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Vogtle Electric Generating Plant, Unit 2
Seventeenth Maintenance/Refueling Outage
Steam Generator Tube Inspection Report

Ladies and Gentlemen:

In accordance with the requirements of Vogtle Electric Generating Plant Technical Specification 5.6.10, Southern Nuclear Operating Company submits this report of the steam generator tube inspections performed during the seventeenth Unit 2 maintenance/refueling outage (2R17). Entry into Mode 4 occurred on October 9, 2014.

This letter contains no NRC commitments. If you have any questions, please contact Ken McElroy at (205) 992-7369.

Respectfully submitted,

C. R. Pierce

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Regulatory Affairs Director

CRP/EGA

Enclosure: 2R17 Steam Generator Tube Inspection Report

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Vogtle Electric Generating Plant – Unit 2
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Enclosure

2R17 Steam Generator Tube Inspection Report

Introduction

The Vogtle Electric Generating Plant (VEGP) seventeenth Unit 2 maintenance/refueling outage (2R17) was conducted in September 2014 after cumulative Steam Generator (SG) service equivalent to approximately 1.4 effective full power years (EFPY) from the previous eddy current inspections. No tube leakage was reported during this operating interval. At the start of VEGP 2R17, approximately 51.9 effective full power months (EFPM) of the 72 EFPM in the fourth sequential inspection period have accrued making 2R17 the second to last inspection of the period. Analyses based on conservative assumptions used in Condition Monitoring (CM) and Operational Assessments demonstrated that there were no tubes that exceeded Regulatory Guide (RG) 1.121 or Nuclear Energy Institute (NEI) Topical Report 97-06, Revision 3, criteria for tube integrity during fuel cycle 17. The eddy current inspections were performed by the Steam Generator Maintenance Services Group of the Westinghouse Nuclear Services Division. Secondary data analysis was performed by NDE Technology under direct contract with Southern Nuclear Operating Company (SNC). No tubes required plugging in any of the four SGs inspected, and no tubes required in situ pressure testing. Permanent H* Alternate Repair Criteria (ARC) were approved by the NRC for implementation. Therefore, tube end +Point inspections below top of tubesheet (TTS) -15.2 inches were omitted, and the TTS inspections ranged from TTS +3 inches to TTS -15.2 inches. The scope of the inspections performed on each SG, and the results of those inspections, are described below.

2R17 SG Inspection Program – Primary Side Base Scope

The inspection program, required by Revision 7 of the Electric Power Research Institute (EPRI) Pressurized Water Reactor (PWR) SG Examination Guidelines, addressed the known degradation mechanisms observed in VEGP Unit 2 in prior inspections as well as those regarded as potential degradation mechanisms. The inspection program implemented during VEGP 2R17 is listed below.

- 100% Bobbin examination of tubes in SGs 1 and 4, full length except for Rows 1 and 2, which were inspected from tube end to the top tube support plate (TSP) from both the hot leg (HL) and cold leg (CL).

- 50% Rotating Pancake Coil (RPC), also known as "Plus Point/+Point", examination of Row 1 and Row 2 U-bends in SG1 and SG4 from the top TSP on the HL to the top TSP on the CL. The sample was taken from the Row 1 and Row 2 U-bends not inspected in SG1 and SG4 during 2R15.

- RPC Examination of Special Interest (possible flaw locations found with bobbin coil probe) including U-bends in both the HL and CL.

- 100% RPC examination of HL tubes in SG2 and 50% in SG1, SG3 and SG4 from three inches above the TTS to the licensed ARC depth for H* (TTS +3/-15.2 inches).

- 50% of the HL tube bulge (BLG) and overexpansion (OXP) populations in SG1 and SG4, defined as follows:

    - Bulge: differential mix diameter discontinuity signal within the tubesheet of 18 volts or greater as measured by bobbin coil probe.

    - Overexpansion: a tube diameter deviation within the tubesheet of 1.5 mils or greater as measured by bobbin coil probe.

- 50% RPC examination of dents and dings ≥ 2 volts in HL straight lengths and U-bends of SG1 and SG4. This sample was taken from the total number of dents and dings identified during previous inspections and any additional identified by the bobbin program.

- 100% visual inspection of HL and CL installed tube plugs from the primary side in all four SGs.

- Visual inspection in all SGs of channel head primary side HL and CL in accordance with Westinghouse Letter NSAL 12-1, "Steam Generator Channel Head Degradation" inclusive of the entire divider plate to channel head weld and all visible clad surfaces.

- In addition, bobbin inspections were performed for tube slippage monitoring.

Inspection Expansion
There was no Non-Destructive Examination (NDE) inspection scope expansion required during the VEGP 2R17 SG in-service inspections.

Damage Mechanisms Found and NDE Techniques Utilized
All of the damage mechanisms found during 2R17 inspections were identified in previous inspections and in the 2R17 SG Degradation Assessment. Based on SG eddy current and visual inspection data, the existing degradation mechanisms in the VEGP Unit 2 SGs are described below.

- Circumferential Outer Diameter Stress Corrosion Cracking (ODSCC) at Hot Leg Expansion Transitions
    - +Point techniques were used to evaluate the indications
- Mechanical Wear due to Foreign Objects
    - +Point and bobbin techniques were used to evaluate the wear indications
- Mechanical Wear at Anti-Vibration Bar (AVB) Supports
    - Bobbin techniques were used to evaluate the wear indications
- Mechanical Wear and Wall Loss from Secondary Side Cleaning Processes
    - Bobbin techniques were used to evaluate the wear indications

Observed tube degradation indications were monitored and assessed to confirm the SG integrity performance criteria. The following sections discuss indications identified during the inspection.

Service Induced Indication Descriptions
Mechanical Wear due to Foreign Objects
Foreign objects were reported as the cause for tube wear at VEGP Unit 2 during prior inspections; therefore, wear due to foreign objects is classified as an existing degradation mechanism and has been addressed in the SG inspections during 2R17.

Historical Possible Loose Part (PLP) signals were visually inspected during prior outages but show no significant change in eddy current signal response, and therefore, the SGs did not require a secondary side inspection during 2R17. No new foreign object wear associated with known foreign objects in the SG secondary side was observed. Historical indications in SG1 and SG2 have been determined to be no more likely than any of the others to be affected by foreign objects during future operation.

The foreign object wear (PCT) indications in SG1 tubes R47C84 and R47C85 have been present for several cycles with no apparent growth or change in character. The PCT indications in SG 4 in tubes R12C57 and R42C93 show no change in sizing result from the prior inspection.

Based on the inspection data, the observed indications did not exceed the condition monitoring limits and did not require in-situ proof of pressure and leakage testing to demonstrate tube integrity.

Table 1
VEGP Unit 2 PLP/PCT for 2R17

SG	Row	Column	Indication	%TWD	Location
1	49	86	PLP	-	TSH +0.38
1	49	86	PLP	-	TSH +0.42
1	48	86	PLP	-	TSH +0.36
1	48	86	PLP	-	TSH +0.14
1	48	86	PLP	-	TSH +0.31
1	47	85	PCT	9	TSH +0.07
1	47	84	PCT	11	TSH +0.09
2	1	118	PLP	-	TSH +0.04
2	33	50	PLP	-	TSH +0.18
2	32	50	PLP	-	TSH +0.65
2	32	49	PLP	-	TSH +1.34
2	31	49	PLP	-	TSH +1.57
4	12	57	PCT	20	TSH +0.40
4	42	93	PCT	24	TSC +0.89

%TWD – Percent Through-wall Depth
PLP - Possible Loose Part
PCT - Foreign Object Wear
TSH – Tubesheet region on HL side
TSC – Tubesheet region on CL side

Mechanical Wear at Anti-Vibration Bar (AVB) Supports
All AVB wear locations were examined in SG1 and SG4. None of the wear locations exceeded the technical specification plugging limit of 40% through-wall. The corresponding inspection of AVB wear locations in SG2 and SG3 was last performed during 2R16, and the results were assessed for operation through 2R18. Based on the inspection data, Condition Monitoring was met in 2R17. None of the indications exceeded the condition monitoring limits and therefore did not require in-situ pressure and leakage testing to demonstrate tube integrity. AVB wear identified is provided in Table 2 (SG1) and Table 3 (SG4).

Table 2
VEGP 2R17 SG1 AVB Wear Indications

Row	Column	Location[1]	2R17% TWD		Row	Column	Location[1]	2R17% TWD
29	105	AV2	10		44	94	AV5	14
29	112	AV2	12		46	24	AV4	17
30	10	AV2	10		46	26	AV4	19
30	10	AV6	13		46	27	AV2	13
32	17	AV5	14		46	32	AV3	15
32	106	AV5	13		46	32	AV4	17
34	13	AV2	13		46	32	AV5	14
34	13	AV4	14		46	43	AV2	14
34	25	AV1	9		47	27	AV2	24
35	14	AV4	14		47	36	AV1	11
35	74	AV4	16		47	36	AV3	14
37	33	AV3	10		47	36	AV4	11
37	35	AV3	11		47	99	AV2	15
37	39	AV4	9		47	99	AV5	14
41	20	AV1	8		48	27	AV2	11
41	20	AV2	20		48	27	AV3	19
41	20	AV3	12		48	28	AV2	18
41	20	AV4	16		48	96	AV2	9
41	20	AV5	17		49	29	AV6	12
41	20	AV6	9		49	36	AV2	19
41	21	AV3	13		49	36	AV5	27
41	23	AV5	14		50	29	AV5	20
41	23	AV6	10		50	92	AV2	14
41	27	AV5	14		50	93	AV3	14
42	20	AV2	21		53	33	AV4	18
43	21	AV3	11		53	34	AV3	14
43	21	AV4	11		53	34	AV4	13
43	100	AV2	15		53	89	AV5	14
43	100	AV3	19		54	50	AV2	14
43	100	AV4	22		54	50	AV3	14
43	100	AV5	13		54	50	AV4	12
44	22	AV4	16		55	39	AV2	9
44	22	AV6	13		55	39	AV3	12
44	23	AV2	12		55	78	AV1	8
44	23	AV3	19		55	81	AV2	10
44	23	AV4	15		58	53	AV1	12
44	23	AV5	25		58	72	AV1	13
44	27	AV2	11		58	73	AV1	11
44	27	AV3	17		58	75	AV6	16
44	27	AV5	11		59	68	AV1	13
44	72	AV6	12					

[1]AV# - Location of AVB intersection with the tube (there are up to 6)
% TWD- Percent Through-wall Depth

Table 3
VEGP 2R17 SG4 AVB Wear Indications

Row	Column	Location[1]	2R17% TWD	Row	Column	Location[1]	2R17% TWD
15	36	AV6	8	43	58	AV5	7
15	46	AV1	7	43	65	AV4	16
27	79	AV5	9	43	68	AV3	24
29	14	AV6	9	43	68	AV4	28
30	9	AV5	22	43	68	AV5	27
31	10	AV5	14	43	69	AV5	19
32	109	AV6	10	43	71	AV4	13
34	81	AV1	8	43	76	AV5	20
35	81	AV1	9	43	85	AV4	12
36	14	AV2	13	43	95	AV3	17
37	74	AV3	12	43	95	AV4	14
37	79	AV1	8	43	95	AV5	12
37	81	AV1	9	44	29	AV3	17
37	87	AV2	12	44	29	AV4	17
38	39	AV4	10	44	29	AV5	12
38	79	AV1	9	44	42	AV3	15
38	81	AV1	9	44	42	AV4	18
39	26	AV3	10	44	42	AV5	25
39	64	AV1	19	44	42	AV6	16
39	64	AV2	25	44	44	AV3	21
39	64	AV3	32	44	53	AV3	10
39	64	AV4	16	44	53	AV5	12
39	64	AV5	16	44	54	AV1	11
39	64	AV6	26	44	54	AV2	16
40	79	AV1	8	44	54	AV5	26
40	106	AV1	10	44	59	AV1	14
40	106	AV3	11	44	59	AV3	18
42	51	AV6	11	44	59	AV4	15
42	87	AV3	10	44	85	AV3	10
43	21	AV4	15	45	22	AV2	9
43	21	AV5	12	45	22	AV3	12
43	21	AV6	12	45	23	AV2	10
43	22	AV4	15	45	23	AV3	10
43	35	AV2	14	45	23	AV5	9
43	36	AV2	14	45	32	AV3	22
43	47	AV2	13	45	42	AV4	30
43	51	AV6	11	45	42	AV5	13
43	53	AV3	9	45	58	AV3	25
43	58	AV4	9	45	58	AV4	10

[1]AV# - Location of AVB intersection with the tube (there are up to 6)
% TWD- Percent Through-wall Depth

Table 3 (Continued)
VEGP 2R17 SG4 AVB Wear Indications

Row	Column	Location[1]	2R17% TWD		Row	Column	Location[1]	2R17% TWD
45	58	AV5	15		51	35	AV4	19
45	66	AV2	18		51	37	AV4	13
45	66	AV3	19		51	39	AV2	13
45	66	AV5	22		51	39	AV3	14
46	26	AV4	13		51	39	AV4	18
46	26	AV6	15		51	43	AV3	12
46	31	AV2	10		51	43	AV4	15
46	31	AV3	26		51	43	AV5	16
46	31	AV4	14		51	54	AV3	11
46	31	AV5	19		51	54	AV4	20
46	51	AV6	11		51	54	AV5	12
46	88	AV3	10		51	55	AV2	15
47	33	AV5	12		51	55	AV3	23
47	36	AV4	11		51	55	AV5	12
47	36	AV6	13		51	60	AV3	13
47	41	AV2	15		51	65	AV4	18
47	41	AV3	13		51	65	AV5	20
48	31	AV3	10		51	76	AV2	15
48	31	AV4	13		51	76	AV4	20
48	57	AV3	13		51	76	AV5	24
48	57	AV4	13		51	92	AV1	12
48	57	AV5	19		52	33	AV2	19
48	58	AV4	7		52	33	AV3	19
48	79	AV2	10		52	33	AV4	19
48	79	AV3	8		52	33	AV5	39
48	81	AV1	7		52	33	AV6	17
48	97	AV2	11		52	45	AV2	14
48	97	AV3	13		52	45	AV3	22
49	53	AV3	11		52	45	AV4	21
49	53	AV4	11		52	45	AV5	14
49	58	AV4	10		52	66	AV1	12
49	83	AV3	16		52	66	AV2	23
49	93	AV4	20		52	66	AV3	14
49	93	AV5	26		52	71	AV1	10
49	96	AV2	12		52	71	AV2	21
50	53	AV3	8		52	71	AV3	24
50	55	AV3	7		52	72	AV2	29
50	70	AV3	20		52	72	AV3	13
51	31	AV4	15		52	78	AV4	15

[1]AV# - Location of AVB intersection with the tube (there are up to 6)
% TWD- Percent Through-wall Depth

Table 3 (Continued)
VEGP 2R17 SG4 AVB Wear Indications

Row	Column	Location[1]	2R17% TWD		Row	Column	Location[1]	2R17% TWD
52	85	AV1	8		58	75	AV2	13
53	34	AV2	11		59	63	AV6	11
53	34	AV6	11		59	66	AV6	14
53	36	AV5	14					
53	36	AV6	12					
53	44	AV3	17					
53	74	AV4	18					
53	80	AV5	16					
53	89	AV6	11					
54	35	AV4	11					
54	35	AV5	19					
54	35	AV6	12					
54	37	AV1	12					
54	37	AV6	12					
54	83	AV5	11					
55	41	AV5	15					
55	83	AV5	13					
56	42	AV5	13					
56	42	AV6	13					
56	45	AV4	16					
56	45	AV5	12					
56	47	AV3	20					
56	76	AV5	12					
56	82	AV2	14					
56	82	AV6	10					
57	48	AV2	18					
57	48	AV3	23					
57	48	AV4	18					
57	48	AV5	37					
57	48	AV6	15					
57	71	AV6	13					
57	73	AV2	15					
57	76	AV5	16					
57	78	AV2	15					
57	78	AV4	12					
57	78	AV6	14					
58	47	AV5	13					
58	47	AV6	14					

[1]AV# - Location of AVB intersection with the tube (there are up to 6)
% TWD- Percent Through-wall Depth

Mechanical Wear and Wall Loss from Secondary Side Cleaning

The tube locations and volumetric indications associated with the ultrasonic energy cleaning (UEC) and pressure pulse cleaning (PPC) secondary side cleaning processes for SG1 are listed in Table 4. The examinations required to be performed to address this existing degradation mechanism are an element of the bobbin inspection program which alternates between two SGs each inspection. Since 100% bobbin inspections in SG1 and SG4 were scheduled, only the tubes listed in SG1 were required to be examined during 2R17.

The volumetric indications reported in Row 1 tubes were also observed by visual inspection in prior outages. They were reported to visually resemble tube oxide removal patterns observed in qualification testing for UEC. No foreign objects were determined to be associated with these tube wear indications. These tubes were left in service for several inspection intervals with no indications of tube wall loss outside of NDE measurement uncertainties. Based on the inspection data, the indications did not exceed the condition monitoring limits and did not require in-situ proof of pressure and leakage testing to demonstrate tube integrity.

Table 4
VEGP Unit 2 Tube Wear and Wall Loss from Secondary Side Cleaning for 2R17

SG	Row	Column	Indication	%TWD	Location
1	1	42	PCT	10	TSH +10.25
1	1	45	PCT	11	TSH +10.13
1	1	46	PCT	20	TSH +10.29
1	1	78	PCT	17	TSH +9.63
1	1	78	PCT	12	TSH+11.44
1	1	78	PCT	28	TSC +11.63

%TWD – Percent Through-wall Depth
PCT - Foreign Object Wear
TSH – Tubesheet region on HL side
TSC – Tubesheet region on CL side

ODSCC

ODSCC at the hot leg expansion transitions is an existing degradation mechanism for VEGP Unit 2. This mechanism was considered in the VEGP 2R17 eddy current inspection scope development. There were no ODSCC indications reported at or near the top of the tubesheet hot leg expansion transitions from RPC inspection during VEGP 2R17.

Number of Tubes Plugged

A 100% visual inspection of tube plugs in all four SGs was performed from the primary side during VEGP 2R17. There were no anomalous conditions, degraded tube plug or surrounding boron deposits reported during performance of the visual inspections.

No tubes were plugged in any of the four SGs during VEGP 2R17. The status of tubes plugged at VEGP Unit 2 after the outage remains as follows (Table 5):

Table 5
Total Plugged Tubes after VEGP 2R17

SG #	#Tubes	2R17 # Plugged	Total # Plugged	% Plugging
1	5,626	0	6	0.11%
2	5,626	0	15	0.27%
3	5,626	0	5	0.09%
4	5,626	0	22	0.39%
Total	22,504	0	48	0.21%

Tube Axial Displacement (Slippage) Monitoring

The bobbin data collected from SG1 and SG4 was screened for large amplitude tubesheet indications of greater than 50 volts with a phase angle between 25° and 50° suggestive of tube severance. No tube severance indications were reported; therefore, no indications of slippage were identified. None of the indications reported during the VEGP 2R17 SG inspections are evaluated to have primary to secondary leakage as accident induced conditions. There was no leakage from the portion of tubing within the H* depth for which to apply the leak rate factor associated with the alternate repair criteria. There was no calculated leakage from any other sources and none of the tube plugs installed in the VEGP Unit 2 SGs require considerations for leakage. Therefore, the accident induced leakage rate for these indications would be zero, and the accident induced leakage performance criterion is satisfied.

Other inspections

SG Channel Head Primary Side Bowl Inspection

A visual inspection of the SG channel head bowl in the vicinity of the drain line was performed in all SGs during VEGP 2R17. Visual inspections were performed of the SG hot leg and cold leg divider plate and drain line areas, inclusive of the entire divider plate to channel head weld and all visible clad surfaces. SG manway channel head bowl inspection was performed using cameras. Satisfactory inspection results were observed in all SGs; no unacceptable degradation was found.

Secondary Side Discussion

The 100% bobbin full length inspection program in SG1 and SG4, the 100% RPC Hot Leg TTS +3/-15.2 inches in SG2, and the 50% RPC Hot Leg TTS +3/-15.2 inches in SG1, SG3 and SG4 are adequate to address the potential for secondary side foreign object wear. All PLP calls identified during the eddy current program are historical, have been visually inspected during prior outages, show no significant change in eddy current signal response and therefore did not require a secondary side inspection during 2R17. No new foreign object wear indications associated with known foreign objects in the SG secondary side were detected during 2R17.

Condition Monitoring Conclusions

Based on the inspection data and the condition monitoring assessment, no tubes exhibited degradation in excess of the condition monitoring limits. No tubes required in situ pressure testing to demonstrate structural and leakage integrity. No tubes required plugging in any of the four SGs inspected. There was no SG primary to secondary leakage prior to the end of the inspection interval. No secondary side tube degradation attributable to known foreign objects was identified (all PLPs identified have been confirmed as historical and unchanged). There was no recurrence of ODSCC at the hot leg tubesheet expansion transitions during 2R17 after one operating cycle since the initial observation in SG2. The condition monitoring limits, and correspondingly, the SG performance criteria for operating leakage and structural integrity were

satisfied for the preceding VEGP Unit 2 SG operating interval. None of the indications reported during the VEGP 2R17 SG inspections were evaluated to have primary to secondary leakage as accident induced conditions.