



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555-0001

January 25, 2018

Mr. Bryan C. Hanson
Senior Vice President
Exelon Generation Company, LLC
President and Chief Nuclear Officer (CNO)
Exelon Nuclear
Byron Station
4300 Winfield Road
Warrenville, IL 60555

SUBJECT: BYRON STATION, UNITS 1 AND 2 – REQUEST FOR RELIEF NOS. 13R-12 AND 13R-15 FROM THE REQUIREMENTS OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS BOILER AND PRESSURE VESSEL CODE (CAC NOS. MF9884, MF9885, AND MF9886; EPID NOS. 000976/05000454/L-2017-LLR-0055, 000976/05000455/L-2017-LLR-0055, AND 000976/05000455/L-2017-LLR-0056)

Dear Mr. Hanson:

By letter dated June 29, 2017 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML17180A367), as supplemented by letter dated January 10, 2018 (ADAMS Accession No. ML18010A682), Exelon Generation Company, LLC (the licensee), submitted relief requests (RRs) 13R-12 and 13R-15 to the U.S. Nuclear Regulatory Commission (NRC), requesting relief from the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, related to inspection impracticality due to limited examinations of certain nozzle-to-vessel welds and limited volumetric examination of reactor vessel circumferential shell welds at Byron Station (Byron), Units 1 and 2.

Specifically, pursuant to paragraph 50.55a(g)(5)(iii) of Title 10 of the *Code of Federal Regulations* (10 CFR), the licensee requested relief and to use alternative requirements (if necessary), for inservice inspection (ISI) items on the basis that the code requirement is impractical.

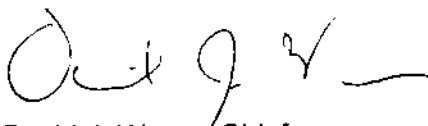
The NRC staff has reviewed the subject requests and concludes, as set forth in the enclosed safety evaluation, that the applicable ASME Code, Section XI, requirements are impractical for the components identified in these RRs. Furthermore, the NRC staff concludes that the licensee's alternative examinations provide reasonable assurance of structural integrity for the subject Class 1 components. Therefore, RR 13R-12 is granted pursuant to 10 CFR 50.55a(g)(6)(i) retroactive for the Byron, Units 1 and 2 third 10-year ISI interval, which ended on July 15, 2016, and RR 13R-15 is granted pursuant to 10 CFR 50.55a(g)(6)(i) retroactive for the Byron, Unit 2 third 10-year ISI interval, which ended on July 15, 2016.

Granting relief pursuant to 10 CFR 50.55a(g)(6)(i) is authorized by law and will not endanger life or property or the common defense and security, and is otherwise in the public interest giving

due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility. All other requirements of the ASME Code, Section XI, for which relief has not been specifically requested and approved, remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

If you have any questions, please contact the Senior Project Manager, Joel S. Wiebe at 301-415-6606 or via e-mail at Joel.Wiebe@nrc.gov.

Sincerely,

A handwritten signature in black ink, appearing to read "David J. Wrona", with a horizontal line extending to the right.

David J. Wrona, Chief
Plant Licensing Branch III
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. STN 50-454 and STN 50-455

Enclosure:
Safety Evaluation

cc: Listserv



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELIEF REQUEST NOS. I3R-12 AND I3R-15

EXELON GENERATION COMPANY, LLC

BYRON STATION, UNITS 1 AND 2

DOCKET NOS. STN 50-454 AND STN 50-455

1.0 INTRODUCTION

By letter dated June 29, 2017 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML17180A367), as supplemented by letter dated January 10, 2018 (ADAMS Accession No. ML18010A682), Exelon Generation Company, LLC (the licensee), submitted Relief Request (RR) Nos. I3R-12 and I3R-15 for the Byron Station (Byron), Units 1 and 2 third 10-year inservice inspection (ISI) interval program. These RRs were submitted due to the impracticality of satisfying the relevant requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, for the specified ASME Code Class 1 components.

2.0 REGULATORY EVALUATION

Pursuant to 10 CFR 50.55a(g), "Inservice inspection requirements," ISI of ASME Code Class 1, 2, and 3 components is to be performed in accordance with the latest edition and addenda of Section XI of the ASME Code, except where specific relief has been granted by the Commission pursuant to 10 CFR 50.55a(g)(6)(i), "Impractical ISI requirements: Granting of relief." Additionally, pursuant to 10 CFR 50.55a(g)(4), "Inservice inspection standards requirement for operating plants," ASME Code Class 1, 2, and 3 components (including supports) shall meet the requirements, except design and access provisions and preservice examination requirements, set forth in the ASME Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," to the extent practical within the limitations of design, geometry, and materials of construction of the components. The regulations require that inservice examination of components and system pressure tests conducted during the first 10-year interval and subsequent intervals comply with the requirements in the latest edition and addenda of Section XI of the ASME Code incorporated by reference in 10 CFR 50.55a(a)(1)(ii), 12 months prior to the start of the 120-month interval, subject to the conditions listed in 10 CFR 50.55a(b).

Section 50.55a(g)(5)(iii) of 10 CFR states, in part, that:

If the licensee has determined that conformance with a Code requirement is impractical for its facility the licensee must notify the NRC and submit, as specified in § 50.4, information to support the determinations. Determinations of

impracticality in accordance with this section must be based on the demonstrated limitations experienced when attempting to comply with the Code requirements during the inservice inspection interval for which the request is being submitted. Requests for relief made in accordance with this section must be submitted no later than 12 months after the expiration of the initial or subsequent 120-month inspection interval for which relief is sought.

Section 50.55a(g)(6)(i) of 10 CFR states,

The Commission will evaluate determinations under paragraph (g)(5) of this section that code requirements are impractical. The Commission may grant such relief and may impose such alternative requirements as it determines are authorized by law, will not endanger life or property or the common defense and security, and are otherwise in the public interest giving due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility.

Pursuant to 10 CFR 50.55a(g)(5)(iii), the licensee has requested relief from the requirements of 10 CFR 50.55a, "Codes and standards," for the third 10-year ISI interval for Byron, Units 1 and 2, on the basis that compliance with the ASME Code requirements is impractical due to physical obstructions and limitations due to design and geometry of the subject weld joints.

Based on the above, and subject to the following technical evaluation, the NRC staff finds that there is a regulatory basis for the licensee to request, and the NRC to authorize, the proposed relief requests. The code of record for the third 10-year ISI interval program at Byron, Units 1 and 2, is the 2001 Edition of the ASME Code, Section XI, through 2003 Addenda. The third 10-year interval ISI program at Byron, Units 1 and 2, ended on July 15, 2016.

3.0 TECHNICAL EVALUATION

3.1 RR I3R-12 (Applicable to Byron, Units 1 and 2)

3.1.1 Component Identification

In RR I3R-12, the licensee requested relief from the ASME Code, Section XI examination requirements for the following pressurizer surge, spray, safety, and nozzle-to-vessel welds at Byron, Units 1 and 2:

<u>Component Number</u>	<u>Drawing Number</u>
<u>Byron, Unit 1</u>	
1RY-01-S/PN-01	
1RY-01-S/PN-02	
1RY-01-S/PN-03	
1RY-01-S/PN-04	Unit 1 - 1PZR-1-ISI
1RY-01-S/PN-05	
1RY-01-S/PN-06	

<u>Component Number</u>	<u>Drawing Number</u>
<u>Byron, Unit 2</u>	
2RY-01-S/PN-01	Unit 2 - 2PZR-1-ISI
2RY-01-S/PN-02	
2RY-01-S/PN-03	
2RY-01-S/PN-04	
2RY-01-S/PN-05	
2RY-01-S/PN-06	

3.1.2 ASME Code, Section XI Requirements

These Class 1 full penetration welded nozzles in vessels are subject to the examination requirements of the ASME Code, Section XI, Table IWB-2500-1, Examination Category B-D, Item Number B3.110. The 2001 Edition through 2003 Addenda of the ASME Code, Section XI, requires volumetric examinations for these welds. The required examination area is specified in Figure IWB-2500-7(b). Mandatory Appendix I of the ASME Code, Section XI, requires ultrasonic examination of vessel welds greater than 2 inches thick to be conducted in accordance with ASME Section V, Article 4, as supplemented by Table 1-2000-1.

Byron, Units 1 and 2 had invoked ASME Section XI Code Case N-460, "Alternative Examination Coverage for Class 1 and Class 2 Welds, Section XI, Division 1." Code Case N-460 states, in part, that "...when the entire examination volume or area cannot be examined... a reduction in examination coverage... may be accepted provided the reduction in coverage for that weld is less than 10%."

3.1.3 Impracticality of Compliance

In accordance with 10 CFR 50.55a(g)(5)(iii), the licensee requested relief from performing the required volumetric examinations of inaccessible regions on the nozzle to vessel (pressurizer) welds. The licensee stated that conformance to the code examinations would require extensive structural modifications to the pressurizer vessel without providing a corresponding increase in the level of quality and safety. Relief was requested for the third 10-year ISI interval at Byron, Units 1 and 2. The geometry and materials of construction of the subject pressurizer nozzles results in limited access to the entire examination volume. The licensee provided information on the examination coverage attained for each of the subject nozzles. During previous outages, the nozzles were examined by ultrasonic testing (UT). The three limiting factors in the scanning of these nozzles are as follows:

- (a) the minimum scanning surface available on the nozzle side of the weld (component geometry);
- (b) the minimum scanning surface available on the vessel side of the weld (obstruction from pressurizer penetrations on lower head); and
- (c) the inability of the ultrasonic beam to reach beyond a 1/2Vee sound path (due to the materials of construction).

In Section 4.0 of the June 29, 2017, submittal, the licensee provided details on the difficulties it encountered in achieving inspection coverage during the previous examinations. Furthermore,

the licensee stated that there were no recordable indications requiring further evaluation noted in any of the volumetric examinations performed. The examinations were conducted and satisfactory results were confirmed, even though essentially 100 percent coverage was not attained. Details on the aggregate examination coverage that was achieved for each pressurizer surge, spray, safety, and relief nozzle-to-vessel welds were addressed in Attachment A of the licensee's submittal dated June 29, 2017. The licensee further stated that system leakage test and associated visual testing (VT-2) examination are performed in accordance with Section XI Examination Category B-P. This leak test and VT-2 examination are performed every outage at nominal system operating pressure and temperature to verify leak tight integrity of the system. No evidence of leakage associated with the pressurizer surge, spray, safety, or relief nozzle-to-vessel welds has been noted. Therefore, the licensee concluded that the results of the ultrasonic examination and system leakage test provide reasonable assurance that pressure boundary integrity has been, and will remain, maintained for the associated components.

3.1.4 NRC Staff Evaluation

The ASME Code, Section XI, requires a 100 percent volumetric examination of the subject welds; however, portions of these welds are not accessible for performing meaningful UT examinations. The licensee has performed UT examinations in accordance with ASME Code, Section XI requirements. The limitations on the inspection coverage on the subject welds are attributed to limiting factors associated with: (a) minimum scanning surface available on the nozzle side of the weld; (b) minimum scanning surface available on the vessel side of the weld; and (c) the inability of the UT beam to reach beyond a ½Vee sound path. Various volumetric coverages were reported for the subject welds and they were addressed in Attachment A of the June 29, 2017, submittal. Based on the above information, the NRC staff has concluded that full surface examination coverage of these welds would result in a considerable burden on the licensee.

The examination volume was limited because these welds could not be completely examined from both sides of the weld due to the limiting factors addressed in Section 3.1.3 (a), (b), and (c) of this safety evaluation. The licensee has demonstrated that due to geometric limitations it was impractical to meet the ASME Code-required "essentially 100 percent" volumetric examination coverage for the pressurizer surge, spray, safety, and relief nozzle-to-vessel welds. The licensee stated that to date, in the subject welds, there were no recordable indications identified in the UT examinations that required further evaluation. Additionally, the staff noted that in addition to the UT examinations, Examination Category B-D welds are also subject to system leakage testing and associated visual testing (VT-2) examination requirements of ASME Code, Section XI during each refueling outage. This leakage testing and VT-2 examination of the pressurizer surge, spray, safety, or relief nozzle-to-vessel welds did not reveal any relevant indications during the third 10-year ISI interval. The subject nozzles and the vessel materials were fabricated using low alloy steel base metals and low alloy steel weld metals and they are classified as ferritic metals. To date, plant experience in light-water reactor (LWR) units indicated that there is no active service induced aging degradation in the ferritic base metal and weld metal.

Even though the licensee did not meet the code-required inspection coverage, based on the information provided by the licensee in its June 29, 2017, submittal, the NRC staff concluded the following:

- (a) There is no active service-induced aging degradation in ferritic base metals and weld metals in light-water reactor units. The UT examinations of the subject welds that were conducted during the third 10-year ISI interval and the previous ISI examinations did not show any relevant indications;
- (b) The system leakage tests and the associated VT-2 examination did not reveal any relevant indications;
- (c) Although the ASME Code-required coverage could not be obtained, the staff determined that the licensee adequately demonstrated that if any service induced aging degradation were to occur in the subject welds, it would have been identified during the previous examinations at Byron, Units 1 and 2; and
- (d) The UT examinations (each interval), system leakage tests, and the visual examinations during each refueling outage provide reasonable assurance that significant service-induced degradation, if present, would be detected and corrected.

Based on the above, the NRC staff determined that the licensee had provided reasonable assurance that significant service-induced degradation, if present in the pressurizer surge, spray, safety, or relief nozzle-to-vessel welds, would have been detected and corrected during the third 10-year ISI interval. Therefore, the staff determined that the licensee complied with impracticality criteria addressed in 10 CFR 50.55a(g)(5)(iii) and, therefore, relief is granted for RR I3R-12 for Byron, Units 1 and 2.

3.2 Relief Request I3R-15

3.2.1 Component Identification

In RR I3R-15, the licensee requested relief from the ASME Code, Section XI examination requirements for the reactor vessel circumferential shell welds at Byron, Unit 2:

Component Number:	2RC-01-R/WR-29 (Unit 2)
Drawing Number:	2RPV-1-ISI (Unit 2)

3.2.2 ASME Code, Section XI, Requirements

The ASME Code, Section XI, 2001 Edition through the 2003 Addenda requires a volumetric and/or surface examination which includes essentially 100 percent of the weld and the applicable base metal, for the affected examination categories.

Table IWB-2500-1, Examination Category B-A, Item B1.11 requires volumetric examination of the reactor vessel circumferential shell welds as detailed in Figure IWB-2500-1. Byron, Unit 2 had invoked ASME Section XI Code Case N-460, "Alternative Examination Coverage for Class 1 and Class 2 Welds, Section XI, Division 1." Code Case N-460 states, in part, that "...when the entire examination volume or area cannot be examined... a reduction in

examination coverage... may be accepted provided the reduction in coverage for that weld is less than 10%."

As required by 10 CFR 50.55a, the 2001 Edition through 2003 Addenda of the ASME Code, Section XI, Appendix VIII, "Performance Demonstration for Ultrasonic Examination Systems," was used for examination procedures, equipment, and personnel.

3.2.3 Impracticality of Compliance

Pursuant to 10 CFR 50.55a(g)(5)(iii), relief is requested on the basis that conformance with the specified Code requirement has been determined to be impractical. Due to the original design and geometry associated with the reactor vessel weld, it is not feasible to effectively perform examinations of 100 percent of the volume of the weld. Therefore, relief is requested on the basis that the Code requirements to examine essentially 100 percent of the weld volume are impractical due to physical obstructions and geometry of the reactor vessel and concrete support structure.

Attaining the necessary geometry to achieve the Code-required examination coverage would involve major modifications to the existing component and support structure without providing a corresponding increase in the level of quality and safety.

The licensee stated that the reactor vessel lower head circumferential weld was clad with stainless steel on the inside diameter surface and is restricted by six core barrel lugs welded to the inner surface of the vessel approximately 4 inches above the weld. These lugs obstruct the automated ultrasonic inspection tool from completely examining the Code-required volume of the weld. Where access is available, the weld metal can be examined from below and between the core barrel lugs on the inside diameter of the vessel. Access to allow examination from the outside diameter (shell side) of the weld is restricted due to the structural concrete surrounding the vessel.

Furthermore, the licensee reiterated that the aggregate examination coverage achieved for the circumferential weld was 79.25 percent and the examination identified zero recordable indications during the Byron, Unit 2 Refueling Outage 13 (i.e., B2R13). This documented coverage is more than what was achieved during the previous ISI interval when 57 percent coverage was attained during B2R07. The details of inspection coverage were addressed in Attachment A of RR I3R-15.

In accordance with 10 CFR 50.55a(g)(5)(iii), the licensee requested relief from performing the required volumetric examinations of inaccessible regions on the reactor vessel weld. Based on this fact, the licensee determined that Code requirements are deemed impractical for the subject weld, and that RR I3R-15 had met the criteria for relief in accordance with 10 CFR 50.55a(g)(5)(iii).

3.2.4 NRC Staff Evaluation

The ASME Code, Section XI, requires a 100 percent volumetric examination of the subject welds, however, portions of these welds are not accessible for performing meaningful UT examinations. The licensee has performed UT examinations in accordance with ASME Code, Section XI requirements. The limitations on the inspection coverage on the subject welds is attributed to limiting factors associated with (a) physical obstructions and geometry of the reactor vessel and concrete support structure, and (b) presence of six core barrel lugs inside the

vessel obstructs the automated ultrasonic inspection tool from completely examining the Code-required volume of the weld. The licensee stated that it achieved an aggregate examination coverage ranging from 57 percent (prior inspection interval) to 79.25 percent (later inspection interval).

The licensee stated that in the subject welds no recordable indications were identified in the UT examinations. In addition to the UT examinations of the weld, the licensee had performed system leakage testing and associated VT-2 examination requirements of ASME Code, Section XI during each refueling outage. This leak tests and VT-2 examination of the reactor vessel lower head weld did not reveal any relevant indications during the third 10-year ISI interval.

Even though the licensee did not meet the Code-required inspection coverage, based on the information provided by the licensee in its June 29, 2017, submittal, the NRC staff concluded the following:

- (a) The reactor shell material and the circumferential shell weld were fabricated using low alloy steel base metals and low alloy steel weld metal. These metals are classified as ferritic metals. Previous operating experience indicated that there is no active service-induced aging degradation in ferritic base metals and weld metals in light-water reactor units. The UT examinations of the subject weld that were conducted during the third 10-year ISI interval did not show any relevant indications;
- (b) The system leakage tests and the associated VT-2 examination did not reveal any relevant indications;
- (c) Although the ASME Code-required coverage could not be obtained, the NRC staff determined that the licensee adequately demonstrated that if any service-induced aging degradation were to occur in the reactor vessel lower head weld, it would have been identified during the previous examinations at Byron, Unit 2; and
- (d) The UT examinations (each interval), system leakage tests, and the visual examinations during each refueling outage provide reasonable assurance that significant service-induced degradation, if present, would have been detected and corrected during the third 10-year ISI interval.

Based on the above, the NRC staff determined that significant service-induced degradation, if present in the reactor vessel lower head weld, would have been detected and corrected during the third ISI interval. Therefore, the staff determined that the licensee complied with impracticality criteria addressed in 10 CFR 50.55a(g)(5)(iii) and, therefore, relief is granted for the RR 13R-15 for Byron, Unit 2.

4.0 CONCLUSION

Based on the above evaluation of RR 13R-12 for Byron, Units 1 and 2, and RR 13R-15 for Byron, Unit 2, the NRC staff concludes that the applicable ASME Code, Section XI, requirements are impractical for these RRs. Furthermore, the NRC staff concludes that the licensee's alternative examinations provide reasonable assurance of structural integrity for the subject Class 1 components. Therefore, RRs 13R-12 and 13R-15 are granted pursuant to

10 CFR 50.55a(g)(6)(i). However, although these requests for relief are granted, the RRs granted are retroactive for the Bryon, Units 1 and 2 third 10-year ISI interval, which ended on July 15, 2016.

Granting relief pursuant to 10 CFR 50.55a(g)(6)(i) is authorized by law and will not endanger life or property or the common defense and security, and is otherwise in the public interest giving due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility. All other requirements of the ASME Code, Section XI, for which relief has not been specifically requested and approved, remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

Principal Contributor: G. Cheruvenki, NRR

Date: January 25, 2018

SUBJECT: BYRON STATION, UNITS 1 AND 2 – REQUEST FOR RELIEF NOS. 13R-12 AND 13R-15 FROM THE REQUIREMENTS OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS BOILER AND PRESSURE VESSEL CODE (CAC NOS. MF9884, MF9885, AND MF9886; EPID L-2017-LLR-0055 AND L-2017-LLR-0056) DATED JANUARY 25, 2018

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