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September 22, 2023

Docket No. 50-424 NL-23-0745

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D. C. 20555-0001

Vogtle Electric Generating Plant – Unit 1
Refueling Outage 1R24 Steam Generator Tube Inspection Report

Ladies and Gentlemen:

In accordance with the requirements of Vogtle Electric Generating Plant (VEGP) Technical Specification 5.6.10 as updated by TS Amendment 211 (Adams Accession No. ML21316A055), Southern Nuclear Operating Company (SNC) submits the enclosed Steam Generator (SG) Tube Inspection Report for the SG tube inspection performed during the twenty-fourth refueling outage on Unit 1 (1R24) as an Enclosure to this letter.

This letter contains no regulatory commitments. If you have any questions, please contact Amy Chamberlain at 205.992.6361.

Respectfully submitted,

Jamie Coleman
Regulatory Affairs Director

JMC/dsp/cbg

Enclosure: 1R24 Steam Generator Tube Inspection Report

cc: Regional Administrator
NRR Project Manager – Vogtle 1 & 2
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RType: CVC7000

Vogtle Electric Generating Plant - Unit 1
Refueling Outage 1R24 Steam Generator Tube Inspection Report

Enclosure

1R24 Steam Generator Tube Inspection Report

Introduction

The Vogtle Electric Generating Plant (VEGP) Unit 1 is a 4-loop Westinghouse plant with Westinghouse Model F steam generators with Inconel 600 thermally treated tubing. Vogtle Unit 1 refueling outage 24 (1R24) was conducted after Steam Generator (SG) service equivalent to approximately 1.39 effective full power years (EFPY) from previous SG eddy current inspections. During this operational interval, no tube leakage was reported. Analysis based on conservative assumptions used in the Condition Monitoring (CM) and Operational Assessments (OA) demonstrated that there were no tubes that exceeded the Reg. Guide 1.121 or NEI 97-06 Revision 3 criteria for tube integrity during Cycle 24.

During VEGP 1R24, a total of seven (7) tubes were plugged. None of the indications exceeded the condition monitoring limits identified in the Degradation Assessment. No tubes required in-situ pressure testing. Permanent H* Alternate Repair Criteria (ARC) has been approved for implementation by the NRC. Therefore, SNC and Westinghouse omitted tube end +Point™ inspections below top of tubesheet (TTS) -15.2 inches. The scope and results of inspections on each SG are described below.

A. Technical Specification 5.6.10.a, the scope of inspections performed on each SG,

- 100% full-length X-probe (Bobbin and Array) examination of tubes in all SGs, tube end to tube end for Row 6 and higher. Straight leg portion of hot leg (HL) and cold leg (CL) (Rows 1-5). This scope covers the tube support plate (TSP) intersections of high stress (2-sigma) tubes, loose parts, and any possible loose parts (PLPs).

- 100% low row U-bend Bobbin and Array probe examination candy cane from CL Rows 3-5, +Point probe examination of Row 1 and Row 2 U-Bends from the top TSP on the HL to the top TSP on the CL.

- 100% tubesheet expansion transition +Point probe examination of HL tubes in all SGs from the 3-inches above TTS to 3-inches below TTS. This inspection, along with the full-length X-probe inspection, satisfied the required periodic sample that accompanies regulatory approval of H*.

- 100% +Point probe examination of dent and dings ≥ 2.0 volts.

- 100% +Point probe examination of the HL tube bulges (BLG) > 42 volts (excluding those below H* distance).

- 100% +Point probe examination of the HL overexpansion (OXP) populations (excluding those below H* distance).

  The BLG and OXP indications are defined as follows:
  - BLG = differential mix diameter discontinuity signal within the tubesheet of 18 volts or greater as measured by bobbin coil probe.
  - OXP = a tube diameter deviation within the tubesheet of 1.5 mils or greater as measured by bobbin coil profile analysis.

- Special Interest +Point probe examination of all I-Codes and as needed to support tube integrity evaluations.

- Tube slippage Bobbin probe examination for H* Tube slippage monitoring.
- 100% visual inspection of all installed tube plugs from the primary side.
- Visual inspection in all SGs of channel head primary side HL and CL inclusive of the entire divider plate to channel head weld and all visible clad surfaces.
- Secondary side activities included:
  - Sludge lancing
  - Cleanliness and foreign object search and retrieval (FOSAR)

B. Technical Specification 5.6.10.b, the nondestructive examination techniques utilized for tubes with increased degradation susceptibility.

+Point probe inspections were performed for HL tubes in all SGs for TTS ± 3-inches, Row 1 and Row 2 U-bends from the top TSP on the HL side to the top TSP on the CL side, HL tube BLG and OXP, and dents and dings at specific volts in straight lengths and U-bends. These regions have increased degradation susceptibility to stress corrosion cracking.

X-probe inspections were performed for 100% of the SG tubes. This includes HL and CL periphery and tubelane to identify foreign objects or foreign object wear. These regions are considered to have increased susceptibility to foreign object wear. The 100% X-probe inspection included all potential high stress tubes and dents/dings.

C. Technical Specification 5.6.10.c, for each degradation mechanism found:
1. The nondestructive examination techniques utilized,

<u>Table 1: Degradation Found and Techniques</u>

Degradation Mechanism Found	Technique Used
Mechanical wear due to foreign objects	X-probe (bobbin or array) - detection +Point – detection and sizing
Mechanical wear at AVB supports	X-probe – detection Bobbin - sizing
Mechanical wear and wall loss from secondary side cleaning process	X-probe – detection +Point – detection and sizing
Mechanical wear at TSP	X-probe – detection +Point - sizing
ODSCC at the Hot Leg Expansion Transitions	+Point – detection and sizing
ODSCC at Bulge and Overexpansion	X-probe - detection +Point - detection and sizing
ODSCC at Dents and Dings	X-probe – detection +Point – detection and sizing

2. The location, orientation (if linear), measured size (if available), and voltage response for each indication. For tube wear at support structures less than 20 percent through-wall, only the total number of indications needs to be reported,

Mechanical wear due to foreign objects

Table 2: Vogtle 1R24 Foreign Object Wear Indications

SG	Row	Column	Location	%TW Depth	Voltage
1	1	2	BPH+15.12	10	0.11
1	24	66	3C+26.27	9	0.06
1	39	100	TSH+0.24	11	0.11
1	41	97	TSC+0.04	24	0.29
1	41	100	TSH+0.16	16	0.17
1	41	100	TSH+0.09	31	0.42
1	41	101	TSH+0.13	24	0.3
1	41	102	TSH+0.11	24	0.29
1	41	103	TSH+0.42	23	0.28
1	55	82	BPH+0.42	24	0.3
1	56	82	BPH+0.68	INR	-
2	6	1	1C+1.14	7	0.07
2	53	48	TSC+0.3	9	0.1
2	54	46	TSC+0.11	15	0.18
3	29	111	BPH-0.15	12	0.13
3	30	111	BPH+0.86	31	0.41
4	38	104	BPH+0.18	DSS	-
4	40	57	6H+13.32	8	0.09
4	49	89	BPH+0.3	11	0.09

BPH - Baffle Plate on HL side
TSH - Tubesheet region on HL side
TSC - Tubesheet region on CL side
#C - Tube support plate # on CL side
#H - Tube support plate # on HL side
INR - Indication Not Reportable
DSS - Distorted Support Signal. No change noted with historical lookbacks.

No loose parts were found to remain at any of the foreign object wear locations in Table 2.

Mechanical wear at Anti-vibration bar (AVB) supports

In SG1, there are a total of 183 indications for AVB wear with 160 less than 20% through-wall (TW). In SG2, there are a total of 249 indications for AVB wear with 214 less than 20% TW. In SG3, there are a total of 288 indications with 244 less than 20% TW. In SG4, there are a total of 243 indications for AVB wear with 212 less than 20% TW. Tables 3 - 6 include V1R24 AVB wear indications greater than or equal to 20%TW.

Table 3: Vogtle 1R24 SG1 AVB Wear Indications ≥ 20%TW

SG	Row	Column	Location	%TW Depth	Voltage
1	26	116	AV5	20	0.85
1	28	115	AV6	25	1.34
1	37	102	AV5	24	1.12
1	38	16	AV4	32	2.18
1	39	48	AV4	23	1.1
1	39	48	AV3	21	0.85
1	40	47	AV4	35	2.21
1	40	47	AV3	33	2.01
1	40	62	AV3	22	0.76
1	41	44	AV3	34	2.21
1	41	44	AV2	22	0.91
1	43	21	AV5	31	1.79
1	43	21	AV4	29	1.58
1	43	83	AV4	20	0.83
1	43	91	AV2	31	1.82
1	44	21	AV3	20	0.84
1	49	28	AV5	21	0.96
1	52	39	AV3	30	1.62
1	52	39	AV4	29	1.48
1	52	39	AV2	22	0.93
1	52	44	AV4	23	1
1	57	45	AV3	36	2.45
1	57	45	AV2	21	0.86

Table 4: Vogtle 1R24 SG2 AVB Wear Indications ≥ 20%TW

SG	Row	Column	Location	%TW Depth	Voltage
2	38	106	AV5	28	1.33
2	39	105	AV5	25	1.22
2	40	93	AV5	20	0.81
2	40	98	AV5	22	0.9
2	40	105	AV5	25	1.24
2	41	33	AV4	24	1.05
2	41	33	AV5	22	0.91
2	41	42	AV5	33	2.08
2	41	42	AV4	27	1.42
2	41	103	AV5	27	1.46
2	42	76	AV5	34	2.06
2	42	76	AV2	26	1.23
2	42	76	AV3	21	0.84
2	42	94	AV4	23	0.92

2	42	97	AV4	36	2.52
2	42	97	AV3	21	0.93
2	42	100	AV4	20	0.78
2	43	87	AV5	20	0.86
2	43	91	AV2	28	1.46
2	43	91	AV5	25	1.18
2	46	49	AV3	25	1.13
2	46	50	AV3	34	1.83
2	46	50	AV2	34	1.87
2	46	50	AV4	30	1.5
2	46	50	AV5	27	1.15
2	46	50	AV1	25	1
2	46	58	AV2	30	1.3
2	49	89	AV5	21	0.89
2	49	89	AV4	21	0.93
2	50	84	AV4	35	2.06
2	50	84	AV3	29	1.43
2	50	89	AV4	32	1.78
2	54	84	AV5	32	1.7
2	54	84	AV3	22	0.88
2	54	84	AV4	20	0.75

Table 5: Vogtle 1R24 SG3 AVB Wear Indications ≥ 20%TW

SG	Row	Column	Location	%TW Depth	Voltage
3	39	102	AV2	20	0.61
3	39	35	AV4	22	0.77
3	39	17	AV6	24	1.02
3	39	17	AV3	24	1.02
3	39	35	AV3	29	1.29
3	39	26	AV2	30	1.41
3	39	102	AV5	30	1.24
3	40	30	AV5	20	0.71
3	40	98	AV2	20	0.64
3	40	100	AV2	21	0.73
3	40	104	AV4	22	0.75
3	40	104	AV6	23	0.85
3	40	102	AV2	29	1.29
3	41	19	AV5	29	1.38
3	41	99	AV5	35	1.9
3	42	58	AV3	21	0.73
3	42	21	AV5	22	0.83
3	42	63	AV4	22	0.79
3	42	27	AV5	26	1.04
3	42	35	AV4	28	1.25
3	42	50	AV2	29	1.5
3	42	23	AV4	35	1.84
3	42	50	AV4	36	2.34

3	44	26	AV2	30	1.37
3	45	40	AV3	20	0.71
3	45	61	AV4	20	0.67
3	45	67	AV3	20	0.92
3	45	46	AV4	21	0.76
3	45	82	AV4	21	0.69
3	45	49	AV2	23	0.92
3	45	67	AV4	24	1.18
3	45	82	AV3	24	0.92
3	45	64	AV3	25	1.33
3	45	48	AV3	26	1.12
3	45	61	AV5	26	1.03
3	45	49	AV3	27	1.16
3	45	46	AV3	31	1.53
3	45	46	AV2	32	1.66
3	47	45	AV4	25	1.01
3	47	38	AV4	31	1.5
3	47	96	AV4	32	1.47
3	49	34	AV4	29	1.34
3	49	96	AV6	33	1.64
3	50	86	AV5	20	0.65

Table 6: Vogtle 1R24 SG4 AVB Wear Indications ≥ 20%TW

SG	Row	Column	Location	%TW Depth	Voltage
4	28	40	AV5	21	0.62
4	30	9	AV5	32	1.69
4	30	114	AV5	32	1.7
4	33	111	AV6	21	0.67
4	33	111	AV3	22	0.7
4	33	111	AV4	25	0.88
4	36	39	AV3	21	0.82
4	37	107	AV3	20	0.62
4	38	104	AV4	21	0.8
4	39	58	AV4	23	0.79
4	40	82	AV5	21	0.75
4	40	88	AV4	21	0.67
4	40	82	AV3	24	1.02
4	40	95	AV4	25	1.06
4	40	106	AV3	26	0.96
4	40	62	AV4	27	1.11
4	40	62	AV2	27	1.06
4	40	106	AV5	30	1.4
4	40	62	AV3	35	1.86
4	40	82	AV4	37	2.42
4	42	101	AV4	24	0.98
4	42	101	AV5	30	1.46
4	43	101	AV5	30	1.27

4	44	97	AV4	22	0.86
4	44	96	AV4	24	0.84
4	44	97	AV5	26	1.15
4	44	97	AV2	26	1.08
4	44	96	AV3	31	1.41
4	45	98	AV5	21	0.64
4	50	63	AV3	25	1.03
4	50	76	AV5	31	1.51

AV# - Location of AVB intersection with the tube (there are up to 6)

Mechanical wear and wall loss from secondary side cleaning process
Table 7 lists tube locations and volumetric indications associated with the ultrasonic energy cleaning (UEC) and pressure pulse cleaning (PPC) secondary side cleaning processes. Based on the nondestructive examination (NDE) uncertainty levels and the results, it is apparent that there has been no measurable progression in the wall loss associated with these historical indications. Further, the mechanisms that caused this form of degradation are no longer applied and therefore no wear progression can occur.

Table 7: Vogtle 1R24 Tube Wall Loss from Secondary Side Cleaning Process

SG	Row	Col	Location	Indication	%TW Depth	Volts
1	1	83	TSH+20.03	PCT	11	0.11
1	1	87	TSH+20.41	PCT	38	0.56
1	58	70	BPH+0.47	PCT	25	0.32
2	1	70	TSC+11.65	PCT	4	0.04
2	1	70	TSC+9.24	PCT	8	0.09
2	1	70	TSC+8.01	PCT	7	0.07
2	1	78	TSC+8.97	PCT	9	0.09
2	1	78	TSC+8.15	PCT	4	0.04
2	1	82	TSC+7.99	PCT	5	0.05
2	16	6	BPC+0.56	PCT	12	0.13
2	16	7	BPC+0.49	PCT	30	0.41
2	1	91	BPC-0.38	PCT	DSS	-
2	10	101	BPH-0.19	PCT	NDD	-

DSS - Distorted Support Signal. No change noted with historical lookbacks.
NDD - No Degradation Detected. No change noted with historical lookbacks.
PCT - Volumetric Indication
BPH - Baffle Plate on the HL side
BPC - Baffle Plate on the CL side

Mechanical Wear at TSP

There are two (2) indications of mechanical wear at TSP and both are less than 20% TW.

ODSCC at the Hot Leg Expansion Transitions

During the 1R24 SG inspections, five (5) circumferential ODSCC indications were reported at HL TTS expansion transitions. All were detected and sized with the +Point probe. Table 8 includes the ODSCC indications.

Table 8: Vogtle 1R24 ODSCC at Tubesheet Expansion Transitions

SG	Row	Column	Volts	Deg	Location	Max Depth% TW	PDA (%)
4	39	68	0.12	93	TSH-0.18	87	18.6
4	43	64	0.33	75	TSH-0.13	56	18.9
4	43	67	0.08	85	TSH+0.00	31	5.27
4	43	74	0.30	142	TSH-0.10	86	27.1
4	49	67	0.24	74	TSH+0.00	74	34.7

TSH - Tubesheet region on HL side
PDA - Percent Degraded Area

ODSCC at Tube Overexpansion

During 1R24, there was one (1) indication of axial ODSCC at an over expansion within the tubesheet. This indication was detected and sized with the +Point probe. This is a first occurrence of axial ODSCC at this location for Vogtle Unit 1. This type of degradation is expected to be within close proximity to the bottom of the expansion transition – a location that was inspected 100% by +Point probe on the HL side and was covered by the planned inspection scope. No changes in future inspection scopes or intervals would be needed to account for this degradation mechanism. Table 9 includes the ODSCC indication.

Table 9: Vogtle 1R24 Axial ODSCC at Tube Overexpansion

SG	Row	Column	+Point Voltage (Vpp)	Deg	Location	Max Depth% TW	Length (in)
4	25	74	0.79	91	TSH-1.24	73.9	0.37

ODSCC at Dents and Dings

During 1R24, there was one (1) indication of axial ODSCC detected at a freespan ding. This is the first occurrence of axial ODSCC at a ding for Vogtle Unit 1. Table 10 includes the ODSCC indication.

Table 10: Vogtle 1R24 Axial ODSCC at Dents and Dings

SG	Row	Column	+Point Voltage (Vpp)	Deg	Location	Max Depth% TW	Length (in)
4	14	42	0.14	127	7H+2.51	37.9	0.33

3. A description of the condition monitoring assessment and results, including the margin to the tube integrity performance criteria and comparison with the margin predicted to exist at the inspection by the previous forward-looking tube integrity assessment

Table 11: Vogtle 1R24 Condition Monitoring Summary for Limiting Flaws

Mechanism	1R24 Limiting Flaw			CM Limit
	Loc	Depth	Length	
Mechanical wear due to foreign objects	SG3-R30-C111	31% TW	0.41-inch	48% TW for 1.5-inch flaw
Mechanical wear at AVB supports	SG4-R40-C82 AV4	37% TW	0.4-inch (assumed)	64% TW for 0.4-inch flaw
Mechanical wear and wall loss from secondary side cleaning process	SG1-R1-C87 TSH+20.41	38% TW	1.21-inch	48% TW for 1.5-inch flaw
Mechanical wear at TSP	SG4-R44-C21 7H-0.58	17% TW	0.35-inch	53% TW 1.12-inch flaw
Circumferential ODSCC at the HL Expansion Transitions	SG4-R49-C67 TSH+0.00	PDA: 34.7%	171° circ	PDA: 53%
Axial ODSCC at Tube OXP in HL Tubesheet	SG4-R25-C74 TSH-1.24	SED: 62.8% TW	SEL:0.29-inch	SED: 67.21% TW for 0.29-inch SEL
ODSCC at Dents and Dings	SG4-R14-C42 7H+2.51	SED: 31.2% TW	SEL: 0.295-inch	SED: 61% TW for 0.29 5-inch SEL

SED - Structural Effective Depth SEL - Structural Effective Length

For volumetric wear flaws with pressure-only loading condition, tube burst and ligament tearing (i.e., pop-through) are coincident, therefore, satisfaction of the tube burst criteria at $3\Delta P_{NO}$ also satisfies the accident-induced leakage performance criteria (AILPC) at steam line break (SLB) differential pressure.

For all SCC flaws, the burst and ligament tearing pressures are greater than the minimum burst and leakage integrity limits of 4044 psi and 2560 psi, respectively. This includes material property, burst relation, and NDE uncertainties at 0.95 probability and 50% confidence.

For existing degradation mechanisms, a comparison of the previous OA projection was compared to the 1R24 inspection results. The following provides a discussion of each comparison.

For potential wear caused by known (legacy) foreign objects remaining in the SGs, the previous 1R23 OA stated that the legacy foreign objects remaining in the SGs will not adversely affect SG tube integrity for at least two full operating cycles. During the 1R24 eddy current inspections no tube wear was reported that was associated with legacy foreign objects. Therefore, the foreign object wear projection methodology remains valid and conservative. During the 1R24 eddy current inspections, there was no new foreign object wear detected.

For AVB wear, the OA projection from the 1R23 assessment predicted an existing AVB wear at a maximum depth of 44% TW for AVB wear inspected in 1R23 (SG2 and 3). The OA projection from the 1R22 assessment predicted an existing AVB wear depth of 49.2% TW for AVB wear inspected in 1R22 (SG 1 and 4). The largest existing AVB wear depth reported during 1R24 was 37% TW. The OA projections from the assessments at 1R22 and 1R23 predicted new AVB wear at a maximum depth of 40.4%TW in SGs 1 and 4 and 26% TW in SGs 1 and 3. The largest new AVB wear depth reported across all four SGs during 1R24 was 13%. Therefore, the OA assumptions, inputs, and methodology for AVB wear projections remain valid and conservative.

For wear and wall loss from secondary cleaning, no wear or wall loss progression is expected outside of eddy current depth measurement uncertainty. The maximum increase in legacy wear from secondary side cleaning from 1R23 to 1R24 is 2% TW, well within the measurement uncertainty. Therefore, the OA assumptions, inputs and methodology for these projections remain valid and conservative.

For TSP wear, the end of cycle (EOC) 24 OA projections for TSP wear was determined in the 1R23 assessment to be 26.5% TW. The largest TSP wear depth reported during 1R24 was 17% TW. The OA projection from this assessment predicted new TSP wear at a maximum depth of 17.5% TW. There were no new indications of TSP wear during 1R24. Therefore, the OA assumptions, inputs and methodology for TSP wear projections remain valid and conservative.

The EOC-24 simplified worst-case degraded tube Monte Carlo OA projection over 1-cycle for circumferential ODSCC at expansion transitions from 1R23 assessment is a flaw with a maximum depth of 97.1% TW, a circumferential extent of 182 degrees (1.09 inch), and a PDA of 34.4%. Fully probabilistic analyses were also performed assuming up to nine undetected flaws with OA durations of one and two cycles. The probability of burst (POB) and probability of leakage (POL) for the most limiting case for the 2-cycle OA duration were 0.011% and 2.104%, respectively. The projected burst pressures for 1- and 2-cycle OA durations were 6949 psi and 6792 psi, respectively. No leakage was projected for the 1-cycle projections, but 0.079 gpm was predicted for the 2-cycle OA duration. The largest circumferential ODSCC indication detected at expansion transitions during 1R24 had a maximum depth of 74%, circumferential extent of 171 degrees, and a PDA of 34.7%. The burst and ligament tearing pressure of this flaw with material, burst relation and NDE uncertainties included at 95/50 are 6989 psi and 9429 psi, respectively. This most limiting flaw detected during 1R24 was bounded by the 1- cycle Monte Carlo and the 1- and 2-cycle fully probabilistic projections.

The EOC-24 fully probabilistic analysis assumed up to nine undetected flaws at the beginning of Cycle 24. This was derived from a Weibull probability of failure evaluation that predicated an additional two flaws initiating during the 1-cycle. This results in a prediction of eleven circumferential ODSCC indications at 1R23. In reality, five indications were detected. Based on this review, the OA assumptions, inputs, and methodology for circumferential ODSCC projections remain valid and generally conservative.

4. The number of tubes plugged during the inspection outage.

Table 12 presents a summary list of all SG tubes plugged in 1R24.

Table 12: Vogtle 1R24 Plugging List

SG	Row	Column	Indication	Location	Plugging Basis	Stabilizer
4	14	42	SAI	7H+2.51	Axial ODSCC	No
4	25	74	SAI	TSH-1.24	Axial ODSCC	No
4	39	68	SCI	TSH-0.18	Circumferential ODSCC	Yes - HL
4	43	64	SCI	TSH-0.13	Circumferential ODSCC	Yes - HL
4	43	67	SCI	TSH 0.0	Circumferential ODSCC	Yes - HL
4	43	74	SCI	TSH -01	Circumferential ODSCC	Yes - HL
4	49	67	MCI	TSH 0.0	Circumferential ODSCC	Yes - HL

SAI – Single Axial Indication, SCI - Single Circumferential Indications, MCI - Multiple Circumferential Indications

D. Technical Specification 5.6.10.d, analysis summary of the tube integrity conditions predicted to exist at the next scheduled inspection (the forward-looking tube integrity assessment) relative to the applicable performance criteria, including the analysis methodology, inputs, and results.

The 1R24 eddy current inspections did not detect any new wear from foreign objects. For the foreign objects known to be remaining in the SG secondary side following 1R24, the analysis performed establishes that at least two cycles of operating would accrue before the object with greatest potential for tube degradation could potentially exceed the plugging limit of 40% TW. There is no wear at locations associated with the foreign objects known to be located on the secondary side in all SGs. Regarding new and existing foreign object wear indications, there has either been no observed growth, or no foreign object observed at these locations and no further growth is expected outside of NDE measurement uncertainties.

Based on application of conservative AVB wear growth rates, the condition of the Vogtle Unit 1 SG tubes has been analyzed with respect to continued operability of the SGs until the end of Cycle 26 without exceeding the limits for structural and leakage integrity. A 2-cycle OA was performed for AVB wear indications existing at 1R24 and assumed undetected flaws. The growth rates were determined by comparative analysis of AVB wear sites for all SGs. The maximum growth rate at 1R24 was 2.19% TW/effective full power years (EFPY). However, in order to provide a level of conservatism, the growth rate from the previous operating interval of 4.0% TW/EFPY was used for 1R24 OA. The OA duration is conservatively assumed to be 3.0 EFPY, with an expected duration of 2.8 EFPY. The condition monitoring limit for AVB wear is 64% TW while the largest AVB wear indication left in service at 1R24 was 37% TW. The maximum AVB wear indication existing at 1R24 is projected to be 49.0% TW at the next planned inspection (1R26), which does not include NDE uncertainties. A conservative depth of 20% TW was assumed for an undetected flaw within the OA evaluation. The maximum AVB wear indication assumed to be undetected at 1R24 is projected to be 32.0% TW at 1R26. All AVB wear projections for 2 cycles satisfy the condition monitoring limit of 64% TW.

Mechanical wear at TSP locations was detected in two tubes during 1R24. Based on application of conservative TSP wear growth rates, the condition of the Vogtle Unit 1 SG tubes has been analyzed with respect to continued operability of the SGs until the end of Cycle 26 for existing and assumed undetected flaws, without exceeding the performance criteria. The depth cycle growth per EFPY used was 5.0% TW. The largest TSP wear indication left in service at 1R24 is 17% TW. The maximum TSP wear indication existing at 1R24 is projected to be 32.0% TW at 1R26, which does not include NDE uncertainties. The maximum TSP wear indication assumed to be undetected at 1R24 is projected to be 32.0% TW at 1R26 (not including NDE uncertainty). All existing and undetected TSP wear projections satisfy the condition monitoring limit of 53% TW.

There has been a recurrence of circumferential ODSCC in the hot leg expansion transitions, with five (5) indications detected at 1R24. One (1) Axial ODSCC at a HL freespan ding was detected at 1R24. One (1) indication of Axial ODSCC at a tubesheet overexpansion which was located 1.24-inches below the top of tubesheet. A fully probabilistic OA analysis was performed for all of existing degradation mechanisms for an inspection interval of 2 cycles.

The operational assessment of SCC degradation mechanisms is performed using fully probabilistic methods. The basic methodology for the fully probabilistic analysis is the same for each SCC mechanism, however, the specific inputs for each mechanism may differ. The basic fully probabilistic analysis method includes:

- Determination of beginning of cycle (BOC) flaw distributions
  - max depth
  - total length
  - PDA (for circumferential flaws)
- Flaw characteristic growth rates
  - based on the EPRI typical default growth rates for SCC
  - corrected for Vogtle Unit 1 hot leg temperature
- Length of cycles
- The remainder of critical inputs to the fully probabilistic model, including number of undetected flaws, tube geometry, material properties, normal operating, accident pressures, and leakage limits.

BOC flaw distributions account for the differences between destructive analysis results and eddy current measurements. The BOC total length distributions were adjusted for non-destructive examination (NDE) measurement uncertainty through probabilistic simulation, including both the mean regression and standard error. In this way, the BOC lengths are based on site-specific history (when available), but also have been adjusted to account for sizing error to true flaw lengths, as determined by destructive analysis of pulled tubes and laboratory cracks. Similarly, the max depth distributions are derived from the site-specific probability of detection (POD) curves. The Vogtle Unit 1 specific POD distributions account for the correlation of measured voltage amplitudes to true flaw max depth via the ETSS voltage amplitude to true depth distribution correlation (Ahat).

Axial ODSCC at a tubesheet overexpansion has not been previously observed at Vogtle or other domestic A600TT SGs. This degradation mechanism shares the same detection technique, sizing technique, and exam scope as axial ODSCC at the expansion transition. For this reason, the flaw that was detected at 1R24 is included in the populations considered in the OA for axial ODSCC at the expansion transition, and the results are applicable to both mechanisms. This is a conservative assumption because axial ODSCC that exists within the expanded tubesheet region has negligible burst potential and very limited leakage potential.

Potential SCC degradation mechanisms were also evaluated for the next 2 cycles.

The results of the OA for those degradation mechanisms detected during 1R24 are summarized in Table 13. The assessments for all existing degradation mechanisms conclude that all SG performance criteria for structural and leakage integrity (including cumulative leakage for all mechanisms) will be satisfied until the next planned inspection at the end of Cycle 26.

Table 13: Vogtle 1R24 OA Results Summary

OA Duration	**Degradation Mechanism**	**POB (%)**	**POL (%)**	**Burst Pressure at Lower 5% (psi)**	**Leak Rate at Lower 5% (gpm)**
2 Cycle	Circ. ODSCC HL TTS	0.03	1.79	6690	0.061
2 Cycle	Axial ODSCC Dent/Ding	0.148	0.055	6373	0.00
2 Cycle	Axial ODSCC Bulge/Overexpansion	0.188	0.099	6106	0.00
Acceptance Criterion		≤ 5%	≤ 5%	≥ 4044 psi	≤ 0.35 gpm

E. Technical Specification 5.6.10.e, Number and percentage of tubes plugged to date, and the effective plugging percentage in each.

Table 14: Total Plugged Tubes after Vogtle 1R24

SG	# Tubes	1R24 # Plugged	Total # Plugged	% Plugging
1	5,626	0	31	0.55%
2	5,626	0	31	0.55%
3	5,626	0	42	0.75%
4	5,626	7	97	1.72%
Total	**22,504**	**7**	**201**	**0.89%**

F. Technical Specification 5.6.10.f, The results of any SG secondary side inspections.

FOSAR inspections were performed at 1R24. A total of forty-eight (48) objects were found during FOSAR and eight (8) were retrieved. The majority of the objects were sludge rocks. Seven (7) objects required further evaluation to ensure tube integrity for upcoming cycle(s). For the objects remaining in the SG secondary side following Vogtle 1R24, the analysis performed establishes that continued steam generator operation with the foreign objects known to be present in the secondary side will not adversely affect the steam generator tube integrity for at least two full operating cycles, or until the 1R26 outage. Sludge lancing was performed and a total of 71.50 lbs. of deposits were removed.

G. Technical Specification 5.6.10.g, 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.

No tube leakage was reported during this operating interval.

H. Technical Specification 5.6.10.h, The calculated accident induced leakage rate from the portion of the tubes below 15.2 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 2.48 times the maximum operational primary to secondary leakage rate, the report should describe how it was determined.

None of the indications reported during the Vogtle 1R24 SG inspections were evaluated to have primary to secondary leakage under 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. Since there was no calculated leakage from any other sources, none of the Vogtle 1 SGs installed tube plugs require leakage calculations. Therefore, for these indications the accident induced leakage rate would be zero, satisfying the accident induced leakage performance criteria.

I. Technical Specification 5.6.10.i, The results of monitoring for tube axial displacement (slippage). If slippage is discovered, the implications of the discovery and corrective action shall be provided.

During 1R24, as part of the tube inspection program, 100% of the tubes in all SGs were tested with the bobbin and array probe. The bobbin data collected was screened for large amplitude tubesheet indications of greater than 50 volts with a phase angle between 25° and 50° suggestive of tube severance. Both manual and automated data screenings have been performed with SVR as the code to report should a sever-type signal be detected. No SVR call was made for the entirety of the bobbin data collected therefore, no indications of slippage were identified.