August 25, 2005

Mr. Joseph E. Venable
Vice President Operations
Entergy Operations, Inc.
17265 River Road
Killona, LA 70066-0751

SUBJECT: REVIEW OF WATERFORD STEAM ELECTRIC STATION, UNIT 3 (WATERFORD 3) STEAM GENERATOR TUBE INSPECTION REPORTS FOR THE 2003 OUTAGE (TAC No. MC5130)

Dear Mr. Venable:

By letter dated November 18, 2003, as supplemented by letters dated November 15, 2004, and July 7, 2005, Entergy Operations, Inc. (Entergy, the licensee) submitted reports summarizing the results of inspections of the Waterford 3 steam generator tubes performed during the 2003 refueling outage (RF12).

As discussed in the enclosed evaluation, the Nuclear Regulatory Commission (NRC) staff concludes that Entergy provided the information required by its technical specifications. In addition, the NRC staff did not identify any technical issues that warrant follow-up action at this time.

If you have questions regarding this response, please contact N. Kalyanam, Project Manager, Waterford 3, at (301) 415-1480.

Sincerely,

/RA/

David Terao, Chief, Section 1
Project Directorate IV
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-382

Enclosure: Evaluation

cc w/encl: See next page

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EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

OF THE STEAM GENERATOR TUBE INSPECTION REPORTS FOR THE 2003 OUTAGE

ENTERGY OPERATIONS, INC.

WATERFORD STEAM ELECTRIC STATION, UNIT 3 (WATERFORD 3)

DOCKET NO. 50-382

By letter dated November 18, 2003 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML033290432), and as supplemented by letters dated November 15, 2004 (ADAMS Accession No. ML043220259), and July 7, 2005 (ADAMS Accession No. ML051930068), Entergy Operations, Inc. (the licensee) submitted reports summarizing the results of inspections of the Waterford 3 steam generator tubes performed during the twelfth refueling outage in 2003 (RF12). Since the next refueling outage (RF13) at Waterford 3 was being conducted at nearly the same time that the response to the request for additional information was received, the Nuclear Regulatory Commission (NRC) staff factored the questions into their discussions with Waterford 3 during the 2005 (RF13) outage.

Waterford 3 has two Combustion Engineering Model 70 steam generators. Each steam generator contains 9,350 mill-annealed Alloy 600 tubes. Each tube has a nominal outside diameter of 0.750-inch and a nominal wall thickness of 0.048-inch. The tubes were explosively expanded (explansion) at both ends for the full length of the tubesheet and are supported by a number of carbon steel eggcrate supports, batwings, and vertical straps. The hot-leg temperature is approximately 605E F. The tubes in rows 1 through 18 are U-shaped while the tubes in rows 19 and greater have two 90-degree bends (i.e., square bends). There are no sleeves installed in either steam generator.

High temperature chemical cleaning of the steam generators was performed during the 2000 (RF10) outage in order to remove copper and residual amounts of lead from the tube bundle. Problems were encountered during the cleaning resulting in copper being plated out on the tubes. This prompted concerns about crack initiation and a reduction in the probability of detection with eddy current techniques. Therefore, a second chemical cleaning was performed during the 2003 (RF12) outage. As a result of this chemical cleaning, the level of detection was improved. After chemical cleaning, tubes which still had copper deposits that resulted in significant noise were removed from service. A total of 12 indications (11 tubes) were identified during the 2003 outage that still had sufficient copper deposits resulting in significant amounts of noise. These tubes were plugged.

The licensee provided the scope, extent, methods, and results of their steam generator tube inspections in the documents referenced above. The licensee also described corrective actions (i.e., tube plugging or repair) taken in response to the inspection findings.

ENCLOSURE

As a result of the review of the reports, the NRC staff has the following observations:

1. Cracks have been observed to initiate in wear scars at several plants. Given the limited ability to distinguish a crack from a wear scar with the bobbin coil, some licensees inspect all bobbin indications which they suspect are a result of wear with a rotating probe each outage. These rotating probe examinations are performed to confirm that the bobbin indication is actually a result of wear and not some other degradation mechanism (e.g., cracks or a combination of a crack within a wear scar). Since bobbin indications attributed to wear scars are sized and left in service, if the bobbin indication is actually a result of a crack within a wear scar (or is simply a crack), the size of the flaw may be underestimated (since the method for sizing a crack and wear may differ). If the flaw is severe enough, it may no longer meet the structural integrity performance criteria at the end of the next operating interval.

   Of the suspected wear indications detected at Waterford 3 in 2003 with a bobbin coil, approximately 20 percent were inspected with a rotating probe including all newly identified potential wear indications (i.e., those bobbin indications expected to be a result of wear for which no previous rotating probe examinations were performed to identify the nature of the degradation). These examinations verified that the reported indications displayed a volumetric response and were not crack-like. Although no crack-like indications have been detected in wear scars at Waterford 3, the operating experience at other plants indicate the potential for cracks to develop in wear scars. Given the goal to ensure tube integrity for all tubes, it is important to have a high degree of confidence that indications are appropriately classified (e.g., as either wear, cracking, or cracking in combination with wear) so that they are appropriately sized and dispositioned. In addition, it is important for tube integrity analyses to reflect the potential for this degradation mechanism to occur.

2. Two crack-like indications were found at dented locations during the 2003 (RF12) outage at Waterford 3. Both indications were axially oriented and were located in steam generator 31. The indications were attributed to outside diameter stress corrosion cracking. The voltages of the dents associated with these crack-like indications were 2.2 and 4.2 volts. The crack-like indications were only detected with the rotating probe. During the 2003 outage, 100 percent of the dents greater than 2 volts in steam generator 31 were inspected with a rotating probe while 20 percent of the dents greater than 2 volts in steam generator 32 were inspected with a rotating probe. Neither of the indications were coincident with the dent and the indications were non-safety significant.

   Although none of the indications detected were attributed to the denting at these locations, operating experience has shown that denting can limit the ability to detect degradation. As a result, by not routinely inspecting all dented/dinged locations with a probe capable of finding the forms of degradation potentially affecting the tube at these locations, tube integrity analysis may become a challenge. This consideration has led many licensees to inspect all dented/dinged locations greater than some voltage threshold with a rotating probe to confirm the absence of cracking at these locations.

3. Three axial freespan indications were identified in one tube in steam generator 32. This was the first inspection where freespan indications were identified. This tube was adjacent to a stay rod and the eddy current inspection revealed “lines” of sludge between

the tube and the stay rod. The indications were located several inches above the first hot-leg eggcrate support and were aligned axially along the length of the tube.

4. Axially oriented outside diameter stress corrosion cracks have been observed at the eggcrate supports. Most of the indications have been detected in the hot-leg although several indications have been detected in the cold-leg (e.g., third cold-leg eggcrate support).

Based on a review of the information provided, the NRC staff concludes that the licensee provided the information required by its technical specifications. In addition, the NRC staff concludes that there are no technical issues that warrant follow-up action at this time since (1) additional tube inspections have been performed subsequent to the submittal of these reports, (2) the inspections appear to be consistent with the objective of detecting potential tube degradation, and (3) the inspection results appear to be consistent with industry operating experience at similarly designed and operated units. Given that the licensee has performed another inspection of the steam generator tubes in 2005 (i.e., superceding the 2003 inspections), additional review of the issues discussed above may be performed as a result of the NRC staff's review of the reports that will be submitted (in accordance with the technical specifications) summarizing the results of the 2005 inspections.

Principal Contributor: Ken Karwoski

Date: August 25, 2005

Waterford Steam Electric Station, Unit 3

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