From: Tobin, Jennifer
To: rpenfield@energyharbor.com
Cc: "Lashley, Phil H"
Subject: Beaver Valley Units 1 and 2 - FINAL Request for Additional Information - Steam Generator Tube Sleeve LAR (EPID L-2019-LRA-0140)
Date: Thursday, October 22, 2020 3:59:00 PM

Dear Mr. Penfield,

By letter dated June 25, 2020, Energy Harbor Nuclear Corp., the licensee, 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. 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 NRC staff has determined that additional information is needed to complete its review of the request. Please inform me whether if would like a telephone conference with the cognizant NRC staff to discuss any questions concerning the clarity or basis for the questions. NOTE: The proprietary version will be sent under secure BOX system later today, the non-proprietary (public) version is below.

Regulatory Analysis Basis

Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.36(b) requires each license authorizing operation of a production or utilization facility of a type described in § 50.21 or § 50.22 will include technical specifications. The technical specification will be derived from the analyses and evaluation included in the safety analysis report, and amendments thereto, submitted pursuant to § 50.34.

Pressurized water reactor (PWR) steam generator (SG) tubes form part of the reactor coolant pressure boundary (RCPB). In Appendix A of 10 CFR 50, General design criteria (GDC) 14, 15, 30, 31, and 32, define requirements for the structural and leakage integrity of the RCPB. As part of the RCPB, the SG tubes must also meet the requirements of 10 CFR 50.55a with respect to inspection and repair requirements of the ASME Code. For SG tubes repaired with sleeves, the sleeve and the sleeve/tube joint also form part of the RCPB. All PWRs have Technical Specifications according to 10 CFR 50.36 that include a Steam Generator Program with specific criteria for the structural and leakage integrity, repair, and inspection of SG tubes. To complete its evaluation of the licensee's request, the staff requests the following information.

Request for Additional Information

1. Enclosure D, Section 5, "Probe Design, Developments and Testing Results," discusses the stages of Ghent probe development for sleeve inspections. In addition to other probe changes, the positioning of coils in Ghent Version 1 probe was modified to improve detection of circumferential flaws by Ghent Version 2 (V2) probe. Given that a **[ ]** through wall (TW) inner diameter (ID) circumferential electro-discharge machined notch was not detected in the sample set used for site specific technique qualification:

a. Is the difference in detection capability of the probe for axial and circumferential cracks associated with the probe design and/or the source of noise in the nickel band region in the lower transition sleeve roll joint?

b. What modification was made to the coil positioning **[ ]** to improve the detection capability of Ghent V2 for circumferential cracks?

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.

2. Table 3-2 in Enclosure E contains the results of destructive examination for axial outer diameter stress corrosion cracking (ODSCC) specimens but provides only the depth of each crack. Please provide the length of each crack in that table.

3. With respect to the Ghent V2 Probe nickel band sleeve test program results:

a. Section 4.2.4 in Enclosure E compares simple probability of detection (POD) to noise-based model assisted POD (MAPOD) and concludes that the simple POD distribution is a better representation of actual flaw performance since the effect of the nickel band material is inherent in the detection result. The Ghent V2 signal amplitude (behind the nickel band) for Flaw #1 in Sample J-8 in Table 4-2 is listed as having a 0.09-volt signal. In view of the relatively large variability in the level of noise among sleeve/tube/collar assemblies, please provide a justification for considering a signal with such a low signal to noise (S/N) as a "hit" in developing the simple POD curve shown in Figure 4-1.

b. Please discuss how the simple POD curve would change if the Flaw #1 in Sample J-8 was not included as a hit by providing the 50th and 95th percentile POD values if a new POD curve did not include that flaw.

c. According to post-test parent tube inspection results shown in Table 3-1, flaws #1 and #2 in Sample J-3 with comparable destructive examination depths (~**[ ]**% TW and ~**[ ]**% TW) have significantly different signal amplitudes (0.28 v and 0.63 v) based on Ghent V2 data. The signal amplitudes based on the +Point™ data for these flaws have the same amplitude (0.44 v). In comparison with +Point™, a weaker correlation between Ghent V2 signal amplitude and maximum depth is also observed for other flaws listed in Tables 3-1 and 3-2. Please discuss the possible sources (i.e., probe design, noise interference, etc.) that may contribute to the differences between Ghent V2 probe and +Point™ results. The staff notes that although the Ghent V2 probe has been qualified according to App. H for detection only (i.e., not sizing), the variability in signal amplitude directly affects the S/N values that are used in POD evaluations.

4. Enclosure E, Section 3.3, describes the test program with the simulated tubesheet collar assembly. Page 14 of 38 states: "*As the Ghent probe is surface riding, not achieving full expansion to the full diameter of a prototypic in-generator tubesheet bore*

would have negligible effects on the eddy current results due to the small amount of tube wall thinning." This statement appears to consider the effects of eddy current probe lift-off. Please discuss if the amount of manual hard rolling could also affect the probe eddy current response due to potential variability in effective conductivity across the parent tube-collar interface.

5. Enclosure E, Page 34 of 38 discusses that the NDE test program and POD curves were based on ODSCC flaw samples due to the unavailability of primary water stress corrosion cracking samples. The primary justification for applying OD flaw detection to ID flaws includes the statement: "*As the magnetic fields at 70 kHz frequency penetrate deeper into the parent tube* material*, the signal strength and the signal density decreases, thus decreasing the flaw detection capability. Consequently, detection of flaws originating at the outer parent tube surface is diminished as compared to flaws originating at the inside parent tube surface.*"

   While the statement above regarding the reduction of magnetic flux density (current density) as a function of depth is correct, the inference regarding lower detection capability for outer diameter (OD) flaws would be true if the effect of noise is negligible. Since the detection probability is a function of S/N, in the presence of ID originated noise (e.g., the presence of nickel band at the sleeve OD-tube ID interface in the tubesheet transition joint), deep OD cracks in a parent tube could plausibly have a higher detection probability than ID flaws of comparable depth. This could be attributed to the smaller influence of the ID originated noise on OD flaws (i.e., larger phase separation between signal and noise). Please discuss any additional supporting information that the POD curves based on OD originating flaws conservatively bound the POD for ID originating flaws in the presence of a nickel band.

6. Page 26 of 38 in Enclosure E states that the noise distribution used in the MAPOD process was developed from tube/sleeve collar assemblies related to the Ghent V2 probe EPRI Appendix H qualification program. This was attributed to no field data (at that time) from which to build an in-generator noise distribution. During the Beaver Valley Ghent V2 Probe LAR pre-submittal meeting on May 26, 2020 (ADAMS Accession No. ML20143A035), Slide 11 states that all 567 sleeves in service were examined with the Ghent V2 probe during the April 2020 refueling outage inspections. Please discuss if the noise data from those inspections confirms that the noise distribution used in the MAPOD process is either representative or conservative with respect to the field data.

7. Section 3.8, "Tube Sleeve Inspections," of Enclosure A ("Evaluation of the Proposed Amendment") states that the Ghent V2 probe will be used to inspect the Alloy 800 tubesheet sleeves each outage. Please provide the following information about these inspections:

   a. Clarify which probe (+Point^{TM} or Ghent V2) will be used for the call of record when inspecting different portions of the sleeve/parent tube assembly.
   b. Please confirm that each in-service sleeve will be inspected each refueling outage throughout the sleeve service life.

Please submit your response to this request for additional information by January 22, 2021 (with the exception of 1.c, due 3/1/21). A clarification call was held October 22nd and resulted in NO changes to the draft RAIs. This e-mail will be be added to public

ADAMS. If you have questions please don't hesitate to contact me.

Thanks!
-Jenny