Progress Energy

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

SHEARON HARRIS NUCLEAR POWER PLANT, UNIT NO. 1
DOCKET NO. 50-400/LICENSE NO. NPF-63

RESPONSE TO THE REQUEST FOR ADDITIONAL INFORMATION CONCERNING THE LICENSE AMENDMENT REQUEST FOR A ONE-TIME INCREASE IN STEAM GENERATOR INSPECTION INTERVAL (TAC NO. MC1633)

Ladies and Gentlemen:

By letter dated March 12, 2004, the NRC requested additional information no later than April 15, 2004 to complete a review of the proposed change to Technical Specification 4.4.5.3a, "Steam Generator Surveillance Requirements," for the Harris Nuclear Plant (HNP).

Attachment 1 provides the requested additional information.

Please refer any question regarding this submittal to Mr. John Caves at (919) 362-3137.

I declare, under penalty of perjury, that the attached information is true and correct (Executed on APR 1 5 2004).

Sincerely,

James Scarola

JS/jpy

Attachments:

1. Response to the Request for Additional Information Concerning the License Amendment Request for a One-Time Increase in Steam Generator Inspection Interval

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Mr. L. A. Reyes, NRC Regional Administrator

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Request for Additional Information #1

1. **The amendment request dated December 8, 2003, states that a 100% inspection of all open tubes was conducted during the first outage (RFO-11) following steam generator (SG) replacement. In the RFO-11 summary report dated July 20, 2003 (ADAMS No. ML032680868), it was stated that: (1) 100% of the open steam generator tubing (all three steam generators) was inspected using a bobbin probe, (2) rotating coil exams were conducted on a sample of benign indications recorded from the preservice inspection, and (3) rotating coil exams were conducted on a sample of benign indications newly found during RFO-11. In the description for the preservice inspection dated April 1, 2002 (ADAMS No. ML020990567), it was stated that the following eddy current inspections were conducted: (1) 100% of all open tubes with a bobbin coil, (2) 100% of all manufacturing dents ≥ 2.0 volts with a rotating coil probe, (3) 100% of all open tubes with rotating coil and pancake coil at the hot leg top-of-tubesheet transitions ± 2-in., and (4) 100% of the Row 1 U-bend region from the upper hot leg to cold leg support with a rotating coil.**

   a. **Discuss whether any tubes were identified that were not expanded for the full depth of the tubesheet. If some tubes were not fully expanded, provide the number of tubes affected, the length of the expansion (include the tubesheet thickness), the tube identification, and any corrective actions taken (or planned). If any tubes are currently in service that were not fully expanded, discuss whether these tubes will retain adequate integrity until the next scheduled inspection. Include in the response your technical basis for your conclusion. The staff notes that a crevice between the tube and tubesheet can result in a corrosive environment (i.e., the crevice region may lead to tube degradation in shorter time periods than what would be observed for nominal tubing).**

   Response to Request 1.a

   The Harris Nuclear Plant (HNP) Steam Generator (SG) tubes in service are all expanded.

Request for Additional Information #1 (Continued)

b. **Discuss whether any tubes were identified that were expanded above the top of the tubesheet or whether any tubes were identified with bulges. If such tubes were identified, provide the number of tubes affected, the size of the bulge, the tube identification, and any corrective actions taken (or planned). If any such tubes are currently in service, discuss whether these tubes will retain adequate integrity until the next scheduled inspection. Include in the response your technical basis for your conclusion. The staff notes that a bulge (i.e., overexpansion) can result in increased stresses in the tube which may lead to degradation in shorter time periods than what would be observed for nominal tubing.**

Response to Request 1.b

The results from the first SG tube Eddy Current Testing (ECT) did not identify any tube as having been expanded above the top of the tubesheet nor were there any tubes noted as having bulges.

c. **With respect to the benign indications identified during RFO-11, discuss the nature of these indications (e.g., manufacturing burnish mark) and the number of indications in each grouping. Discuss whether these indications could be traced to the baseline inspection. If any of the indications could not be traced back to baseline, discuss the cause of these indications and your technical basis for leaving them in service.**

Response to Request 1.c

Benign indications recorded during refueling outage (RFO)-11 were recorded as NQS (Non-Quantifiable Signal) and PVN (Permeability Variation). Please see the Response to Request #2, second half of the request, and second paragraph for more detail on the nature of the NQS recorded signals.

From the RFO-11 results:

Steam Generator	A	B	C
NQS Indications	64	88	93
PVN Indications	1	2	1

All of the benign indications recorded during RFO-11 were traceable to the baseline inspection.

Request for Additional Information #2

2. **It was indicated that some of the preservice inspection benign indications displayed a slight signal phase rotation upon eddy current examination during RFO-11, and that phase rotation after the first cycle of plant operation has been observed by the eddy current analysis at other plants with replacement steam generators with similar tubing. It was noted that signal phase rotation was not evident of tube degradation.**

Response to Request #2 (First Half of the Request)

All of the NQS signals recorded during the baseline examination, regardless of amplitude, were reviewed during the RFO-11 first inservice inspection (ISI). Some of the signals showed a slight phase change from the baseline inspection. This phenomenon has been noted at other sites after the first cycle of operation, after the tubes go through a "heat cycle". Since the anomalous signals are quite small, most less than 0.25 volts, a slight change in conductivity in the tube, such as can occur from a heat cycle, can affect the signal phase. It was also noted on some indications, that the absolute channel showed a larger offset during the first inservice inspection as compared to the baseline signal. There is no differential signal change, and the absolute signals show no phase change between frequencies, again indicating a slight conductivity variation from the nominal tube.

Request for Additional Information #2 (Continued)

Discuss the cause of this phase rotation and whether the phase rotation observed at Harris was caused by the same mechanism as that which caused the phase rotation at the other plants. That is, provide a basis for the conclusion that no service-induced degradation is occurring in the benign indications that experienced signal phase rotation. Include in your response a discussion of why all of the benign indications did not have a slight phase rotation.

Response to Request #2 (Second Half of the Request)

The cause of the phase rotation, based on experience with other replacement steam generators after the first cycle, is believed to be a "relaxing" of the metallurgical condition of the tube from a full heat cycle. After the first cycle, the signal stays the same and does not change over time. There is little change to the differential signal amplitude, and sometimes a slight change in the absolute signal amplitude, with no phase change noted. These signals are very small in amplitude, most below 0.25 volts and not indicative of degradation. Samplings of the anomalous indications were examined with rotating coil (plus point and pancake coils) and no discernable indication was noted where the bobbin probe showed an absolute signal change.

The benign indications, or as classified at HNP, NQS indications, are not from the same source, therefore they may not show a phase change. A NQS indication could be from a small physical imperfection in the tube during manufacture, a small metallurgical imperfection (such as an alloy anomaly or permeability change), a small nick in the tube due to installation of the tube, a small nick in the tube that has been buffed or burnished, etc. A heat cycle may alter the conductivity of the tube and affect a metallurgical anomaly, whereas it may not affect a small mechanical imperfection to the degree where it is noted on the eddy current display.

Request for Additional Information #3

3. **It was noted in the amendment request that no indications of mechanical wear were noted in areas where the tubes contact with the anti-vibration bars (AVBs). It is also stated that the Westinghouse Delta 75 steam generators are designed in such a way that the potential for tube wear is reduced.**

Clarify whether any service-induced AVB wear has been observed in Westinghouse Delta Series steam generators. If wear has been observed, discuss the maximum growth rate observed and whether tube integrity will be maintained for the operating interval between inspections.

Response to Request #3

VC Summer has Westinghouse Delta 75 SGs.
These units are similar to HNP's Delta 75's: same diameter/wall thickness tubing, same number of tubes (6307 per SG), and same number of Anti-vibration Bar (AVB) sets (four). No wear was identified from AVBs (ADAMS No. ML 031840466).

South Texas Project 1 has Westinghouse Delta 94 SGs.
These units have the same diameter/wall thickness tubing, same number of Anti-Vibration Bar sets, but more tubes (7585 per SG). No wear was detected from AVBs (ADAMS No. ML 021910231). [NOTE: STP Unit 2 also has Delta 94 SGs, but their first inspection following SGR is this Spring 2004.]

ANO 2 has Westinghouse model Delta 109 SGs.
These units have the same diameter/wall thickness tubing, more tubing (10637 per SG), more Anti-Vibration Bar sets (five). One indication of AVB wear was identified with a % tube through-wall value of 12% during their first SG ISI after a cycle of operation following SG replacement (ADAMS No. ML 031080421). ANO discussed the evaluation of tube integrity for two full-cycles of plant operation in their NRC submittal letter (ADAMS No. ML 023600429).

Based on the HNP RFO-11 SG ECT results with no active degradation mechanisms, and from a review of the information of similar Westinghouse Delta model SGs noted above, the HNP SGs are expected to meet tube integrity criteria following a 40-month period of operation at the next inservice inspection.

Request for Additional Information #4

4. **Describe what actions, if any, were taken to verify that the steam generator tubes were manufactured (i.e., processing, heat treatment, etc.) as specified so as to exhibit optimal resistance to degradation (refer to NRC Information Notice 2002-21 dated April 1, 2003). If tubes with non-optimal tube processing have been identified, discuss the implications of these findings with respect to tube integrity for the proposed 40-month interval between inspections.**

Response to Request #4

As part of the SG manufacturing responsibility, Westinghouse had a Quality Control individual monitoring key portions of the tube manufacturing process. HNP also sent a vendor surveillance person to periodically monitor the key activities during tube manufacturing. The HNP vendor surveillance individual reviewed the records of different manufacturing processes while at Sandvik, and the records were satisfactory.

During the HNP RFO-11 SG tube ECT examination process, the data from the seventeen innermost rows of tubing, which received thermal stress relief after tube bending, was monitored to identify signals that might be representative of the Seabrook heat treating/tube straightening issue. No signals were detected that might indicate the manufacturing problem as noted in NRC IN 2002-21.

Request for Additional Information #5

5. **Provide the following general design information regarding for the steam generators:**

   a. **Schematic which depicts the tube supports and the tube support naming conventions**

   Response to Request 5.a

   See attachment

   b. **Tubesheet map which depicts the rows and columns of the tubes**

   Response to Request 5.b

   See attachment

   c. **Tube manufacturer**

   Response to Request 5.c

   Sandvik

   d. **Tube outside diameter and wall thickness**

   Response to Request 5.d

   Tube outside diameter – 0.688 inch (nominal)
   Tube wall thickness – 0.040 inch (nominal)

   e. **Tube pitch and orientation (i.e., 1.1-in. triangular)**

   Response to Request 5.e

   Tube Pitch – 0.980 inch
   Tube Orientation - Triangular

   f. **Any other noteworthy design characteristics, not included in your amendment request, that could be a factor regarding tube integrity**

   Response to Request 5.f

   No additional noteworthy design characteristics that might be a factor regarding tube integrity.

Request for Additional Information #5 (Continued)

g. Measurement scheme when reporting eddy current analysis results (i.e., points of reference for measurements: the bottom of a support, middle of support, etc.)

Response to Request 5.g

Location Reporting Practices

1. Test extents (length of individual examinations) shall be reported using the first and last inspected intersection. Only tube end, top of tube-sheet and supports shall be used for extents tested.
2. All location or length measurements shall be recorded in one-hundredths (0.01) of an inch from the center of each support or tube-sheet edge.
3. All indication locations shall be recorded with a positive (+) offset from the center of the nearest structure or tube-sheet edge except as noted in 6 below.
4. An indication between the top supports of the hot leg (HL) and cold leg (CL) shall be measured from the structure closest to the HL.
5. No U-bend indications shall be measured positively beyond the top support on the CL except as allowed by 6 below.
6. Indications within a ±1" band from the support structure or tube-sheet edge shall be recorded from the centerline of the structure in a positive (+) or negative (-) direction, as applicable.
7. Indications at or above the top of tubesheet shall be measured from the top of the tubesheet. Indications within the tubesheet shall be measured from the tube end except as allowed in 6 above. A tubesheet minus measurement may be performed in cases where no tube end was recorded.

h. Tube support (including AVB) thickness

Response to Request 5.h

Tube Support Plate thickness – 1.125 inch
Flow Distribution Baffle plate thickness – 0.75 inch
AVB thickness - 0.160 inch

Request for Additional Information #6

6. **Clarify what will be required under your proposed technical specifications if the next inspection is classified as C-2 or C-3. For example, would NRC approval be required to continue with 40-month inspection intervals? If not, modify the proposed wording such that if the next inspection is not C-1, NRC approval would be required to continue with a 40-month inspection interval.**

   Response to Request #6

   If the next inspection is classified as C-2 or C-3, NRC approval would be required to continue with 40-month inspection intervals.

Request for Additional Information #7

7. **A primary-to-secondary leak was observed at a plant which recently replaced their steam generators. In reviewing the eddy current data for the leaking tube (both preservice and inservice inspection data), the licensee noticed an anomalous dent signal. Although the leak was attributed to this dent signal, there was no clear indication of a 100% through-wall flaw based on the rotating probe data (the leak was attributed to this location based on visual and non-destructive examination data).**

Given that your steam generators contain dents/dings, discuss the potential for a through-wall or near through-wall flaw to exist at these locations (e.g., are there anomalous dent/ding signals?). Please discuss your primary-to-secondary leakage history since installation of the steam generators. Discuss whether the hydrostatic test and/or other pressure tests performed during fabrication would have been able to detect small leaks through the tubes. Discuss whether any other inspection data could represent through-wall or near through-wall flaws (e.g., do other types of indications exhibit anomalous signals?).

Response to Request #7

HNP dents/dings:

The dent/ding issue was discovered while performing a 20% sample inspection of the SG tubes while the units were still at the manufacturing facility (June 1998). The 100% ECT preservice inspection (PSI) baseline identified the rest of the dent population (performed at HNP in June 2001). Dent signals 2 volts and greater were examined using a rotating coil probe that included a plus point coil and pancake coil during the PSI.

The mechanism that has been attributed to creating the dents/dings on the HNP tubes during the manufacturing process was the Post Weld Heat Treatment of the channel head to tubesheet weld. The majority of the dents appear at the upper tube support plate in the outer periphery with some at lower tube support plates. Westinghouse performed research into this issue while manufacturing the STP Unit 1 SGs that followed the HNP units in production at Pensacola. The shell barrel elongated and the barrel holds the tube support plates in place. The tube plate support stayrods are anchored into the tubesheet. The tubes are also firmly attached to the tubesheet. The tube support plates deflected slightly at the outer edges with the growth of the shell barrels (while the center of the plate did not deflect as much since the stayrods did not experience as much growth from the thermal effect).

Request for Additional Information #7 (Continued)

Response to Request #7 (Continued)

The HNP Replacement Steam Generators (RSGs) and the STP Unit 1 RSGs were the last SGs manufactured in the Westinghouse Pensacola facility.

The SG ECT Level III individual has indicated that there were no anomalous dent/ding signals reported during the RFO-11 inspection.

Primary-to-Secondary Leakage since SG Replacement:

There has not been Primary-to-Secondary leakage since installation of the SGs (reference Page A1-6 of 8 in HNP-03-116, third paragraph, second sentence).

Hydrostatic Tests at the manufacturing facility:

ASME Code hydrostatic tests were performed on both the secondary and primary side. These preservice tests were performed at the manufacturing facility to verify the integrity of the tubes and the tube-to-tubesheet welds.

During the secondary side hydrostatic test, a small droplet was identified on one of the tubes after about 1 ½ hours at the inspection pressure. This tube had been previously manually weld repaired, and the weld repair had migrated into the tube creating a defect. This condition was determined to be an isolated event that occurred during the weld repair. This tube was subsequently plugged and successfully hydrostatically tested.

Inspection data that could represent through-wall or near through-wall flaws:

As described earlier in response to Question #2, benign signals, which represent various tube anomalies such as permeability variations, dents, buff marks, etc. were reported during the RFO11 inspection. These signals were traceable to the pre-service inspection. Benign signals of any size (voltage) reported during the pre-service inspection or during the RFO11 inspection by bobbin probe were sampled with rotating probes as well. The majority of the benign signals reported by bobbin probe are less than one volt, and have little potential to mask or distort a flaw signal. There were no benign signals reported by bobbin probe or subsequent rotating probe that indicated through-wall or near through-wall flaw signals.

As additional information regarding the manufacture of the SG ECT calibration standards, the ECT calibration standards used during the SG Eddy Curent Inspection were manufactured in accordance with the ASME Code for the bobbin probe exams, and EPRI's PWR Steam Generator Examination Guidelines for the rotating coil probe exams.

Response to Request 5.a
Schematic which depicts the tube supports and the tube support naming conventions

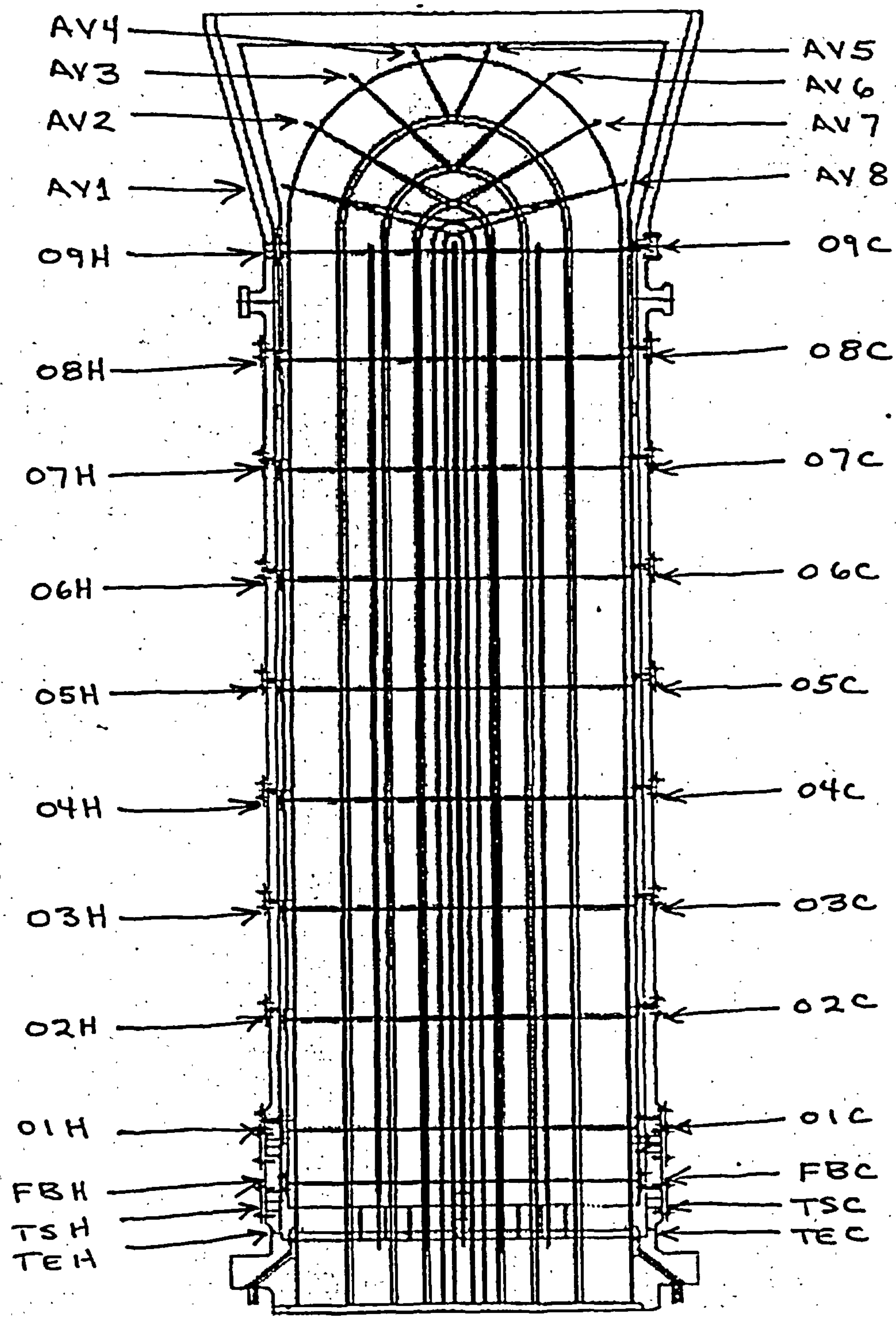

Figure 1 – W model D75 S/G

Response to Request 5.b
Tubesheet map which depicts the rows and columns of the tubes