

February 21, 2002

Mr. Oliver D. Kingsley, President
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4300 Winfield Road
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SUBJECT: QUAD CITIES NUCLEAR POWER STATION, UNITS 1 AND 2 - RELIEF
REQUEST CR-37, INSERVICE INSPECTION PROGRAM RELIEF REGARDING
EXAMINATION OF PRESSURE RETAINING WELDS IN PIPING SUBJECT TO
APPENDIX VIII, SUPPLEMENT 11, EXAMINATION (TAC NOS. MB3767 AND
MB3768)

Dear Mr. Kingsley:

By letter dated January 4, 2002, Exelon Generation Company, LLC (the licensee) submitted Relief Request CR-37 related to the Third 10-Year Interval Inservice Inspection (ISI) Program for Quad Cities Nuclear Power Station (Quad Cities), Units 1 and 2. The licensee requested relief to utilize the Performance Demonstration Initiative (PDI) for implementation of certain ISI requirements of the American Society of Mechanical Engineers (ASME) *Boiler and Pressure Vessel Code*, 1995 Edition, 1996 Addenda, Section XI, Appendix VIII, Supplement 11.

Based on the information provided in the Relief Request CR-37, the Nuclear Regulatory Commission (NRC) staff concludes that the alternative proposed for the third 10-year ISI interval will provide an acceptable level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the NRC staff authorizes the ISI program alternative proposed in Relief Request CR-37 for the third 10-year ISI interval for Quad Cities Units 1 and 2, which is scheduled to conclude on February 17, 2003, and March 9, 2003, respectively.

The detailed results of the staff's review are provided in the enclosed safety evaluation. If you have any questions concerning this action, please call Mr. F. Lyon of my staff at (301) 415-2296.

Sincerely,

/RA/

Anthony J. Mendiola, Chief, Section 2
Project Directorate III
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket Nos. 50-254 and 50-265

Enclosure: Safety Evaluation

cc w/encl: See next page

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

OF THE THIRD TEN-YEAR INTERVAL INSERVICE INSPECTION PROGRAM

REQUEST FOR RELIEF CR-37

EXELON GENERATION COMPANY, LLC

QUAD CITIES NUCLEAR POWER STATION, UNITS 1 AND 2

DOCKET NOS. 50-254 AND 50-265

1.0 INTRODUCTION

The inservice inspection of American Society of Mechanical Engineers (ASME) *Boiler and Pressure Vessel Code* (Code) Class 1, Class 2, and Class 3 components are to be performed in accordance with Section XI of the ASME Code and applicable edition and addenda as required by 10 CFR 50.55a(g), except where specific relief has been granted by the Commission pursuant to 10 CFR 50.55a(g)(6)(i). 10 CFR 50.55a(a)(3) states in part that alternatives to the requirements of paragraph (g) may be used, when authorized by the NRC, if the licensee demonstrates that: (i) the proposed alternatives would provide an acceptable level of quality and safety, or (ii) compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Pursuant to 10 CFR 50.55a(g)(4), ASME Code Class 1, 2, and 3 components (including supports) will meet the requirements, except the design and access provisions and the 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(b) twelve months prior to the start of the 120-month interval, subject to the limitations and modifications listed therein. The components (including supports) may meet the requirements set forth in subsequent editions and addenda of the ASME Code incorporated by reference in 10 CFR 50.55a(b) subject to the limitations and modifications listed therein and subject to Commission approval.

By letter dated January 4, 2002, Exelon Generation Company, LLC (the licensee), requested relief (CR-37) from inservice inspection requirements associated with the implementation of Supplement 11 to Appendix VIII of Section XI of the ASME Code, 1995 Edition, 1996 Addenda, at the Quad Cities Nuclear Power Station, Units 1 and 2. The licensee's proposed alternative is to use the Electric Power Research Institute (EPRI) Performance Demonstration Initiative (PDI) program in lieu of Code requirements.

2.0 RELIEF REQUEST CR-37, EXAMINATIONS OF WELD OVERLAYS

This request is applicable to Class 1, Table IWB 2500-1, Examination Category B-J, Item B9.11 weld overlays.

2.1 Code Requirements for which Relief is Requested

Pursuant to 10 CFR 50.55a(a)(3)(i), the licensee is requesting relief from the weld overlay requirements in the following paragraphs to Section XI, Appendix VIII, Supplement 11.

Paragraph 1.1(d)(1) requires that all base metal flaws be cracks.

Paragraph 1.1(e)(1) requires that at least 20 percent but not less than 40 percent of the flaws shall be oriented within ± 20 degrees of the axial direction.

Paragraph 1.1(e)(1) also requires that the rules of IWA-3300 shall be used to determine whether closely spaced flaws should be treated as single or multiple flaws.

Paragraph 1.1(e)(2)(a)(1) requires that a base grading unit shall include at least 3 inches of the length of the overlaid weld and the outer 25 percent of the overlaid weld and base metal on both sides.

Paragraph 1.1(e)(2)(a)(3) requires that for unflawed base grading units, at least 1 inch of unflawed overlaid weld and base metal shall exist on either side of the base grading unit.

Paragraph 1.1(e)(2)(b)(1) requires that an overlay grading unit shall include the overlay material and the base metal-to-overlay interface of at least 6 square inches. The overlay grading unit shall be rectangular, with minimum dimensions of 2 inches.

Paragraph 3.2(b) requires that all extensions of base metal cracking into the overlay material by at least 0.1 inch are reported as being intrusions into the overlay material.

2.2 Licensee's Proposed Alternative to Code

The proposed alternative is to use the EPRI-PDI program in lieu of the requirements of Section XI, Appendix VIII, Supplement 11.

2.3 Licensee's Bases for Requesting Relief

Paragraph 1.1(d)(1), requires that all base metal flaws be cracks. As illustrated [in the submittal], implanting a crack requires excavation of the base material on at least one side of the flaw. While this may be satisfactory for ferritic materials, it does not produce a useable axial flaw in austenitic materials because the sound beam, which normally passes only through base material, must now travel through weld material on at least one side, producing an unrealistic flaw response. To resolve this issue, the PDI program revised this paragraph to allow use of alternative flaw mechanisms under controlled conditions. For example, alternative flaws shall be limited to when implantation of cracks precludes obtaining

an effective ultrasonic response, flaws shall be semielliptical with a tip width of less than or equal to 0.002 inches, and at least 70 percent of the flaws in the detection and sizing test shall be cracks and the remainder shall be alternative flaws.

Relief is requested to allow closer spacing of flaws provided they didn't interfere with detection or discrimination. The existing specimens used to date for qualifications to the Tri-party (NRC/BWROG[Boiling Water Reactor Owners Group]/EPRI) agreement have a flaw population density greater than allowed by the current Code requirements. These samples have been used successfully for all previous qualifications under the Tri-party agreement program. To facilitate their use and provide continuity from the Tri-party agreement program to Supplement 11, the PDI Program has merged the Tri-party test specimens into their weld overlay program. For example: the requirement for using IWA-3300 for proximity flaw evaluation in paragraph 1.1(e)(1) was excluded, instead indications will be sized based on their individual merits; paragraph 1.1(d)(1) includes the statement that intentional overlay fabrication flaws shall not interfere with ultrasonic detection or characterization of the base metal flaws; paragraph 1.1(e)(2)(a)(1) was modified to require that a base metal grading unit include at least 1 inch of the length of the overlaid weld, rather than 3 inches; paragraph 1.1(e)(2)(a)(3) was modified to require sufficient unflawed overlaid weld and base metal to exist on all sides of the grading unit to preclude interfering reflections from adjacent flaws, rather than the 1 inch requirement of Supplement 11; paragraph 1.1(e)(2)(b)(1) was modified to define an overlay fabrication grading unit as including the overlay material and the base metal-to-overlay interface for a length of at least 1 inch rather than the 6 square inch requirement of Supplement 11; and paragraph 1.1(e)(2)(b)(2) states that overlay fabrication grading units designed to be unflawed shall be separated by unflawed overlay material and unflawed base metal-to-overlay interface for at least 1 inch at both ends, rather than around its entire perimeter.

Additionally, the requirement for axially oriented overlay fabrication flaws in paragraph 1.1(e)(1) was excluded from the PDI Program as an improbable scenario. Weld overlays are typically applied using automated gas tungsten arc welding techniques with the filler metal being applied in a circumferential direction. Because resultant fabrication induced discontinuities would also be expected to have major dimensions oriented in the circumferential direction axial overlay fabrication flaws are unrealistic.

The PDI Program revised paragraph 2.0 to permit the overlay fabrication flaw test and the base metal flaw tests be performed separately.

The requirement in paragraph 3.2(b) for reporting all extensions of cracking into the overlay is omitted from the PDI Program because it is redundant to the RMS [root mean square] calculations performed in paragraph 3.2(c) and its presence adds confusion and ambiguity to depth

sizing as required by paragraph 3.2(c). This also makes the weld overlay program consistent with the Supplement 2 depth sizing criteria.

The PDI Program omits the phrase “and base metal on both sides,” in paragraph 1.1(e)(2)(a)(1) because some of the qualification samples included flaws on both sides of the weld. To avoid confusion, several instances of the term “cracks” or “cracking” were changed to the term “flaws” because of the use of alternative flaw mechanisms.

2.4 Evaluation

The nuclear power industry tasked PDI with the implementation of a Section XI, Appendix VIII, Supplement 11, performance demonstration program. The PDI program is routinely assessed by the staff for consistency with the Code and proposed Code changes. In order to meet the scheduled implementation date of November 22, 2001, specified in 10 CFR 50.55a(g)(6)(ii)(C), PDI evaluated the applicability of using test specimens from an existing weld overlay program¹ for its Supplement 11 performance demonstration program. Their evaluation identified differences with Paragraphs 1.1(e)(1), 1.1(e)(2)(a)(1), 1.1(e)(2)(a)(3), 1.1(e)(2)(b)(1), and 3.2(b). PDI proposed through the Code that these paragraphs be changed to permit using the existing weld overlay test specimens.

Paragraph 1.1(e)(1) requires that at least 20 percent but not less than 40 percent of the flaws shall be oriented within ± 20 degrees of the axial direction. In the PDI program, the flaws satisfy the requirement and specifies that the flaws must be in the base metal. This is a tightening of the requirements. Hence, PDI's application of flaw angles to the axial direction is acceptable.

Paragraph 1.1(e)(1) also requires that the rules of IWA-3300 shall be used to determine whether closely spaced flaws should be treated as single or multiple flaws. PDI treats each flaw as an individual flaw and not as part of a system of closely spaced flaws. PDI controls the flaws going into a test specimen set such that the flaws are free of interfering reflections from adjacent flaws. In some cases, this would permit flaws to be closer together than what is allowed by IWA-3300, thus making the performance demonstration more challenging. Hence, PDI's application for closely spaced flaws is acceptable.

Paragraph 1.1(e)(2)(a)(1) requires that a base grading unit shall include at least 3 inches of the length of the overlaid weld, and the base grading unit includes the outer 25 percent of the overlaid weld and base metal on both sides. The PDI program reduced the criteria to 1 inch of the length of the overlaid weld and eliminated from the grading unit the need to include both sides of the weld. The test specimens from the existing weld overlay program have flaws on both sides of the welds which prevents them from satisfying the base grading unit requirements. These test specimens have been used successfully for testing the proficiency of personnel for over 16 years. This is a more challenging test because the individual must locate the flaw on the correct side of the weld. Hence, PDI's application of the 1 inch length of the overlaid weld base grading unit and elimination from the grading unit of the need to include both sides of the weld is acceptable.

¹

The existing weld overlay program is the industry's response to Generic Letter 88-01 which resulted in a Tri-party Agreement between NRC, EPRI, and the Boiling Water Reactor Owners Group (BWROG), “Coordination Plan for NRC/EPRI/BWROG Training and Qualification Activities of NDE Personnel,” July 3, 1984.

Paragraph 1.1(e)(2)(a)(3) requires that for unflawed base grading units, at least 1 inch of unflawed overlaid weld and base metal shall exist on either side of the base grading unit. This is to minimize the number of false identifications of extraneous reflectors. The PDI program stipulates that unflawed overlaid weld and base metal exist on all sides of the grading unit and be free of interfering reflections from adjacent flaws, which addresses the same concerns as the Code. Hence PDI's application of the variable flaw free area adjacent to the grading unit is acceptable.

Paragraph 1.1(e)(2)(b)(1) requires that an overlay grading unit shall include the overlay material and the base metal-to-overlay interface of at least 6 square inches. The overlay grading unit shall be rectangular, with minimum dimensions of 2 inches. The PDI program reduces the base metal-to-overlay interface to at least 1 inch (in lieu of a minimum of 2 inches) and eliminates the minimum rectangular dimension. This criterion is more challenging than the Code because of the variability associated with the shape of the grading unit. Hence, PDI's application of the grading unit is acceptable.

Paragraph 3.2(b) requires that all extensions of base metal cracking into the overlay material by at least 0.1 inch be reported as intrusions into the overlay material. The PDI program omits this criteria. The PDI program requires that cracks be sized to the tolerance specified in the Code, which is 0.125 inches. Since the Code tolerance is close to the 0.1 inch value of Paragraph 3.2(b), any crack extending beyond 0.1 inch into the overlay material would be identified from its dimensions. The reporting of an extension in the overlay material is redundant for performance demonstration testing. Hence, PDI's omission of highlighting a crack extending beyond 0.1 inch into the overlay material is acceptable.

In addition to the changes for flaw locations, PDI determined that certain Supplement 11 requirements pertaining to location and size of cracks would be extremely difficult to achieve. In an effort to satisfy the requirements, PDI developed a process for fabricating flaws that exhibited crack-like reflective characteristics. Instead of all flaws being cracks, as required by Paragraph 1.1(d)(1), the PDI weld overlay performance demonstrations contain at least 70 percent cracks with the remainder being fabricated flaws exhibiting crack-like reflective characteristics. The NRC has reviewed the flaw fabrication process, and has compared the reflective characteristics between cracks and fabricated flaws. NRC found the fabricated flaws acceptable for the application.^{2,3}

² NRC memorandum, "Summary of Public Meeting Held January 31 - February 2, 2001," with PDI Representatives, March 2, 2001.

³ NRC memorandum, "Summary of Public Meeting Held June 12 through June 14, 2001," with PDI Representatives, November 29, 2001.

2.5 Conclusion

Based on the above evaluation, the staff has concluded that the proposed alternative to use the EPRI-PDI program requirements in lieu of Appendix VIII, Supplement 11 will provide an acceptable level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the alternative proposed in Relief Request CR-37 is authorized for the third 10-year interval for Quad Cities Nuclear Power Station, Units 1 and 2, which is scheduled to conclude on February 17, 2003, and March 9, 2003, respectively.

Principal Contributor: D. Naujock

Date: February 21, 2002