January 29, 2007

Mr. Christopher M. Crane
President and Chief Nuclear Officer
Exelon Generation Company, LLC
Byron Station, Unit No. 1
4300 Winfield Road
Warrenville, IL 60555

SUBJECT: BYRON STATION, UNIT NO. 1 - EVALUATION OF RELIEF REQUEST I3R-08 PERTAINING TO STRUCTURAL WELD OVERLAYS (TAC NO. MD1761)

Dear Mr. Crane:

By letter to the Nuclear Regulatory Commission (NRC) dated April 28, 2006, as supplemented by letters dated August 18 and September 14, 2006, Exelon Generation Company, LLC (the licensee) submitted a request for relief from the American Society of Mechanical Engineers *Boiler and Pressure Vessel Code* (ASME Code), Section XI, 2001 Edition through the 2003 Addenda, IWA-4000, for Byron Station (Byron), Unit No. 1, for the third 10-year interval, which began June 30, 2006, and will end on July 1, 2016. The licensee requested relief from the repair/replacement requirements for structural weld overlays on pressurizer spray, relief, safety, and surge nozzle safe ends.

The NRC staff concludes, based on the enclosed safety evaluation, that pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50 Section 55a(a)(3)(i), relief request I3R-08 is authorized for Byron, Unit No. 1 on the basis that the proposed alternatives provide an acceptable level of quality and safety. Relief from the requirements of ASME Code Cases N-504-2 and N-638-2 are authorized for the remaining service life of the subject welds. Relief from the requirements of ASME Code, Appendix VII, Supplement 11 are authorized for the reaminder of the third 10-year interval.

The letter date April 28, 2006 requested relief so that the 48-hour time hold prior to examination of the weld would begin after the third weld layer installation, instead of beginning the hold time after the weld reaches ambient temperature which is required by the ASME Code. This relief request was withdrawn by the licensee in its August 18, 2006 supplement and is not authorized.

The NRC staff's review of relief request I3R-08 for Byron, Unit No. 2 is ongoing. Relief Request I3R-08 will be addressed in future NRC correspondence for Byron, Unit No. 2.

During a teleconference call between the NRC staff and the licensee on September 14, 2006, verbal relief was authorized for Byron, Unit No. 1 for the third 10-year interval pursuant to 50.55a(a)(3)(i), based on the information provided in the licensee's April 28, 2006 submittal, as supplemented by letters dated August 18 and September 14, 2006.

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

Sincerely,

/RA/

Michael L. Marshall Jr., Chief
Plant Licensing Branch III-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. STN 50-454

Enclosure:
Safety Evaluation

cc w/encl: See next page

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

Sincerely,

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Michael L. Marshall Jr., Chief
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Safety Evaluation

cc w/encl: See next page

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED RELIEF TO REQUEST I3R-08

PERTAINING TO STRUCTURAL WELD OVERLAYS

EXELON GENERATION COMPANY, LLC

BYRON STATION, UNIT NO. 1

DOCKET NO. STN 50-454

1.0 INTRODUCTION

By letter to the Nuclear Regulatory Commission (NRC, Commission) dated April 28, 2006 (Agencywide Documents Access and Management System (ADAMS) Accession Number ML061180496), as supplemented by letters dated August 18, 2006 (ADAMS Accession Number ML062300200), and September 14, 2006 (ADAMS Accession Number ML062580460), Exelon Generation Company, LLC (Exelon, the licensee), proposed alternatives under relief request I3R-08, for the Byron Station (Byron), Unit Nos. 1 and 2, to the repair requirements of American Society of Mechanical Engineers *Boiler and Pressure Vessel Code* (ASME Code) Cases N-504-2, "Alternative Rules for Repair of Class 1, 2, and 3 Austenitic Stainless Steel Piping, Section XI, Division 1"; N-638-1, "Similar and Dissimilar Metal Welding Using Ambient Temperature Machine GTAW [Gas Tungsten-Arc Welding] Temper Bead Technique"; and Appendix VIII, Supplement 11, "Qualification Requirements for Full Structural Overlaid Wrought Austenitic Piping Welds," to the 1995 Edition with the 1996 Addenda of ASME Code, Section XI. The NRC staff has completed its review of relief request I3R-08 for Byron, Unit No. 1 which is addressed in the following safety evaluation (SE). The NRC staff is continuing its review of relief request I3R-08 for Byron, Unit No. 2, which will be addressed in future NRC correspondence. The alternatives would be used to perform preemptive full structural weld overlays on pressurizer spray, relief, safety, and surge nozzle safe ends.

2.0 REGULATORY EVALUATION

Pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.55a(g)(4), ASME Code Class 1, 2, and 3 components (including supports) must 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 (ISI) 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) 12 months prior

to the start of the 120-month interval, subject to the limitations and modifications listed therein. The ISI Code of record for Byron for the third 10-year ISI interval is the 2001 Edition of the ASME Code through the 2003 Addenda.

In accordance with 10 CFR 50.55a(g)(6)(ii)(C)(1), the implementation of Supplements 1 through 8, 10, and 11 of Appendix VIII to Section XI, the 1995 Edition with the 1996 Addenda of the ASME Code, was required on a phased schedule ending on November 22, 2002. Supplement 11 was required to be implemented by November 22, 2001. Additionally, 10 CFR 50.55a(g)(6)(ii)(C)(2) requires licensees implementing the 1989 Edition and earlier editions of paragraph IWA-2232 of Section XI of the ASME Code to implement the 1995 Edition with the 1996 Addenda of Appendix VIII and supplements to Appendix VIII of Section XI, Division 1, of the ASME Code.

Pursuant to 10 CFR 50.55a(g)(4)(iv), ISI items may meet the requirements set forth in subsequent editions and addenda of the ASME Code that are incorporated by reference in 10 CFR 50.55a(b), subject to the limitations and modifications listed therein, and subject to Commission approval. Portions of editions and addenda may be used provided that related requirements of the respective editions and addenda are met.

Pursuant to 10 CFR 50.55a(a)(3), alternatives to requirements may be authorized by the NRC if the licensee demonstrates that: (i) the proposed alternatives 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. The licensee submitted relief request I3R-08, pursuant to 10 CFR 50.55a(a)(3)(i), which proposed alternatives to the implementation of the ASME Code, Section XI, Appendix VIII, Supplement 11, N-504-2 and N-638-1 for the deposition of preemptive full structural weld overlays.

3.0 TECHNICAL EVALUATION

3.1 ASME Code Requirements for which Relief is Requested

Under the rules of IWA-4120, repairs shall be performed in accordance with the licensee's design specification and the original Construction Code. Later editions and addenda of the Construction Code or of ASME Code, Section III, either in their entirety or portions thereof, and ASME Code Cases may be used.

The licensee has requested relief from the requirements of ASME Code Cases N-638-1 and N-504-2, with conditions as specified in Regulatory Guide (RG) 1.147, Revision 14, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1," as well as ASME Code, Section XI, 1995 Edition with the 1996 Addenda, Appendix VIII, Supplement 11, which is required to be implemented per 10 CFR 50.55a(g)(6)(ii)(C).

3.2 Evaluation of Requests for Relief from Code Cases N-504-2 and N-638-1

3.2.1 Licensee's Proposed Alternatives to N-504-2

The licensee proposed to use N-504-2 with the following alternatives, which are discussed in Table 2 of the licensee's April 28, 2006 submittal, for full structural weld overlays:

1. Use of a nickel-based alloy weld material, Alloy 52/52M/152 rather than the low-carbon (0.035 percent maximum) austenitic stainless steel.

2. Relaxation from the requirement to perform delta ferrite measurements to meet the 7.5 Ferrite Number (FN) requirement of N-504-2. The FN requirement cannot be met because the Alloy 52/52M/152 weld material is 100-percent austenitic and contains no delta ferrite.

In Table 2, the licensee discusses a proposed modification to paragraph h) of N-504-2 which requires that the completed repair be pressure tested in accordance with IWA-5000, "System Pressure Tests." The ASME Code of record (2001 Edition through the 2003 Addenda) requires a hydrostatic test under conditions specified in IWA-4540. Since the flaw(s) did not breach the pressure boundary, a system leakage test is sufficient under N-504-2 and Appendix Q. Therefore, the NRC staff did not consider this a modification to the ASME Code.

3.2.2 Licensee's Basis for Relief From Requirements of N-504-2

Pursuant to 10 CFR 50.55a(a)(3)(i), the licensee stated that the weld overlay has been designed consistent with the requirements of N-504-2 with the specific thickness and length computed according to the guidance provided in N-504-2. The licensee stated that Alloy 52/52M/152 material is highly resistant to primary water stress-corrosion cracking (PWSCC) and that industry operational experience has shown that PWSCC in Alloy 82/182 will blunt at the interface with stainless steel base metal, ferritic base metal, or Alloy 52/52M/152 weld metal. The 360° structural weld overlay will control growth in any PWSCC crack and maintain weld integrity. The weld overlay will induce compressive stress in the weld, thus impeding growth of any reasonably shallow cracks.

The weld metal used will be Alloy 52/52M/152, which is an austenitic nickel alloy. These filler materials were selected for their improved resistance to PWSCC. Alloys 52 and 52M contain about 30-percent chromium that imparts excellent corrosion resistance. The existing Alloy 82/182 weld and the Alloy 52/52M/152 overlay are nickel based and have ductile properties and toughness similar to austenitic stainless steel piping welds at pressurized-water reactor operating temperature. These filler materials are suitable for welding over the ferritic nozzle, Alloy 82/182 weld and the austenitic stainless steel elbow.

Paragraph (e) of N-504-2 requires as-deposited delta ferrite measurements of at least 7.5 FN for the weld reinforcement. The licensee proposed that delta ferrite measurements will not be performed for this overlay because the deposited Alloy 52/52M/152 is 100-percent austenitic and contains no delta ferrite due to the high nickel composition (approximately 60-percent nickel).

3.2.3 NRC Staff Evaluation of Alternatives to N-504-2

Under the rules of IWA-4120, in editions and addenda up to and including the 1989 Edition through the 1990 Addenda, repairs shall be performed in accordance with the Owner's Design Specification and the original Construction Code of the component or system. Later editions and addenda of the Construction Code, or of Section III, either in their entirety or portions thereof, and ASME Code Cases may be used. In addition to the above requirements, defects shall be removed or reduced in size in accordance with IWA-4300, "Design." Alternatively, the component may be evaluated and accepted in accordance with the design rules of either the Construction Code, or Section III, when the Construction Code was not Section III. N-504-2 is being used by the licensee to perform full structural weld overlays on the Byron, Unit No. 1 pressurizer welds listed in Table 1 of the licensee's April 28, 2006, submittal as a preemptive measure against cracking due to PWSCC. N-504-2 was conditionally approved by the NRC staff for use under RG 1.147, Revision 14. Therefore, the use of N-504-2 as an alternative to the mandatory ASME Code repair provisions is acceptable to the NRC staff, provided that all conditions and provisions of the ASME Code Case are complied with.

The first proposed alternative to the N-504-2 provisions involves the use of a nickel-based alloy weld material, rather than the low-carbon austenitic stainless steel. The licensee stated that Paragraph (b) of N-504-2 requires that the reinforcement weld material shall be low-carbon (0.035 percent maximum) austenitic stainless steel. In lieu of the stainless steel weld material, Alloy 52/52M/152, a consumable welding wire highly resistant to PWSCC, was proposed for the overlay weld material. The NRC staff notes that the use of Alloy 52/52M/152 material is consistent with weld filler material used to perform similar weld overlays at operating boiling water reactor (BWR) facilities. The NRC staff finds that the proposed use of weld material Alloy 52/52M/152 for the full structural overlays provides an acceptable level of quality and safety and is, therefore, acceptable.

The second proposed alternative to the N-504-2 provisions involved Paragraph (e) of N-504-2 which requires as-deposited delta ferrite measurements of at least 7.5 FN for the weld reinforcement. The licensee proposed that delta ferrite measurements will not be performed for this overlay because the deposited Alloy 52/52M/152 material contains no delta ferrite due to the high nickel composition (approximately 60-percent nickel). N-504-2 allows the use of weld overlay repair by deposition of weld reinforcement on the outside surface of the pipe in lieu of mechanically reducing the defect to an acceptable flaw size. However, N-504-2 is only applicable to weld overlay repair of austenitic stainless steel piping. Therefore, the material requirements regarding the carbon content limitation (0.035 percent maximum) and the delta ferrite content of at least 7.5 FN, as delineated in N-504-2, Paragraphs (b) and (e), apply to austenitic stainless steel weld overlay materials. These requirements are not applicable to Alloy 52/52M/152, a nickel-based material which the licensee will use for the weld overlays, therefore, the NRC staff finds the licensee's proposed alternative to not measure delta ferrite composition acceptable.

The NRC staff notes that the licensee is performing a full structural overlay on dissimilar metal welds made of Alloy 182 material. For material compatibility in welding, the NRC staff considers Alloy 52/52M/152 a better choice of filler material than austenitic stainless steel material for this weld joint configuration. Alloy 52/52M/152 contains about 28-percent chromium which would provide excellent resistance to PWSCC in the reactor coolant environment. This material is identified as F-No. 43 Grouping for Ni-Cr-Fe, classification UNS N06052 Filler Metal

and has been previously approved by the NRC staff for similar applications. Therefore, the NRC staff finds that the licensee's proposed use of Alloy 52/52M/152 for the weld overlays as an alternative to the requirements of N-504-2, paragraphs (b) and (e) is acceptable.

3.2.4 Licensee's Proposed Alternatives to N-638-1

The licensee proposed to use N-638-1 with the following alternatives for full structural weld overlays:

- The maximum area of an individual weld based on the finished surface over the ferritic material will slightly exceed 100 square inches (in^2).

- Full ultrasonic testing (UT) of the 1.5T band on either side of the overlay(s) will not be performed. UT will be performed on the actual weld overlay, meeting the requirements of ASME Code, Section XI, Nonmandatory Appendix Q, "Weld Overlay Repair of Class 1, 2, and 3 Austenitic Stainless Steel Piping Weldments."

- The weld overlay will be examined using a surface and ultrasonic method when the three tempering layers are completed and have been in place for at least 48 hours.

3.2.5 Licensee's Basis for Relief From the Requirements of N-638-1

For the first alternative, the licensee stated that the one-half base metal thickness limitation, which also includes the 100 in^2 surface area limitation under 1.0(a) of N-638-1, applies only to excavation and repair. Therefore, the 100 in^2 surface area limitation is not applicable to this application which consists of an overlay. There have been a number of temper bead weld overlay repairs applied to safe end-to-nozzle welds in the nuclear industry and a structural weld overlay was recently approved for the Susquehanna Steam Electric Station. The licensee also stated that ASME Code Case N-432-1, "Repair Welding Using Automatic or Machine Gas Tungsten-Arc Welding (GTAW) Temper Bead Technique," which is approved for use in RG 1.147, allows temper bead welding on low-alloy steel nozzles without limiting the surface area.

For the second alternative, the licensee stated that a full UT of 1.5T band will not be performed because later editions of ASME Code, Section XI and the next revision to N-638-1 removed the 1.5T requirement. This is in line with the less restrictive requirements for UT of the ferritic nozzle due to hydrogen cracking which is not considered an issue in later editions of the ASME Code and N-638-1. The licensee stated that if the cracking were to occur, it would be beneath the weld overlay instead of the 1.5T area that is not covered by the overlay. The licensee in its September 14, 2006, submittal committed to:

> [p]rovide the details of the ultrasonic examination results of the structural weld overlays on the Byron Station Unit 1 pressurizer spray, relief, safety and surge nozzle safe-ends to the NRC within 14 days of the completion of the final ultrasonic examination. EGC [Exelon] will notify the NRC Project Manager for Byron Station when the examination of the final structural weld overlay is complete.

For the third alternative, the licensee stated that a white paper in support of a proposed revision to ASME Code Case N-638-x, to allow the 48-hour hold time to begin after the third weld layer installation is completed, was provided as described in Attachment 2 to the submittal.

3.2.6 NRC Staff Evaluation of Alternatives to N-638-1

N-638-1 allows the use of machine GTAW with ambient temperature preheat and no post-weld heat treatment when draining the vessel is impractical. N-638-1, paragraph 1(a) limits the size of the repair to a 100 in^2 maximum. However, because of the diameter of components listed in Table 1 of the submittal, the weld overlays will slightly exceed the 100 in^2 limit on the ferritic material, according to the information provided by the licensee. In the licensee's response to the NRC staff's request for additional information dated August 18, 2006, the licensee provided the following information with respect to surface areas of weld materials deposited on both austenitic and ferritic materials:

Nozzle ID	Estimated Total Surface Area of Weld Overlay (square inches)	Estimated Total Surface Area of Weld Overlay on Ferric Nozzle (square inches)
Spray-FN-02	158	30
Relief-FN-03	219	43
Safety-FN-04	221	43
Safety-FN-05	217	43
Safety-FN-06	217	43
Surge-FN-07	485	108

N-638-1 limits the size of the repair to a maximum of 100 in^2 and a depth not greater than one-half the ferritic base metal thickness. Some of the reasons for these limits are distortion of weld and base metal, cracking in the weld and base metal, and high residual stresses when a large repair excavation is being performed in the ferritic material of a dissimilar metal weld. The final weld surface areas requested in these relief requests are significantly larger than those allowed by the ASME Code for the austenitic portion of the dissimilar metal weld, but within the bounds for the ferritic portion. In the application of the preemptive weld overlay for this relief request, there is no large excavation in the ferritic portion of the material, therefore, the 100 in^2 limitation would not significantly contribute to cracking when the ferritic material is overlaid rather than excavated. The NRC staff concludes that the alternative to exceed the 100 in^2 limitation to the size as described in the table above, on the ferritic portion of the overlay, will provide an acceptable level of quality and safety and, therefore is acceptable.

The second alternative requested by the licensee is that full UT of the 1.5T band will not be performed, which is required under Paragraph 4.0(b). The NRC staff notes that the post weld overlay area, as defined under ASME Code, Section XI, Nonmandatory Appendix Q is one-half inch on either side of the overlay for surface examination and the completed overlay for UT examination. Appendix Q is a condition to the use of N-504-2 imposed by the NRC staff under RG 1.147, Revision 14, which the licensee specifically states that it will comply with. The issues

of cracking and/or distortion of the weld and base metal were not specifically addressed in the ASME Code case development work. Since the weld overlays are fabricated from austenitic materials with inherent toughness, no cracking in the overlays is expected to occur due to the shrinkage associated with the weld overlay. With respect to the ferritic portion of the overlays, many temper bead weld overlays have been applied in the nuclear industry at these nozzle to safe-end locations. In no instance has there been any reported cracking due to the weld overlay application. The stiffness and high toughness inherent in the low-alloy steel material is expected to protect against any cracking and limit any distortion that might occur in the low-alloy steel material. In its supplemental letter dated August 18, 2006, the licensee stated that it will be measuring and evaluating axial shrinkage for impact on the materials and on the piping system after the weld overlay is deposited, which is in accordance with the requirements of N-504-2. In addition, any cracking that might occur should be detected by the final nondestructive examination (NDE) of the weld overlay required under Appendix Q, which provides additional assurance of the deposition of a defect free, structurally sound overlay. The assessment of the shrinkage stresses on the piping, plus post-weld NDE volumes under Appendix Q, provide reasonable assurance that defect free welds will result in continued structural integrity of the piping. The NRC staff finds that the alternative testing under Appendix Q will provide an acceptable level of quality and safety. Therefore, the NRC staff authorizes the licensee's proposed alternative to the 1.5T band UT examination requirement under N-638-1.

In its supplemental letter dated August 18, 2006, the licensee stated that it recognized the NRC staff's position with respect to the 48-hour hold time alternative and that the licensee was revising its position to comply with the requirement to begin the post-overlay 48 hours after the weld overlay has reached ambient temperature. The NRC staff finds that the alternative requested no longer exists and relief is not granted from this requirement.

Based on the above evaluation, the NRC staff finds that the licensee's proposed alternatives to the requirements of N-504-2 and N-638-1 for preemptive weld full structural overlay of the subject welds are acceptable, because they will provide an acceptable level of quality and safety.

3.3 Evaluation of Request for Relief from ASME Code, Section XI, Appendix VIII, Supplement 11

3.3.1 ASME Code, Section XI, Appendix VIII, Supplement 11 Requirements for which Relief is Requested

Pursuant to 10 CFR 50.55a(a)(3)(i), the licensee requested relief from the weld overlay requirements in the following paragraphs to ASME Code, Section XI, Appendix VIII, Supplement 11 (only those items considered by the NRC staff to be modifications to Appendix VIII, Supplement 11 are listed in this SE):

Paragraph 1.0(b) limits the maximum thickness for which a procedure may be qualified. In addition, the specimen set must include at least one specimen with overlay thickness within minus 0.1 inch to plus 0.25 inch of the maximum nominal overlay thickness for which the procedure is applicable.

Paragraph 1.1(d)(1) requires that all base metal flaws be cracks in or near the butt weld heat-affected zone, open to the inside surface, and extending at least 75 percent through the base metal wall.

Paragraph 1.1(e)(1) requires that at least 20 percent but not more 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, "Flaw Characterization," shall be used to determine whether closely spaced flaws should be treated as single or multiple flaws.

Specimens shall be divided into base and overlay grading units with each specimen containing one or both types of grading units.

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 in^2. The overlay grading unit shall be rectangular with minimum dimensions of 2 in.

Paragraph 3.1 requires that examination procedures, equipment and personnel are qualified for detection when the results of the performance demonstration satisfy the acceptance criteria of Table VII-S2-1 for both detection and false calls. The criteria shall be satisfied separately by the demonstration results for base grading units and for overlay grading units.

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

3.3.2 Licensee's Proposed Alternatives to ASME Code Section XI, Appendix VIII, Supplement 11 Requirements

In lieu of the requirements of ASME Code, Section XI, 1995 Edition through the 1996 Addenda, Appendix VIII, Supplement 11, the Electric Power Research Institute (EPRI) Performance Demonstration Initiative (PDI) program as described in Table 4 of the licensee's submittal shall be used. The duration of the relief is for the remainder of the Byron, Unit No. 1 third 10-year ISI interval.

3.3.3 Licensee's Basis for Relief from ASME Code Section XI, Appendix VIII, Supplement 11 Requirements

The licensee stated that the UT of the completed preemptive weld overlays will be accomplished in accordance with ASME Code, Section XI, 1995 Edition through the 1996 Addenda, Appendix VIII, Supplement 11 with the modifications described in Table 4 of the submittal. These modifications were developed by the EPRI PDI program to implement the requirements of Appendix VIII. These EPRI modifications to Supplement 11 have previously been approved for use by the NRC staff.

3.3.4 NRC Staff Evaluation of Alternatives to ASME Code Requirements

EPRI created the PDI to implement performance demonstration requirements contained in Appendix VIII of Section XI of the ASME Code. To this end, PDI has developed a program for qualifying equipment, procedures, equipment, and personnel in accordance with the UT criteria of Appendix VIII, Supplement 11. Prior to the Supplement 11 program, EPRI was maintaining a performance demonstration program for weld overlay qualification under the Tri-party Agreement dated July 3, 1984. Instead of having two programs with similar objectives, the NRC staff recognized the PDI program for weld overlay qualifications as an acceptable alternative to the Tri-party Agreement. The PDI program does not fully comport with the existing requirements of Supplement 11. The differences are discussed below.

Paragraph 1.1(b) of Supplement 11 states limitations to the maximum thickness for which a procedure may be qualified. The ASME Code states, "The specimen set must include at least one specimen with overlay thickness within minus 0.10-inch to plus 0.25 inch of the maximum nominal overlay thickness for which the procedure is applicable." The ASME Code requirement addresses the specimen thickness tolerance for a single specimen set, but is confusing when multiple specimen sets are used. The PDI proposed alternative states, "the specimen set shall include specimens with overlay not thicker than 0.10-inch more than the minimum thickness, nor thinner than 0.25-inch of the maximum nominal overlay thickness for which the examination procedure is applicable." The proposed alternative provides clarification on the application of the tolerance. The tolerance is unchanged for a single specimen set, however, it clarifies the tolerance for multiple specimen sets by providing tolerances for both the minimum and maximum thicknesses. The proposed wording eliminates confusion while maintaining the intent of the overlay thickness tolerance. Therefore, the NRC staff finds that the licensee's use of the PDI Program revision is acceptable.

Paragraph 1.1(d)(1) requires that all base metal flaws be cracks. PDI determined that certain Supplement 11 requirements pertaining to location and size of cracks would be extremely difficult to achieve. For example, flaw implantation requires excavating a volume of base material to allow a pre-cracked coupon to be welded into this area. This process would add weld material to an area of the specimens that typically consists of only base material, and could potentially make UT examination more difficult and not representative of actual field conditions. In an effort to satisfy the requirements, PDI developed a process for fabricating flaws that exhibit 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 fabricated flaws are semi-elliptical with tip widths of less than 0.002 inches. The licensee provided further information describing a revision to the PDI program alternative to

clarify when real cracks, as opposed to fabricated flaws, will be used; “Flaws shall be limited to the cases where implantation of cracks produces spurious reflectors that are uncharacteristic of actual flaws.” The NRC staff has reviewed the flaw fabrication process, compared the reflective characteristics between actual cracks and PDI-fabricated flaws, and finds the fabricated flaws acceptable.

Paragraph 1.1(e)(1) requires that at least 20 percent but not more than 40 percent of the flaws shall be oriented within ± 20 degrees of the axial direction of the piping test specimen. Flaws contained in the original base metal heat-affected zone satisfy this requirement. However, PDI excludes axial fabrication flaws in the weld overlay material. PDI has concluded that axial flaws in the overlay material are improbable because the overlay filler material is applied in the circumferential direction (parallel to the girth weld), therefore fabrication anomalies would also be expected to have major dimensions in the circumferential direction. The NRC staff finds this approach to implantation of fabrication flaws to be reasonable. Therefore, the NRC staff finds that the licensee’s use of PDI’s application of flaws oriented in 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 permits flaws to be spaced closer than what is allowed for classification as a multiple set of flaws by IWA-3300, thus potentially making the performance demonstration more challenging. The NRC staff finds that the licensee’s use of 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 proposed change permits the PDI program to continue using test specimens from the existing weld overlay program which have flaws on both sides of the welds. These test specimens have been used successfully for testing the proficiency of personnel for over 16 years. The weld overlay qualification is designed to be a near-side [relative to the weld] examination, and it is improbable that a candidate would detect a flaw on the opposite side of the weld due to the sound attenuation and redirection caused by the weld micro-structure. However, the presence of flaws on both sides of the original weld (outside the PDI grading unit) may actually provide a more challenging examination, as candidates must determine the relevancy of these flaws, if detected. Therefore, the NRC staff finds that the licensee’s request to adopt PDI’s use of the 1-inch length of the overlaid weld base grading unit and elimination from the grading unit the need to include both sides of the weld, as described in the revised PDI program alternative, is acceptable.

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 exists on all sides of the grading unit and that flawed grading units must be free of interfering reflections from adjacent flaws, which addresses the same concerns as ASME Code. The NRC staff finds that the licensee’s use of 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 a base metal-to-overlay interface of at least 6 in^2. 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 necessary to allow use of existing examination specimens that were fabricated in order to meet NRC Generic Letter 88-01 (Tri-party Agreement dated July 3, 1984). This criterion may be more challenging than the ASME Code because of the variability associated with the shape of the grading unit. The NRC staff finds that the licensee's proposed reduction of the base metal-to-overlay interface to at least 1 inch and elimination of the minimum rectangular dimension is acceptable.

Paragraph 2.3 states, for depth sizing tests, that 80 percent of the flaws shall be sized at a specific location on the surface of the specimen identified to the candidate. This requires detection and sizing tests to be separate. PDI revised the weld overlay program to allow sizing to be conducted either in conjunction with, or separately from, the flaw detection test. If performed in conjunction with detection, and the detected flaws do not meet the Supplement 11 range criteria, additional specimens will be presented to the candidate with the regions containing flaws identified. Each candidate will be required to determine the maximum depth of flaw in each region. For separate sizing tests, the regions of interest will also be identified and the maximum depth and length of each flaw in five of the regions will similarly be determined. In addition, PDI stated that grading units are not applicable to sizing tests, and that each sizing region will be large enough to contain the target flaw, but small enough that candidates will not attempt to size a different flaw. The above clarification provides a basis for implementing sizing tests in a systematic, consistent manner that meets the intent of Supplement 11. As such, the NRC staff finds that this method is acceptable.

Paragraphs 3.1 and 3.2 of Supplement 11 state that procedures, equipment and personnel as a complete ultrasonic system are qualified for detection or sizing of flaws, as applicable, when certain criteria are met. The PDI program allows procedure qualification to be performed separately from personnel and equipment qualification. Historical data indicate that, if ultrasonic detection or sizing procedures are thoroughly tested, personnel and equipment using those procedures have a higher probability of successfully passing a qualification test. In an effort to increase this passing rate, PDI has elected to perform procedure qualifications separately in order to assess and modify essential variables that may affect overall system capabilities. For a procedure to be qualified, the PDI program requires three times as many flaws to be detected (or sized) as shown in Supplement 11 for the entire ultrasonic system. The personnel and equipment are still required to meet Supplement 11. Therefore, the NRC staff finds that the licensee's use of the PDI program is acceptable because it exceeds ASME Code requirements for personnel, procedures, and equipment qualification.

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 being intrusions into the overlay material. The PDI program omits this criterion because of the difficulty in actually fabricating a flaw with a 0.1-inch minimum extension into the overlay, while still knowing the true state of the flaw dimensions. However, the PDI program requires that cracks be depth-sized to the tolerance of 0.125 inch as specified in ASME Code. Since the ASME 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 as such from the characterized dimensions. The reporting of an extension in the overlay material is redundant for performance demonstration testing because of the flaw sizing

tolerance. Therefore, the NRC staff finds that the licensee's request to adopt PDI's omission of highlighting a crack extending beyond 0.1 inch into the overlay material is acceptable.

3.4 Commitments

The licensee, in its September 14, 2006, submittal committed to:

> [p]rovide the details of the ultrasonic examination results of the structural weld overlays on the Byron Station Unit 1 pressurizer spray, relief, safety and surge nozzle safe-ends to the NRC within 14 days of the completion of the final ultrasonic examination. EGC will notify the NRC Project Manager for Byron Station when the examination of the final structural weld overlay is complete.

4.0 CONCLUSION

Based on the evaluation above, the NRC staff concludes that the alternatives to ASME Code Cases N-504-2 and N-638-1 proposed in Relief Request I3R-08, for the preemptive full structural overlay of the Byron Unit No. 1 pressurizer welds listed in Table 1 of the licensee's submittal dated April 28, 2006, will provide an acceptable level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the NRC staff authorizes the proposed alternatives for the remaining service life of the subject welds.

Based on the evaluation above, the NRC staff concludes that the proposed alternatives to ASME Code, Appendix VIII, Supplement 11, will provide an acceptable level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), the NRC staff authorizes the proposed alternatives for the remainder of the third 10-year ISI interval fo Byron, Unit No. 1.

The licensee's submittal dated April 28, 2006 requested relief to allow a 48-hour hold time to begin after the third weld layer installation. In its supplemental letter dated August 18, 2006, the licensee stated that it recognized the NRC staff's position with respect to the 48-hour hold time alternative and that the licensee was revising its position to comply with the requirement to begin the post overlay 48 hours after the weld has reached ambient temperature. The NRC staff finds that the alternative requested no longer exists and relief is not granted from this requirement.

The NRC staff's review of relief request I3R-08 for Byron, Unit No. 2 is ongoing. Relief request I3R-08 will be addressed in future NRC correspondence for Byron, Unit No. 2.

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

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Date: January 29, 2007

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