



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

February 24, 2016

Mr. Oscar A. Limpias
Vice President-Nuclear and CNO
Nebraska Public Power District
72676 648A Avenue
Brownville, NE 68321

SUBJECT: COOPER NUCLEAR STATION - REQUEST FOR RELIEF RR5-01,
ALTERNATIVE WELD OVERLAY REPAIR FOR A DISSIMILAR METAL WELD
JOINING NOZZLE TO CONTROL ROD DRIVE END CAP IN LIEU OF
SPECIFIC AMERICAN SOCIETY OF MECHANICAL ENGINEERS BOILER AND
PRESSURE VESSEL CODE REQUIREMENTS (CAC NO. MF6332)

Dear Mr. Limpias:

By letter dated June 9, 2015 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML15167A066), as supplemented by letter dated October 29, 2015 (ADAMS Accession Number ML15310A059), Nebraska Public Power District (NPPD, the licensee) requested an alternative to the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, IWA-4000, "Repair/Replacement Activities," and Nonmandatory Appendix Q, "Weld Overlay Repair of Classes 1, 2, and 3 Austenitic Stainless Steel Piping Weldments," at Cooper Nuclear Station (CNS).

Pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(z)(1), the licensee proposed an alternative to codes and standards requirements on the basis that the alternative would provide an acceptable level of quality and safety. Specifically, Relief Request RR5-01 proposes an Inservice Inspection (ISI) alternative to install a full structural weld overlay (FSWOL) on the control rod drive nozzle to cap weld at CNS during Refueling Outage 29, which is projected to occur during the fifth 10-year ISI interval. The licensee intends to use the ISI alternative only as a contingency in the event that a flaw is discovered in the control rod drive nozzle to cap weld resulting in the need for a FSWOL.

The U.S. Nuclear Regulatory Commission (NRC) staff has reviewed the subject relief 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(z)(1) and is in compliance with the requirements of the ASME Code, Section XI for which relief was not requested. Therefore, the NRC staff authorizes the use of Relief Request RR5-01 at CNS as a contingency, if a flaw is discovered during Refueling Outage 29. The proposed alternative is authorized for the fifth 10-Year ISI interval.

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

O. Limpias

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If you have any questions, please contact Thomas Wengert at 301-415-4037 or via e-mail at Thomas.Wengert@nrc.gov.

Sincerely,

A handwritten signature in black ink, appearing to read 'Meena K. Khanna', with a large, sweeping flourish at the end.

Meena K. Khanna, Chief
Plant Licensing IV-2 and Decommissioning
Transition Branch
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-298

Enclosure:
Safety Evaluation

cc w/encl: Distribution via Listserv



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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

REQUEST FOR RELIEF RR5-01

ALTERNATIVE WELD OVERLAY REPAIR FOR A DISSIMILAR
METAL WELD JOINING NOZZLE TO CONTROL ROD DRIVE END CAP

NEBRASKA PUBLIC POWER DISTRICT

COOPER NUCLEAR STATION

DOCKET NO. 50-298

1.0 INTRODUCTION

By letter dated June 9, 2015 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML15167A066), as supplemented by letter dated October 29, 2015 (ADAMS Accession Number ML15310A059), Nebraska Public Power District (NPPD, the licensee) requested an alternative to the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, IWA-4000, "Repair/Replacement Activities," and Nonmandatory Appendix Q, "Weld Overlay Repair of Classes 1, 2, and 3 Austenitic Stainless Steel Piping Weldments," at Cooper Nuclear Station (CNS).

Pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(z)(1), the licensee proposed an alternative to codes and standards requirements on the basis that the alternative would provide an acceptable level of quality and safety. Specifically, Relief Request RR5-01 proposes an inservice Inspection (ISI) alternative to install a full structural weld overlay (FSWOL) on the control rod drive nozzle to cap weld at CNS during Refueling Outage 29, which is projected to occur during the fifth 10-year ISI interval. The licensee intends to use the ISI alternative only as a contingency in the event that a flaw is discovered in the control rod drive nozzle to cap weld resulting in the need for an FSWOL. CNS currently has no weld overlays installed.

2.0 REGULATORY EVALUATION

The licensee requested authorization of an alternative to the requirements of Article IWA-4000 of the ASME Code, Section XI, pursuant to 10 CFR 50.55a(z)(1).

Adherence to Section XI of the ASME Code is mandated by 10 CFR 50.55a(g)(4), which states, in part, that ASME Code Class 1, 2, and 3 components (including supports) will meet the

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requirements, except the design and access provisions and the pre-service examination requirements, set forth in the ASME Code, Section XI.

The regulation in 10 CFR 50.55a(z) states, in part, that alternatives to the requirements of paragraph (g) of 10 CFR 50.55a may be used, when authorized by the U.S. Nuclear Regulatory Commission (NRC), if the licensee demonstrates that: (1) the proposed alternative provides an acceptable level of quality and safety, or (2) compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. The proposed alternative must be submitted and authorized prior to implementation.

Based on the above, and subject to the following technical evaluation, the NRC staff finds that regulatory authority exists for the licensee to request the use of an alternative and the NRC to authorize the proposed alternative.

3.0 TECHNICAL EVALUATION

3.1 ASME Code Components Affected

Code Class: ASME Section XI Code Class 1
Examination Categories: B-F
Item Number: B5.10
Component Numbers: RCA-BF-1, 5 inch Control Rod Drive Return Cap to Nozzle N9 Weld

3.2 Applicable Code Edition and Addenda

ASME Code, Section XI, 2007 Edition through 2008 Addenda.

3.3 Applicable Code Requirements

ASME Section XI, Article IWA-4000, "Repair/Replacement Activities" provides requirements for repair or replacement of Class 1, 2 or 3 components. Article IWA-4400, "Welding, Brazing, Metal Removal, Fabrication, and Installation" provides requirements for repair/replacement of Class 1, 2 or 3 components by welding.

ASME Section XI, IWA-4411 requires repair/replacement activities to be performed in accordance with the Owner's Requirements and the original Construction Code of the component or item. Alternatively, IWA-4411(a) and (b) allows use of later Editions and Addenda of the Construction Code either in its entirety or portions thereof, Code Cases, and revised Owner Requirements. IWA-4411(e) permits the use of IWA-4600(b) when welding is to be performed without postweld heat treatment (PWHT) required by the Construction Code. IWA-4411(h) permits the use of Nonmandatory Appendix Q for the installation of welded overlays for the repair of stress corrosion cracking (SCC) in Class 1, 2 or 3 austenitic stainless steel pipe weldments.

ASME Section XI, IWA-4190(a) requires Code Cases used for repair/replacement activities to be applicable to the Edition and Addenda of Section XI specified for the activity.

IWA-4600(b) provides temper bead welding requirements in accordance with IWA-4620, IWA-4630 and IWA-4640 as an alternative to the welding and postweld heat treatment requirements of the Construction Code. NRC-approved Code Cases may also be used as an alternative to the welding and postweld heat treatment requirements of the Construction Code.

ASME Section XI, Code Case N-638-4, "Similar and Dissimilar Metal Welding Using Ambient Temperature Machine GTAW [Gas Tungsten Arc Welding] Temper Bead Technique," may be used as an alternative to following the preheat and PWHT requirements of IWA-4400. Code Case N-638-4 is the latest version of this Code Case approved by the NRC, but is not applicable for editions of the Code later than 2004. Paragraph 2.1 of Code Case N-638-4 provides the requirements for qualifying procedures used to perform temper bead welding of similar and dissimilar metal weld joints using the ambient temperature machine GTAW technique. Paragraph 2.1.c of Code Case N-638-4 requires that consideration shall be given to the effects of irradiation on the properties of material for applications in the core belt line region of the reactor vessel. Paragraphs 2.1.g, 2.1.h, 2.1.i and 2.1.j of Code Case N-638-4 contain the requirements for performing Charpy V-notch impact testing of procedure qualification test assemblies of ferritic materials.

ASME Section XI Mandatory Appendix VIII provides procedure and personnel qualification requirements for ultrasonic examination and is required by Nonmandatory Appendix Q. Appendix VIII, Supplement 11 is applicable to full structural overlaid wrought austenitic piping welds. Appendix VIII, Supplement 11 is not applicable to overlays of dissimilar metal welds.

ASME Section XI Nonmandatory Appendix Q, "Weld Overlay Repair of Classes 1, 2, and 3 Austenitic Stainless Steel Piping Weldments" provides guidance for the weld overlay repair of austenitic stainless steel pipe weldments. Appendix Q is not applicable to the repair of weldments involving alloy steel and/or austenitic nickel-based alloys.

3.4 Reason for Request

The licensee stated that the control rod drive return line cap to nozzle weld (which is a dissimilar metal weld) is considered susceptible to SCC and is classified as Category D in BWRVIP-75A "BWR [Boiling-Water Reactor] Vessel and Internals Project Technical Basis for Revisions to Generic Letter 88-01 Inspection Schedules." Category D welds are defined in BWRVIP-75A as welds that are susceptible to intergranular stress corrosion cracking (IGSCC), a subset of SCC, which have not been treated with an IGSCC remedy, but for which cracks have not been reported. The licensee stated that previous ultrasonic examinations of this component weld have not identified any relevant indications. In the event an examination during Refueling Outage 29 identifies conditions requiring repair, such as SCC, the methods currently available within ASME Section XI do not provide techniques to support a repair without draining the reactor vessel. The licensee proposes to perform a FSWOL, as specified by Nonmandatory Appendix Q, for the repair of Class 1 austenitic stainless steel pipe weldments in the event that SCC is found in the subject component weld during Refueling Outage 29. The licensee proposes to use weld material Alloy 52M to perform this FSWOL.

The licensee further stated that, because ASME Section XI, Nonmandatory Appendix Q does not specifically apply to the overlay of dissimilar metal welds, or materials other than austenitic stainless steel, and because the requirements of IWA-4600(b) or Code Case N-638-4 do not specifically apply to the welding of overlays, an alternative is required to combine the

requirements of Nonmandatory Appendix Q and Code Case N-638-4 to provide a complete set of requirements for a FSWOL of the control rod drive return line cap to nozzle weld. Also, the following requirements of Nonmandatory Appendix Q cannot be applied to the subject dissimilar metal weld because they were not intended for dissimilar metal welds made with Alloy 52M weld material:

- Nonmandatory Appendix Q, paragraph Q-2000(a), requires the reinforcement weld metal to be low carbon (0.035 percent maximum) austenitic stainless steel.
- Nonmandatory Appendix Q, paragraph Q-2000(d), requires the first two layers of the weld overlay to have a ferrite content of at least 7.5 Ferrite Number (FN).

ASME Section XI, IWA-4190(a) requires Code Cases used for repair/replacement activities to be applicable to the Edition and Addenda specified for the repair/replacement activity. The applicability of Code Case N-638-4 (latest approved by the NRC) is limited to the 2004 Edition of ASME Section XI but the ASME Section XI edition that is specified for this repair/replacement activity is the 2007 Edition with the 2008 Addenda. The limitation of Code Case N-638-4 applicability to the 2004 Edition of Section XI is not due to any technical limitations of Code Case N-638-4, but rather due to a change in Section XI numbering that occurred in the 2005 Addendum. An alternative to IWA-4190(a) is required to permit use of Code Case N-638-4 with the 2007 Edition through the 2008 Addenda of ASME Section XI as described in this request.

The licensee noted that Code Case N-638-4, paragraphs 4(a), and 4(a)(4) state that all welds (including repair welds) shall be volumetrically examined in accordance with the requirements and acceptance criteria of the Construction Code or ASME Section III. An alternative is required to use the examination requirements of Article Q-4100 of ASME Section XI, Nonmandatory Appendix Q.

3.5 Proposed Alternative

The licensee proposes to repair the following component at CNS, as needed, to correct any relevant indications identified by ISI during Refueling Outage 29. The repair, if needed, would consist of a FSWOL to replace the original pressure boundary of the dissimilar metal weld identified below.

Component Identification	Component Description	Nozzle Material	End Cap Material	Maximum Surface Area Of Overlay
RCA-BF-1	5 inch Control Rod Drive Return Line End Cap to Nozzle N9 Weld	A-508, Class 2 (low alloy steel)	SB-166 (Inconel Alloy 600)	260 square inches on the ferritic side

In its letter dated June 9, 2015, the licensee stated, in part, that:

The weld overlay [if needed], will extend around the full circumference of the end cap to nozzle weldment location in accordance with Nonmandatory Appendix Q. The overlay length will extend across the projected flaw intersection with the outer surface beyond the extreme axial boundaries of the flaw. The design thickness and length will be determined in accordance with the guidance provided in Nonmandatory Appendix Q (paragraph Q-3000(a)) and ASME Section XI, paragraph IWB-3640, 2007 Edition through the 2008 Addenda for the evaluation methodology for flawed pipe. The overlay will completely cover the area of the flaw and other Alloy 182 or susceptible austenitic stainless steel material with the highly resistant Alloy 52M weld filler material. The overlay length will conform to Nonmandatory Appendix Q, paragraph Q-3000(a), which satisfies the stress and load transfer requirements.

The licensee further states that Nonmandatory Appendix Q applies specifically to austenitic stainless steel piping and weldments. As an alternative, the licensee proposes to use Code Case N-638-4 and Nonmandatory Appendix Q to install a weld overlay on a configuration that consists of an A-508, Class 2 low alloy steel nozzle, Alloy 182/82 weld materials, and an SB-166, Alloy 600 nickel alloy cap using ERNiCrFe-7A (Alloy 52M) filler metal. As needed for welding within 0.125 inch from the low alloy steel nozzle material, the licensee proposes to use Code Case N-638-4 with the condition that demonstration for ultrasonic examination of the repaired volume is required using representative samples, which contain construction type flaws. In monitoring preheat and interpass temperatures during the application of the overlay, the licensee proposes to comply with 3(e)(1) of the Code Case, which means that the interpass temperature will be directly measured during the welding process. The conditions proposed by the licensee for the use of Code Case N-638-4 are consistent with the conditions imposed by the NRC in Regulatory Guide (RG) 1.147, Revision 17, "Inservice Inspection Code Case Acceptability ASME Section XI, Division 1 (ADAMS Accession No. ML13339A689).

Appendix Q, Article Q-2000(a) requires weld metal used to fabricate weld overlays be low carbon steel (0.035%) austenitic stainless steel. As an alternative, the licensee proposes to perform the weld overlay using ERNiCrFe-7A (Alloy 52M) which is an austenitic nickel based alloy.

The licensee stated that Appendix Q, Article Q-2000(d) requires the weld overlay to consist of at least two austenitic stainless steel weld layers, each layer having an as-deposited delta ferrite content of at least 7.5 FN, or 5 FN under certain conditions. As an alternative, the licensee proposes to perform the weld overlay using ERNiCrFe-7A (Alloy 52M), which is purely austenitic. Since the alternative weld deposits are purely austenitic, the licensee maintains that the delta ferrite requirements of Appendix Q are not applicable.

In its letter dated June 9, 2015, the licensee further states, in part:

Code Case N-638-4, Paragraphs 4(a) and 4(a)(4), state that all welds (including repair welds) shall be examined in accordance with the requirements and acceptance criteria of the Construction Code or ASME Section III. As an alternative, CNS proposes to examine the weld overlay in accordance with the requirements and acceptance criteria of Nonmandatory Appendix Q,

Article Q-4000 of ASME Section XI. The examination requirements and acceptance standards in Nonmandatory Appendix Q, [Article] Q-4100 were developed specifically for weld overlays unlike those in Code Case N-638-4. However, the examinations required by Nonmandatory Appendix Q will not be performed until after the three tempering layers have been in place for at least 48 hours as required by [paragraph] 4(a)(2) of Code Case N-638-4.

ASME Section XI Mandatory Appendix VIII with Supplement 11, is applicable to full structural overlaid wrought austenitic piping welds. As an alternative, the licensee proposes to use the Electric Power Research Institute (EPRI) Performance Demonstration Initiative (PDI) qualification program, as described in the licensee's submittal dated June 9, 2015.

ASME Section XI Nonmandatory Appendix Q, "Weld Overlay Repair of Classes 1, 2, and 3 Austenitic Stainless Steel Piping Weldments," provides guidance for the weld overlay repair of austenitic stainless steel pipe weldments. As an alternative, the licensee proposes to use Nonmandatory Appendix Q for the FSWOL of the subject dissimilar metal weld.

3.6 Basis for Use

Code Case N-638-4 is approved (with Conditions) for generic use in RG 1.147, Revision 17, and was developed for both similar and dissimilar metal welding using ambient temperature machine GTAW temper bead technique. The licensee proposes to follow the approved welding methodology of this Code Case (consistent with the conditions imposed by RG 1.147) for the overlay, whenever welding within the 0.125-minimum distance from the low alloy steel nozzle base material.

The licensee stated that nonmandatory Appendix Q is approved in 10 CFR 50.55a with no conditions and was developed for welding on and using austenitic stainless steel material. The weld overlay proposed is austenitic nickel-based material having a mechanical behavior similar to austenitic stainless steel. It is also compatible with the existing weld and base materials.

3.7 Duration of Proposed Alternative

This proposed alternative will be used for the Fifth 10-Year Interval of the ISI Program for CNS.

4.0 NRC STAFF EVALUATION

4.1 Weld Description

The licensee stated that the control rod drive return line cap to nozzle weld is classified as Category D in BWRVIP-75A. Per BWRVIP-75A, Category D welds are classified as not resistant to IGSCC, with no mitigating stress improvement performed, but with no reported cracking. The licensee proposes to apply Alloy 52M FSWOL to this weld if SCC is found during the Refueling Outage 29 inspection of the weld. In nickel-based alloys, increasing levels of chromium are associated with increasing level of corrosion resistance. Alloy 52M contains nominally 28 percent chromium, which imparts excellent corrosion resistance to the material. By comparison, Alloy 82 contains nominally 20 percent chromium, while Alloy 182 has a nominal chromium content of 15 percent. Alloy 82 is considered resistant to SCC, but

Alloy 182, with its lower chromium content, is considered to be less resistant to SCC. Operating experience indicates that alloy 182 welds are not immune to SCC.

The control rod drive return line cap to nozzle weld is a dissimilar metal weld, which joins a low alloy steel (SA 508, Cl 2) nozzle to a nickel-based alloy (Alloy 600) end cap. The licensee stated in its submittals that the existing weld consists of both nickel-based Alloys 82 and 182. In its response to Request for Information (RAI)-3, dated October 29, 2015, the licensee clarified that, although Alloy 82 weld metal was used to weld the cap to the nozzle, Alloy 182 is still present in the weld joint from a previous weld that was not completely removed when that weld joint was cut. Also, as discussed in the licensee's response to RAI-3, the profile of the existing weld joint is as follows: a low alloy steel nozzle is joined to Alloy 182 weld metal (full penetration); the Alloy 182 weld metal (full penetration) is joined to Alloy 82 weld metal (full penetration); and, the Alloy 82 weld metal (full penetration) is joined to the nickel-based alloy end cap.

The licensee proposes to use Alloy 52M austenitic nickel-based alloy weld material for the overlay. Based on the weld joint description provided by the licensee, the overlay would cover the following materials: alloy steel (SA 508, Cl 2) base material, Alloy 182 weld material, Alloy 82 weld material, and Alloy 600 base material. Although there is no Code section or NRC-approved Code Case with specific requirements for performing FSWOL with this material combination, it is generally accepted that Alloy 52M is compatible with this material combination and the Code would allow this overlay, provided the welding procedure is properly qualified.

4.2 Code Welding Requirements

The application of this FSWOL falls under the requirements of Article IWA-4400 for welding repairs. When performing weld repairs, a licensee may opt to follow the temper bead welding requirements of Article IWA-4600(b) or the NRC-approved Code Case as an alternative to the welding and postweld heat treatment requirements of the Construction Code. In this request, the licensee has proposed to follow the temper bead welding requirement of Code Case N-638-4, which was approved by the NRC staff in RG 1.147. Although a licensee may opt to perform welding repairs in accordance with the temper bead welding requirements of NRC-approved Code Case N-638-4, NPPD must request NRC-approval for the proposed FSWOL since this Code Case is not applicable to the Edition and Addenda specified for the repair/replacement activity. As stated previously in this safety evaluation (SE), the limitation of Code Case N-638-4 applicability to the 2004 Edition of Section XI is not due to any technical limitation of Code Case N-638-4, but rather due to a change in Section XI numbering that occurred in the 2005 Addendum. In the proposed alternative, the licensee included a cross-reference that will allow the use of Code Case N-638-4 with later editions and addenda of the Code. The NRC staff has reviewed this cross-reference and determined it to be an acceptable method to apply Code Case N-638-4 to the Code Edition and Addenda applicable to the welding repairs proposed by the licensee.

In RG 1.147, the NRC staff approved Code Case N-638-4 with the following Conditions:

1. Demonstration for ultrasonic examination of the repaired volume is required using representative samples which contain structural type flaws

2. The provisions of [paragraphs] 3(e)(2) and 3(e)(3) may only be used when it is impractical to use the interpass temperature measurement methods described in [paragraph] 3(e)(1), such as in situations where the weldment area is inaccessible...or when there are extenuating radiological circumstances.

As stated previously in this SE, the licensee proposes to comply with Condition 1 and also to measure interpass temperature directly in accordance with paragraph 3(e)(1). Therefore, the licensee proposes to use Code Case N-638-4 in accordance with the Conditions imposed by the NRC staff in RG 1.147. The staff finds the licensee's request to use Code Case N-638-4, rather than the later revision of this Code Case applicable to the Code of Record, acceptable, because Code Case N-638-4, which is conditionally approved by NRC staff in RG 1.147, is compatible with the proposed alternative, and the licensee has submitted an acceptable cross-reference, which will allow the use of this Code Case with the 2007 Edition through 2008 Addenda of the Code.

4.3 Irradiation Effects

Code Case N-638-4 requires that the welding procedure and welding operators shall be qualified in accordance with Section IX and the requirements of paragraphs 2.1 and 2.2 of the Code Case. Paragraph 2.1.c of Code Case N-638-4 requires that consideration shall be given to the effects of irradiation on the properties of material "for applications in the core belt line region of the reactor vessel." Because irradiation effects were not discussed in the licensee's submittal, the NRC staff issued RAI-2 to request the licensee to identify whether the proposed FSWOL will be in the core belt line region discussed in Code Case N-638-4, and if so, to discuss how consideration was given to the effects of irradiation. In RAI-2, the NRC staff clarified the core belt line to be that region of reactor vessel ferritic materials with a fluence projected to be greater than 1×10^{17} neutrons per square centimeter (n/cm^2) for Energy greater than 1 million electron volts ($E > 1MeV$). In the licensee's response to RAI-2 dated October 29, 2015, the licensee stated that the weld subject to the proposed FSWOL is physically located outside the core belt line region, and does not identify any consideration given to the effect of irradiation on the properties of the material. The NRC staff finds the licensee response to RAI-2 acceptable because, based on its location outside the core belt line region, the proposed FSWOL would be in a region with a projected fluence of less than $1 \times 10^{17} n/cm^2$ ($E > 1MeV$) and Code Case N-638-4 would not require that any consideration be given to the effects of irradiation on the properties of the material.

4.4 Impact Testing Requirements

Paragraph 2.1.j of Code Case N-638-4 states, in part, that for weld procedures qualified for use with Code Case N-638-4:

The average lateral expansion value of the three HAZ Charpy V-notch specimens shall be no less than the average lateral expansion value of the three unaffected base metal specimens. However, if the average lateral expansion value of the HAZ Charpy V-notch specimens is less than the average value for the unaffected base metal specimens and the procedure qualification meets all the other requirements of this Case, either of the following shall be performed:

- (1) The welding procedure shall be requalified.
- (2) An Adjustment Temperature for the procedure qualification shall be determined in accordance with the applicable provisions of NB-4335.2 of Section III, 2001 Edition with the 2002 Addenda. The RT_{NDT} [Reference Temperature for Nil Ductility Transition] or lowest service temperature of the materials for which the welding procedure will be used shall be increased by a temperature equivalent to that of the Adjustment Temperature.

Because paragraph 2.1.j, option 2, has the potential to affect reactor vessel integrity analyses, the NRC staff issued RAI-1, requesting the licensee to identify whether option 1 or option 2 was used to qualify the subject weld repair overlay. In the licensee's response to RAI-1 dated October 29, 2015, the licensee clarified that a vendor has not yet been chosen to perform the overlay and therefore, the procedure qualification records have not yet been reviewed. The licensee also clarified that option 2 would only be chosen after option 1 had been attempted and it was determined that option 2 is the only available solution. The licensee also stated, in part, in its response to RAI-1:

If option 2 is determined to be the only available solution, the effects of the Adjusted Temperature would be determined before the Full Structural Weld Overlay (FSWOL) is installed. If the new Adjusted Temperature is determined to affect the pressure-temperature curves, the curves would be revised before plant startup from refuel outage 29. However, because the location of the FSWOL is outside of the beltline region [fluence values greater than 1×10^{17} n/cm² ($E > 1$ MeV)], it is not expected that minor changes to the Adjusted Temperature would affect the pressure-temperature curves.

The NRC staff finds the licensee's response to RAI-1 acceptable, because the licensee clarified how the welding procedure would be qualified and, because the welding procedure would be qualified in accordance with the requirements of the Code as specified in Code Case N-638-4.

The NRC staff finds the licensee's statement that, "If the new Adjusted Temperature is determined to affect the pressure-temperature curves, the curves would be revised before plant startup from refuel outage 29," to be acceptable, because the licensee will evaluate the effect on the pressure-temperature (P-T) limits if an adjustment temperature must be determined as a result of the weld procedure qualification. The licensee also indicated in its response to RAI-1 that it does not expect a change to the P-T limits to be necessary due to the low fluence at the location of the FSWOL. However, the NRC staff notes that, as clarified in Regulatory Issue Summary (RIS) 2014-11, "Information on Licensing Applications for Fracture Toughness Requirements for Ferritic Reactor Coolant Pressure Boundary Components," 10 CFR 50, Appendix G requires that all ferritic materials within the entire reactor vessel be considered in the development of the P-T limits, not just those with fluence greater than 1×10^{17} n/cm² ($E > 1$ MeV). This is because the effects of structural discontinuities for a material with a lower reference temperature, such as a nozzle with a lower fluence, may result in more restrictive allowable P-T limits than those for the vessel shell material with a higher reference temperature.

4.5 Design and Ultrasonic Examination Requirements

The licensee proposes to use a modified version of ASME Section XI, Nonmandatory Appendix Q for this potential repair. Nonmandatory Appendix Q is applicable to the FSWOL of austenitic stainless steel material (per Article Q-1000) using austenitic stainless steel weld material (per Article Q-2000(a) & (d)) and contains design considerations (Article Q-3000) and ultrasonic examination requirements (Article Q-4000). As stated previously in this SE, the licensee's proposed alternative is applicable to the FSWOL of a dissimilar metal weld using austenitic nickel-base material. The NRC staff agrees that, despite the material differences, the design consideration and ultrasonic examination requirements of Appendix Q can be used for the proposed alternative with the following two exceptions:

- Appendix Q (Article Q-2000(a)) requires the weld overlay to be fabricated from low carbon austenitic stainless steel weld metal. The proposed alternative will fabricate the weld overlay from ERNiCrFe-7A (Alloy 52M) filler metal which is an austenitic nickel-based alloy.
- Appendix Q (Article Q-2000(d)) imposes minimum delta ferrite requirements on the weld overlay. This requirement is appropriate for overlays made with austenitic stainless steel weld metal which as deposited contain both austenite and delta ferrite phases. The proposed alternative will not impose minimum delta ferrite requirements on the weld overlay since the proposed alternative will use nickel-based alloy, which will be deposited without any delta ferrite phase.

The NRC staff finds the licensee's request to use Appendix Q with the above exceptions for the proposed alternative to be acceptable because the design considerations and the ultrasonic examination requirements of Appendix Q can be applied to the dissimilar metal weld combination of the proposed alternative, and will result in a FSWOL with sufficient structural integrity to mitigate the detrimental impact of SCC, if found.

ASME Section XI, Mandatory Appendix VIII provides procedure and personnel qualification requirements for ultrasonic examination and is required by Nonmandatory Appendix Q. Supplement 11 to Mandatory Appendix VIII is applicable to full structural overlaid wrought austenitic piping welds, but is not applicable to overlays of dissimilar metal welds. As an alternate to Mandatory Appendix VIII with Supplement 11, the licensee proposes to use the EPRI PDI qualification program as described in the licensee's submittal. The NRC staff performed a comprehensive review of the proposed PDI qualification program and Mandatory Appendix VIII, Supplement 11. An NRC staff review of the two programs has determined that the PDI Program for qualifying procedures, equipment, and personnel, as described in the relief request, is very similar to Mandatory Appendix VIII, Supplement 11. For the qualification of full structural weld overlays, the primary differences between the Appendix VIII requirements and the PDI Program are administrative or semantic in nature, such as changing "base metal flaws" to "service-induced flaws." The staff finds the licensee's request acceptable because the PDI qualification program, as described in the licensee's submittal, is applicable to overlays of dissimilar metal welds and is similar to the Mandatory Appendix VIII requirements except for administrative or semantic differences.

4.7 Summary

The licensee's proposed alternative FSWOL, which follows the design requirements of Nonmandatory Appendix Q with the exceptions noted previously, will provide an acceptable repair for any SCC defects found during ISI, as discussed in Section 4.5 (of this SE). Alloy 52M with its high chromium content will provide superior corrosion resistance to the Alloy 82 and 182 weld materials used in the existing weld, as discussed in Section 4.1. The temper bead welding Code Case N-638-4 is acceptable for welding to alloy steel when post weld heat treatment of the weld joint is not performed, as discussed in Section 4.2. The welding for the proposed alternative will be performed and qualified in accordance with Code requirements, as discussed in Section 4.4. Because the projected neutron fluence is less than 1×10^{17} n/cm² (E>1 MeV), the Code Case requirement that irradiation effects be considered for applications in the core belt line does not apply here, as discussed in Section 4.3. The PDI Program is acceptable for qualifying ultrasonic examination procedures, equipment, and personnel to be used for the proposed alternative, as discussed in Section 4.5. Therefore, the NRC staff finds that the proposed alternative provides an acceptable level of quality and safety and structural integrity.

5.0 CONCLUSION

As set forth above, the NRC staff determines that the proposed alternative demonstrates an acceptable level of quality and safety and provides a reasonable assurance of structural integrity for the subject weld. Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(z)(1) and is in compliance with the requirements of the ASME Code, Section XI for which relief was not requested. Therefore, the NRC staff authorizes the use of Relief Request RR5-01 at CNS as a contingency, if a flaw is discovered during Refueling Outage 29. The proposed alternative is authorized for the fifth 10-Year ISI interval.

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

Principal Contributor: J. Jenkins

Date: February 24, 2016

O. Limpias

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If you have any questions, please contact Thomas Wengert at 301-415-4037 or via e-mail at Thomas.Wengert@nrc.gov.

Sincerely,

/RA/

Meena K. Khanna, Chief
Plant Licensing IV-2 and Decommissioning
Transition Branch
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-298

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