VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

October 30, 2012

United States Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555-0001

Serial No. 12-640
SPS-LIC/CGL R1
Docket No. 50-280
License No. DPR-32

**VIRGINIA ELECTRIC AND POWER COMPANY**
**SURRY POWER STATION UNIT 1**
**STEAM GENERATOR TUBE INSERVICE INSPECTION REPORT**
**FOR THE SPRING 2012 REFUELING OUTAGE**

Technical Specification 6.6.A.3 for Surry Power Station Units 1 and 2 requires the submittal of a Steam Generator Tube Inspection Report to the NRC within 180 days after $T_{avg}$ exceeds 200°F following completion of an inspection performed in accordance with Technical Specification 6.4.Q, Steam Generator Program. Attached is the Surry Unit 1 report for the Spring 2012 refueling outage.

If you have any questions concerning this information, please contact Mrs. Candee G. Lovett at (757) 365-2178.

Very truly yours,

N. L. Lane
Site Vice President
Surry Power Station

Attachment: Surry Unit 1 Steam Generator Tube Inspection Report for the Spring 2012 Refueling Outage

Commitments made in this letter: None

A047
NRR

cc: U.S. Nuclear Regulatory Commission
Region II
Marquis One Tower
245 Peachtree Center Avenue NE
Suite 1200
Atlanta, Georgia 30303-1257

Ms. K. R. Cotton
NRC Project Manager - Surry
U. S. Nuclear Regulatory Commission
One White Flint North
Mail Stop 08 G9A
11555 Rockville Pike
Rockville, Maryland 20852-2738

Dr. V. Sreenivas
NRC Project Manager – North Anna
U. S. Nuclear Regulatory Commission
One White Flint North
Mail Stop 08 G9A
11555 Rockville Pike
Rockville, Maryland 20852-2738

NRC Senior Resident Inspector
Surry Power Station

Mr. R. A. Smith
Authorized Nuclear Inspector
Surry Power Station

Serial No.: 12-640
Docket No.: 50-280

# ATTACHMENT

# SURRY UNIT 1 STEAM GENERATOR TUBE INSPECTION REPORT FOR THE SPRING 2012 REFUELING OUTAGE

## VIRGINIA ELECTRIC AND POWER COMPANY (DOMINION)

# SURRY UNIT 1 STEAM GENERATOR TUBE INSPECTION REPORT FOR THE SPRING 2012 REFUELING OUTAGE

The following satisfies the Surry Power Station Technical Specification (TS) reporting requirement in TS 6.6.A.3. During the Surry Unit 1 Spring 2012 refueling outage, steam generator (SG) inspections in accordance with TS 6.4.Q were completed for all three SGs.

This was the first inspection in the 4th inspection period which has a duration of 60 Effective Full Power Months (EFPM).

Surry Unit 1 exceeded 200°F on June, 2 2012; therefore, this report is required to be submitted by November 29, 2012. The SGs had operated for 300.1 EFPM at the time of this inspection.

***Bold italicized*** text represents TS verbiage. The required information is provided under each reporting requirement as follows:

***A report shall be submitted within 180 days after $T_{avg}$ exceeds 200°F following completion of an inspection performed in accordance with the Specification 6.4.Q, "Steam Generator (SG) Program." The report shall include:***

***a. The scope of inspections performed on each SG***

The planned eddy current examination scope is identified below in Table 1. The only scope expansions required were those necessary to bound foreign objects and foreign object related degradation, as well as to resolve ambiguous indications. A complete summary of the tube examinations performed during the outage is provided in the final inspection status (Table 2).

The primary side inspections activities also included a video/visual examination of all six channel heads (as-found/as-left, specifically including all plugs, the divider plate weld region, and the bottom of the bowl per NSAL-12-1 with the bowl dry). No anomalous conditions associated with these inspections were found.

**Table 1 - Primary Side Examination Scope**

| Scope | SG A | SG B | SG C |
|---|---|---|---|
| Bobbin Probe: Full Length (except row 1 and 2 U-bends) | 100% | - | 100% |
| Array Probe: H/L Tubesheet and Expansion Transition | 100% | 36% | 100% |
| Array Probe: C/L Tubesheet and Expansion Transition | 37% | | 36% |
| Plus Point Probe: Row 1 and 2 U-bends (07C to 07H) | 100% | | 100% |

**Table 2 – EOC24 Actual ECT Examination Scope**

| Scope Description | Extent | SG A | SG B | SG C |
|---|---|---|---|---|
| | | Acquired | Acquired | Acquired |
| Bobbin Coil Exams | | | | |
| Full Length | TEHTEC | 3023 | | 3031 |
| C/L Straight (Row 1-2) | 7HTEC | 181 | | 275 |
| H/L Straight (Row 1-3) | 7CTEC | 264 | | 181 |
| H/L Candycane (Row 3) | 7HTEH | 10 | | 94 |
| Restricted Tube (R5C35) | TEHTEC | 1 | | |
| C/L Candycane (Row 3) | 7HTEC | 83 | | |
| Array Exams | | | | |
| H/L Array (Non-Baffle Plate) | TSH1H | 835 | 266 | 837 |
| H/L Array (Baffle Plate) | TSHBPH | 2463 | 931 | 2469 |
| C/L Array (Non-Baffle Plate) | TSC1C | 295 | | 282 |
| C/L Array (Baffle Plate) | TSCBPC | 933 | | 924 |
| C/L Array (Bounding) | Various | 2 | | |
| MRPC Exams | | | | |
| U-bend +PT (Row 1-2) | 7H7C | 181 | | 181 |
| Select Tube +PT | Various | 33 | 12 | 68 |
| MRPC Special Interest | | | | |
| H/L Previous Indications | Various | 17 | 10 | 10 |
| H/L Previous DNT>2V | Various | 167 | | 130 |
| H/L Indications | Various | 45 | 1 | 40 |
| U-bend Previous DNT>2V | Various | 2 | | 3 |
| U-bend Indications | Various | 14 | | 3 |
| C/L Previous Indications | Various | 3 | | 1 |
| C/L Previous DNT>2V | Various | 3 | | 2 |
| C/L Indications | Various | 33 | | 10 |
| | **Total** | 8588 | 1220 | 8541 |

The following Secondary side exams were conducted:

SGs A, B, and C:

- Post-lancing visual examination of the top-of-tubesheet annulus and no-tube lane.
- Visual examination of historical foreign object-related locations.
- Visual investigation of any accessible locations having eddy current indications potentially related to foreign objects and removal of retrievable foreign objects.

SG A:

- Visual examination, from the steam drum in SG A, of all accessible steam drum components and structures, including the feedring exterior, the upper tube bundle, and 7$^{th}$ TSP via probe drops through the primary moisture separators. No adverse conditions were noted during this inspection.

***b. Active degradation mechanisms found***

Degradation mechanisms targeted by the inspection plan included anti-vibration bar (AVB) wear, pitting, foreign object wear, tube support wear, and stress corrosion cracking (SCC) at various locations within the steam generator tube bundle. AVB wear, foreign object wear, tube support plate wear, one legacy pit indication, and one legacy sludge lance wear flaw were detected. No SCC was detected.

A permanent alternate repair criteria (ARC) was incorporated into the Surry Technical Specifications, effective during the EOC24 outage. The ARC specifies that tubes with service-induced flaws located greater than 17.89 inches below the top of the tubesheet do not require plugging. Tubes with service-induced flaws located in the portion of the tube from the top of the tubesheet to 17.89 inches below the top of the tubesheet shall be plugged upon detection.

***c. Nondestructive examination techniques utilized for each degradation mechanism***

Inspections focused on the following degradation mechanisms listed in Table 3 utilizing the referenced eddy current techniques.

**Table 3 – Inspection Method for Applicable Degradation Modes**

| Classification | Degradation Mechanism | Location | Probe Type |
|---|---|---|---|
| Existing | Tube Wear | Anti-Vibration Bars | Bobbin – Detection<br>Bobbin and +PointTM – Sizing |
| Existing | Tube Wear | Tube Support Plate | Bobbin – Detection<br>Bobbin and +PointTM – Sizing |
| Existing | Tube Wear (foreign objects) | Freespan, TTS, FDB, TSPs | Bobbin and Array – Detection<br>+PointTM - Sizing |
| Existing | ODSCC | Hot Leg Top-of-Tubesheet Sludge Pile Area | Bobbin and Array – Detection<br>+PointTM - Sizing |
| Existing | PWSCC | At the Tube ends<br>TE + 4 Inches | Inspection not required per PARC |
| Existing | PWSCC | Hot Leg Top-of-Tubesheet | Array – Detection and Sizing |
| Existing | OD Pitting | Top-of-Tubesheet | Bobbin – Detection<br>+PointTM - Sizing |
| Potential | Tube Wear | Flow Distribution Baffle | Bobbin – Detection<br>Bobbin and +PointTM – Sizing |
| Potential | ODSCC | Freespan and Tube Supports | Array – Detection<br>+PointTM – Sizing |
| Potential | PWSCC | Hot Leg Within Tubesheet Anomaly locations | Array – Detection<br>+PointTM – Sizing |

***d. Location, orientation (if linear), and measured sizes (if available) of service induced indications***

As stated in the (b) response above, several wear type indications were noted. Tables 4 and 5 provide the detailed information regarding these indications.

**Table 4 – AVB Indications**

| SG | Row | Col | AVB No. | Depth (%TW) (ETSS 96004.1) 2009 | 2012 |
|---|---|---|---|---|---|
| SGA | 9 | 54 | AV1 | 11 | 11 |
| SGA | 12 | 45 | AV2 | 11 | 11 |
| SGA | 12 | 47 | AV4 | 14 | 13 |
| SGA | 30 | 57 | AV2 | 16 | 15 |
| SGA | 32 | 48 | AV3 | 15 | 14 |
| SGA | 32 | 65 | AV2 | 14 | 11 |
| SGA | 32 | 66 | AV2 | - | 11 |
| SGA | 32 | 69 | AV2 | 22 | 22 |
| SGA | 32 | 69 | AV3 | 17 | 15 |
| SGA | 32 | 69 | AV4 | 19 | 19 |
| SGA | 33 | 16 | AV2 | 11 | 12 |
| SGA | 33 | 63 | AV3 | 20 | 20 |
| SGA | 33 | 63 | AV4 | 14 | 15 |
| SGA | 33 | 66 | AV1 | 10 | 12 |
| SGA | 33 | 66 | AV2 | 12 | 15 |
| SGA | 34 | 59 | AV2 | 14 | 11 |
| SGA | 35 | 17 | AV2 | - | 10 |
| SGA | 35 | 78 | AV2 | 12 | 14 |
| SGA | 36 | 47 | AV1 | - | 11 |
| SGA | 36 | 75 | AV2 | 14 | 15 |
| SGA | 36 | 76 | AV2 | 12 | 10 |
| SGA | 37 | 75 | AV2 | 12 | 11 |
| SGA | 38 | 62 | AV4 | 10 | 10 |
| SGA | 39 | 42 | AV1 | 11 | 12 |
| SGA | 39 | 71 | AV4 | 11 | 10 |
| SGA | 39 | 72 | AV4 | 14 | 15 |
| SGA | 40 | 42 | AV1 | 13 | 14 |
| SGA | 40 | 69 | AV4 | 11 | 13 |
| SGA | 46 | 43 | AV1 | 11 | 12 |
| SGA | 46 | 44 | AV1 | 13 | 13 |
| SGA | 46 | 45 | AV1 | 14 | 15 |
| SGA | 46 | 45 | AV4 | 10 | 10 |

**Table 4 – AVB Indications (continued)**

| SG | Row | Col | AVB No. | Depth (%TW) (ETSS 96004.1) | |
|---|---|---|---|---|---|
| | | | | 2009 | 2012 |
| SGC | 24 | 33 | AV2 | - | 10 |
| SGC | 27 | 10 | AV3 | 11 | 12 |
| SGC | 33 | 16 | AV2 | - | 11 |
| SGC | 35 | 17 | AV1 | 20 | 25 |
| SGC | 35 | 17 | AV4 | 10 | 11 |
| SGC | 35 | 46 | AV2 | - | 12 |
| SGC | 35 | 46 | AV3 | 14 | 15 |
| SGC | 38 | 67 | AV3 | 16 | 24 |
| SGC | 39 | 23 | AV1 | 16 | 18 |
| SGC | 39 | 23 | AV2 | 18 | 20 |
| SGC | 39 | 23 | AV3 | 22 | 26 |
| SGC | 39 | 69 | AV3 | 15 | 15 |
| SGC | 42 | 31 | AV1 | 19 | 23 |
| SGC | 42 | 31 | AV2 | 19 | 23 |
| SGC | 42 | 31 | AV3 | 16 | 19 |
| SGC | 42 | 31 | AV4 | 13 | 15 |
| SGC | 44 | 47 | AV3 | 11 | 10 |
| SGC | 45 | 38 | AV3 | 10 | 10 |
| SGC | 45 | 40 | AV4 | 13 | 12 |
| SGC | 45 | 58 | AV4 | 11 | 10 |

- Not reported during that outage.

## Table 5 – Summary of Non-AVB-Wear Volumetric Degradation

| SG | Row | Col | Location | ETSS | Max Depth (%TW) | Axial Length (in) | Circ. Length (in) | Initially Reported | Signal Present Prior to Current Outage? | Cause | Foreign Object Remaining? | In-Situ Tested? | Plugged & Stabilized? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | 2 | 57 | 06C-0.39" | 96910.1 | 19 | 0.29 | 0.37 | 2006 | Yes. No change since initially reported. | TSP Wear | n/a | No | No |
| A | 3 | 66 | 05C-0.78" | 27901.1 | 26 | 0.30 | 0.45 | 2009 | Yes. No change since initially reported. | Foreign Object | No | No | No |
| A | 6 | 88 | TSH+0.28" | 27901.1 | 25 | 0.30 | 0.40 | 2006 | Yes. No change since initially reported. | Foreign Object | No | No | No |
| A | 8 | 38 | TSH+0.45" | 21998.1 | 21 | 0.27 | 0.35 | 2001 | Yes. No change since initially reported. | Legacy Pitting | No | No | No |
| A | 34 | 67 | TSH+0.01" | 27901.1 | 24 | 0.27 | 0.37 | 2006 | Yes. No change since initially reported. | Foreign Object | No | No | No |
| A | 38 | 30 | TSC+1.78" | 27901.1 | 19 | 0.33 | 0.42 | 2006 | Yes. No change since initially reported. | Foreign Object | No | No | No |
| B | 1 | 7 | TSH+0.26" | 21998.1 | 20 | 0.70 | 0.29 | 2007 | Yes. No change since initially reported. | Historical SG Maint- | n/a | No | No |
| B | 31 | 15 | BPH+0.55" | 27901.1 | 19 | 0.32 | 0.35 | 2010 | Yes. No change since initially reported. | Foreign Object | No | No | No |
| B | 31 | 16 | BPH+0.58" | 27901.1 | 22 | 0.27 | 0.40 | 2010 | Yes. No change since initially reported. | Foreign Object | No | No | No |
| B | 32 | 15 | BPH+0.50" | 27901.1 | 18 | 0.24 | 0.35 | 2010 | Yes. No change since initially reported. | Foreign Object | No | No | No |
| B | 32 | 18 | BPH+0.59" | 27901.1 | 19 | 0.24 | 0.38 | 2010 | Yes. No change since initially reported. | Foreign Object | No | No | No |
| B | 33 | 18 | BPH+0.58" | 27901.1 | 21 | 0.29 | 0.46 | 2010 | Yes. No change since initially reported. | Foreign Object | No | No | No |
| B | 35 | 20 | BPH+1.10" | 27902.1 | 17 | 0.51 | 0.43 | 2010 | Yes. No change since initially reported. | Foreign Object | No | No | No |
| B | 40 | 50 | TSH+0.24" | 27901.1 | 31 | 0.32 | 0.48 | 2007 | Yes. No change since initially reported. | Foreign Object | No | No | No |
| B | 40 | 51 | TSH+0.34" | 27901.1 | 33 | 0.35 | 0.48 | 2007 | Yes. No change since initially reported. | Foreign Object | No | No | No |
| B | 41 | 51 | TSH+0.10" | 27901.1 | 24 | 0.27 | 0.37 | 2007 | Yes. No change since initially reported. | Foreign Object | No | No | No |
| C | 27 | 82 | BPH+0.58" | 27901.1 | 27 | 0.32 | 0.49 | 2010 | Yes (2000). No change since 2000. | Foreign Object | No | No | No |
| C | 36 | 24 | BPH-0.22" | 96910.1 | 3 | 0.31 | 0.40 | 2012 | Yes (2006). Not present in 2000. | TSP Wear | n/a | No | No |
| C | 36 | 64 | TSC+0.04" | 27901.1 | 30 | 0.29 | 0.40 | 2012 | No relevant RPC exams in history. | Foreign Object | No | No | No |
| C | 38 | 66 | TSC+0.11" | 27901.1 | 29 | 0.40 | 0.46 | 2009 | Yes. No change since initially reported. | Foreign Object | No | No | No |

***e. Number of tubes plugged during the inspection outage for each active degradation mechanism***

No tubes required plugging as a result of SG inspections performed during the EOC24 outage.

***f. Total number and percentage of tubes plugged to date***

Table 6 provides the plugging totals and percentages to date.

**Table 6 – Tube Plugging Summary**

| | Tubes Installed | Tubes Plugged To-Date |
|---|---|---|
| SG A | 3,342 | 44 (1.3%) |
| SG B | 3,342 | 26 (0.8%) |
| SG C | 3,342 | 36 (1.1%) |
| Total | 10,026 | 106 (1.1%) |

***g. The results of condition monitoring, including the results of tube pulls and in-situ testing***

The condition monitoring assessment of the EOC24/REOC19 structural and leakage integrity concluded that the Surry Unit 1 steam generators, as indicated by the results of the primary and secondary side inspections performed during this outage; satisfy required structural and leakage integrity criteria. Therefore, there was no need to pull tubes or in-situ test.

***h. The effective plugging percentage for all plugging in each SG***

Since none of the Surry Unit 1 SG tubes have been sleeved, the effective plugging percentage is identical to the plugging percentages provided in the response to (f).

***i. The primary to secondary LEAKAGE rate observed in each SG (if it is not practical to assign the LEAKAGE to an individual SG, the entire primary to secondary LEAKAGE should be conservatively assumed to be from one SG) during the cycle preceding the inspection which is the subject of the report***

During the cycle preceding the EOC24 outage, no measurable primary-to-secondary leakage (>1 GPD) was observed in any Unit 1 SG.

***j. The calculated accident induced LEAKAGE rate from the portion of the tubes below 17.89 inches from the top of the tubesheet for the most limiting accident in the most limiting SG. In addition, if the calculated accident induced LEAKAGE rate from the most limiting accident is less than 1.80 times the maximum operational primary to secondary LEAKAGE rate, the report should describe how it was determined.***

The permanent ARC requires that the component of operational leakage from the prior cycle from below the H-star distance be multiplied by a factor of 1.8 and added to the total accident leakage from any other source, and compared to the allowable accident induced leakage limit. Since there is reasonable assurance that no tube degradation identified during this outage would have resulted in leakage during an accident, the contribution to accident leakage from other sources is zero. Assuming that the prior cycle operational leakage of <1 GPD originated from below the H-star distance, and multiplying this leakage by a factor of 1.80 as required by the permanent ARC, yields an accident induced leakage value of <1.80 GPD. This value is well below the 470 GPD limit for the limiting SG and provides reasonable assurance that the accident induced leakage performance criteria would not have been exceeded during a limiting design basis accident.

***k. The results of the monitoring for tube axial displacement (slippage). If slippage is discovered, the implications of the discovery and corrective action shall be provided.***

No indications of tube slippage were identified during the evaluation of bobbin probe examination data from SGs A or C. No bobbin probe examinations were performed in SG B during EOC24. All tubes in SG B were screened for slippage during EOC23 (no slippage was identified) and will again be screened during EOC25.

## Acronyms

| | |
|---|---|
| **ARC** | Alternate Repair Criteria |
| **BPC** | Baffle Plate Cold |
| **BPH** | Baffle Plate Hot |
| **C/L** | Cold Leg |
| **DNT** | Dent |
| **EOC** | End of Cycle |
| **ETSS** | Eddy Current Technical Specification Sheet |
| **GPD** | Gallons Per Day |
| **H/L** | Hot Leg |
| **MRPC** | Motorized Rotating Pancake Coil |
| **OD** | Outside Diameter |
| **ODSCC** | Outside Diameter Stress Corrosion Cracking |
| **PWSCC** | Primary Water Stress Corrosion Cracking |
| **REOC** | Replacement End of Cycle |
| **RPC** | Rotating Pancake Coil (also a generic term for rotating probes of any kind) |
| **TEC** | Tube End Cold Leg |
| **TEH** | Tube End Hot Leg |
| **TSC** | Top of Tubesheet Cold Leg |
| **TSH** | Top of Tubesheet Hot Leg |
| **TSP** | Tube Support Plate |
| **TW** | Through Wall |