



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

January 30, 2013

Mr. Michael J. Pacilio  
Senior Vice President  
Exelon Generation Company, LLC  
President and Chief Nuclear Officer (CNO)  
Exelon Nuclear  
4300 Winfield Road  
Warrenville, IL 60555

SUBJECT: BRAIDWOOD STATION, UNITS 1 AND 2 - RELIEF FROM THE  
REQUIREMENTS OF THE ASME CODE FOR THE THIRD 10-YEAR  
INTERVAL OF INSERVICE INSPECTON (TAC NOS. ME9748 AND ME9749)

Dear Mr. Pacilio:

By letter dated October 8, 2012, Exelon Nuclear Generation Company, LCC, (the licensee), submitted a request to the U.S. Nuclear Regulatory Commission (NRC) for relief from certain requirements of the American Society of Mechanical Engineers , Boiler and Pressure Vessel Code (ASME Code), 2001 Edition, including the 2003 Addenda, for the third 10-year Inservice Inspection (ISI) Program for Braidwood Station, Units 1 and 2.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 10 CFR 50.55a(g)(6)(i), the licensee requested relief and to use alternative requirements (if necessary), for inservice inspection items on the basis that the code requirement is impractical.

The NRC staff has reviewed the subject request and concludes, as set forth in the enclosed safety evaluation, that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(g)(6)(i). Therefore, the NRC staff grants relief for the subject examinations of the components contained in RR I3R-10 for Braidwood Station, Units 1 and 2, third 10-year ISI interval.

M. Pacilio

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If you have any questions, please contact Joel S. Wiebe at (301) 415-6606 or via e-mail at [Joel.Wiebe@nrc.gov](mailto:Joel.Wiebe@nrc.gov).

Sincerely,

A handwritten signature in black ink, appearing to read "Nicholas DiFrancesco". The signature is fluid and cursive, with a long horizontal stroke at the end.

Nicholas DiFrancesco, Acting Chief  
Plant Licensing Branch III-2  
Division of Operating Reactor Licensing  
Office of Nuclear Reactor Regulation

Docket Nos. STN 50-456 and STN 50-457

Enclosure:  
Safety Evaluation

cc w/encl: ListServ



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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELIEF REQUEST NO. 13R-10 REGARDING

THE THIRD 10-YEAR INTERVAL OF INSERVICE INSPECTION

EXCELON NUCLEAR GENERATION COMPANY, LCC

BRAIDWOOD STATION, UNITS 1 AND 2

DOCKET NUMBERS: 50-456 AND 50-457

1.0 INTRODUCTION

By letter dated October 8, 2012, Exelon Nuclear Generation Company, LCC, (the licensee), submitted a request to the U.S. Nuclear Regulatory Commission (NRC, the Commission) for relief from certain requirements of the American Society of Mechanical Engineers, Boiler and Pressure Vessel Code (ASME Code), 2001 Edition, including the 2003 Addenda, for the third 10-year inservice inspection (ISI) program for Braidwood Station, Units 1 and 2.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 10 CFR 50.55a(g)(6)(i), the licensee requested relief and to use alternative requirements (if necessary), for inservice inspection items on the basis that the code requirement is impractical.

2.0 REGULATORY EVALUATION

Section 50.55a(g)(4) of 10 CFR requires ASME Code Class 1, 2, and 3 components (including supports) to meet the requirements, except the design and access provisions and the preservice examination requirements, set forth in the ASME Code, Section XI, to the extent practical within the limitations of design, geometry, and materials of construction of the components. 10 CFR 50.55a(f)(4)(ii) requires 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, which was incorporated by reference in 10 CFR 50.55a(b) 12 months prior to the start of the 120-month interval, subject to the limitations and modifications listed therein.

Section 50.55a(g)(5)(iii) of 10 CFR, states, in part, that licensees may determine that conformance with certain ASME Code requirements is impractical and that the licensee shall notify the Commission and submit information in support of the determination. Determination 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 ISI interval for which the request is being submitted. Requests for relief made in accordance with this section

Enclosure

must be submitted to the NRC no later than 12 months after the expiration of the initial 120-month inspection interval or subsequent 120-month inspection interval for which relief is sought. 10 CFR 50.55a(g)(6)(iii) states that 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 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.

The licensee has requested relief from ASME Code requirements pursuant to 10 CFR 50.55a(g)(5)(iii). The ASME Code of record for Braidwood Station, Units 1 and 2, third 10-year the ISI program is the 2001 Edition, including the 2003 Addenda of Section XI, of the ASME Boiler and Pressure Vessel Code. The third 10-year ISI interval for Braidwood Station, Unit 1, started on July 29, 2008, and is projected to end on July 28, 2018. For Braidwood Station, Unit 2, the third 10-year ISI interval started on October 17, 2008, and is projected to end on October 15, 2018.

### 3.0 TECHNICAL EVALUATION

The information provided by the licensee in support of the request for relief from, or alternative to, ASME Code requirements has been evaluated and the bases for disposition are documented below. The licensee requested relief from the ASME Code, Section XI, examination requirements for the ASME Code, Class, 1 component welds listed Tables 1 and 2 below on page 4 of this safety evaluation (SE) for Braidwood Station, Units 1 and 2.

#### 3.1 The Licensee's Relief Request and Alternative

##### ASME Code Requirement

ASME Code, Section XI, 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 of Class 1 components. "Essentially 100 percent," as clarified by ASME Code Case N-460, "Alternative Examination Coverage for Class 1 and Class 2 Welds," is greater than 90 percent coverage of the examination volume, or surface area, as applicable. ASME Code Case N-460 has been approved for use by the NRC in Regulatory Guide (RG) 1.147, Revision 16, "*Inservice Inspection Code Case Acceptability*" (RG 1.147, Revision 16).

ASME Code, Section XI, Table IWB-2500-1, Examination Category B-D requires volumetric examination of Item B3.110 (pressurizer nozzle-to-vessel welds). Figure IWB-2500-7(b) depicts the required examination volume (A-B-C-D-E-F-G-H) which includes the actual circumferential weld and adjacent base metal on either side of the weld extending to a distance of one-half the thickness of the wall from the extremities of the weld crown.

ASME Code, Section XI, Mandatory Appendix I, requires ultrasonic (UT) examination of vessel welds greater than 2 inches thick to be conducted in accordance with ASME Code Section V, Article 4. ASME Code, Section V, Article 4, requires:

T-472.1.1 Beam Angle: The search unit and beam angle selected shall be appropriate for the configuration being examined and shall be capable of detecting the calibration reflectors, over the required angle beam path.

T-472.1.2 Reflectors Parallel to the Weld Seam: The angle beam shall be directed at approximate right angles to the weld axis from both sides of the weld (i.e., from two directions) on the same surface when possible. The search unit shall be manipulated so that the UT energy passes through the required volume of weld and adjacent base metal material.

T-472.1.3 Reflectors Transverse to the Weld Seam: The angle beam shall be directed essentially parallel to the weld axis. The search unit shall be manipulated so that the ultrasonic energy passes through the required volume of weld and adjacent base material. The search unit shall be rotated 180 degrees and the examination repeated.

#### Licensee's ASME Code Relief Request

In accordance with 10 CFR 50.55a(g)(5)(iii), the licensee requested relief from the ASME Code, Section XI, requirements for performing a full (essentially 100 percent) volumetric examination of the region specified in Figure IWB-2500-7(b) of the ASME Code, Section XI, for the pressurizer nozzle-to-vessel welds at Braidwood, Units 1 and 2. Relief was requested for the third 10-year ISI interval at Braidwood Station, Units 1 and 2. The geometry and materials of construction of the Pressurizer Nozzle-to-Vessel and Pressurizer Relief Nozzle-to-Shell welds result in limited access to the entire examination volume.

#### Licensee's Basis for Relief Request (as stated in their October 8, 2012, submittal)

Pursuant to 10 CFR 50.55a(g)(5)(iii), relief is requested on the basis that conformance with the specified [ASME] Code requirement has been determined to be impractical. Due to the original design and/or the base metal materials associated with these welds, it is not feasible to effectively perform examinations of 100 [percent] of the volume of these welds. Therefore, relief is requested on the basis that the [ASME] Code requirements to examine essentially 100 [percent] of the welds' volume are impractical due to physical obstructions and geometric interference. Attaining the geometry required to achieve the [ASME] Code required examination coverage would require major modifications to existing components without providing a corresponding increase in the level of quality and safety.

[Tables 1<sup>1</sup> and 2] identify the limitations for examination coverage of the welds encountered at Braidwood Station, Unit 1 and Unit 2, respectively, during the first period examinations.

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<sup>1</sup> Tables 1 and 2 from the licensee's submittal dated October 8, 2012, are reproduced on page 4 of this SE.

RR I3R-10 Table 1 - Braidwood, Unit 1 Nozzle-to-Vessel Welds				
Component ID ASME Code Category and Item	Outage Examined (Month/Year)	Cumulative Examination Coverage Achieved Percent	Reference Sketch/Coverage Plot**	Remarks
1PZR-01-N2 Category B-D Item B3.110	A1R15 (10/2010)	56.56	Attachment 1-1	Pressurizer Spray Nozzle-to-Shell Weld. No recordable indications noted in any of the ultrasonic scans performed.
1PZR-01-N3 Category B-D Item B3.110	A1R15 (10/2010)	60.92	Attachment 1-2	Pressurizer Relief Nozzle-to-Shell Weld. No recordable indications noted in any of the ultrasonic scans performed.

RR I3R-10 Table 2 - Braidwood, Unit 2 Nozzle-to-Vessel Welds				
Component ID ASME Code Category and Item	Outage Examined (Month/ Year)	Cumulative Examination Coverage Achieved [Percent]	Reference Sketch/Coverage Plot**	Remarks
2PZR-01-N2 Category B-D Item B3.110	A2R15 (4/2011)	88.5	Attachment 2-1	Pressurizer Spray Nozzle-to-Shell Weld. No recordable indications noted in any of the ultrasonic scans performed.
2PZR-01-N3 Category B-D Item B3.110	A2R15 (4/2011)	88.5	Attachment 2-2	Pressurizer Relief Nozzle-to-Shell Weld. No recordable indications noted in any of the ultrasonic scans performed.

\*\*Note: Reference to Sketch/Coverage Plot Attachments in Tables 1 and 2 are not included in this SE.

Compliance with the examination requirements of ASME [Code], Section XI would require significant modification of plant components to remove obstructions, redesign of plant systems/components, and/or replacement of components where geometry is inherent to the component design.

The pressurizer vessel spray nozzle-to-vessel weld is approximately 2.7 inches thick. The pressurizer nozzle and vessel are clad with stainless steel on the inside diameter surface. The geometry of the nozzle along with the presence of the cladding on the inside diameter of the pressurizer resulted in limited access to the entire examination volume. The propagation for the [UT] beam was in the shear mode. Normally, this mode would allow the [UT] beam to reflect off the inside surfaces and create a two-beam axis at right angles to each other, however, the presence of the stainless steel cladding precludes the [UT] beams from reflecting at the inside diameter from the shell/cladding interface.

The nozzle geometry tapers away from the weld which resulted in limited scanning surfaces available for the transducer coupling on the nozzle side of the weld, which resulted in additional examination limitations. These factors resulted in limited examination coverage from the scan directions required by ASME [Code,] Section V and Section XI. These limitations are inherent to the original design of the pressurizer

vessel. Conformance with the ASME [Code,] Section XI requirements for essentially 100 [percent] of the volumetric coverage would require extensive structural modifications to the pressurizer vessel.

Attachments 1-1, 1-2, 2-1, and 2-2<sup>2</sup> provide the basis for the limited examination coverage, which include drawings/sketches, as applicable. The differences between the aggregate examination coverage achieved and the coverage previously attained during the Second 10-Year ISI Program Interval examination are due to changes in ASME [Code,] Section V requirements. While it may be possible to increase the overall coverage using alternative or additional angles, it would not necessarily increase the level of quality and safety in detecting flaws or relevant conditions, and would increase the radiation dose received by the examiners due to additional time spent to scan the welds.

In addition to the completion of required volumetric examination performed to the extent practical, numerous system leakage tests ([ASME Code], Section XI, Category B-P and Generic Letter 88-05 [*Boric Acid Corrosion of Carbon Steel Reactor Pressure Boundary Components in PWR Plants*] (Generic Letter 88-05)) at nominal system operating pressure (2235 [pounds per square inch gage (psig)]) and temperature (557°F) have been performed with no evidence of leakage associated with the pressurizer spray nozzle-to-vessel welds. The system leakage tests will continue to be performed throughout the remainder of the interval.

Radiography [(RT)] as an alternative is not feasible because access is not available for film placement. No alternative examinations are planned for the weld during the current inspection interval. No additional [UT] examinations will be completed during the inspection interval for these welds since the examination was performed to the extent practical. The results of this examination along with the results of the pressure tests and plant monitoring provide reasonable assurance that pressure boundary integrity has been and will be maintained for the components throughout the interval.

Licensee's Proposed Alternative Examination (as stated in their October 8, 2012, submittal)

Braidwood Station proposes to perform the [ASME] Code required volumetric examinations to the maximum extent possible. Due to the original design of these welds, there are no alternative examination techniques currently available to increase the examination volume. There were no cases in any of the listed examination components where outside diameter surface features (i.e., weld crowns, weld shrinkage, surface roughness, etc.) could have been conditioned to maximize the coverage attained without major modification to the components.

As a minimum, all components received the required volumetric examination to the extent practical due to limited or lack of access availability. 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. Additionally, multiple VT-2 [visual] examinations were and will continue to be performed on the subject

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<sup>2</sup> Attachments 1-1, 1-2, 2-1, and 2-2 are not included in this SE and may found in the licensee's submittal dated October 8, 2012.

components throughout the interval through the required system pressure tests (examinations required by [ASME] Code, Section XI and Generic Letter 88-05). No evidence of leakage was observed at these components, providing additional assurance that the structural integrity of the subject components will be maintained throughout the remainder of the interval.

In addition to the periodic visual inspections performed under ASME Code, Section XI and Generic Letter 88-05, reactor coolant pressure boundary leakage is monitored through a number of other activities, which provide a high level of confidence that in the unlikely event that leakage did occur, it would be detected and proper action taken. Specifically, system leak rate limitations imposed by [Braidwood Station, Units 1 and 2] Technical Specifications Section 3.4.13, "RCS Operational Leakage," as well as the reactor makeup control system, reactor cavity and containment floor drain sump monitoring, containment radiation monitoring, and containment atmospheric monitoring, provide additional assurance that any leakage would be detected prior to gross failure of these components.

### 3.2 NRC Staff Evaluation

ASME Code, Section XI, requires essentially 100 percent volumetric coverage of the examination volume specified in Figure IWB-2500-7(b) for the pressurizer nozzle-to-vessel and relief nozzle-to-shell welds. This examination volume includes the actual weld, as well as the adjacent base metal on either side of the weld extending to a distance of one-half the thickness of the vessel wall from the extremities of the weld crown. The geometry of the subject pressurizer nozzles and the presence of vessel cladding resulted in limited access to the entire examination volume. UT scans of the examination volume from the nozzle side of the weld were limited due to the geometry of the nozzle relative to the available transducer sizes. Specifically, the nozzle geometry tapers away from the weld resulting in limited scanning surfaces available for transducer coupling on the nozzle side of the weld resulting in additional examination limitations. Furthermore, the stainless steel cladding at the inner surface of the pressurizer vessel resulted in significant scattering of reflected UT energy from the clad-weld interface. These two factors resulted in limited examination coverage from the four orthogonal scan directions that are required by the ASME Code, Section V, for UT scans of these welds and the two orthogonal scan directions required for the adjacent base metal. Imposing conformance with the ASME Code, Section XI, requirements for essentially 100 percent volumetric examination coverage would require extensive structural modifications to the pressurizer vessel and would be a burden on the licensee.

The licensee calculated the overall examination coverage that was achieved for both the weld and the adjacent base metal for each of the subject nozzle-to-vessel welds. This overall examination coverage was calculated by averaging the examination coverage percentages for each of the ASME Code-required scan directions at each beam angle. Tables 1 and 2, on page 4, of this SE, shows the average volumetric examination coverage that was achieved for each of the subject nozzle-to-vessel welds.

The licensee noted that the differences between the aggregate examination coverage achieved and the coverage previously attained during the second 10-year ISI program Interval examination are due to changes in ASME Code, Section V, requirements. It may have been



possible to increase the overall coverage using alternative or additional angles, however; it would not necessarily increase the possibility in detecting flaws or relevant conditions, and if additional examinations were performed by the licensee it would have increased the radiation dose received by the examiners due to additional time spent scanning of the subject welds. The difference between the percentage coverage in the third 10-year ISI interval and second 10-year ISI interval was 17-19 percent greater than that of the Braidwood Station, Unit 1, third 10-year ISI interval examinations of the subject welds. However, for the Braidwood, Unit 2, second 10-year ISI interval examinations the third 10-year ISI interval examinations were 5-9 percent greater in coverage than that of the examinations performed in the second 10-year ISI interval. In either case the examinations performed in the third 10-year ISI interval of the subject welds would have detected any flaws and relevant conditions and provided reasonable assurance of the structural integrity of the subject welds. The licensee did consider RT as an alternative examination; however; it determined that RT was not feasible because access to the subject welds was not available for film placement.

The licensee's limited scope volumetric examination was able to achieve 56.56 and 60.92 percent coverage for Braidwood Station, Unit 1 (1PZR-01-N2 and 1PZR-01-N3), and 88.5 and 88.5 percent coverage for Braidwood Station, Unit 2 (2PZR-01-N2 and 2PZR-01-N3), of the ASME Code-required examination volume specified in ASME Code, Figure IWB-2500-5, for the nozzle-to-vessel welds. In addition to performing the 0, 45, 60, and 70 degree UT scans required by ASME Code, Appendix I, the licensee performed numerous system leakage tests (ASME Code, Section XI, Category B-P, at nominal system operating pressure and temperature with no evidence of leakage. No recordable indications, other than geometric conditions associated with the pressurizer spray and relief nozzle-to-vessel welds were noted during the course of the interval.

Based on the above considerations, the NRC staff determined that the ASME Code, Section XI, requirement to perform volumetric examinations of the pressurizer nozzle-to-vessel and pressurizer spray welds with essentially 100 percent coverage of the examination volume is impractical. The NRC staff determined that based on the volumetric coverage obtained, it is reasonable to conclude that if significant service-induced degradation had occurred in the subject welds, evidence of it would have been detected. Furthermore, the staff determined that the examinations performed provide reasonable assurance of structural integrity of the subject welds for Braidwood Station, Units 1 and 2.

#### 4.0 CONCLUSION

As set forth above, the NRC staff concludes that 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 given due consideration to the burden upon the licensee that could result if the requirements were imposed on the facility. The NRC staff further concludes that it is impractical for the licensee to comply with the requirement and that the proposed inspection provides reasonable assurance of structural integrity of the subject components. Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(g)(6)(i). Therefore, the NRC staff grants relief for the subject examinations of the components contained in RR I3R-10 for Braidwood Station, Units 1 and 2, third 10-year ISI interval.

All other ASME Code, Section XI requirements for which relief was not specifically requested and approved in the subject requests for relief remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

Principal Contributor: Thomas K. Mclellan

Date: January 30, 2013

M. Pacilio

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

Sincerely,

**/ RA /**

Nicholas DiFrancesco, Acting Chief  
Plant Licensing Branch III-2  
Division of Operating Reactor Licensing  
Office of Nuclear Reactor Regulation

Docket Nos. STN 50-456 and STN 50-457

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