. CEOG 1151 CE Owners Group "Methodology for Evaluation of Axial Degradation in Steam Generator Tubing"

Questions pertaining to the November 18, 2003 letter

Question 1:

Table 2.2 indicates that two indications in SG32 were attributed to wear greater than or equal to 39% through-wall. However, Attachment 2 in the November 15, 2004 letter lists three tubes with wall thickness penetrations of greater than or equal to 39% (SG32-R48-C18, SG32-R54-C88, and SG32-R56-C88). The latter two tubes were plugged.

Clarify whether it was your intent to plug all tubes with wear indications greater than or equal to 39% through-wall. If so, discuss why tube SG32-R48-C18 was not plugged. Clarify why three tubes were not reflected in Table 2.2.

Response 1:

Entergy complies with the Technical Specification (TS) 3.4.4 requirement to plug or repair tubes that may become unserviceable prior to the next inspection and has a greater than or equal to 40% of the nominal tube wall thickness. Preventative plugging based on wear and wear rate is performed on tubes that do not exceed the TS 3.4.4 limit of 40%.

Tube	Thru Wall (TW)	Plugged	Basis
R48-C18	39%	No	Stable
R56-C88	42%	Yes	Exceeds TS 3.4.4 (40%)
R54-C88	39%	Yes	Growth – Conservative Decision

Tube SG32-R48-C18 was not plugged because the 39% through wall wear existed previously but did not show an increase in tube degradation.

Tube SG32-R56-C88 was plugged due to reported wear depth exceeding the TS limit of 40%TW by NDE. The reported RF12 depth was 42%TW at BW9, with a growth of 10%TW for the Cycle 12 period. This was the only wear indication at a support required to be plugged based on TS repair criterion. An immediately adjacent tube SG32-R54-C88 with a 39%TW indication also at BW9 was conservatively repaired by plugging. The growth of this indication was 5%TW for Cycle 12. This tube was selected for preventive repair based on +Pt coil length measurement of

BW9 wear scars that indicated the axial length of these scars was approximately 4" or the entire contact length of BW9.

Table 2.2 included tubes removed from service. Some tubes had multiple indications which would have removed them from service. Only two were removed from service as detailed, therefore only two were listed in Table 2.2.

Table 2.2 is a summary of the information provided in detail in Attachment 2 of Ref 1. Two errors were identified in this table. The number of Copper Residual indications should have been 12 and the number of PVN should have been 1 for SG31. The table also includes "Dent at Support Plate with Axial Indications." The dents are not part of the listing in Attachment 2.

Question 2:

Table 3.1.2 describes a circumferential flaw with a through-wall depth of 99% at the top-of-tubesheet (TTS) in tube SG32-R75-C91. The indication exceeded the criteria for in-situ leakage testing under main steam line break (MSLB) pressure.

A. Given the size of the flaw, discuss the results of previous inspections at this location (i.e., discuss whether the flaw was below the threshold of detection during the Spring 2002 inspection).

B. If a flaw signal was present during the previous inspection (based on hindsight analysis), discuss corrective actions taken to improve the detection of similar flaw signals.

C. If a flaw signal was not present during the previous inspection (based on hindsight analysis), discuss whether the apparent growth rate is consistent with past experience, and discuss any implications regarding tube integrity.

Response 2:

A. The indication in tube R75-C91 had been detected in the RF10 and RF11 outages. The indication was identified (called) by both primary and secondary analysts as a Single Circumferential Indication (SCI) but removed during the resolution process. A hindsight review was performed that showed that the indication was also present in RF09 but was not identified (called) by either primary or secondary analysts.

A review was conducted for similar evaluation reversals in RF11. During RF11, there were a total of 41 evaluations (21 in SG31 and 20 in SG32) that primary and secondary analyst reported flaw-like ECT signals with the resolution analyst ultimately reclassifying the ECT signals as NDDs (non-detectable defect). These findings initiated an independent hindsight review of all available RF11 data on the 41 tubes +Point data (RF11 data was found to be corrupt for 3 tubes). The review concluded that the only inappropriate disposition was on tube R75-C91. As part of the RF12 inspection plan, all 41 tubes were examined. The RF12 review provided strong evidence that the occurrence was an isolated case and the overall ECT analysis process was strong.

B. Condition Report CR-W3-2003-3309 was written to address this issue. Immediately following the identification of the SCI in R75-C91 a package of information was prepared

that contained the RF12 ECT +Point data and the ECT +Point data from RF09, RF10 and RF11. The information package was immediately provided to all primary, secondary, resolution and Independent QDA analysts performing data analysis for the RF12 steam generator inspection as lessons learned to ensure the issue was not repeated. The information package was also thoroughly discussed with Region IV NRC ISI inspection personnel.

In preparation for RF13, this information was incorporated into the training material presented to the analysts prior to the start of the inspection. Analysts were required to review the actual data from the RF09, RF10, RF11 and RF12 outages on this indication. This training provided additional assurance that the issue experienced with R75-C91 would not be repeated in future outages.

C. The flaw signal was present during previous inspections; therefore, a response to this question is not applicable based on the discussion above.

Question 3:

Section 3.4 states that three free span axial indications were found for the first time, and that lines of sludge were detected between the tube with the indications (tube SG31-R42-C140) and the stay rod. The +Point™ coil was used to identify the presence of three indications at the location of a distorted indication from the bobbin coil.

A. Provide an estimate of the severity (i.e., length, depth) for the three axial cracks. Discuss the cracking mechanism (i.e., ODSCC, etc.), and clarify whether or not the three cracks were associated with the lines of sludge and/or dents/dings at this location.

B. Discuss the position of the cracks in relation to each other (e.g., discuss whether the cracks were axially aligned, or were offset in the circumferential direction). With regard to the relative position of the three cracks, discuss whether any of the three cracks could interact with one another (i.e., discuss whether the presence of one crack affects the burst pressure and/or leakage of another crack, or whether the ligaments between cracks are so small that two or more cracks behave as one larger crack).

Response 3:

A. A single tube was reported with axial ODSCC at a non-ding, freespan location several inches above 01H. The severity of the identified cracks are ranging in length from 0.18" to 0.29" inches with maximum depth of approximately 50%TW using the CEOG 1151 amplitude based sizing process. Maximum depth as reported by phase analysis was 22%TW. This tube, R42 L140 in SG32 is adjacent to a stayrod. The cracks are associated with a line of sludge.

B. The cracks were aligned axially. Interaction of the cracks was performed by analysis. Using the sizing information of the cracks, a burst capability evaluation was performed. Specific return to null is observed for the area between each flaw, suggesting that the initiation sites are not linked. Burst capability of this indication is bounded by the integrity assessment of eggcrate axial ODSCC indications. This indication was also depth profiled. The 0% depth reports between the individual initiation sites were

conservatively assigned a depth of 20%, assuming that a flaw was present at low level but not reportable. The overall length is then 0.83", with an average depth of 25.9%. Based on these flaw parameters, the predicted burst pressure at 90% probability, 50% confidence, is 7777 psi. These free-span axial indications in SG32 were the first observed indications of this type in the Waterford 3 steam generator.

There is a typographical error in section 3.4 identifying the location as SG31, the correct location is SG32. Table 2.2 does identify the correct SG location as SG32.

Question 4:

In Section 3.6, it is stated that the +Point™ examination identified two flaw-like indications at dents in SG31, thereby resulting in expansion of the inspection to include "all dented intersections" on the hot leg side of SG31.

A. Clarify whether the +Point™ inspection expansion scope in SG31:
(I) included all dented tubes at the eggcrate intersections, regardless of voltage, or merely all dents voltages greater than or equal to 2.0 volts; or
(ii) was limited to tubes with new dents and/or dents greater than or equal to 2.0 volts and showed an increase in voltage of 20% in RF12.

B. Provide the voltages for the dents that were associated with the two flaw indications. If the voltage for either of these two dents was near 2.0 volts, provide your basis for not expanding the scope of the +Point™ inspection to include dents with voltages less than 2.0 volts (assuming the scope was limited to dents greater than or equal to 2.0 volts). Discuss whether the two flaws were detected with a bobbin coil, and discuss the severity of these flaws.

C. Provide your basis for not expanding the inspection scope in SG32, since the potential for cracking of dented tubes at eggcrate intersections should be similar for both steam generators.

Response 4:

A. The expansion scope in SG31 included all eggcrate locations with dents greater than 2.0 volts.

B. The voltages for the dents with the two flaws:

Flaw at tube Row 47 Column 57 01H the dent voltage was 4.17 volts.
Flaw at tube Row 49 Column 55 01H the dent voltage was 2.18 volts.

The flaws were identified to be at the edge of the dents in these locations. Bobbin coil is unqualified to size for PWSCC in dents greater than 2.0 volts or ODSCC for dents greater than 5.0 volts. These cracks were not capable of being seen with the bobbin coil based on their small size.

A 20% sample of hot leg dented intersections with a bobbin amplitude >2.0 volts were inspected using +Pt in each SG. No PWSCC indications were observed.

Two axial ODSCC indications were reported at dented hot leg intersections in SG31. The bobbin coil data could not identify a possible flaw signal due to the dent influence. In both cases, the location of the axial ODSCC was judged not to be coincident with the dent, thus the axial ODSCC was not associated with the dent. The hot leg dent program was expanded to include all hot leg dents >2V by bobbin. No additional indications were reported.

The axial length of the two indications was reported at 0.23" and 0.12". Maximum depth was estimated at <40%TW using the CEOG Task 1151 sizing methodology.

C. The initial scope in both generators was a 20% sample of dents at hot leg eggcrates greater than or equal to 2.0 volts. There were no cracks identified in SG32 inspection. In SG 31 however, a small axial crack was identified adjacent to a dent at an 01 Hot eggcrate support. The scope was expanded to 100% of the dents at hot leg eggcrate supports greater than and equal to 2.0 volts. During that expansion, a second axial crack was also identified in an 01 Hot support. Based on the EPRI guidelines, the use of a critical area was used and the requirement was to do a 20% sample of the critical area in the other generators which was the initial scope so no further action was required.

Question 5:

It is stated on page one of the cover letter that the +Point™ coil was used to examine "...any wear indications that required RPC testing." The staff notes that it is difficult to use bobbin signals to differentiate a crack in a wear scar. If a crack is present in a wear scar but is assumed to not exist, an assessment of the wear scar could lead to an under prediction of its severity.

A. Provide your technical basis for determining when wear indications are inspected using a rotating probe.

B. Given that not all wear scars are inspected with a rotating probe, discuss how you incorporate the potential for undetected cracks (in wear scars) into your tube integrity calculations and conclusions.

Response 5:

A. Waterford 3 completes a 20% sampling program which conforms to the intentions of the Pressurized Water Reactor Steam Generator Examination Guidelines: Rev 6, Requirements (EPRI TR-1003138). The bobbin coil is used as a screening examination. If areas are characterized as new wear they are examined with the rotating coil and then added to the "wear population". The wear locations will be examined with the rotating coil on a 20% per outage basis that will examine 100% of the wear within the 60 EFPM per the EPRI Guideline.

The following were extracted from the RF12 Degradation Assessment:

- Any wear (%TW) associated with an eggcrate (01H – 07H only) will require testing with plus point due to the fact that stress corrosion cracking has been identified in this area. Additionally, the wear at 07H – 10H will also be tested with plus point to ensure no cracking is seen in the upper spans of the hot leg.
- Wear indications sized with bobbin will be removed from service at ≥ 40% through wall. Wear indications that are new will require rotating probe technology for further diagnostics.
- If a wear "+Pt." examination identifies a crack like indication, then 100% of all wear will be spun.

B. Cracking in wear scars has not been detected in the Waterford 3 Steam Generators. Therefore, it is not considered an active damage mechanism and is not included in the tube integrity calculations.

Question pertaining to the November 15, 2004 letter

Question 6:

Section 4.0 states that Attachment 2 denotes the location and percent wall-thickness penetration for each indication, and that the only flaws that were sized and left in service are for wear.

A. In Attachment 2, one tube (SG31-R6-C22) is denoted as having a 29% through-wall penetration at the TTS location. Clarify whether this indication is due to wear and the source of the wear (e.g., loose part, etc.).

B. Discuss whether a foreign object search and retrieval (FOSAR) was performed and whether any loose parts were removed from the SGs. If loose parts were detected but not removed, discuss whether you performed an engineering assessment on the impact that loose parts may have had on tube integrity and the results of that assessment.

Response 6:

A. The indication is due to wear from a loose part.

B. During Waterford 3's Refuel 12 the Steam Generator was chemically cleaned and followed with a secondary side Upper Bundle flush and sludge lancing. Loose parts were identified and entered into the site's corrective action program. Specifically, a loose part in SG31 affecting R6-C22 was identified in condition report CR-WF3-2003-03254. The FOSAR crew was notified of the location and inspected the area. The post bundle flush/sludge removal inspection determined the loose part was no longer present. During the FOSAR inspection following tubesheet sludge lancing foreign objects observed were identified and entered into the site's corrective action program in condition report CR-WF3-2003-03496. An assessment is contained within this condition report evaluating the loose parts that were irretrievable. The assessment concluded that loose parts will have no adverse safety or operational affects due to their small size and geometry (predominately wires). A review and evaluation of the RF12 loose parts was provided by Westinghouse which was referenced by Entergy in the assessment (LTR-SGDA-03-296).