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

Byron Station Unit 1
Facility Operating License No. NPF-37
NRC Docket No. STN 50-454

Subject: Supplement to Byron Station Unit 1, Inservice Inspection Relief Request I3R-19: Alternative Requirements for the Repair of Reactor Vessel Head Penetrations

References:

(1) Letter from J. Hansen (Exelon) to U. S. NRC, "Byron Station Unit 1 Inservice Inspection Relief Request I3R-19: Alternative Requirements for the Repair of Reactor Vessel Head Penetrations," dated March 24, 2011

(2) Email from N. DiFrancesco (U. S. NRC) to R. McIntosh (Exelon), "Byron Station, Unit No. 1 – Request for Additional Information re: Relief Request I3R-19 (TAC No. ME5877)," dated March 25, 2011

(3) Letter from D. M. Benyak (Exelon) to U. S. NRC, "Additional Information Related to Byron Station Unit 1, Inservice Inspection Relief Request I3R-19: Alternative Requirements for the Repair of Reactor Vessel Head Penetrations," dated March 25, 2011

(4) Memorandum from N. DiFrancesco (U. S. NRC) to R. Carlson (U. S. NRC), "Verbal Authorization of Relief Request I3R-19 – Alternative Requirements for Repair of Reactor Vessel Head Penetrations 64 and 76 (TAC No. ME5877)," dated March 29, 2011

(5) Letter from D. M. Benyak (Exelon) to U. S. NRC, "Additional Information Related to Byron Station Unit 1, Inservice Inspection Relief Request I3R-19: Alternative Requirements for the Repair of Reactor Vessel Head Penetrations," dated March 31, 2011

In Reference 1, in accordance with 10 CFR 50.55a, "Codes and standards," paragraph (a)(3)(i), Exelon Generating Company, LLC (EGC), submitted the Relief Request I3R-19 from the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," on the basis that the proposed alternatives would provide an acceptable level of quality and safety. Specifically, Reference 1 proposed to perform an alternative repair technique using an imbedding seal weld methodology on the reactor Vessel Head Penetration (VHP) housings and J-groove welds of Byron Station, Unit 1. The performance of the imbedded flaw seal weld technique in accordance with the Relief Request I3R-19, in Reference 1, essentially uses the

non-structural seal weld to isolate the Primary Water Stress Corrosion Cracking (PWSCC) susceptible material, alloy 600 and its weld materials alloy 182/82, from primary coolant with highly PWSCC resistant weld material Alloy 52 or 52M. During performance of the repairs during the ongoing Byron Station, Unit 1, Refueling Outage B1R17, EGC has concluded that supplemental information is necessary for Relief Request I3R-19 to describe additional applicable requirements for eliminating mechanical discontinuities detected in the seal welds during performance of the repairs, with the additional information about the proposed alternative, and its basis and method of implementation. EGC has determined that compliance with the Code requirements for eliminating such mechanical discontinuities detected in the seal welds would result in hardship or unusual difficulty without a corresponding significant increase in quality or safety for the repairs in B1R17. This information is provided in Attachment 1 of this letter.

Reference 4 discusses the verbal authorization dated March 29, 2011, which EGC has used to begin performance of seal welds on the first two nozzles during B1R17. In Reference 2, dated March 25, 2011, the NRC requested additional information regarding these nozzles that EGC determined would require repair during B1R17. EGC has since responded with the information provided in References 3 and 5. There are four penetration nozzles, 31, 43, 64 and 76, that require this repair method during B1R17.

EGC requests an expedited verbal approval by noon on April 10, 2011, to use the Relief Request I3R-19 as supplemented with the information in Attachment 1. To achieve As Low As Reasonably Achievable dose and produce a technically acceptable repair of nozzles 31 and 64, this supplement adds a provision for approval under 10 CFR 50.55a(a)(3)(ii), to use these additional alternative requirements in eliminating mechanical discontinuities detected in the seal welds during performance of the repairs.

There are no new regulatory commitments in this submittal. More specifically, the regulatory commitment from EGC's recent response to an RAI (i.e., Reference 3) will remain applicable to Relief Request I3R-19.

If you have any questions about this letter, please contact Mr. Richard W. McIntosh at (630) 657-2816.

Respectfully,

Jeffrey L. Hansen
Manager - Licensing

Attachment:
1. Supplement to the Alternative Requirements for the Repair of Reactor Vessel Head Penetrations, I3R-19
2. Reports of Nondestructive Examination for Penetrations 31 and 64
3. Dose Estimates

ATTACHMENT 1
SUPPLEMENT TO THE ALTERNATIVE REQUIREMENTS FOR THE REPAIR OF REACTOR VESSEL HEAD PENETRATIONS, I3R-19

Exelon Generating Company , LLC (EGC) is supplementing Relief Request I3R-19 to add the following additional requirement to Section 3.0, "APPLICABLE CODE REQUIREMENT," under section titled, "Weld Metal Defect Repairs":

ASME Section III, NB-4450 addresses repair of weld metal defects.

This section lists the requirements that in part state the following:

ASME Section Ill, NB-4451 states; that unacceptable defects in weld metal shall be eliminated and, when necessary, repaired in accordance with NB-4452 and NB-4453.

ASME Section III, NB-4452 addresses elimination of weld metal surface defects and specifies defects are to be removed by grinding or machining.

ASME Section III, NB-4453.1 addresses removal of defects in welds and requires the defect removal to be verified with magnetic particle or [Liquid Penetrant] PT examinations in accordance with NB-5340 or NB-5350. In the case of partial penetration welds where the entire thickness of the weld is removed, only a visual examination is required to determine suitability for re-welding.

Section 4.0, "REASON FOR THE REQUEST," is revised to include the following additional bulleted item for which relief is requested from:

- The requirements of ASME Section III, NB-4450, to eliminate mechanical discontinuities detected in the seal weld during initial installation.

Section 4.0, is also revised to include the following:

4.1 HARDSHIP OR UNUSUAL DIFFICULTY FOR NOZZLES 31 AND 64:

Following initial seal welding on penetration nozzles 31 and 64, the repair area was subjected to PT. The Nondestructive Examination (NDE) reports and photographs on nozzles 31 and 64 are in Attachment 2. There are four indications on nozzle 31 and nine indications on nozzle 64.

There is significant radiation dose estimated for the work needed to eliminate mechanical discontinuities. As Low As Reasonably Achievable (ALARA) considerations are being used to perform the work under the reactor vessel head that can not be done by the automated welding equipment, and which involves worker exposure to high radiation fields for surface conditioning, grinding, and repetitive PT and visual examinations. An estimate of the dose for personnel working under the reactor pressure vessel head is provided in Attachment 3, which show the potential reduction in dose that is estimated for using the alternative requirements in this request, which is a minimum 7 rem savings for penetrations 31 and 64.

Grinding of PT indications in high radiation areas is a dose-intensive operation. Specifically, PT indications are relatively small, and are typically not visually detectable. Grinding to reduce these indications to an acceptable size, therefore, is

a carefully controlled process with an emphasis on minimal metal removal. Since PT indications typically can not be seen, the primary means of determining whether removal has been accomplished is to re-perform the PT. The PT itself is also a dose-intensive work activity, requiring multiple entries into the high radiation area for the various steps in the examination sequence. The suitability/acceptability of the excavation is unknown until PT is completed and results are evaluated. These results may determine the excavation to be acceptable, or may identify that additional grinding is needed (either to continue with removal of the original indication, or to address other indications revealed during the grinding process). The uncertainty regarding PT results contributes to the potential of an iterative repair process, involving one or more repetitions of minor grinding, PT rejection, minor grinding, etc. For this reason, grinding to remove small indications associated with normal welding anomalies (i.e., indications other than cracks) is less preferable than utilizing reliable welding with automated equipment to consume/repair these flaws.

Considering the nature of this hardship, as long as the post-repair examinations are as required in accordance with I3R-19, there is no corresponding significant increase in quality and safety through compliance with requirements of ASME Section III, NB-4450, to eliminate mechanical discontinuities detected in the seal weld during initial installation.

Section 5.0, "PROPOSED ALTERNATIVE AND BASIS FOR USE," is revised to include the following additional alternative:

5.1 ALTERNATIVE REQUIREMENTS FOR ELIMINATING MECHANICAL DISCONTINUITES DETECTED IN THE SEAL WELD DURING INITIAL INSTALLATION

Mechanical discontinuities detected by PT of the finished seal weld will be repaired by the addition of Alloy 52 or 52M weld bead(s) in lieu of repair in accordance with the rules of NB-4450. Mechanical discontinuities are considered locations such as bead-to-bead junctures and welding start/stop locations with tight corners which trap PT penetrant. These locations will be re-consumed with the application of additional weld metal. Each area with additional weld metal applied to re-consume the mechanical discontinuity will be re-examined by PT using ASME Section III acceptance standards. In the event the PT does not pass, the indication would then be repaired in accordance with the rules of ASME Section III, NB-4450.

5.1.1 Penetration 31

<u>Indications 1, 2 and 3</u>:
(The same alternative as Penetration 64, indications 1, 3, 6, 7, 8 and 9)

These indications are material discontinuities that will be welded-through and re-consumed. Following the weld-through, a PT will be performed using ASME Section III acceptance standards. If the PT results are not acceptable, this would indicate a flaw and not a mechanical discontinuity. The indication will be ground and a PT performed to the ASME Section III acceptance

standards and the resulting excavation PT inspected to ASME Section III acceptance standards.

The basis for the alternative involves the bead to bead characteristic of these indications, which was confirmed during internal reviews with the PT examiners. This bead to bead characteristic also suggests the indications are shallow and have minimal bleed out. Based on experience, these types of indications are superficial and will be re-consumed in the weld process.

Indication 4:
(The same alternative as used with Penetration 64, indication 4)

Indication 4 is large enough based on PT bleed-out to warrant the grinding and removal to obtain an acceptable PT post welding.

5.1.2 Penetration 64

Indications 1, 3, 6, 7, 8 and 9:
(The same alternative as Penetration 41, indications 1, 2 and 3)

These indications are material discontinuities that will be welded-through and re-consumed. Following the weld-through, a PT will be performed using ASME Section III acceptance standards. If the PT results are not acceptable, this would indicate a flaw and not a mechanical discontinuity. The indication will be ground and a PT performed to the ASME Section III acceptance standards and the resulting excavation will be PT inspected to ASME Section III acceptance standards.

The basis for the alternative involves the bead-to-bead characteristic of these indications, which was confirmed during internal reviews with the PT examiners. This bead to bead characteristic also suggests the indications are shallow and have minimal bleed out. Based on experience, these types of indications are superficial and will be re-consumed in the weld process.

Indications 2 and 5:

These indications are acceptable.

Indication 4:
(The same alternative as used with Penetration 31, indication 4)

Indication 4 is large enough based on PT bleed-out to warrant the grinding and removal to obtain an acceptable PT post welding.

5.1.3 Basis Regarding the Proposed Alternative Requirements for Eliminating Mechanical Discontinuites Detected in the Seal Weld During Initial Installation

The QC inspector performing the PT examinations for penetrations 31 and 64 was interviewed to further assess the nature and appearance of the indications. Based on observations, penetration 31 indications 1, 2, and 3 are typical of interbead indications, and had an appearance typically associated with weld surface roughness (i.e., trapped penetrant due to surface roughness). Penetration 64, indications 1, 3, 6, 7, 8 and 9 are similar to indications 1, 2, and 3 in Penetration 31, and were of similar appearance and nature (the primary difference being that indications 8 and 9 are circumferentially oriented). None of the indications were considered crack-like in nature. PCI Welding Engineering evaluation of the indications (based on review of photographs and discussions with responsible QC personnel) confirms that the physical characteristics of the listed indications (i.e., orientation, size, and color contrast) are consistent with mechanical discontinuities/surface roughness, as opposed to weld defects such as cracking.

PCI Welding Engineering describes their past experience with repairs of this nature indicates an estimated success rate of approximately 60% when iteratively grinding lightly/PT is performed, compared to an estimated first-time success rate of approximately 90% when flaws are consumed by welding.

The embedded flaw repair is a non-structural/non-pressure retaining seal weld whose only function is to provide a barrier which isolates the PWSCC susceptible material from Primary Water (PW) environment. As such, re-consuming defect(s) caused by mechanical discontinuities by welding will not undermine the function of the seal weld because these mechanical discontinuities are readily consumed by welding with a high degree of confidence.

ATTACHMENT 2
REPORTS OF NONDESTRUCTIVE EXAMINATION FOR PENETRATIONS 31 AND 64

PCI EnergyServices

Report of Nondestructive Examination
Visible, Solvent Removable Liquid Penetrant Examination

Client: Exelon (PO # 00000828, Release 00473) | Project No.: 901348 | Report No.: 901348-03
Line/Drawing No.: N/A (Exelon Relief Request 13R-19) | Weld/Item No: RVHP # 31 | Date: 4-06-11
Part Shape / Size: **Penetration 31** | Material Type: A8 SS Cladding/ER 309L/ERNiCrFe-7A | Time: 1300
NDE Procedure : GQP-9.7 Rev. 13 | Acceptance Standard: Appendix A Sec 1.0 & 2.0 | Surface Finish: As Welded/ground
Material Thickness: Approx . 0. 200" | Stage of Fabrication: Final PT of J-Weld/Pen O.D. Overlay | Joint Design: J-Weld/Pen.OD Overlay

TYPE II VISIBLE PENETRANT EXAMINATION, METHOD C SOLVENT REMOVABLE

Cleaner: SKC-S | Penetrant: SKL-SP1 | Developer: SKD-S2 | Penetrant Application : Brush
Batch No: 10F16K | Batch No: 09K02K | Batch No: 09L05K | Penetrant Removal: Dry Wipe/Solvent Wipe
Preclean Dry Time: 7 Min. | Penetrant Dwell Time: 14 Min. | Post-removal Dry Time 7 Min. | Developing Time: 16 Min. | Type of Lighting Equipment Flashlight | Light Intensity B152FC A150FC
Part Temperature: 76 °F | Thermometer No: QTC-135 | Cal. Due Date: 9-25-11 | Light Meter No: QLM-15 | Cal. Due Date: 9-15-11

IND. NO:	Distance from Zero	Dimensions	TYPE	ACC	REJ
1	11:00	1/8" X 3/8"	Linear		X
2	1:00	1/16" X 1"	Linear		X
3	1:00	¼" X ¼"	Rounded		X
4	8:00	½" X 5/8"	Rounded		X

Comments: B= Before Testing A = After Testing

No relevant indications were identified on the J-Weld overlay surface.

Weld / Item is ☐ Acceptable ☒ Rejectable

Sketch:

See attached pages 2 and 3

Examiner: Kim Campbell Kim Campbell Level: II Date: 4/06/11 Client Reviewer: Date:
Reviewer: [signature] Level: III Date: 4/6/11 AI/ANI/ ANII: