



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

September 15, 2015

Mr. Bryan C. Hanson
President and Chief Nuclear Officer
Exelon Nuclear
4300 Winfield Road
Warrenville, IL 60555

SUBJECT: THREE MILE ISLAND NUCLEAR STATION, UNIT 1 – RELIEF REQUEST
RR-14-01 REGARDING ALTERNATIVE ROOT MEAN SQUARE DEPTH SIZING
REQUIREMENTS (TAC NO. MF4873)

Dear Mr. Hanson:

By letter dated September 19, 2014, as supplemented by letter dated November 19, 2014 (Agencywide Documents Access and Management System Accession Nos. ML14262A002 and ML14328A189, respectively), Exelon Generation Company, LLC (the licensee) submitted Relief Request (RR)-14-01 to the U.S. Nuclear Regulatory Commission (NRC), requesting the use of alternate root mean square (RMS) error criteria for sizing flaws that are greater than the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) Case N-695, "Qualification Requirements for Dissimilar Metal Piping Welds" (N-695), for the fourth 10-year inservice inspection (ISI) interval at the Three Mile Island Nuclear Station (TMI), Unit 1.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.55a(g)(5)(iii), the licensee requested relief from the depth-sizing uncertainty qualification requirement for ultrasonic examinations conducted from the inside diameter of pipes (i.e., RMS error not greater than 0.125 inches), contained in ASME Code Case N-695. The licensee requested relief from the requirements for ISI items on the basis that the Code requirement is impractical.

The NRC staff has reviewed RR-14-01 and concludes, as set forth in the enclosed safety evaluation, that granting relief pursuant to 10 CFR 50.55a(g)(6)(i) is authorized by law, 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 described inspections provide reasonable assurance of structural integrity or leak tightness of the subject welds. Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(g)(5)(iii). Therefore, subject to the imposed alternative contained within the safety evaluation, the NRC staff grants the licensee's RR-14-01 at TMI, Unit 1, for the duration of the fourth ISI interval, which began on April 20, 2011, and ends no later than April 19, 2022, including the 1-year extension allowed by paragraph IWA-2430(d)(1) of ASME Section XI.

All other ASME Code, Section XI requirements for which relief was not specifically requested and authorized herein by the NRC staff remain applicable, including the third party review by the Authorized Nuclear Inservice Inspector.

B. Hanson

- 2 -

If you have any questions, please contact the Project Manager, Robert L. Gladney, at 301-415-1022 or Robert.Gladney@nrc.gov.

Sincerely,

A handwritten signature in black ink, appearing to read "Douglas A. Broaddus", followed by a circular stamp or mark.

Douglas A. Broaddus, Branch Chief
Plant Licensing Branch I-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-289

Enclosure:
Safety Evaluation

cc w/enclosure: Distribution via Listserv



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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELIEF REQUEST RR-14-01

FOR THE FOURTH 10-YEAR INSERVICE INSPECTION INTERVAL

EXELON GENERATION COMPANY, LLC

THREE MILE ISLAND NUCLEAR STATION, UNIT 1

DOCKET NO. 50-289

1.0 INTRODUCTION

By letter dated September 19, 2014, as supplemented by letter dated November 19, 2014 (Agencywide Documents Access and Management System (ADAMS) Accession Nos. ML14262A002 and ML14328A189, respectively), Exelon Generation Company, LLC (Exelon, the licensee) submitted Relief Request (RR)-14-01 to the U.S. Nuclear Regulatory Commission (NRC) requesting the use of alternate root mean square (RMS) error criteria for sizing flaws that are greater than the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) Case N-695, "Qualification Requirements for Dissimilar Metal Piping Welds," for the fourth 10-year inservice inspection interval (ISI) at the Three Mile Island Nuclear Station (TMI), Unit 1.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.55a(g)(5)(iii), the licensee requested relief from the depth-sizing uncertainty qualification requirement for ultrasonic examinations conducted from the inside diameter (ID) of pipes (i.e., RMS error not greater than 0.125 inches), contained in ASME Code Case N-695. The licensee requested relief from the requirements for ISI items on the basis that the ASME Code requirement is impractical.

2.0 REGULATORY EVALUATION

In its letter dated September 19, 2014, the licensee requested relief from the 0.125 inch RMS error depth-sizing acceptance criteria contained in ASME Code Case N-695 pursuant to 10 CFR 50.55a(g)(5)(iii).

ASME Code Case N-695 is accepted for use in NRC Regulatory Guide (RG) 1.147, Revision 17, "Inservice Inspection Code Case Acceptability. ASME Section XI, Division 1," and incorporated by reference in 10 CFR 50.55a(a).

Enclosure

As stated, in part, in 10 CFR 50.55a(g)(4)(ii): "Inservice examination of components and system pressure tests conducted during successive 120-month inspection intervals must comply with the requirements of the latest edition and addenda of the Code incorporated by reference in paragraph (a) of this section 12 months before the start of the 120-month inspection interval (or the optional ASME Code Cases listed in NRC Regulatory Guide 1.147."

As stated, in part, in 10 CFR 50.55a(g)(5)(iii), licensees may determine that conformance with certain Code requirements is impractical and that the licensee shall notify the Commission and submit information in support of the determination.

As stated, in part, in 10 CFR 50.55a(g)(6)(i), the Commission will evaluate determinations under paragraph (g)(5) of this section that Code requirements are impractical and that 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.

Based on the above, and subject to the following technical evaluation, the NRC staff finds that regulatory authority exists for the licensee to request, and the Commission to grant, the relief requested by the licensee.

3.0 TECHNICAL EVALUATION

3.1 The Licensee's Relief Request

Component Descriptions

RR-14-01 covers two reactor core flood nozzle to Safe-End Dissimilar Metal Welds designated RCT0001RC0009BMWELD for the Core Flood "B" Nozzle to Safe-End Weld and RCT0001RC0010BMWELD for the Core Flood "A" Nozzle to Safe-End Weld.

Both welds are approximately equal to 1.69 inches thick with a 0.19 inch (3/16th) thick onlay. The nozzles are constructed of American Society for Testing and Materials (ASTM) A508-64 low-alloy steel, and both safe-ends are constructed of SA-336-65 stainless steel. The Core Flood "B" Nozzle to safe-end weld has an alloy 82 weld onlay, and the Core Flood "A" Nozzle has an alloy 52 weld onlay. Both welds have an ER309L stainless steel weld buildup on both sides. The welds were machined to provide a smooth surface at the ID of the weld.

These weld inspections are also governed by ASME Code Case N-770-1. Both welds are Examination Category Item No. B, "Unmitigated Butt Weld at Cold Leg Operating Temperature."

Applicable Code Requirement

The code of record for the fourth 10-year inservice inspection (ISI) interval at Three Mile Island (TMI), Unit 1, is the ASME Section XI, 2004 Edition. For ASME Code Section XI, Appendix VIII, the 2001 edition is used, as per 10 CFR 50.55a(b)(2)(xv).

As discussed by the licensee and as required by 10 CFR 50.55a(g)(6)(ii)(F), ASME Code Case N-770-1, "Alternative Examination Requirements and Acceptance Standards for Class 1 PWR Piping and Vessel Nozzle Butt Welds Fabricated With UNS N06082 or UNS W86182 Weld Filler Material With or Without Application of Listed Mitigation Activities, Section XI, Division 1," is

utilized as amended by 10 CFR 50.55a(g)(6)(ii)(F). Code Case N-770-1, Table 1, Footnote (4) applies to volumetric examination of Inspection Items B and H, and requires that, "Ultrasonic volumetric examination shall be used and shall meet the applicable requirements of Appendix VIII." ASME Section XI 2001 Edition, Appendix VIII, Supplement 10, paragraph 3.2(b), requires that examination procedures, equipment, and personnel be qualified for depth sizing with an RMS error less than or equal to 0.125 inches.

ASME Code Case N-695 provides alternatives to the qualification requirements of Appendix VIII, Supplement 10. ASME Code Case N-695 Section 3.3(c) also requires that examination procedures, equipment, and personnel be qualified for depth-sizing with an RMS error less than or equal to 0.125 inches.

Reason for Request

This request is being submitted in accordance with 10 CFR 50.55a(g)(5)(iii). The licensee will perform volumetric examinations of the subject welds from the inner diameter during the upcoming refueling outage (October 2015) and will implement the requirements of ASME Section XI, Code Case N-695. Code Case N-695, Section 3.3(c), requires that qualified procedures, equipment, and personnel shall demonstrate a flaw depth-sizing error less than or equal to 0.125 inch RMS. As indicated by the licensee, no known inspection vendor has met the RMS error requirements to date.

The repeated inability of examination procedures to achieve the required RMS error value is due to a combination of factors such as surface condition (i.e., roughness), scan access, base materials, and the dendritic structure in the welds themselves. The combination of these factors has proven too difficult for vendors to achieve an RMS error value that meets the established requirements. The examination vendor the licensee intends to utilize has demonstrated an RMS error of 0.224 inches.

Proposed Alternative and Basis for Use

The licensee proposes to utilize an alternate depth-sizing RMS error value greater than the 0.125 inch RMS error value stated in ASME Code Case N-695 for the examination of the welds listed above. The licensee proposes to utilize an alternate RMS of 0.224 inch as demonstrated by the vendor for depth sizing. In the event of indications requiring depth-sizing, the licensee proposes to utilize the following approach:

1. The difference between the required RMS error (0.125 inch) and the demonstrated RMS error (0.224 inch) of 0.099 inch shall be added to the through-wall measurement for comparison with the applicable acceptance criteria.
2. Eddy Current examination techniques will be available to perform surface examinations as required to verify a flaw is not surface breaking.
3. Inner Diameter (ID) surface breaking flaws greater than 50 percent through-wall and subsurface flaws greater than 50 percent through-wall shall be repaired or evaluated prior to plant restart. Evaluations shall be submitted to the NRC for review and approval prior to plant restart.

4. If an improved depth-sizing RMS is demonstrated prior to examination performance, the excess of this new RMS error over the required RMS will be added to the measured value for comparison to the acceptance criteria.
5. For subsurface planar flaws, the difference between the RMS error and the demonstrated RMS error (0.099 inch) shall be added to both ends of the indication:
 - a. 0.099 inches will be added to the lower tip towards the ID surface
 - b. 0.099 inches will be added to the upper tip towards the outside diameter (OD) surface

All other requirements of the ASME Section XI Code and Code Cases N-695 and N-770-1 shall apply.

The licensee proposed the following regulatory commitment:

Inner Diameter (ID) surface breaking flaws greater than 50% through-wall and subsurface flaws greater than 50% through-wall shall be repaired or evaluated prior to plant restart. Evaluations shall be submitted to the NRC for review and approval prior to plant restart.

Basis for the Request (as stated)

Based on the conclusions from EPRI Materials Reliability Program Letter MRP 2012-046, the licensee proposes that the alternative will provide reasonable assurance that flaws detected during examination will be sized sufficiently for comparison with the acceptance criteria of Code Case N-770-1.

Duration of the Proposed Alternative

The licensee requested that RR-14-01 be applicable for the fourth ISI interval, which began on April 20, 2011, and ends no later than April 19, 2022, including the 1-year extension allowed by paragraph IWA-2430(d)(1) of ASME Section XI.

3.2 NRC Staff Evaluation

The licensee will use NRC-approved Code Case N-695 to satisfy the requirements of ASME Code, Section XI, Appendix VIII, Supplement 10. Code Case N-695 requires that procedures used to inspect welds from the inside surface of the pipe be qualified by performance demonstration. The acceptance criterion in Code Case N-695 specifies that the RMS error of the examination procedures shall not be greater than 0.125 inches. The licensee's inspection vendor could not meet the RMS error value in ASME Code Case N-695 and the licensee proposes an alternative to the acceptance criterion in ASME Code Case N-695 in accordance with 10 CFR 50.55a(g)(5)(iii).

The NRC staff has confirmed that since 2002, the industry has not been able to satisfy the RMS error acceptance criterion of less than 0.125 inches when qualifying the volumetric examination inspection procedures performed from the inside surface of a pipe. Developing

new technology capable of meeting the 0.125 inch RMS error and qualifying the new technology to meet the requirements of ASME Code Case N-695 would be a burden on the licensee. The NRC staff concludes that this repeated inability to qualify inside surface volumetric examination inspection techniques in accordance with ASME Code Case N-695 constitutes an impracticality as described in 10 CFR 50.55a(g)(5)(iii).

To address the issue of increased potential for undersizing of flaws by inside surface volumetric examination inspection procedures that do not meet ASME Code Case N-695 acceptance criterion, in 2012, the NRC staff, in conjunction with personnel from the Performance Demonstration Initiative, examined the proprietary volumetric examination data set compiled from all attempts to date to qualify inside surface volumetric examination inspection procedures to the acceptance criterion contained in ASME Code Case N-695. Based on this examination, the NRC staff concluded as follows:

- (a) For flaw depths less than or equal to 50 percent pipe wall thickness, a flaw could be appropriately depth sized if a correction factor is added to the measured flaw depth such that the adjusted flaw depth is equal to the measured flaw depth plus the difference between the vendor procedure qualification RMS error and 0.125 inches (procedure qualification RMS error - 0.125).
- (b) For flaw depths greater than 50 percent wall thickness, the variability of sizing errors is sufficiently large so that no single mathematic flaw size adjustment formula is sufficient to provide reasonable assurance of appropriate flaw depth-sizing. As a result, the NRC staff finds it necessary to evaluate the flaws that have depth greater than 50 percent through-wall on a case-by-case basis.

To provide reasonable assurance of the structural integrity of examined welds, the NRC staff determined that the following compensatory measures shall be applied to any proposed alternative examination to address the measurement uncertainty in flaw depth-sizing when examining welds from the inside surface:

- (1) Examine the welds under consideration using a volumetric examination technique that is qualified for flaw detection and length sizing.
- (2) For flaw(s) with a measured depth of less than 50 percent of the wall thickness, the depth shall be adjusted by adding the measured flaw depth to the difference between the procedure qualification RMS error and 0.125 inches (i.e., procedure qualification RMS error - 0.125).
- (3) For flaw(s) with measured depth of greater than 50 percent of the wall thickness, either the degraded weld needs to be repaired in accordance with the ASME Code, or a flaw evaluation needs be submitted to the NRC staff for review and approval prior to reactor startup. In addition, the flaw depth analyzed in the flaw evaluation shall also be adjusted by adding the measured flaw depth to the difference between the procedure qualification RMS and 0.125 inches (i.e., Procedure RMS - 0.125).
- (4) In addition to information normally contained in flaw evaluations performed in accordance with ASME Code, Section XI, IWB-3600, the submitted flaw evaluation shall include (a) information concerning the degradation mechanism that caused the crack,

(b) information concerning the surface roughness and/or profile in the area of the examined pipe and/or weld, and (c) information concerning areas in which the volumetric examination probe may "lift off" from the surface of the pipe and/or weld.

- (5) Perform eddy current examination(s) to confirm whether a flaw is connected to the inside surface of the pipe and/or weld.

As described above, the letter dated September 19, 2014, proposed the following regulatory commitment:

Inner Diameter (ID) surface breaking flaws greater than 50% through-wall and subsurface flaws greater than 50% through-wall shall be repaired or evaluated prior to plant restart. Evaluations shall be submitted to the NRC for review and approval prior to plant restart.

As per 10 CFR 50.55a(g)(6)(i), this proposed regulatory commitment will be elevated to a requirement of the relief request. As such, it will be imposed as part of the alternative in accordance with 10 CFR 50.55a(g)(6)(i).

The NRC staff concludes that the licensee's alternative is consistent with the compensatory measures discussed above, because (1) the licensee will add the correction factor to the crack tip(s); (2) the licensee will use eddy current testing to verify whether an embedded flaw is connected to the weld surface; and (3) the licensee will submit any flaw analysis for flaws greater than 50 percent through-wall to the NRC staff for review and approval prior to startup.

Therefore, the NRC staff determines that the alternative to the RMS error acceptance criterion of ASME Code Case N-695 provides reasonable assurance of the structural integrity and leak tightness in the subject welds.

4.0 CONCLUSION

As set forth above, the NRC staff determines that granting relief pursuant to 10 CFR 50.55a(g)(6)(i) is authorized by law, 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. Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(g)(5)(iii). Therefore, subject to the imposed alternative contained within this safety evaluation, the NRC staff grants the licensee's RR-14-01 at TMI, Unit 1, for the duration of the fourth ISI interval, which began on April 20, 2011, and ends no later than April 19, 2022, including the 1-year extension allowed by paragraph IWA-2430(d)(1) of ASME Section XI.

All other ASME Code, Section XI, requirements for which relief was not specifically requested and authorized herein by the NRC staff remain applicable, including the third party review by the Authorized Nuclear Inservice Inspector.

Principal Contributor: S. Cumblidge

Date: September 15, 2015

B. Hanson

- 2 -

If you have any questions, please contact the Project Manager, Robert L. Gladney, at 301-415-1022 or Robert.Gladney@nrc.gov.

Sincerely,

/RA JLamb for/

Douglas A. Broaddus, Branch Chief
Plant Licensing Branch I-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-289

Enclosure:
Safety Evaluation

cc w/enclosure: Distribution via Listserv

DISTRIBUTION:

PUBLIC
RidsNrrDeEpnb
Rids NrrDorlLpl1-2
RidsNrrDeEvib

LPLI-2 R/F
RidsACRS_MailCTR
RidsRgn1MailCenter

SCumblidge, NRR
RidsNrrPMThreeMileIsland
RidsNrrLALRonewicz

ADAMS Accession No.: ML15163A249

*by e-mail

OFFICE	DORL/LPLI-2/PM	DORL/LPLI-2/LA	DE/EPNB/BC*	DE/EVIB	DORL/LPLI-2/BC
NAME	RGladney	LRonewicz	DAlley	JMcHale	(JLamb for) DBroaddus
DATE	9/15/2015	9/15/2015	9/15/2015	6/19/2015	9/15/2015

OFFICIAL RECORD COPY