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Withhold from Public Disclosure Under 10 CFR 2.390
When Separated from Enclosure C, this document can be decontrolled.

April 16, 2010
L-10-123

10 CFR 50.55a

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

SUBJECT:
Davis-Besse Nuclear Power Station
Docket No. 50-346, License No. NPF-3
Request for Additional Information Regarding 10 CFR 50.55a Request RR-A34 for Alternative Repair Methods for Reactor Pressure Vessel Head Penetration Nozzles (TAC NO. ME3703)

By correspondence dated April 1, 2010, FirstEnergy Nuclear Operating Company (FENOC) submitted 10 CFR 50.55a Request RR-A34, which requests Nuclear Regulatory Commission (NRC) approval of alternative methods to repair the reactor pressure vessel (RPV) penetration nozzles at the Davis-Besse Nuclear Power Station (DBNPS).

By correspondence dated April 9, 2010, the NRC staff requested additional information to complete its review of RR-A34. The attachment provides responses to the NRC staff questions and information requests. In support of the attached responses, Enclosure C is provided, which contains the AREVA fracture mechanics analysis for the triple-point anomaly. The complete triple point analysis, "DB-1 CRDM Nozzle Weld Anomaly Flaw Evaluation of IDTB Repair," contains proprietary information that is to be withheld from public disclosure pursuant to 10 CFR 2.390. Therefore, Enclosure A provides a nonproprietary version of the AREVA triple point analysis for full public disclosure. Enclosure B contains the AREVA affidavit to support the disclosure request for the proprietary triple point analyses, and Enclosure C provides the complete triple point analysis that contains sections to be withheld from public disclosure.

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The proposed alternatives are to be implemented during the ongoing DBNPS maintenance and refueling outage. Therefore, as stated in the correspondence dated April 1, 2010, FENOC is requesting expedited NRC staff review and approval of the proposed alternative, RR-A34.

There are no regulatory commitments contained in this letter. If there are any questions or if additional information is required, please contact Mr. Thomas A. Lentz, Manager – Fleet Licensing, at 330-761-6071.

Sincerely,

Barry S. Allen

Barry S. Allen

Attachment:

Response to April 9, 2010 Request for Additional Information Related to 10 CFR 50.55a Request RR-A34, Alternative To Repair The Reactor Pressure Vessel Head Penetration Nozzles

Enclosures:

A. DB-1 CRDM Nozzle Weld Anomaly Flaw Evaluation of IDTB Repair (Nonproprietary)
B. Affidavit for DB-1 CRDM Nozzle Weld Anomaly Flaw Evaluation of IDTB Repair
C. DB-1 CRDM Nozzle Weld Anomaly Flaw Evaluation of IDTB Repair (Proprietary)

cc: NRC Region III Administrator w/o Enclosures B and C
NRC Resident Inspector w/o Enclosures B and C
NRC Project Manager w/o Enclosures B and C
Utility Radiological Safety Board w/o Enclosures B and C

By letter dated April 9, 2010, the Nuclear Regulatory Commission (NRC) staff submitted to FirstEnergy Nuclear Operating Company (FENOC) a request for additional information (RAI) pertaining to the 10 CFR 50.55a Request RR-A34, which requests NRC approval of alternative methods to repair the reactor pressure vessel (RPV) penetration nozzles at the Davis-Besse Nuclear Power Station (DBNPS). To complete its review, the staff has requested additional information and responses to specific questions. The FENOC responses to the NRC staff's requests are provided below. Each of the NRC staff's questions is presented in bold, followed by the FENOC response.

REQUEST RR-A34

1. **Pages 1 to 3.**
   Section 3.0 of Relief Request RR-A34 lists 14 applicable [ASME] code requirements. The licensee provided alternatives for some, but not all, of the applicable code requirements. For example, as discussed in Section 5 of RR-A34, the licensee provided alternatives to certain requirements in Code Case N-638-1 that it asks for relief. Identify which requirements relief is being requested and provide alternatives and reasons why the alternatives are acceptable.

   Response:

   Relief is requested from the following requirements as listed in Section 3.0 of 10 CFR 50.55a Request RR-A34. The remaining Code paragraphs cited were intended to provide code references applicable to the repair process and analyses.

   - The monitoring of interpass temperatures specified in 1995 Edition/96 Addenda of ASME Code Section XI, subparagraph IWA-4610(a). As an alternative interpass temperatures will be determined in accordance with the methods described in Section 5 of RR-A34.

   - The acceptance examination area defined in ASME Section XI Code Case N-638-1 paragraph 4.0(b) which references paragraph 1.0(d). As an alternative, the nondestructive examination (NDE) will be performed on the area described in Section 5 of RR-A34.

- The completed weld 48-hour hold requirement of ASME Section XI Code Case N-638-1 paragraph 4.0(b). As an alternative, NDE of the completed weld will be performed 48 hours after the completion of the third temper bead layer as described in Section 5 of RR-A34.

- The indications requirement of 1992 Edition ASME Code Section III subparagraph NB-5330(b). A small anomaly may remain at the triple point between the control rod drive mechanism (CRDM) nozzle, the temper bead repair weld, and the RPV head base material following welding as described in the Triple Point Anomaly section in Section 5 of RR-A34.

- The inservice examination area specified in ASME Section XI Code Case N-729-1 Figure 2. As an alternative, the preservice and inservice inspection examination area will be as described in the Inservice Inspections section of Section 5 of RR-A34.

Although not part of the request for relief, additional information was provided within RR-A34 on the RPV head to nozzle J-groove weld. The original nozzle to RPV head J-groove weld cannot be examined with ultrasonic testing (UT) due to the compound curvature and fillet radius around the nozzle circumference. Therefore, a flaw in the J-groove weld is characterized using worst-case postulated flaw sizes. This worst case flaw size is evaluated in accordance with IWB-3600 as described in Section 7 of RR-A34.

2. **Page 4.**
The licensee states that the area above the repair in the nozzle will be roll expanded.

   1) **Discuss the distance of the roll expansion above the nozzle cut.**

   Response:

   The effective length of the roll expansion region is 2-5/8 inches. The effective length of roll expansion starts ½ inch below the nozzle cut and extends 2-1/8 inches above the nozzle cut. The roll expansion roller has a ¾ inch radius on each end that provides for a transition between the rolled region and the original nozzle inside diameter.

2) **Discuss how the roll expansion is controlled and monitored so that the region of the nozzle immediately outside of the vessel head penetration (bore) will not be expanded unnecessarily.**

Response:

The location of the roll expansion is established through field measurements and the dimensions that are monitored and controlled via the engineering change package. The roll expansion region is contained within the penetration bore and should not extend beyond the RPV head surface.

3) **Discuss the vertical distance of the nozzle that will be applied with the abrasive water jet.**

Response:

The abrasive water jet machining will extend to slightly above the upper roll expansion transition region; therefore the weld and approximately 2 inches of the nozzle remnant inside diameter surface will receive abrasive water jet machining.

4) **Discuss why the PT and UT are performed before the abrasive water jet is applied to the remnant nozzle. It seems that PT and UT of the nozzle should be the last step to be performed (after the abrasive water jet is applied) in the repair process to ensure that the repaired nozzle is fit for service.**

Response:

The liquid penetrant test (PT) and UT of the weld and adjacent area prior to the water jet process ensures that the weld area does not contain any unacceptable flaws. If weld repairs are required, it is preferred from a radiation dose and repair duration perspective to perform those repairs prior to abrasive water jet machining. Approximately 0.030 inches of material may be removed by the water jet machining process. Since this is less than 10 percent of the wall thickness (tube wall thickness is approximately 0.6 inches), surface examination is not required to be repeated as specified in NB-4121.3(b).

3. **Page 6.**
The licensee states that the UT is qualified to detect flaws in the new weld to the maximum practical extent. In the last paragraph on page 7, the licensee states that approximately 70 percent of the [new] weld surface will be scanned by UT examination.

1) **Specify to which ASME Code section and subsection is the UT qualified.**

Response:

The UT is qualified to ASME Section III, NB-5112 and Section V, Article 1, T-150. Additionally, a mockup is used to demonstrate the procedure on construction type flaws as required by NRC Regulatory Guide 1.147, Rev 15, Table 2, conditional acceptance of Code Case N-638-1.

2) **Justify why it is acceptable that the UT cannot achieve 100-percent examination coverage.**

Response:

NB-5245 specifies PT in ½ inch increments and final surface only for partial penetration welds. As noted in RR-A34 Section 5, Figures 4 through 8, depict an approximation of the UT volume coverage of the new weld using the different scans and angles. In this case, since much of the weld volume and heat affected zone is suitable for UT coverage, and the final surface PT is performed, it is concluded that the examinations to be performed are superior to the progressive PT as specified in NB-5245.

3) **Without achieving 100 percent coverage, justify how the new weld can be demonstrated to be free of fabrication defects.**

Response:

As described in the previous response, the UT exam combined with the final surface PT are considered a superior detection method of fabrication defects when compared to the progressive PT method specified in NB-5245.

4. **Page 6, last paragraph.**
The licensee states that the UT is capable of scanning from cylindrical surfaces with inside diameters near 2.75 inches. Confirm that 2.75 inches is the nominal inside diameter of the nozzle.

Response:

The manufacturing drawing specifies the nozzle inside diameter as 2.765 +0.000/-0.030 inches. However, it has been determined that nozzle 28 actually has an inside diameter of 2.786 inches. As these diameters are greater than the minimum required diameter required for the UT tooling, the UT equipment will be capable of performing the required UT examinations.

5. **Page 8, third paragraph.**
The licensee states that a weld anomaly of 0.1 inch deep and 360 degrees in circumferential extent is modeled at the triple point. Discuss the depth of a flaw at the triple point that the UT is qualified to detect and discuss how the UT is qualified.

Response:

The procedure qualification was performed by demonstrating the effectiveness of the procedure to detect the reflectors in the calibration block consisting of drilled holes used to establish the reference sensitivity levels and additional inside diameter (ID) and outside diameter (OD) electric discharge machining (EDM) notches of varying depths. The EDM notches serve to demonstrate the ability of the procedure to detect planar flaws and ability to measure the depth of the flaw.

The demonstration also includes a mockup of the temper bead weld repair for CRDM nozzles. The configuration includes a carbon steel ring used to simulate the nozzle penetration bore in the vessel head. An Alloy 600 nozzle is positioned part way into the bore and attached with the temper bead Alloy 52M weld repair as will be done in the field for the repaired nozzles. The purpose of this mockup is to demonstrate that construction type flaws can be detected. Construction flaws that are simulated in the mockup include lack of bond flaws between weld beads and at the weld to carbon steel interface. Underbead cracking in the carbon steel material is also simulated beneath the weld. All of these flaws are simulated using 1/8 inch diameter flat bottom holes. An EDM notch is included in the mockup in the temper bead weld. This notch is to simulate lack of fusion.

This weld configuration may result in a triple point weld solidification anomaly at the junction of the Alloy 600 tube, the low alloy steel, and the weld due to different cooling rates of these materials. The shape of this anomaly is usually volumetric but can have planar features. To simulate the triple point anomaly with planar characteristics, EDM notches have been machined at the triple point at depths of 0.050 inches, 0.113 inches, and 0.159 inches, measured from the tube OD and extending toward the ID surface. These notches were all detected and sized. A volumetric triple point anomaly is more closely simulated with the side drilled holes in the calibration block.

Examination of the mockup for this demonstration did detect the presence of a triple point anomaly around the entire circumference, but it did not exhibit any planar characteristics and is very small. Destructive examinations performed during development of the temper bead weld repair process in 2001 revealed that the triple point anomaly is usually less than 0.030 inch in size.

This demonstration was also successful in detecting the required calibration reflectors in the calibration block. The additional axial and circumferential EDM notches are also easily resolved with good signal to noise ratio. The simulated construction type flaws in the mockup are detected with good signal to noise ratio. A small triple point anomaly was also detected in the mockup and is typical of what can be expected in field installations.

6. **Page 8, fourth paragraph.**
   The licensee discussed a fracture mechanics analysis for the weld anomaly at the triple point. Please submit the referenced fracture mechanics analysis.

   Response:

   The fracture mechanics evaluation for the weld anomaly at the triple point is contained in Enclosure C, AREVA calculation 32-9134666-002, DB-1 CRDM Nozzle Weld Anomaly Flaw Evaluation of IDTB Repair.

7. **Page 8, second to the last paragraph.**
   The licensee states that Alloy 600 nozzle material properties or equivalent are used to ensure that another potential path through the heat affected zone between the new repair weld and the Alloy 600 nozzle material is bounded. Clarify pictorially this other potential path.

   Response:

   Enclosure C, AREVA calculation 32-9134666-002, DB-1 CRDM Nozzle Weld Anomaly Flaw Evaluation of IDTB Repair, specifically within Section 1.3 and Figure 1-2, addresses the characterization of the anomaly for the analysis.

8. **Page 8, last two paragraphs.**
   For flaw path 1, discuss the length and depth of the axial flaw. Use a diagram similar to that in Figure 3 to show the exact location of the axial and circumferential weld anomalies.

   Response:

   Enclosure C, AREVA calculation 32-9134666-002, DB-1 CRDM Nozzle Weld Anomaly Flaw Evaluation of IDTB Repair, specifically within Section 1.3 and Figure 1-2, addresses the characterization of the anomaly for the analysis.

9. **Page 9, second paragraph.**
   The licensee states that the results of flaw evaluation at the triple point show that the 0.10 inch weld anomaly is acceptable for greater than a four-year design life for the new [nozzle] configuration. The four-year design life implies that after four years the repaired nozzles will no longer be acceptable for service. The staff understands that the licensee plans to replace the reactor vessel head in four years. However, the licensee may need to design the half nozzle repair longer than four years in case the new reactor vessel head cannot be delivered to and installed in the plant within four years. Confirm that the design life of the half-nozzle repair is four years from the date of the relief request implementation.

   Response:

   Enclosure C, AREVA calculation 32-9134666-002, DB-1 CRDM Nozzle Weld Anomaly Flaw Evaluation of IDTB Repair, demonstrates that the 0.10 inch weld anomaly is acceptable for a 25-year design life of the CRDM nozzle inside diameter temper bead weld repair. Although the design life of the weld repairs is 25 years, the actual life is only intended to be four years from implementation of the modifications, since it is expected the RPV head will be replaced at that time.

10. **Page 9.**
    Lay out the flaw path 2 on a diagram similar to Figure 3 of the submittal. Discuss whether the flaw sizes (weld anomaly) in path 2 are the circumferential and axial flaws with the same depth and length as described in the last paragraph on page 8 for path 1.

    Response:

Enclosure C, AREVA calculation 32-9134666-002, DB-1 CRDM Nozzle Weld Anomaly Flaw Evaluation of IDTB Repair, specifically within Section 1.3 and Figure 1-2, addresses the characterization of the anomaly for the analysis.

11. Page 9, last two paragraphs.
The licensee discusses the preservice and inservice inspections for the repaired nozzles.

1) Confirm that Davis Besse will follow ASME Code Case N-729-1 with conditions in accordance with 10 CFR 50.55a(g)(6)(D) for the preservice and inservice inspection of the repaired nozzles.

Response:

The preservice and inservice examinations will be performed in accordance with ASME Code Case N-729-1 with conditions in accordance with 10 CFR 50.55a(g)(6)(D) in conjunction with the inspection area described in 10 CFR 50.55a Request RR-A34.

2) Discuss the inservice inspection schedule for the repaired nozzles.

Response:

The inservice inspection frequency of the repaired nozzles will be every refueling outage in accordance with 10 CFR 50.55a(g)(6)(ii)(D)(5).

12. Figure 3.
Figure 3 provides a vertical distance of 1 and 1.5 inches of the remnant nozzle for the preservice (post-weld) surface and UT examinations.

1) Discuss whether the 1 to 1.5 inch distance covers the region of the nozzle that has been rolled. If the 1 or 1.5 inches do not cover the entire rolled region, the staff expects that the entire rolled region of the nozzle needs to be inspected to ensure that flaws do not occur in the rolled region of the remnant nozzle. Figure 9 also provides the same vertical distance of 1 inch and 1.5 inches of the remnant nozzle for the inservice surface examination. For inservice inspection, the staff expects that the entire rolled region of the nozzle be inspected to ensure that flaws do not occur in the rolled region of the remnant nozzle.

Response:

Prior to roll expansion, the portion of the nozzle subject to rolling is UT examined to assure the repair is being performed on sound nozzle base material. After welding, the area from ¼ inch above the roll transition down through the roll transition to ½ inch below the lower weld toe is liquid penetrant examined. This area is also subject to the abrasive water jet machining operation to reduce the susceptibility of the Alloy 600 material to primary water stress corrosion cracking.

2) Discuss whether the entire rolled region of the remnant nozzle will be inspected.

Response:

The inservice inspection examination area is depicted in Figure 9 of RR-A34, which requires examination of 1 or 1.5 inches of the remnant nozzle based on the nozzle location. This examination surface is consistent with the examination area specified in Code Case N-729-1. Although this examination does not completely encompass the rolled region of the nozzle, it does examine a significant portion of the rolled area.

13. Please submit a fracture mechanics analysis demonstrating that the acceptability of the structural integrity of the reactor vessel head assuming the flaw in the remnant J-groove weld has propagated into the vessel head.

Response:

This analysis will be provided to the NRC staff under separate correspondence.