Attachment 2 to
ULNRC-06595

# Response to Request for Additional Information (Redacted)

framatome

# RAI Response Regarding Framatome Operational Assessment for Callaway Unit 1 One-Time License Amendment Request (LDCN 20-0013)

ANP-3867Q1NP
Revision 1

Licensing Report

August 2020

## Nature of Changes

| Item | Section(s) or Page(s) | Description and Justification |
|---|---|---|
| 1 | All | Initial Issue |
| 2 | Section 4.0 | Corrected a typo in Reference 6 from "Lice" to "License" |

## Contents

## List of Figures

## Nomenclature

| Acronym | Definition |
|---|---|
| AVB | Anti-Vibration Bar |
| ECT | Eddy Current Testing |
| EFPY | Effective Full Power Years |
| LAR | License Amendment Request |
| OA | Operational Assessment |
| PLP | Potential Loose Part |
| RAI | Request for Additional Information |
| SG | Steam Generator |
| TTS | Top-of-Tubesheet |

## 1.0 INTRODUCTION

Framatome supported a one-time license amendment request (LAR) from Ameren Missouri for the deferral of fall 2020 steam generator (SG) tube inspections at the Callaway Plant (Unit 1) (Reference 1) by providing the technical justification in an operational assessment (OA) (References 2, 3, and 4).

On August 12, 2020, the U.S. Nuclear Regulatory Commission (NRC) staff requested the following additional information in order to complete their review of the subject LAR.

**Request for Additional Information (RAI)**

1. Section 5.1.3 of Attachment 2 discusses the treatment of new wear indications at the tube anti-vibration bar (AVB) locations. The analysis conservatively predicts over 700 total new indications at 1R25 that are introduced in two populations at different intervals after 1R21.
   a. Please discuss how the number of new indications are apportioned between the two populations and the basis for those numbers.
   b. Please provide an updated Figure 5-2 that also includes the 1R18 new indication depth distribution. Discuss why the new indication deferral distribution sampled in the analysis as shown in Figure 5-2 is expected to be representative or conservative.
2. Table 3-4, Section 4.2.1, and Section 5.4 of the operational assessment describe the inspections performed with bobbin and array probes to detect foreign objects. The array probes were used in certain areas of the hot leg periphery and no tube lane to supplement the 100 percent bobbin probe inspection. Please discuss the reasoning behind supplemental array probe inspection in the hot leg only, in terms of probability of foreign object wear in the hot leg or cold leg tubes.

Note that all section numbers, tables and figures referenced in the request for additional information (RAI) are from the proprietary version of the OA (Attachment 2 of Reference 1). A non-proprietary version of the OA is included in Reference 2.

## 2.0 RAI 1

**QUESTION:**

Section 5.1.3 of Attachment 2 discusses the treatment of new wear indications at the tube anti-vibration bar (AVB) locations. The analysis conservatively predicts over 700 total new indications at 1R25 that are introduced in two populations at different intervals after 1R21.

a. Please discuss how the number of new indications are apportioned between the two populations and the basis for those numbers.

b. Please provide an updated Figure 5-2 that also includes the 1R18 new indication depth distribution. Discuss why the new indication deferral distribution sampled in the analysis as shown in Figure 5-2 is expected to be representative or conservative.

**RESPONSE:**

The number of new AVB wear indications initiated in the probabilistic model is determined through use of a Weibull fit to the cumulative number indications identified in the Callaway steam generators (SGs), as shown in Figure 2-1. The Weibull fit utilized in the evaluation reflects a more aggressive initiation rate than is expected to occur going forward and would project a much larger number of new indications during 1R21 than actually occurred. This can be observed by noting that the actual number of newly reported indications decreased in 1R21 as compared with 1R18, which is a behavior consistent with the experience of most plants experiencing structure wear.

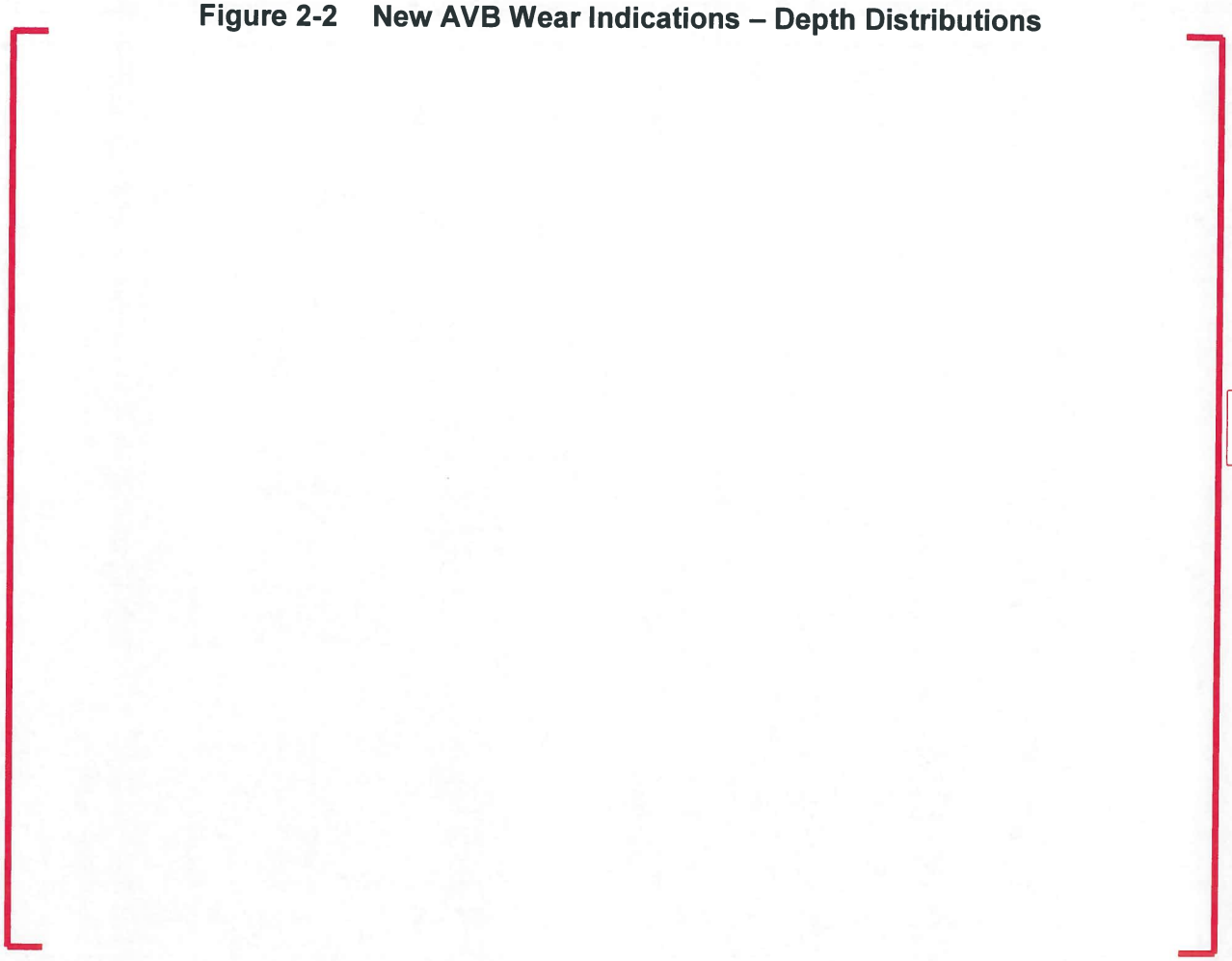
Since the Kunin distribution of new wear depths (Figure 2-2) is based on a three-cycle operating interval (1R18 to 1R21), it is appropriate to introduce new flaws to the simulation at 1R24 (i.e., three cycles after 1R21). The second population of new flaws is introduced at 1R25, after only one additional cycle of operation. This is quite conservative since the same 3-cycle Kunin depth distribution is used for this purpose.

Attenuation of AVB wear growth over time is an observed behavior; therefore, it is assumed that the depth distribution of new indications at 1R21 will be similar if not bounding of an expected new indication depth distribution that would be identified after the following three-cycles (i.e., at 1R24). This attenuation can be observed in the Callaway new indication depth distributions from 1R15, 1R18 and 1R21, as shown in Figure 2-2. It should be noted that the SGs had only operated one cycle at 1R15, so the new indications at 1R15 were adjusted to a comparable 3-cycle length of 4.016 EFPY (i.e., the summation of Cycles 15, 16 and 17 from Reference 2).

**Figure 2-1 AVB Wear Indications – Weibull Fit**

[d,e]

**Figure 2-2 New AVB Wear Indications – Depth Distributions**



[d,e]

## 3.0 RAI 2

**QUESTION:**

Table 3-4, Section 4.2.1, and Section 5.4 of the operational assessment describe the inspections performed with bobbin and array probes to detect foreign objects. The array probes were used in certain areas of the hot leg periphery and no tube lane to supplement the 100 percent bobbin probe inspection. Please discuss the reasoning behind supplemental array probe inspection in the hot leg only, in terms of probability of foreign object wear in the hot leg or cold leg tubes.

**RESPONSE:**

No foreign object wear or foreign objects that could potentially impact tube integrity have been identified in the Callaway SGs to date, and the incorporation of loose part trapping features within the SG design provides a high level of assurance that tube integrity will not be impacted by foreign material going forward.

The array probe examination of the hot leg periphery tubes performed during 1R21 represents a 50% sample of the most important tubesheet region with respect to foreign object wear (i.e., 50% of hot leg plus cold leg locations). In the absence of any indication of foreign objects or wear during this examination, no expansion of the inspection scope into the cold leg was considered to be necessary. In addition, 100% of the top of tubesheet region (hot and cold leg) was examined with bobbin probes. While bobbin probe detection of foreign objects and wear very close to the TTS is not equal to that of the array probe, the bobbin probe inspection nonetheless provides additional assurance that significant foreign object wear was not present in the tubes.

The 1R21 CMOA (Reference 5) summarizes these points:

1. Callaway has no history of foreign object wear or foreign objects. Neither ECT examinations nor secondary side visual inspections have identified foreign object wear or foreign objects through 9.369 EFPY of operation (through 1R21).

2. During 1R18 and 1R21, visual inspections were performed along both the hot and cold leg periphery and inner bundle passes from the no-tube lane to the sludge pile region. These visual inspections can typically see 8 tubes deep into the bundle and as identified above, have identified no foreign objects.

3. During 1R18 and 1R21, visual inspections were performed in the upper steam drum of all four SGs. These inspections revealed no foreign objects on the loose part trapping screen, or any degradation of secondary side components that could result in foreign material entering the SG tube bundle.

4. Callaway water lanced all four SGs during 1R18 and 1R21. A review of the material found in the lancing strainers at 1R18 (Reference 7) and 1R21 identified only a small number of foreign objects such as tube scale, rubber, plastic, sludge rocks, string, and two small metallic pieces less than 0.5" in length, none of which pose a threat to tube integrity.

## 4.0 REFERENCES

1. NRC ADAMS Accession No. ML20178A668, "Callaway Plant Unit 1, Request for One-Time License Amendment to Defer Upcoming Steam Generator Inspection (LDCN 20-0013)."
2. NRC ADAMS Accession No. ML20178A673 "Attachment 3 – Callaway Unit 1, Steam Generator Operational Assessment to Support Deferral of Planned Inspections from 1R24 to 1R25, Revision 1 (Redacted)." (Corresponds to Framatome Documents 51-9312589-000 (Proprietary) and 51-9312589-001 (Non-Proprietary).)
3. Framatome Letter Framatome-20-01407, from Josh Harrison to Carissa Richardson, "Subject: Transmittal of the following Framatome Proprietary Documents and Related Affidavit for Ameren/Callaway Records and Use", dated June 25, 2020.
4. Framatome Letter Framatome-20-05105, from Josh Harrison to Carissa Richardson, "Subject: 51-9312589-000 Callaway Unit 1 Steam Generator Operational Assessment to Support Deferral of Planned Inspections from 1R24 to 1R25", dated July 14, 2020.
5. Framatome Document 51-9259621-000, "Callaway Unit 1 SG Condition Monitoring for Cycles 19, 20 and 21 and Final Operational Assessment for Cycles 22, 23 and 24."
6. NRC ADAMS Accession No. ML20203M328, "Callaway Plant Unit 1, Supplement to License Amendment Request Regarding Deferral of Upcoming Steam Generator Inspection (LDCN 20-0013)."
7. Framatome Document 51-9177474-000, "Callaway 1R18 Steam Generator Deposit Characterization."