VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

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VIRGINIA ELECTRIC AND POWER COMPANY
SURRY POWER STATION UNIT 2
STEAM GENERATOR TUBE INSPECTION REPORT
FOR THE FALL 2018 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 2 report for the Fall 2018 refueling outage.

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

Very truly yours,

Fred Mladen
Site Vice President
Surry Power Station

Attachment: Surry Unit 2 Steam Generator Tube Inspection Report for the Fall 2018 Refueling Outage

Commitments made in this letter: None

A047
NRR

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ATTACHMENT

SURRY UNIT 2
STEAM GENERATOR TUBE INSPECTION REPORT
FOR THE FALL 2018 REFUELING OUTAGE

VIRGINIA ELECTRIC AND POWER COMPANY
(DOMINION ENERGY VIRGINIA)

SURRY UNIT 2
STEAM GENERATOR TUBE INSPECTION REPORT
FOR THE FALL 2018 REFUELING OUTAGE

The following satisfies the Surry Power Station Technical Specification (TS) reporting requirement section 6.6.A.3. During the Surry Unit 2 Fall 2018 End-Of-Cycle 28 (EOC28) refueling outage, Steam Generator (SG) inspections in accordance with TS 6.4.Q were completed for SG A and SG C.

The Unit 2 SGs are in the 5th inspection period which has a duration of 72 Effective Full Power Months (EFPM). The Fall 2018 refueling outage was the first inspection of the 5th period.

Unit 2 exceeded 200°F on December 3, 2018; therefore, this report is required to be submitted by June 3, 2019 (the next Federal working day after the due date of June 1, 2019 (Saturday) in accordance with 10CFR50.4). At the time of this inspection, the Unit 2 SGs had operated for 366.0 EFPM since the first inservice inspection.

In the discussion below Bold Italicized wording represents TS verbiage and the required information is provided directly below each reporting requirement. A list of acronyms is attached at the end of this report.

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,

Primary Side

A summary of the eddy current testing (ECT) tube examinations performed during the outage is provided in Table 1. The tubing in SG A and SG C was inspected with bobbin coils over their full length and with array coils at the hot leg and cold leg tubesheets to address wear and other potential degradation mechanisms. All high residual stress (HRS) tubes in SG C (SG A does not have HRS tubes) were examined full length with both Bobbin and Array probes. The only scope expansions required were those rotating probe or array exams necessary to bound indications potentially related to foreign objects and to resolve ambiguous indications.

The primary side work scope also included video / visual examinations (as-found/as-left) of both channel heads in SG A and SG C specifically including:

- all plugs
- the divider plate weld region
- the bottom of the bowl (with the bowl dry)

Visual examinations were performed in each primary side channel head in SG A and SG C. No degradation associated with the divider plate, welds, cladding, channel head, channel head drain, or previously installed plugs was observed.

Secondary Side

During the Surry Unit 2 Fall 2018 refueling outage, a visual inspection of upper steam drum moisture separator components, feedring components, and top of bundle U-bend region components through the secondary manway in SG B was performed. This included all accessible steam drum components and structures, including the feedring exterior, the upper tube bundle, and the 7th tube support plate (TSP) via probe insertions through the primary moisture separators. No adverse conditions were noted during these inspections. Visual investigation of accessible locations at the top of the tubesheet, in the annulus, and no-tube lane having eddy current signals potentially related to foreign objects was performed in SG A and SG C.

Table 1 – Unit 2 Fall 2018 Refueling Outage ECT Examination Scope

Exam Description	SG A Exams Performed	SG C Exams Performed
Bobbin Coil Probe		
• Full Length	2849	2828
• Candycane (07C to TEH)	279	282
• H/L Straight (07H to TEH)	184	182
• C/L Straight (07C to TEC)	463	464
Array Probe		
• H/L Tubesheet	3312	3278
• C/L Tubesheet	3312	3277
• Full Length	0	14
+Point™ Probe		
• Low Row U-bends	184	182
• H/L Special Interest	168	286
• C/L Special Interest	32	31
• U-bend Special Interest	0	1
• C/L Restricted Tubesheet	N/A	1
• Miscellaneous Bounding	60	243
Note: The H/L and C/L Array Exams were analyzed down to the H-star dimension.		

b. Degradation mechanisms found,

Degradation mechanisms targeted by the inspection plan included anti-vibration bar (AVB) wear, pitting, foreign object wear, tube support plate (TSP) wear, and stress corrosion cracking (SCC) at various locations within the steam generator tube bundle. During the Unit 2 Fall 2018 refueling outage, AVB wear, tube support plate (TSP) wear, flow distribution baffle (FDB) wear, and foreign object wear were detected.

c. Nondestructive examination techniques utilized for each degradation mechanism,

The inspection program focused on the degradation mechanisms listed in Table 2 and utilized the referenced eddy current techniques.

Table 2 – Inspection Method for Applicable Degradation Modes

Classification	Degradation Mechanism	Location	Probe Type
Existing	Wear	Anti-Vibration Bars	Bobbin - Detection and Sizing
Existing	OD Pitting	Top-of-Tubesheet (TTS)	Bobbin and Array - Detection +Point™ - Sizing
Existing	Wear	Tube Support Plate	Bobbin - Detection +Point™ - Sizing
Existing	Tube Wear (Foreign Objects)	Freespan and TTS	Bobbin and Array - Detection +Point™ - Sizing
Existing	PWSCC	Tubesheet Overexpansions (OXP)	Array - Detection +Point™ - Sizing
Existing	PWSCC	Tube Ends	N/A*
Existing	Wear	Flow Distribution Baffle (FDB)	Bobbin - Detection +Point™ - Sizing
Potential	ODSCC PWSCC	Bulges, Dents, Manufacturing Anomalies, and Above Tubesheet Overexpansions (OVR)	Array - Detection +Point™ - Sizing
Potential	ODSCC	Tubesheet Crevice in Tubes With No Tubesheet Expansion (NTE)	N/A**
Potential	Tube Slippage	Within Tubesheet	Bobbin - Detection
Existing	ODSCC PWSCC	Hot Leg TTS	Array - Detection +Point™ - Sizing
Potential	ODSCC PWSCC	Row 1 and 2 U-bends	+Point™ - Detection and Sizing
Potential	ODSCC	Freespan and Tube Supports	Bobbin - Detection +Point™ - Sizing
Existing	ODSCC PWSCC	High Residual Stress Tubes	Bobbin and Array - Detection +Point™ - Sizing
* Inspection not required per technical specification alternate repair criteria. ** The tubes with NTE have already been plugged.			

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

As stated in the (b) response above, service induced indications were identified. Tables 3 and 4 provide the required information.

Table 3 - Unit 2 Fall 2018 Refueling Outage Inspection Summary - AVB Wear Indications

SG	Row	Column	AVB Number	Depth (%TW)
				2018
A	23	27	AV1	14
A	25	57	AV2	15
A	26	9	AV4	12
A	26	85	AV2	13
A	26	86	AV3	20
A	29	28	AV3	9
A	29	70	AV2	12
A	30	12	AV1	10
A	30	64	AV2	8
A	33	26	AV4	9
A	36	62	AV2	26
A	36	62	AV3	14
A	36	62	AV4	29
A	36	66	AV2	15
A	36	66	AV3	12
A	37	20	AV1	11
A	37	20	AV4	12
A	38	57	AV1	14
A	38	70	AV3	11
A	38	72	AV4	25
A	38	74	AV4	20
A	40	25	AV4	10
A	40	49	AV1	10
A	40	49	AV2	10
A	40	49	AV3	12
A	40	51	AV2	10
A	40	65	AV2	21
A	40	65	AV3	12

SG	Row	Column	AVB Number	Depth (%TW)
				2018
A	40	65	AV4	13
A	40	66	AV3	11
A	42	62	AV3	9
A	44	35	AV1	10
A	44	38	AV2	8
A	45	44	AV2	12
A	46	45	AV1	11
A	46	49	AV1	12
A	46	49	AV2	11
C	24	8	AV4	12
C	25	9	AV1	13
C	25	9	AV3	14
C	25	27	AV1	18
C	25	27	AV2	32
C	25	27	AV3	16
C	25	29	AV2	13
C	25	29	AV3	23
C	26	26	AV3	20
C	26	26	AV4	18
C	26	39	AV3	17
C	27	84	AV4	11
C	31	65	AV2	16
C	31	69	AV2	22
C	31	69	AV3	19
C	31	75	AV2	15
C	31	75	AV3	17
C	31	75	AV4	16
C	33	59	AV3	21
C	33	59	AV4	16
C	33	67	AV3	11
C	33	68	AV1	21
C	33	68	AV2	22
C	33	69	AV1	14
C	33	69	AV2	12
C	33	70	AV1	15
C	33	70	AV3	20

SG	Row	Column	AVB Number	Depth (%TW)
				2018
C	34	29	AV3	14
C	34	29	AV4	19
C	34	79	AV1	10
C	35	77	AV2	12
C	35	77	AV3	10
C	36	73	AV3	10
C	37	63	AV2	12
C	37	73	AV3	18
C	37	75	AV3	12
C	38	28	AV1	9
C	38	28	AV3	17
C	38	30	AV2	15
C	38	43	AV3	14
C	38	67	AV3	12
C	38	73	AV1	13
C	38	73	AV2	14
C	38	74	AV2	11
C	39	50	AV3	16
C	39	53	AV3	30
C	39	55	AV3	25
C	39	55	AV3	13
C	39	55	AV4	24
C	39	71	AV3	9
C	39	72	AV4	8
C	40	33	AV2	26
C	40	33	AV3	26
C	40	33	AV2	13
C	40	63	AV3	19
C	40	63	AV4	21
C	40	66	AV3	12
C	41	35	AV3	INR
C	41	64	AV1	13
C	41	66	AV3	19
C	41	68	AV4	INR
C	42	42	AV3	11
C	43	39	AV2	17
C	43	61	AV1	25

SG	Row	Column	AVB Number	Depth (%TW)
				2018
C	43	63	AV1	15
C	44	51	AV2	12
C	44	51	AV3	12
C	44	61	AV1	12
C	45	58	AV3	INR
C	46	45	AV2	12
C	46	45	AV3	11
C	46	46	AV1	10
C	46	46	AV2	16
C	46	46	AV3	11
C	46	46	AV4	12
Note: INR = Indication Not Reportable				

Table 4 - Summary of Non-AVB Volumetric Degradation Identified

SG	Row	Col	Location	Max Depth (%TW)	Cause	Foreign Object Remaining?	Plugged & Stabilized?
A	4	37	TSC +0.82"	21	Foreign Object	No	No
			TSC +1.81"	26	Foreign Object	No	No
A	6	60	05H -0.59"	7	TSP Wear	N/A	No
A	11	45	TSH +0.96"	26	Foreign Object	No	No
A	15	16	TSH +0.23"	23	Foreign Object	No	No
A	17	16	TSH +0.04"	29	Foreign Object	No	No
A	18	16	TSH +0.02"	25	Foreign Object	No	No
A	32	27	TSC +0.02"	19	Foreign Object	No	No
A	33	27	TSC +0.12"	24	Foreign Object	No	No
A	39	24	TSH +0.45"	18	Foreign Object	No	No
A	42	52	TSC +0.26"	20	Foreign Object	No	No

SG	Row	Col	Location	Max Depth (%TW)	Cause	Foreign Object Remaining?	Plugged & Stabilized?
A	43	61	BPH +0.56"	22	Foreign Object	No	No
A	43	64	BPH +0.62"	23	Foreign Object	No	No
C	3	72	03C +0.47"	8	TSP Wear	N/A	No
			03C+0.48"	6	TSP Wear	N/A	No
C	28	22	TSH +0.17"	26	Foreign Object	No	No
C	28	23	TSH +0.52"	27	Foreign Object	No	No
			TSH +0.21"	25	Foreign Object	No	No
C	28	71	TSH +0.27"	22	Foreign Object	No	No
C	28	84	03H +0.50"	8	TSP Wear	N/A	No
C	30	48	BPH +0.58"	17	Foreign Object	No	No
C	30	74	TSH +6.47"	19	Foreign Object	No	No
C	32	36	BPH +0.58"	15	Foreign Object	No	No
C	33	17	TSH +2.69"	15	Foreign Object	No	No
C	34	18	TSH +0.97"	20	Foreign Object	No	No
C	34	20	TSH +0.91"	24	Foreign Object	No	No
C	34	74	TSH +0.06"	27	Foreign Object	No	No
C	35	19	TSH +0.32"	25	Foreign Object	No	No
C	35	22	TSH +1.03"	28	Foreign Object	Nc	No
C	35	30	TSH +0.11"	35	Foreign Object	No	No

SG	Row	Col	Location	Max Depth (%TW)	Cause	Foreign Object Remaining?	Plugged & Stabilized?
C	36	32	BPH +0.55"	18	Foreign Object	No	No
C	36	68	TSH +0.17"	26	Foreign Object	No	No
C	37	31	TSH +0.09"	22	Foreign Object	No	No
C	37	32	TSH +0.02"	19	Foreign Object	No	No
C	37	33	TSH +0.04"	24	Foreign Object	No	No
C	37	34	TSH -0.06"	24	Foreign Object	No	No
C	37	35	BPH +0.60"	32	Foreign Object	No	No
C	37	54	TSH +0.12"	26	Foreign Object	No	No
C	37	73	07C -0.48"	20	TSP Wear	N/A	No
			07C -0.52"	NDF	TSP Wear	N/A	No
C	38	32	BPH +0.60"	20	Foreign Object	No	No
C	38	53	TSH +0.08"	22	Foreign Object	No	No
C	39	32	BPH +0.61"	21	Foreign Object	No	No
			BPH +0.60"	24	Foreign Object	No	No
C	39	34	BPH +0.57"	24	Foreign Object	No	No
C	40	34	BPH +0.60"	22	Foreign Object	No	No
C	40	60	BPH +1.19"	17	Foreign Object	No	No
C	44	42	TSH +0.12"	23	Foreign Object	No	No
C	44	43	TSH +0.19"	23	Foreign Object	No	No

SG	Row	Col	Location	Max Depth (%TW)	Cause	Foreign Object Remaining?	Plugged & Stabilized?
C	44	47	TSH +0.06"	26	Foreign Object	No	No
C	44	60	BPH +0.17"	10	FDB Wear	No	No
C	45	42	TSH +0.26"	19	Foreign Object	No	No
C	45	43	TSH +0.23"	22	Foreign Object	No	No
			TSH +0.24"	23	Foreign Object	No	No
			TSH +0.72"	21	Foreign Object	No	No
C	45	47	TSH +0.17"	24	Foreign Object	No	No
C	45	49	01C +0.08"	9	TSP Wear	N/A	No

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

Tube plugging was not required or performed in any of the Unit 2 steam generators during the Fall 2018 refueling outage.

f. The number and percentage of tubes plugged to date, and the effective plugging percentage in each steam generator.

Table 5 provides the plugging totals and percentages to date.

Table 5 – Tube Plugging Summary

	Tubes Installed	Tubes Plugged To-Date
SG A	3,342	30 (0.9%)
SG B	3,342	19 (0.6%)
SG C	3,342	50 (1.5%)
Total	10,026	99 (1.0%)

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

All tubes with degradation identified during the Fall 2018 inspection satisfied condition monitoring requirements for SG tube structural and leakage integrity. Further, the results from the current outage inspection validate prior outage operational assessment assumptions. Tube pulls and in-situ pressure testing were not required during the current outage.

h. 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,

Routine primary-to-secondary leak monitoring is conducted in accordance with station procedures. During the cycle preceding the Unit 2 Fall 2018 refueling outage, no measurable primary-to-secondary leakage (i.e., >1 gallons per day (GPD)) was observed in any Unit 2 SG.

i. 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 alternate repair criteria (PARC) 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 1.8 as required by the PARC, yields an accident induced leakage value of <1.8 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.

j. 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 SG A and SG C. Note that there were no bobbin eddy

current examinations performed in SG B during the Unit 2 Fall 2018 refueling outage. All tubes in SG B were screened for slippage during the Unit 2 Spring 2017 refueling outage and will again be screened during the Unit 2 Spring 2020 refueling outage.

Acronyms

AVB	Anti-Vibration Bar
BPC	Baffle Plate Cold
BPH	Baffle Plate Hot
C/L	Cold Leg
ECT	Eddy Current Testing
EFPM	Effective Full Power Month
EOC	End of Cycle
ETSS	Examination Technique Specification Sheet
FDB	Flow Distribution Baffle
GPD	Gallons Per Day
H/L	Hot Leg
HRS	High Residual Stress
MRPC	Motorized Rotating Pancake Coil
NSAL	Nuclear Safety Advisory Letter
NTE	No Tube Expansion
OD	Outer Diameter
ODSCC	Outside Diameter Stress Corrosion Cracking
OVR	Over Roll
OXP	Over Expansion
PARC	Permanent Alternate Repair Criteria
PLP	Possible Loose Part
PWSCC	Primary Water Stress Corrosion Cracking
SCC	Stress Corrosion Cracking
SG	Steam Generator
TEC	Tube End Cold-leg
TEH	Tube End Hot-leg
TSC	Top of Tube Sheet Cold-leg
TSH	Top of Tube Sheet Hot-leg
TSP	Tube Support Plate
TTS	Top of Tubesheet
TW	Through Wall