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10 CFR 50.55a

RS-07-055

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U. S. Nuclear Regulatory Commission
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Washington, DC 20555-0001

Byron Station Unit 2
Facility Operating License No. NPF-66
NRC Docket No. STN 50-455

Subject: Byron Station Unit 2 Inservice Inspection Relief Request I3R-14: Alternative Requirements for the Repair of a Reactor Vessel Head Penetration

References: (1) Westinghouse WCAP-15987, Revision 2-A, "Technical Basis for the Embedded Flaw Process for Repair of Reactor Vessel Head Penetrations," December 2003

(2) Letter from H. N. Berkow (U. S. NRC) to H. A. Sepp (Westinghouse Electric Company), "Acceptance for Referencing – Topical Report WCAP-15987-P, Revision 2, 'Technical Basis for the Embedded Flaw Process for Repair of Reactor Vessel Head Penetration,' (TAC NO. MB8997)," dated July 3, 2003

In accordance with 10 CFR 50.55a, "Codes and standards," paragraph (a)(3)(i), Exelon Generation Company, LLC (EGC) is requesting relief 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, a relief request is being proposed to perform an alternative repair technique using the embedding methodology of Reference 1 on the reactor vessel head penetration (VHP) housing and J-groove weld of Byron Station Unit 2 penetration number 68. The embedded flaw methodology to be used has been approved generically by the NRC in the Reference 2 safety evaluation. The details of this request are contained in Byron Station Relief Request I3R-14 attached to this letter.

During the current Byron Station Unit 2 Spring 2007 Refueling Outage, EGC performed volumetric examinations of the VHPs in accordance with First Revised Order EA-03-009, "Interim Inspection Requirements for Reactor Pressure Vessel Heads at Pressurized Water Reactor," (the Order). Ultrasonic examination identified an unacceptable axial indication, confirmed by dye penetrant examination, in VHP 68.

Although a root-cause has not been completed and the damage mechanism has not been confirmed, the repair process conservatively assumes the indication is the result of primary water stress corrosion cracking (PWSCC) and embedding the flaw within PWSCC resistant materials (i.e., Alloy 52 weld metal) will assure structural integrity of the VHP 68 connection.

Supporting the embedded flaw methodology application to the VHPs for Byron Station Unit 2 is the analysis provided in Westinghouse WCAP-16401-P, Revision 0, "Technical Basis for Repair Options for Reactor Vessel Head Penetration Nozzles and Attachment Welds: Byron and Braidwood Units 1 and 2." This WCAP provides the technical basis for the use of an embedded repair involving the VHP housing and/or the VHP housing attachment weld (i.e., the J-groove weld) by evaluating the bounding loading conditions, fatigue crack growth predications, and fracture mechanics results. WCAP-16401-P will be submitted to the NRC in a separate letter, following completion of an affidavit to support withholding of proprietary information.

EGC requests that this repair alternative be verbally approved by April 17, 2007, to support the VHP repair and restoration/restart activities at Byron Station Unit 2. While EGC recognizes the burden associated with an accelerated review and approval of I3R-14, the need for a repair of a VHP at Byron Station Unit 2 as a result of the Order examinations was unexpected.

Byron Station Unit 2 is ranked as a low susceptibility plant with an Effective Degradation Year rating of 2.2 with a very low probability of PWSCC initiation and consequently, there was no expected need to prepare and submit, for NRC review, a contingency Relief Request for an alternative repair methodology in advance of the Byron Station Unit 2 refueling outage.

There are no regulatory commitments contained in this submittal. If you have any questions about this letter, please contact Mr. David Chrzanowski at (630) 657-2816.

Respectfully,

Darin M. Benyak
Director, Licensing and Regulatory Affairs

Attachment – Byron Station Relief Request I3R-14, "Alternative Requirements for the Repair of a Reactor Vessel Head Penetration"

Attachment

Byron Station Relief Request I3R-14

Alternative Requirements for the Repair of a Reactor Vessel Head Penetration

10 CFR 50.55a RELIEF REQUEST I3R-14
Revision 0

Request for Relief
Alternative Requirements for the Repair of a Reactor Vessel Head Penetration
In Accordance with 10 CFR 50.55a(a)(3)(i)

1.0 ASME CODE COMPONENT AFFECTED

Code Class:	1
Reference:	NRC First Revised Order EA-03-009
Identification:	Byron Unit 2 Reactor Vessel Head Penetration (VHP) 68
Description:	VHP Housing to Reactor Vessel Head Partial Penetration Weld (J-Groove Weld)
Drawing Numbers:	185282E Revision 0, 185283E Revision 1, and 185286E Revision 1

2.0 APPLICABLE CODE EDITION AND ADDENDA

American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, 2001 Edition, through 2003 Addenda.

3.0 APPLICABLE CODE REQUIREMENT

ASME Section XI, 2001 Edition, through 2003 Addenda, requires repair activities to be conducted in accordance with the requirements of IWA-4000. ASME Section XI, IWA-4411 requires that welding, brazing, and installation be performed in accordance with the Owner's Requirements and the original Construction Code of the item. The original Code of Construction for the reactor vessel closure head and VHP housings is ASME Section III, 1971 Edition through Summer 1973 Addenda.

ASME Section XI, IWA-4421(c) states that defect removal or mitigation by welding or brazing be performed in accordance with IWA-4411.

Base Metal Defect Repairs

ASME Section III, NB-4131 states that defects in materials, such as the VHP penetration tube base material, may be eliminated or repaired by welding, provided the defects are removed, repaired, and examined in accordance with the requirements of NB-2500.

ASME Section III, NB-2538 addresses elimination of base material surface defects and specifies defects are to be removed by grinding or machining. Defect removal must be verified by a magnetic particle or liquid penetrant examination in accordance with NB-2545 or NB-2546. If the removal process reduces the section

thickness below the NB-3000 design thickness, then repair welding per NB-2539 is to be performed.

ASME Section III, NB-2539.1 addresses removal of defects and requires defects to be removed or reduced to an acceptable size by suitable mechanical or thermal methods.

ASME Section III, NB-2539.4 provides the rules for examination of the base material repair welds and specifies they shall be examined by the magnetic particle or liquid penetrant methods in accordance with NB-2545 or NB-2546. Additionally, if the depth of the repair cavity exceeds the lesser of 3/8" or 10% of the section thickness, the repair weld shall be examined by the radiographic method in accordance with NB-5110 using the acceptance standards of NB-5320.

Weld Metal Defect Repairs

ASME Section III, 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. Defect removal must be verified by a magnetic particle or liquid penetrant examination using acceptance criteria of NB-5340 or NB-5350. NB-4453.4 also specifies that repairs of 3/8" or 10%, which ever is less, be verified by a magnetic particle or liquid penetrant examination. If the removal process reduces the section thickness below the NB-3000 design thickness, then repair welding per NB-4453 is to be performed.

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 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.

As an alternative, the proposed repair will be conducted in accordance with the appropriate edition of ASME Section III and the alternative requirements, based on Reference 1, proposed below.

4.0 REASON FOR THE REQUEST

During the ongoing Byron Station Unit 2 refueling outage, Exelon Generation Company, LLC (EGC) was conducting inspections of the reactor VHPs in accordance with NRC First Revised Order EA-03-009 dated February 20, 2004 (the Order). An axial flaw indication has been found on the outside diameter (OD) of Control Rod Drive Mechanism (CRDM) VHP 68 involving the J-groove attachment weld on the underside of the reactor vessel head.

Ultrasonic testing identified a flaw approximately 0.52-inches in length with a through-wall depth into the OD of the VHP 68 housing of approximately 0.33-inches (i.e., approximately 50 percent through the nominal VHP thickness of 0.625-inches). The extent of penetration into the J-groove weld is not available at this time.

Relief is requested from the requirements of ASME Section XI, IWA-4411 to perform repairs on VHP 68 in accordance with the rules of the ASME Section III Construction Code.

Specifically, relief is requested from the requirements in ASME Section III, NB-4131, NB-2538 and NB-2539.1 to eliminate base material defects prior to repair welding. Relief is requested to use substitute examination methods in lieu of those specified in NB-2539.4 for the following case.

Relief is requested from the requirements in ASME Section III, NB-4451, NB-4452, and NB-4453.1 to eliminate weld metal defects prior to repair welding.

5.0 PROPOSED ALTERNATIVE AND BASIS FOR USE

EGC proposes to use the less intrusive embedded flaw process (Reference 1) for the repair of VHP 68 as approved by the NRC (Reference 2).

Design, implementation of repairs, and inspections will be consistent with the requirements of References 1, 2 and 3. Following the removal of a portion (i.e., a boat sample) of the affected housing/J-groove material for metallurgical evaluation, the VHP 68 housing OD and associated J-groove weld repair/embedment of the remainder of the flaw indication will be addressed as specified below.

- The boat sample excavation will be filled with primary water stress corrosion cracking (PWSCC) resistant weld material (i.e., Alloy 52 material).
- It is expected that a portion of the indication will remain after boat sample excavation; however, a dye penetrant examination will be performed on the excavation to assess the pre-repair condition.
- Depending on the extent of the excavation, the repair procedure requires the Alloy 52 weld material to extend a minimum of 0.50 inches outboard of the Alloy 82-stainless steel clad interface.
- The embedded flaw repair overlay weld on the VHP 68 J-groove weld will consist of a minimum of three deposited layers of Alloy 52 material.
- The embedded flaw repair overlay weld on the OD of VHP 68 will consist of a minimum of two deposited layers of weld, consistent with Reference 4, to minimize welding induced residual stresses and material distortion.

- In lieu of ASME Section III requirements, the completed weld repair area will be examined in accordance with the requirements of Reference 2 for axial indications in the J-groove weld area. An ultrasonic examination of VHP 68 will be performed from the penetration tube inner diameter (ID) surface to identify evidence of flaw growth or evidence of a leak path. This ultrasonic examination will be performed in conjunction with a surface examination of the Alloy 52 weld material overlaying the affected portion of the J-groove weld. The combination of examination methods will assure 100 percent coverage of the affected area.

These proposed substitute examination methods have been previously demonstrated to be adequate for flaw detection and sizing as described in Reference 4. Also, to support the conclusion of the ultrasonic leak-path examination that VHP 68 has no cracking through the Alloy 82 weld past the carbon steel-cladding interface into the annulus of the VHP, a bare metal visual (BMV) examination on the top of the reactor vessel closure head around VHP 68, will be performed.

The BMV examination is intended to confirm that there has been no reactor coolant system boundary leakage past the J-groove weld onto the reactor vessel closure head surface as evidenced by boric acid deposits. The expected acceptable results of this BMV examination will be provided verbally to the NRC Project Manager for Byron Station as soon as they are available. These results will also be included in the 60-day report required by the Order.

The embedded flaw repair process is considered a permanent repair that will last through the useful life of the reactor pressure vessel head. As long as the remnants of the flaw remain isolated from the primary water environment, the only other known mechanism for any further propagation is fatigue. Reference 3 documents the fatigue evaluation for the embedded flaw in the VHP. The embedded axial flaw size in VHP 68 is significantly smaller than the allowable flaw size calculated in Reference 3.

The thickness of the weld used to embed the flaw has been set to provide a permanent embedment of the flaw and the embedded flaw process imparts less residual stresses than a standard weld repair following the complete removal of the flaw.

Since the Alloy 52 weldment is considered highly resistant to PWSCC, a new PWSCC crack would not initiate and grow through the Alloy 52 overlay to reconnect the primary water environment with the embedded flaw. The resistance of the Alloy 690 material has been demonstrated by laboratory testing, and in approximately 10 years of operational service in steam generator tubes, no PWSCC has been found.

As previously discussed, an additional analysis was performed using the same methodology as Reference 1 to evaluate and analyze VHP 68 for an embedded flaw repair. The results of this analysis (Reference 3) demonstrate that the embedded flaw repair in VHP 68 nozzle will meet ASME Section XI Code requirements for allowable

flaw size for the duration of the design life of the reactor vessel closure head and 10 years of operation for the J-groove weld.

EGC will utilize the flaw repair and evaluation acceptance criteria specified in Reference 1 as approved by the NRC in the Reference 2.

Future inspections of this nozzle will be performed to meet the NRC Order and will be consistent with the requirements for VHP repairs below the J-groove weld. Inspections will be performed each refueling outage and the results will be included in the 60-day post refueling outage report required by the Order.

In accordance with Section 5, "Conditions and Limitations," of the Reference 2 Safety Evaluation, EGC has concluded that the NRC flaw evaluation guidelines (Reference 5) have been followed and the appropriate non destructive examinations (NDE) listed in the Reference 2, Section 5 Table will be implemented for the repairs to VHP 68 at Byron Station Unit 2.

For the reasons stated above, the embedded flaw repair process is considered to be an alternative to Code requirements that provides an acceptable level of quality and safety, as required by 10 CFR 50.55a(a)(3)(i).

6.0 DURATION OF THE PROPOSED ALTERNATIVE

The duration of the proposed alternative is for the remainder of the Byron Station Unit 2 Third Inservice Inspection Interval currently scheduled to end in 2016.

7.0 PRECEDENT

In Reference 2, the NRC generically approved the embedded flaw repair process described in Reference 1. Requests to use the embedded flaw technique to repair cracks on the OD of VHPs as well as to repair flaws in the J-groove attachment welds of VHPs have been previously approved by the NRC on a plant specific basis.

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Revision 0

8.0 REFERENCES

1. Westinghouse WCAP-15987, Revision 2-A, "Technical Basis for the Embedded Flaw Process for Repair of Reactor Vessel Head Penetrations," December 2003
2. Letter from H. N. Berkow (U. S. NRC) to H. A. Sepp (Westinghouse Electric Company), "Acceptance for Referencing – Topical Report WCAP-15987-P, Revision 2, 'Technical Basis for the Embedded Flaw Process for Repair of Reactor Vessel Head Penetrations,' (TAC NO. MB8997)," dated July 3, 2003
3. Westinghouse WCAP-16401-P, Revision 0, "Technical Basis for Repair Options for Reactor Vessel Head Penetration Nozzles and Attachment Welds: Byron and Braidwood Units 1 and 2"
4. Letter LTR-NRC-03-61 from J. S. Galembush (Westinghouse Electric Company) to Terence Chan (U. S. NRC) and Bryan Benney (U.S. NRC), "Inspection of Embedded Flaw Repair of a J-groove Weld," dated October 1, 2003
5. Letter from R. J. Barrett (U. S. NRC) letter to A. Marion (Nuclear Energy Institute), "Flaw Evaluation Guidelines," dated April 11, 2003.