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John J. Grabnar
Site Vice President, Beaver Valley Nuclear

724-682-5234

February 16, 2021
L-21-055

10 CFR 50.90

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

Subject:
Beaver Valley Power Station, Unit No. 2
Docket No. 50-412, License No. NPF-73
Response to Request for Additional Information Regarding Steam Generator Tube Sleeve License Amendment Request (EPID L-2020-LLA-0140)

By correspondence dated June 25, 2020 (Accession No. ML20177A272), Energy Harbor Nuclear Corp. submitted to the Nuclear Regulatory Commission (NRC) a request to amend Beaver Valley Power Station, Unit No. 2 Technical Specification requirements related to methods of inspection and service life for Alloy 800 steam generator tubesheet sleeves. By email dated October 22, 2020 (Accession No. ML20297A322), the NRC requested additional information to complete its review. This letter forwards the response to question 1.c. The responses to the other requests for information were provided in an Energy Harbor Nuclear Corp. letter dated January 22, 2021.

The response to request for additional information question 1.c is provided in enclosures A and B that present non-proprietary and proprietary versions, respectively, of the attachments to document number LTR-CDMP-21-1, “Response to Request for Additional Information for Question 1.c Regarding Beaver Valley Power Station Unit No. 2 Steam Generator Tube Inspection and Repair.”

Enclosure C contains Affidavit CAW-21-5144 signed by Westinghouse Electric Company LLC (“Westinghouse”). The affidavit sets forth the basis on which proprietary information owned by Westinghouse that is contained in Enclosure B may be withheld from public disclosure by the Nuclear Regulatory Commission (“Commission”) and addresses with specificity the considerations listed in paragraph (b)(4) of Section 2.390 of the Commission’s regulations.

Accordingly, it is respectively requested that the information that is proprietary to Westinghouse be withheld from public disclosure in accordance with 10 CFR Section 2.390 of the Commission's regulations.

Correspondence with respect to the copyright or proprietary aspects of the items listed above or the supporting Westinghouse Affidavit should reference CAW-21-5144 and should be addressed to Zachary S. Harper, Manager, Licensing Engineering, Westinghouse Electric Company, 1000 Westinghouse Drive, Suite 165, Cranberry Township, Pennsylvania 16066.

The information provided by this submittal does not invalidate the significant hazards consideration analysis provided in the June 25, 2020 submittal.

There are no regulatory commitments contained in this submittal. If there are any questions or if additional information is required, please contact Mr. Phil H. Lashley, Manager - Fleet Licensing, at (330) 696-7208.

I declare under penalty of perjury that the foregoing is true and correct. Executed on February 16, 2021.

Sincerely,

Grabnar, John 19072

Grabnar, John 19072
Site Vice President, Beaver Valley
I am approving this document
Feb 16 2021 5:45 PM
DocuSign

John J. Grabnar

Enclosures:

A. Responses to Request for Additional Information for Question 1.c Regarding Beaver Valley Power Station Unit No. 2 Steam Generator Tube Inspection and Repair (Non-proprietary)
B. Responses to Request for Additional Information for Question 1.c Regarding Beaver Valley Power Station Unit No. 2 Steam Generator Tube Inspection and Repair (Proprietary)
C. Affidavit for Withholding Proprietary Information

cc: NRC Region I Administrator
NRC Resident Inspector
NRR Project Manager
Director BRP/DEP
Site BRP/DEP Representative

Enclosure A
L-21-055

Responses to Request for Additional Information for Question 1.c Regarding
Beaver Valley Power Station Unit No. 2
Steam Generator Tube Inspection and Repair
(Non-proprietary)

(13 pages follow)

Westinghouse Electric Company

LTR-CDMP-21-1 NP-Attachment
Revision 0

Responses to Request for Additional Information for Question 1.c Regarding Beaver Valley Power Station Unit No. 2 Steam Generator Tube Inspection and Repair

January 20, 2021

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Responses to Request for Additional Information for Question 1.c Regarding Beaver Valley Power Station Unit No. 2 Steam Generator Tube Inspection and Repair

Background

By letter dated June 25, 2020, Energy Harbor Nuclear (EHN) Corporation submitted a License Amendment Request (LAR) to revise Beaver Valley Power Station Unit 2 Technical Specifications (TS) related to Inspection Method and Service Life for Alloy 800 Steam Generator Tubesheet Sleeves (Reference 1). The requested changes revise TS 5.5.5.2.d, "Provisions for SG [Steam Generator] Tube Inspection," and TS 5.5.5.2.f.3, "Provisions for SG Tube Repair Methods," requirements related to methods of inspection and service life for Alloy 800 steam generator tubesheet sleeves.

The Nuclear Regulatory Commission (NRC) Staff has determined that additional information is needed to complete its review of the request (Reference 2). As a result, Westinghouse was contracted by Energy Harbor Nuclear Corporation to respond to the NRC request for additional information (RAI). The RAI consisted of seven questions with various sub-parts delineated in Reference 2. Reference 4, and supported by Reference 3, provided the Westinghouse responses to RAI Questions #1 through #6, excluding the response to RAI Question #1.c. The response to RAI Question #7 was provided by Energy Harbor Nuclear.

The Westinghouse response to RAI Question 1.c is provided below.

Responses to Request for Additional Information

1.c Enclosure D, Page 5-1, discusses unexpected results during probe development believed to be attributed to the sleeves having **[** **]** compared to the sleeves used during the feasibility study. Please discuss if differences in **[** **]** for installed sleeves would affect the probability of detection of cracks using the Ghent V2 probe.

<u>Response</u>:

A testing program was developed to determine the effects of the tubesheet sleeve nickel band thickness on the probability of detection (POD) of cracks using the Ghent Version 2 probe. Electro discharge machining (EDM) notches in parent tubing with inserted tubesheet sleeves containing varying nickel band thicknesses were inspected with a Ghent Version 2 probe to evaluate the effects on eddy current responses relating to the POD. The observed effects from the nickel material were related to the POD testing program of crack samples provided in Reference 3. For this program, the effect of the nickel material is evaluated through a voltage-based approach and voltage-based POD distributions, as described below.

Reference 3 provided the results of a Ghent Version 2 probe POD study using axial oriented outer diameter stress corrosion crack (SCC) samples and was used to support the June 25, 2020

Energy Harbor Nuclear (EHN) sleeve License Amendment Request (LAR) (Reference 1) and RAI response provided in Reference 4. Stress corrosion crack (SCC) samples were not available for this nickel thickness test program provided in this response. Therefore, a 7/8-inch parent tube [ ]a,c,e was used in this test program. The sleeve samples were inserted into the [ ]a,c,e. Hard rolling of the sleeve into [ ]a,c,e for consistent results. This test program was developed as a comparative program to evaluate the differences (i.e., deltas) in eddy current signal response compared to a reference nickel thickness and, therefore, the results are expected [ ]a,c,e.

A feasibility study performed in development of this test program showed that the Ghent Version 2 probe axial sensitive coil voltage response [ ]a,c,e was within the range of voltage amplitudes of the outside diameter stress corrosion cracking (ODSCC) samples evaluated in Reference 3. As provided in Reference 3, the peak-to-peak voltage of the 100% TW axial ODSCC flaw was 3.76 volts in a sleeve with a [ ]a,c,e nickel thickness and the voltage amplitudes were smaller at lower flaw depths. The feasibility study resulted in a peak-to-peak voltage of 2.65 volts using the axial coil on the [ ]a,c,e of the same [ ]a,c,e nickel thickness. This result was expected since [ ]a,c,e. Therefore, all testing was performed using the [ ]a,c,e Ghent Version 2 coil (G4) and the [ ]a,c,e. The use of the [ ]a,c,e also addresses eddy current signals originating on both the inner diameter and outer diameter surfaces of the parent tube.

All testing was performed using the same technique procedures and setup parameters as used in the Ghent Version 2 Appendix H qualification program provided in Reference 5 and was used in the original POD study of Reference 3.

The manufacturing tolerance of the nickel band thickness ranges from [ ]a,c,e. Five production tubesheet sleeves for 7/8-inch tubing were obtained for the testing program that contained nickel band thicknesses ranging from [ ]a,c,e at approximately [ ]a,c,e increments between samples. An additional sleeve sample that contained no nickel band was also used in the testing program. Table 1 provides a listing of the nickel band thickness of each sleeve sample used in the testing program.

The six [ ]a,c,e samples were tested with the Ghent Version 2 probe operating at a frequency of 70 kHz using the technique described in Reference 5. The resultant peak-to-peak voltage (Vpp) amplitudes and vertical maximum voltage amplitudes (Vvm) were recorded and included in Table 1. Figure 1 shows that the voltage amplitudes for Vpp and Vvm decrease linearly with increasing nickel thickness with a very strong correlation. The nickel band thickness for all samples within the original crack sample POD study presented in Reference 3

was [ ]a,c,e. Therefore, a comparative evaluation was performed to determine the effect of the nickel band thickness at [ ]a,c,e compared to that at [ ]a,c,e. Table 1 provides the percent [ ]a,c,e in signal voltage of each sample from the voltage at [ ]a,c,e (Sample-3). The percent [ ]a,c,e in voltage for the [ ]a,c,e sample (Sample-6) when compared to the [ ]a,c,e sample is [ ]a,c,e for Vpp and [ ]a,c,e for Vvm. This is shown graphically in Figure 2 and Figure 3 for Vpp and Vvm, respectively.

A voltage-based POD curve was generated using the axial ODSCC data from the original POD study provided in Reference 3 which was based on the [ ]a,c,e nickel thickness of the crack sample assemblies. These crack samples have measured Ghent Version 2 probe voltage amplitudes and actual crack depths from destructive examination (DE). These results are shown in Table 2. Figure 4 provides the correlation of flaw voltage amplitude to flaw depth and flaw depth to flaw voltage amplitude for Vpp and for Vvm. Additionally, from Reference 3, the flaws that were detected and not detected with the Ghent Version 2 probe are known. Since the non-detected flaws do not have a measured voltage (i.e., no flaw to measure), the voltages were derived from the flaw depth to voltage correlation from Figure 4. Therefore, crack voltage-based simple hit-miss log-logistic POD curves were generated for Vpp and Vvm detection using the binary generalized linear modeling (GLM) methodology. Figure 6 shows the voltage-based POD using Vpp as the detection parameter and Figure 7 shows the voltage-based POD using the Vvm detection parameter. The 95th percentile POD is [ ]a,c,e for Vpp and [ ]a,c,e for Vvm. Using the voltage-to-crack depth correlations from Figure 4, crack depth POD curves were developed from the voltage-based POD function. The resultant 95th percentile POD values are 73.4% TW and 73.9% TW when using the Vpp and Vvm detection parameters, respectively. This method correlates well with the DE depth-based simple hit-miss POD of 74.5% TW provided in Reference 3. These results are specific to tubesheet sleeves containing a [ ]a,c,e band thickness.

A voltage-based hit-miss POD curve for sleeves with a nickel band thickness of [ ]a,c,e cannot be generated directly since the flaw detections and non-detections are not known at this nickel thickness. The voltage-based POD curve for [ ]a,c,e sleeves is based on known detections and non-detections of cracks, therefore, this curve is applicable for the voltage detection capability for any thickness of the nickel band since detection is based on voltage only and not depth. The flaws that contain the same voltage have different depths dependent on the nickel thickness as shown by Figures 4 and 5. For example, a 0.25 volt (Vvm) flaw signal in a [ ]a,c,e nickel thickness sleeve would be [ ]a,c,e but would be [ ]a,c,e in a [ ]a,c,e thickness sleeve using the voltage-to-depth correlations from Figure 5. A [ ]a,c,e flaw depth at [ ]a,c,e nickel thicknesses for the same voltage is expected because of the voltage [ ]a,c,e caused by additional nickel thickness.

Applying the voltage-to-depth correlations for the specified nickel thickness to the voltage-based POD curves of Figure 7 (for Vpp) and Figure 8 (for Vvm) produces the depth POD curves for the [ ]a,c,e and [ ]a,c,e nickel thickness sleeves. Figure 8 shows the depth-based POD curve for cracking in the parent tube behind the [ ]a,c,e and [ ]a,c,e thick nickel band sleeves for the Vpp detection parameter. [ ]a,c,e the nickel thickness increases the 95th percentile POD from 73.4% TW at [ ]a,c,e to

75.2% TW at [ ]a,c,e when using Vpp for the detection parameter. Likewise, when using Vvm for the detection parameter, the 95th percentile increases from 73.9% TW at [ ]a,c,e to 80.4% TW at [ ]a,c,e as shown in Figure 9.

Response Summary:

The effect of nickel band material was shown to [ ]a,c,e the voltage amplitude of a flaw. The amount of voltage [ ]a,c,e is dependent on the type of voltage measurement, i.e., peak-to-peak voltage (Vpp) or vertical maximum voltage (Vvm). The amount of voltage reduction for Vpp is [ ]a,c,e when the nickel thickness is increased from [ ]a,c,e to [ ]a,c,e. Likewise, the voltage [ ]a,c,e is [ ]a,c,e for Vvm over the same nickel thickness. Using the prior crack POD study results from Reference 3, in which all sleeves used with the parent tube crack samples had nickel thicknesses of [ ]a,c,e, voltage-to-depth correlations and voltage-based POD curves (Vpp and Vvm) were developed from that test program hit-miss data. From these voltage-based POD curves, depth-based POD curves were generated for nickel band thicknesses of [ ]a,c,e and [ ]a,c,e using the applicable voltage-to-depth correlations from testing. The 95th percentile POD increased by nearly 2% TW when increasing the nickel thickness from [ ]a,c,e to [ ]a,c,e when using Vpp as the detection parameter. Likewise, for the Vvm detection parameter, the 95th percentile POD increased by about 6.4% TW.

Per Beaver Valley Power Station Technical Specification (BVPS TS) 5.5.5.2.c.3, tubes with a flaw in a sleeve to tube joint shall be plugged. The effect of the varying nickel thickness on the outside surface of the Alloy 800 sleeve does not hinder the ability of the Ghent Version 2 probe to adequately detect parent tube flaws behind the nickel band. Therefore, tubes with a flaw in the parent tube at the tube-to-sleeve joint can be adequately detected and plugged as required by TS 5.5.5.2.c.3.

Table 1. Ghent Version 2 Probe Nickel Band Thickness Testing Results

Sleeve Sample	Sleeve Serial Number	Sleeve Nickel Band Thickness, mils a,c,e	[ ]e Voltage(2), Vpp	[ ]e Voltage(2), Vvm	Voltage Change from [ ]a,c,e Sample, Vpp	Percent Change from [ ]a,c,e Sample, Vpp	Voltage Change from [ ]a,c,e Sample, Vvm	Percent Change from [ ]a,c,e Sample, Vvm
Sample-1(1)	A456							
Sample-2	A456							
Sample-3	A279							
Sample-4	A100							
Sample-5	A384							
Sample-6	A133							

b

The tested portion of Sample 1 was outside the nickel band region of a tubesheet sleeve to represent a no-nickel condition.
Ghent Version 2 Probe, G4 axial sensitive coil, 70kHz frequency.

a,c,e

Figure 1. Ghent V2 Probe Voltage Response to Nickel Thickness

a,c,e

Figure 2. Percentage Change in Voltage from [ ]a,c,e Nickel Thickness, Vpp

a,c,e

[ ]

Figure 3. Percentage Change in Voltage from [ ][a,c,e] Nickel Thickness, Vvm

a,c,e

Figure 4. Ghent V2 Probe Voltage-to-Depth Correlations for [ ]a,c,e Nickel Thickness

a,c,e

[ ]

Figure 5. Ghent V2 Probe Voltage-to-Depth Correlations for [ ]a,c,e Nickel Thickness

Table 2. EPRI Crack Sample Voltage Summary for [ ]a,c,e and [ ]a,c,e Nickel Thicknesses

EPRI Crack Sample	Flaw	Location (deg)	[ ]a,c,e Nickel IND	[ ]a,c,e Nickel Ghent V2 Vpp	[ ]a,c,e Nickel Ghent V2 Vvm	[ ]a,c,e Nickel Vpp	[ ]a,c,e Nickel Vvm	DE Depth %TW (b)
J-2-3	1	31	NDD	[ ]a,c,e	[ ]a,c,e	-	-	
	2	71	SAI	0.35	0.31	[ ]a,c,e	[ ]a,c,e	
	3	102	NDD	[ ]a,c,e	[ ]a,c,e	-	-	
	4	285	NDD	[ ]a,c,e	[ ]a,c,e	-	-	
J-3	1	91	NDD	[ ]a,c,e	[ ]a,c,e	-	-	
	2	91	NDD	[ ]a,c,e	[ ]a,c,e	-	-	
	3	168	SAI	3.76	3.45	[ ]a,c,e	[ ]a,c,e	
	4	278	NDD	[ ]a,c,e	[ ]a,c,e	-	-	
	5	354	NDD	[ ]a,c,e	[ ]a,c,e	-	-	
J-8	1	46	SAI	0.23	0.19	[ ]a,c,e	[(2)]a,c,e	
	2	228	NDD	[ ]a,c,e	[ ]a,c,e	-	-	
J-12A	1	312	SAI	0.39	0.38	[ ]a,c,e	[ ]a,c,e	

(1) Voltage calculated from correlations from Figures 4(a) and 4(c) for Vpp and Vvm, respectively.

(2) Voltage calculated from percent [ ]a,c,e from voltages from [ ]a,c,e nickel thickness test data.

a,c,e

Figure 6. Ghent Version 2 Probe Voltage-Based POD at [ ]^{a,c,e} Nickel Thickness, Vpp

a,c,e

Figure 7. Ghent Version 2 Probe Voltage-Based POD at [ ]^{a,c,e} Nickel Thickness, Vvm

a,c,e

Figure 8. Ghent Version 2 Probe Depth POD from Voltage Correlation, Vpp

a,c,e

Figure 9. Ghent Version 2 Probe Depth POD from Voltage Correlation, Vvm

References

1. Energy Harbor Nuclear Letter, L-2020-071, "License Amendment Request to Revise Beaver Valley Unit 2 Technical Specification Requirements Related to Inspection Method and Service Life for Alloy 800 Steam Generator Tubesheet Sleeves," June 25, 2020. (Adams Accession Number ML20177A272)

2. Email from Timothy L. Saibena, Energy Harbor to Jay R. Smith, Westinghouse, RE: [External] Beaver Valley Units 1 and 2 – DRAFT Request for Additional Information – Steam Generator Tube Sleeve LAR (EPID L-2019 – LRA-0140), October 8, 2020. (Attached in EDMS)

3. Westinghouse Report SG-CDMP-19-19 P-Attachment, Revision 2, "Probability of Flaw Detection in the Alloy 800 Mechanical Sleeve Lower Tubesheet Joint Using the Ghent Version 2 Eddy Current Probe," January 2021.

4. Westinghouse Letter LTR-CDMP-20-38 P-Attachment, Revision 0, "Responses to Request for Additional Information Regarding Beaver Valley Power Station Unit No. 2 Steam Generator Tube Inspection and Repair," January 2021.

5. Westinghouse Report SG-CDMP-19-17-P, Revision 1, "Qualification of an Examination Technique to Inspect Parent Tube Flaws Adjacent to the Nickel Band of an Alloy 800 Sleeve at Beaver Valley Unit 2," April 2020.

Enclosure C
L-21-055

Affidavit for Withholding Proprietary Information

(3 pages follow)

COMMONWEALTH OF PENNSYLVANIA:
COUNTY OF BUTLER:

(1) I, Zachary S. Harper, 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 LTR-CDMP-21-1 P-Attachment, Revision 0, "Responses to Request for Additional Information Regarding Question 1.c Beaver Valley Power Station Unit No. 2 Steam Generator Tube Inspection and Repair," 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: 01/21/2021

Zachary S. Harper, Manager
Licensing Engineering