Southern Nuclear

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U. S. Nuclear Regulatory Commission
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Vogtle Electric Generating Plant – Unit 1
Responses to Second Round NRC Request for Additional Information
for Refueling Outage 1R24 Steam Generator Tube Inspection Report

Ladies and Gentlemen:

By letter dated September 22, 2023 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML23265A249), as supplemented by letter dated January 22, 2024 (ML24022A222), Southern Nuclear Operating Company (SNC) submitted the Steam Generator (SG) Tube Inspection Report for the SG tube inspection performed during the twenty-fourth refueling outage on Vogtle Electric Generating Plant (Vogtle), Unit 1 (1R24) in accordance with the requirements of Vogtle Technical Specification 5.6.10 as updated by TS Amendment 211 (ML21316A055).

On February 16, 2024, the NRC staff provided a second round of draft RAI questions to SNC to make sure that the RAIs are understandable, the regulatory basis is clear, to ensure there is no proprietary information, and to determine if the information was previously docketed. On February 20, 2024, SNC stated that it would need a clarifying call. On March 11, 2024, a clarifying call was held, and SNC stated that it would provide the RAI response within 45 days from the date of issuance of the final RAIs (April 26, 2024).

Enclosure 2 to this letter provides the SNC Responses to the Second Round NRC Request for Additional Information for Refueling Outage 1R24 Steam Generator Tube Inspection Report. This enclosure contains proprietary information as defined by 10 CFR 2.390. Westinghouse Electric Company LLC (“Westinghouse”), as the owner of the proprietary information, has executed the enclosed affidavit, which identifies that the enclosed proprietary information has been withheld from public disclosure. The proprietary information was provided to Southern Nuclear (SNC) in a Westinghouse transmittal which included the affidavit provided as Enclosure 1 to this letter, as well as a non-proprietary version of the Responses to the NRC Request for Additional Information, which is provided as Enclosure 3. The proprietary information has been faithfully reproduced in the enclosed documentation, such that, the affidavit remains applicable.

Enclosure 2 to this letter contains Proprietary Information to be withheld from public disclosure per 10 CFR 2.390. When separated from Enclosure 2 this transmittal document is decontrolled.

Westinghouse hereby requests that the enclosed proprietary information provided in Enclosure 2 to this letter be withheld from public disclosure in accordance with the provisions of 10 CFR 2.390.

This letter contains no NRC commitments. If you have any questions, please contact Ryan Joyce at 205.992.6468.

Respectfully submitted,

Jamie Coleman

Jamie M. Coleman
Regulatory Affairs Director

JMC/dsp/cbg

Enclosures:
1. CAW-24-021, Affidavit for GAE-NRCD-RF-LR-000003 (Non-Proprietary)
2. GAE-NRCD-RF-LR-000003 P-Attachment, Revision 0 (PROPRIETARY)
3. GAE-NRCD-RF-LR-000003 NP-Attachment, Revision 0 (Non-Proprietary)

cc: Regional Administrator, Region II
NRR Project Manager – Vogtle 1 & 2
Senior Resident Inspector – Vogtle 1 & 2
RType: CVC7000

Enclosure 2 to this letter contains Proprietary Information to be withheld from public disclosure per 10 CFR 2.390. When separated from Enclosure 2 this transmittal document is decontrolled.

Vogtle Electric Generating Plant – Unit 1
Responses to Second Round NRC Request for Additional Information for Refueling Outage 1R24 Steam Generator Tube Inspection Report

Enclosure 1

CAW-24-021, Affidavit for GAE-NRCD-RF-LR-000003
(Non-Proprietary)

Westinghouse Non-Proprietary Class 3

AFFIDAVIT CAW-24-021

Commonwealth of Pennsylvania:

County of Butler:

(1) I, Zachary Harper, Manager, Licensing Engineering, have been specifically delegated and authorized to apply for withholding and execute this Affidavit on behalf of Westinghouse Electric Company LLC (Westinghouse).

(2) I am requesting the proprietary portions of GAE-NRCD-RF-LR-000003 P-Attachment, Revision 0, "Responses to Second Round Request for Additional Information (RAI) - Vogtle, Unit 1 - SG Tube Inspection Report - 1R24 (L-2023-LRO-0067)," be withheld from public disclosure under 10 CFR 2.390.

(3) I have personal knowledge of the criteria and procedures utilized by Westinghouse in designating information as a trade secret, privileged, or as confidential commercial or financial information.

(4) Pursuant to 10 CFR 2.390, the following is furnished for consideration by the Commission in determining whether the information sought to be withheld from public disclosure should be withheld.

(i) The information sought to be withheld from public disclosure is owned and has been held in confidence by Westinghouse and is not customarily disclosed to the public.

(ii) The information sought to be withheld is being transmitted to the Commission in confidence and, to Westinghouse's knowledge, is not available in public sources.

(iii) Westinghouse notes that a showing of substantial harm is no longer an applicable criterion for analyzing whether a document should be withheld from public disclosure. Nevertheless, public disclosure of this proprietary information is likely to cause substantial harm to the competitive position of Westinghouse because it would enhance the ability of competitors to provide similar technical evaluation justifications and licensing defense services for commercial power reactors without commensurate expenses. Also, public disclosure of the information would enable others to use the information to meet NRC requirements for licensing documentation without purchasing the right to use the information.

(5) Westinghouse has policies in place to identify proprietary information. Under that system, information is held in confidence if it falls in one or more of several types, the release of which might result in the loss of an existing or potential competitive advantage, as follows:

(a) The information reveals the distinguishing aspects of a process (or component, structure, tool, method, etc.) where prevention of its use by any of Westinghouse's competitors without license from Westinghouse constitutes a competitive economic advantage over other companies.

(b) It consists of supporting data, including test data, relative to a process (or component, structure, tool, method, etc.), the application of which data secures a competitive economic advantage (e.g., by optimization or improved marketability).

(c) Its use by a competitor would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing a similar product.

(d) It reveals cost or price information, production capacities, budget levels, or commercial strategies of Westinghouse, its customers or suppliers.

(e) It reveals aspects of past, present, or future Westinghouse or customer funded development plans and programs of potential commercial value to Westinghouse.

(f) It contains patentable ideas, for which patent protection may be desirable.

(6) The attached documents are bracketed and marked to indicate the bases for withholding. The justification for withholding is indicated in both versions by means of lower-case letters (a) through (f) located as a superscript immediately following the brackets enclosing each item of information being identified as proprietary or in the margin opposite such information. These lower-case letters refer to the types of information Westinghouse customarily holds in confidence identified in Sections (5)(a) through (f) of this Affidavit.

I declare that the averments of fact set forth in this Affidavit are true and correct to the best of my knowledge, information, and belief. I declare under penalty of perjury that the foregoing is true and correct.

Executed on: 4/23/2024

Signed electronically by

Zachary Harper

Vogtle Electric Generating Plant – Unit 1
Responses to Second Round NRC Request for Additional Information for Refueling Outage 1R24 Steam Generator Tube Inspection Report

Enclosure 3

GAE-NRCD-RF-LR-000003 NP-Attachment, Revision 0
(Non-Proprietary)

Westinghouse Electric Company

GAE-NRCD-RF-LR-000003 P-Attachment
Revision 0

Responses to Second Round Request for Additional Information (RAI) - Vogtle, Unit 1 - SG Tube Inspection Report - 1R24 (L-2023-LRO-0067)

April 2024

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Responses to Second Round Request for Additional Information (RAI) - Vogtle, Unit 1 - SG Tube Inspection Report - 1R24 (L-2023-LRO-0067)

REQUEST FOR ADDITIONAL INFORMATION (RAI)

By letter dated September 22, 2023 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML23265A249), as supplemented by letter dated January 22, 2024 (ML24022A222), Southern Nuclear Operating Company (SNC, the licensee), submitted information summarizing the results of the spring 2023 steam generator (SG) inspections performed at Vogtle Electric Generating Plant (Vogtle), Unit 1, during the twenty-fourth refueling outage (1R24).

All pressurized water reactors have Technical Specifications (TS) according to § 50.36 of Title 10 of the Code of Federal Regulations that include a SG Program with specific criteria for the structural and leakage integrity, repair, and inspection of SG tubes. Vogtle, Unit 1, TS Section 5.6.10 requires that a report be submitted within 180 days after the initial entry into hot shutdown (MODE 4) following completion of an inspection of the SGs performed in accordance with TS Section 5.5.9, which requires that a SG Program be established and implemented to ensure SG tube integrity is maintained.

To complete its review of the inspection report, the U.S. Nuclear Regulatory Commission (NRC) staff requests the following additional information: The responses are provided below.

REGULATORY BASIS

In Title 10 of the Code of Federal Regulations (10 CFR), Section 50.36, the Commission established its regulatory requirements related to the content of the TSs. Pursuant to 10 CFR 50.36, Technical Specifications (TSs) are required to include items in the following five specific categories related to station operation: (1) safety limits, limiting safety system settings, and limiting control settings; (2) limiting conditions for operation (LCOs); (3) surveillance requirements; (4) design features; and (5) administrative controls. The rule does not specify the particular requirements to be included in a plant's TSs. In 10 CFR 50.36(d)(5), administrative controls are stated to be "the provisions relating to organization and management, procedures, recordkeeping, review and audit, and reporting necessary to assure operation of the facility in a safe manner." This also includes the programs established by the licensee and listed in the administrative controls section of the TSs for the licensee to operate the facility in a safe manner. The requirements for SG tube integrity and SG tube reporting on inspections and repair for Vogtle, Unit 1, are in TS 3.4.17, "Steam Generator (SG) Tube Integrity," and TS 5.6.10, "Steam Generator Tube Inspection Report," respectively. In addition, TS 5.5.9 contains the requirements for the SG Program.

TS 5.5.9(d) states, in part, "In addition to meeting the requirements of d.1, d.2, and d.3 below, the inspection scope, inspection methods, and inspection intervals shall be such as to ensure that SG tube integrity is maintained until the next SG inspection." Therefore, NRC staff questions related to a specific SG inspection technique used to detect tube cracking and the technique's probability of detection, which is an input used when projecting future tube integrity, is appropriate.

RAI #1

The SNC response to NRC RAI 1a dated January 22, 2024 (ML24022A222) discussed the site-specific probability of detection (POD) function for maximum flaw depth that was developed using the Electric Power Research Institute (EPRI) model assisted probability of detection (MAPOD) code. The MAPOD process for this technique relies on the regression that is calculated between the voltage amplitude from the +Point™ probe and the true depth distribution. This regression is called the Ahat.

a. Discuss why the analyst reporting probability (ARP) provided in Figure 1 (ML24022A222) is appropriate relative to the knowledge gained from previous inspections for circumferential outside diameter stress corrosion cracking (ODSCC) in the hot leg expansion transition region, including previously performed lookback analysis.

b. The eddy current technique (ETSS 21410.1) relies on an eddy current signal phase-to-crack depth relationship, rather than a voltage amplitude-to-crack depth relationship, for sizing ODSCC at this location. This is presumably due to a better statistical fit between phase angle and crack depth, as compared to voltage amplitude and crack depth. The NRC staff notes that the maximum depth sizing correlation coefficient shown in ETSS 21410.1 is smaller than the minimum value required for the 95-percent confidence level shown in Table 4-1 in the EPRI Integrity Assessment Guidelines. Please discuss if there is a statistically acceptable relationship between voltage amplitude and crack depth to support the MAPOD Ahat development.

Response 1a

Eddy current inspection POD modeling uses the EPRI MAPOD software (Reference 3) to create POD curves for detection of SG tube degradation and the population of flaws that may be undetected following a SG inspection. One of the critical inputs to the MAPOD model is the eddy current analyst reporting parameter (ARP). The ARP defines a lower bound signal-to-noise (S/N) ratio for non-detection, an upper bound signal-to-noise ratio for reliable detection, and MAPOD randomly samples flaw detection between these two bounds for each simulation. The other inputs to the MAPOD model are a noise distribution and a flaw true depth to flaw voltage amplitude regression (Ahat). The appropriate selection of the ARP is dependent upon the type of tube degradation being investigated and the inspection probe type used for detection. The EPRI MAPOD manual recommends a default ARP range of [ ]^{a,b,c} for all degradation mechanisms and probe types but allows for other ARP values when justified.

Figure 1 from ML24022A222 (Reference 5) provides the results of the Vogtle specific MAPOD simulation for circumferential ODSCC at tubesheet expansion transitions for maximum depth (MD). The ARP values used in the MAPOD simulation for Vogtle 1R24 are [

]^{a,c}

Studies by both Westinghouse and EPRI have shown that certain tube degradation mechanisms are reliably detected by eddy current techniques in the field for signal-to-noise ratios that are less than 1.5. The intention of the EPRI default ARP values is to provide conservative signal to noise thresholds, applicable to any degradation mechanism. A 2021 Westinghouse study of ARP thresholds for +Point probe, [

]^{a,b,c}

Additionally, circumferential ODSCC flaws from recent Vogtle Unit 1 inspections were reviewed, including the lookback results from previous inspection data (see Figure 1a-1). Flaw signal voltage and noise voltage [

]a,b,c

Therefore, the EPRI default ARP threshold values used in the Vogtle 1R24 Operational Assessment (OA) for circumferential ODSCC at the tubesheet expansion transition are conservative and appropriate.

[a,b,c

]

Figure 1a-1. Vogtle Unit 1 Expansion Transition Flaw Signal and Noise Distributions
(SG4 noise and flaw signals selected because this SG contains the vast majority of recent circumferential ODSCC)

Response 1b

A relationship between signal voltage amplitude and crack depth was developed by Westinghouse and used in the development of a maximum depth site-specific POD curve for circumferential ODSCC at expansion transitions. Descriptions and discussions of the signal voltage amplitude to depth, burst pressure, and percent degraded area (PDA) relationships are further discussed below.

A site-specific POD curve was generated for circumferential ODSCC at expansion transitions using MAPOD. The EPRI MAPOD code generates a log-logistic POD curve through a simulation process of generated binary detections and non-detections from a probabilistic sampling process that includes a flaw voltage to depth regression (Ahat).

The MAPOD methodology uses a flaw depth to flaw voltage amplitude to depth Ahat regression. The Ahat regression is based on the flaw data set contained in the EPRI Examination Technique Specification Sheet (ETSS) 21410.1 for the +POINT probe detection of circumferential ODSCC at expansion transitions. ETSS 21410.1 is a technique from Appendix H of the SG Examination Guidelines (Reference 7) that contains the metallurgical maximum depths but does not provide the voltage amplitude sizing information necessary to create an Ahat regression. Westinghouse obtained the raw +POINT probe data for the flaws in the ETSS data set and the data were re-analyzed to obtain the voltage amplitude to metallurgical flaw depth correlation. Figure 1b-1 provides the Ahat data and regression that was used for the site-specific POD development. The associated correlation coefficient (R^2) of the Ahat regression is [ ]^{a,b,c}, which is a statistically acceptable relationship for the data set size. Note that the regression shown in the figure is in terms of the natural log (Ln) of metallurgical depth and the natural log of the vertical maximum voltage (Vvm) amplitude for use in the EPRI MAPOD software code.


a,b,c

Figure 1b-1. ETSS 21410.1 Ahat Regression

RAI # 2

A summary of circumferential ODSCC at the hot leg expansion transition region from recent tube inspections is provided in the table below:

Refueling Outage	ODSCC Indications	Average PDA[1] (%)
1R21	None	N/A
1R22	2	4.6
1R23	8	10.3
1R24	5	20.9

1 – PDA = Percent Degraded Area

The NRC staff notes the average PDA is increasing with time based on the four most recent outages. The 1R24 circumferential indication with the maximum PDA had significant margin to the condition monitoring limit. The data set for ETSS 21410.1, however, shows that the PDA was consistently undersized, particularly for the pulled tube data. According to NRC staff calculations, the average PDA for 1R24 in the table above, when combined with the average amount of PDA undersizing for pulled tubes in ETSS 21410.1, approaches the condition monitoring limit. Please discuss if the PDA trend shown above and the potential for the measured PDA to undersize PDA (ETSS data set) were considered when projecting this degradation mechanism to the next tube inspection.

Response 2

The most recent average PDA at 1R24 is higher than has been historically typical for Vogtle Unit 1. However, this data point appears to be an outlier compared to a trend of overall consistent average PDA values. Figure 2-1 shows the trend of average PDA values at Vogtle Unit 1. The 1R24 circumferential indication with the maximum PDA had significant margin to the condition monitoring limit and no long-term trend of increasing PDA is apparent.

The sizing uncertainties of ETSS 21410.1 are inadequate for tube integrity calculations for circumferential ODSCC and are not used for the determination of flaw depth, length, or PDA at Vogtle. As an alternative, the sizing technique used for circumferential ODSCC at the expansion transition is [

]^{a,b,c}

The PDA sizing regression and associated uncertainties applied at Vogtle Unit 1 account for potential under sizing that may occur. OA projections take advantage of benchmarking, following the methodology prescribed by Section 8.3 of the EPRI SG Integrity Assessment Guidelines (IAGL) (Reference 2). Benchmarking of the fully probabilistic OA methods for this mechanism was completed by comparing OA simulation results from prior outages with actual detection results. It was found that [

]^{a,c}, the potential for the measured PDA to be under sized has been adequately considered when projecting to the next inspection.


b

Figure 2-1. Vogtle Unit 1 Hot Leg Expansion Transition ODSCC Trends

References

1. Vogtle Electric Generating Plant, Unit 1, Refueling Outage 1R24 Steam Generator Tube Inspection Report (ML23265A249), September 22, 2023.
2. *Steam Generator Management Program: Steam Generator Integrity Assessment Guidelines, Revision 5. EPRI, Palo Alto, CA: 2021. 3002020909.*
3. EPRI Computer Software 3002010334, "Steam Generator Management Program: Model Assisted Probability of Detection Using R (MAPOD-R) Version 2.1," 2017.
4. Nuclear Regulatory Commission Document, ML22220A134, "VOGTLE ELECTRIC GENERATING PLANT, UNIT 1 – REVIEW OF THE REFUELING OUTAGE 1R23 (FALL 2021) STEAM GENERATOR TUBE INSPECTION REPORT (EPID L-2022-LRO-0030)," August 9, 2022.
5. Nuclear Regulatory Commission Document, ML22220A134, "Vogtle Electric Generating Plant - Unit 1 Responses to NRC Request for Additional Information for Refueling Outage 1 R24 Steam Generator Tube Inspection Report," January 22, 2024 (ML24022A222)
6. Depth Based Structural Methods for Steam Generator Circumferential Indications, EPRI, Palo Alto, CA: 1997. TR-107197.
7. Steam Generator Management Program: Pressurized Water Reactor Steam Generator Examination Guidelines: Revision 8. EPRI, Palo Alto, CA: 2016. 3002007572.