



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D.C. 20555-0001

October 2, 2009

Vice President, Operations  
Entergy Operations, Inc.  
Waterford Steam Electric Station, Unit 3  
17265 River Road  
Killona, LA 70057-3093

SUBJECT: WATERFORD STEAM ELECTRIC STATION, UNIT 3 – EVALUATION OF 180-DAY STEAM GENERATOR TUBE INSPECTION REPORTS FOR 2007 MID-CYCLE AND 2008 REFUELING OUTAGE 15 (TAC NO. ME0164)

Dear Sir or Madam:

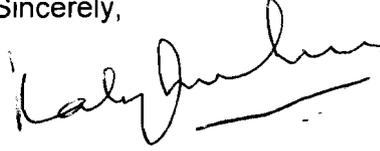
By letters dated May 20 and November 25, 2008, and June 1, 2009 (Agencywide Documents Access and Management System (ADAMS) Accession Nos. ML081440106, ML083330083, and ML091540016, respectively), Entergy Operations, Inc. (the licensee), submitted information pertaining to the 2007 mid-cycle steam generator (SG) tube inspections and 2008 refueling outage 15 (RFO15) SG tube inspections at the Waterford Steam Electric Station, Unit 3. In addition to these reports, the U.S. Nuclear Regulatory Commission (NRC) staff summarized information concerning these inspections in letters dated November 23, 2007, and February 20 and October 28, 2008 (ADAMS Accession Nos. ML073190171, ML080510251, and ML081780404, respectively).

The NRC staff has reviewed the licensee's reports and concludes that the licensee provided the information required by their technical specifications, with the possible exception of not reporting all service-induced indications, as discussed in the enclosed review. Furthermore, the staff's review of these reports did not identify any new technical issues that warrant follow-up action. The staff will continue to monitor the licensee's efforts to manage the damaged batwing supports and to ensure that no significant consequential damage of the SG tubing is occurring.

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If you have any questions, please contact me at 301-415-1480 or via electronic mail at [kaly.kalyanam@nrc.gov](mailto:kaly.kalyanam@nrc.gov).

Sincerely,

A handwritten signature in black ink, appearing to read "N. Kalyanam", with a horizontal line underneath.

N. Kalyanam, Project Manager  
Plant Licensing Branch IV  
Division of Operating Reactor Licensing  
Office of Nuclear Reactor Regulation

Docket No. 50-382

Enclosure:  
As stated

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UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
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STAFF EVALUATION OF 180-DAY STEAM GENERATOR TUBE INSPECTION REPORTS

FOR THE 2007 MID-CYCLE AND 2008 REFUELING OUTAGE 15

WATERFORD STEAM ELECTRIC STATION, UNIT 3

DOCKET NO. 50-382

1.0 INTRODUCTION

By letters dated May 20 and November 25, 2008, and June 1, 2009 (Agencywide Documents Access and Management System (ADAMS) Accession Nos. ML081440106, ML083330083, and ML091540016, respectively), Entergy Operations, Inc. (the licensee), submitted information pertaining to the 2007 mid-cycle steam generator (SG) tube inspections and 2008 refueling outage 15 (RFO15) SG tube inspections at the Waterford Steam Electric Station, Unit 3 (Waterford 3). In addition to these reports, the U.S. Nuclear Regulatory Commission (NRC) staff summarized information concerning these inspections in letters dated November 23, 2007, and February 20 and October 28, 2008 (ADAMS Accession Nos. ML073190171, ML080510251, and ML081780404, respectively).

Waterford 3 has two Model 70 SGs designed and fabricated by Combustion Engineering. The mill-annealed Alloy 600 SG tubes have an outside diameter of 0.750 inches and a nominal wall thickness of 0.048 inches. Each SG contains 9,350 tubes. The tubes are explosively expanded for the full depth of the tubesheet at each end and are supported by a number of carbon steel lattice-grid (i.e., eggcrate) tube supports, diagonal bars (also referred to as batwings), and vertical straps. The tubes in rows 1 through 18 are U-bends and the tubes in rows 19 through 147 are square bends. The upper end of the batwings are connected by a double-sided weld to a wraparound bar located in the periphery of the tube bundle. The center region of the tube bundle contains no tubes and is referred to as the stay-cavity region.

Degradation of the batwings in the stay-cavity region was observed in 2005 in one of the SGs. This degradation is summarized in NRC Information Notice 2005-29, "Steam Generator Tube and Support Configuration," dated October 27, 2005 (ADAMS Accession No. ML052280011). Additional batwing degradation has been detected in subsequent outages. The degradation of the batwings led to several corrective actions including stabilizing and plugging many tubes, additional analyses, and enhanced inspections in this region. A summary of the findings from the 2008 outage is provided below.

Enclosure

## 2.0 REGULATORY EVALUTION

The licensee provided the scope, extent, methods, and results of its SG tube inspections in the documents referenced above. In addition, the licensee described corrective actions (e.g., tube plugging) taken in response to the inspection findings.

The NRC staff has reviewed the information provided by the licensee and has the following observations and comments:

In SG 31, a visual inspection during RFO15 revealed no degradation of the wraparound bar or the welds between the wraparound bar and the batwings. One single-sided weld between columns 85 and 86 on the hot-leg side was repaired during RFO15. A visual inspection of the batwing-to-tube interface, at the innermost row of tubes adjacent to the stay-cavity region, identified tube wear including through-wall wear. This wear was expected based on operating experience at other plants in the 1980s.

The affected tubes were previously stabilized and plugged in response to this operating experience. In some cases, the stabilizing cable was visible. There was no wear evident on the stabilizing cable. All observed wear, including a few wear indications observed on the second row of tubes from the stay-cavity region, was evaluated and determined to be acceptable and within expectations. The tubes in the second row of tubes from the stay-cavity region were also previously plugged but not stabilized. Visual inspections also revealed that six to eight batwings might be broken at the intersection of the batwing and the perforated center support plate located in the stay-cavity region; however, none of these batwings were detached from the center support plate.

In SG 32, a visual inspection during RFO15 revealed no degradation of the wraparound bar. For the welds between the wraparound bar and the batwings, and the weld-clips installed during refueling outage 14 (RFO14) to correct insufficient welds between the wraparound bar and the batwings, there was no significant degradation or change, except for the batwing on the cold-leg between columns 84 and 85, which had slipped into the tube bundle (as had been previously observed during RFO14). A visual inspection of the batwing-to-tube interface, at the innermost row of tubes adjacent to the stay-cavity region, identified tube wear including through-wall wear. This wear was expected based on operating experience at other plants in the 1980s. The affected tubes were previously stabilized and plugged in response to this operating experience. In some cases, the stabilizing cable was visible. There was no evidence of wear on the stabilizing cable. Wear was also visually detected at the intrados of some tubes. There are no broken/deformed batwings in the immediate vicinity of these wear indications. All observed wear, including a few wear indications observed on the second row of tubes from the stay-cavity region, was evaluated and determined to be acceptable and within expectations. The tubes in the second row of tubes from the stay-cavity region were also previously plugged but not stabilized. Four batwing segments (loose parts) were observed including one that appears to have moved since the 2007 mid-cycle inspection. The loose part that appears to have moved is now lodged between several tubes in the upper stay-cavity region. The licensee concluded that this segment is fixed in its current position and is not expected to migrate further into the tube bundle. All

tubes that are in contact with this loose batwing segment have been plugged (and some have been stabilized). Visual inspections revealed extensive batwing degradation in the stay-cavity region including missing pieces of some batwings (which are the source of the four loose parts mentioned previously). There has been no significant change in the batwing condition since the mid-cycle outage. The batwing between columns 84 and 85 which slipped into the tube bundle since it was disconnected from the wraparound bar (this condition was identified during RFO14) has not slipped into the central cavity. Several tubes around this batwing were hydraulically expanded during RFO15 to lock this batwing in place.

Two axially oriented freespan indications, attributed to outside diameter stress-corrosion cracking (ODSCC), were observed during RFO15. These indications were located on the hot-leg side of the SG. The NRC staff reviewed the eddy current data for one of these indications (located in the tube in row 109, column 99) and concluded that the indication was greater than 3.5 inches long and was relatively shallow, approximately 30 to 40 percent through-wall. There is an absolute drift signal in the 100-kilohertz channel in both the 2006 and 2008 eddy current data. The signal from these two outages is virtually identical.

The tube, at row 26 column 58 (R26C58) in SG 31, was identified in RFO15 to have both axially oriented ODSCC and wear at the same tube support intersection. However, the wear and the crack-like indication were not coincident. The two indications were separated by approximately 90 degrees on the tube, that is, they are at different bars of the eggcrate tube support at this axial elevation. Initially, an indication was identified at this location with a bobbin coil. A subsequent inspection with a rotating probe confirmed the presence of both the axial crack-like indication and the wear indication. There were no indications called at this location in prior inspections.

In a telephone conversation in August 2009, the licensee clarified that no cracks were found in dents or dings in any SG tubes. However, one crack was found near a 2.56 volt ding which was near the 3<sup>rd</sup> hot-leg tube support in SG 31. This distorted indication was detected with the bobbin coil and confirmed with a rotating probe to be crack-like.

All service-induced indications may not have been reported in the 180-day report, dated November 25, 2008. For example, the licensee in its response dated June 1, 2009, to the NRC staff's request for additional information, identified tubes R74C48 and R110C32 as having flaws. However these flaws were not listed in the November 25, 2008, letter. The licensee explained that appropriate evaluations of the data were performed and this discrepancy was a reporting issue. Since the licensee appears to have appropriately evaluated the data and this potential "non-reporting" issue was entered into its corrective action program, the NRC staff has determined that no additional follow-up is required at this time.

3.0 CONCLUSION:

The NRC staff has reviewed the licensee's reports and concludes that the licensee provided the information required by its technical specifications, with the possible exception of not reporting all service-induced indications, as discussed above. The staff's review of these reports did not identify any new technical issues that warrant follow-up action at this time. The staff will continue to monitor the licensee's efforts to manage the damaged batwing supports and to ensure that no significant consequential damage of the SG tubing is occurring.

Principal Contributor: A. B. Johnson

Date: October 2, 2009

If you have any questions, please contact me at 301-415-1480 or via electronic mail at [kaly.kalyanam@nrc.gov](mailto:kaly.kalyanam@nrc.gov).

Sincerely,

*/RA/*

N. Kalyanam, Project Manager  
Plant Licensing Branch IV  
Division of Operating Reactor Licensing  
Office of Nuclear Reactor Regulation

Docket No. 50-382

Enclosure:  
As stated

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**ADAMS Accession No. ML092610086** \*Memo dated

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DATE	10/2/09	9/24/09	9/14/09	10/2/09	10/2/09

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