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

August 13, 2014

Vice President, Operations
Entergy Nuclear Operations, Inc.
Palisades Nuclear Plant
27780 Blue Star Memorial Highway
Covert, MI 49043-9530

SUBJECT: PALISADES NUCLEAR PLANT – RELIEF REQUEST NUMBER RR-4-19, PROPOSED ALTERNATIVE TO THE REQUIREMENTS OF ASME CODE CASE N-638-4 (TAC NO. MF3517)

Dear Sir:

By letter dated February 26, 2014 (Agencywide Documents and Access Management System (ADAMS) Accession No. ML14057A766), as supplemented by letter dated March 5, 2014 (ADAMS Accession No. ML14064A475), Entergy Nuclear Operations, Inc. (the licensee) submitted a request to the U.S. Nuclear Regulatory Commission (NRC) for the use of alternatives to certain American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (B&PV Code) requirements at Palisades Nuclear Plant (PNP).

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(a)(3)(ii), the licensee requested relief from article IWA-4000 of Section XI of the ASME Code to permit the use of modified ASME Code Case N-638-4 to repair the dissimilar metal butt weld of pressurizer safety relief valve, RV-1041, on the basis that complying with the specified requirement would result in hardship or unusual difficulty.

On March 6, 2014, the NRC staff verbally authorized the use of Relief Request Number 4-19 at PNP (ADAMS Accession No. ML14066A130) for the fourth 10-year inservice inspection (ISI) interval which ends on December 12, 2015. This safety evaluation (SE) provides the technical basis for the verbal authorization.

The NRC staff has reviewed the subject request and concludes, as set forth in the enclosed SE, that Entergy Nuclear Operations, Inc. has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(a)(3)(ii) 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 RR 4-19 at the PNP for the fourth 10-year ISI interval which ends on December 12, 2015.

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.

If you have any questions, please contact the Project Manager, Jennivine Rankin at 301-415-1530 or via e-mail at Jennivine.Rankin@nrc.gov.

Sincerely,

David Pelton, Chief
Plant Licensing Branch III-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-255

Enclosure:
Safety Evaluation

cc w/encl: Distribution via ListServ

UNITED STATES
NUCLEAR REGULATORY COMMISSION
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELIEF REQUEST NUMBER RR 4-19

ALTERNATIVE REPAIR OF WELD AT

PRESSURIZER SAFETY RELIEF VALVE NOZZLE

PALISADES NUCLEAR PLANT

ENTERGY NUCLEAR OPERATIONS, INC.

DOCKET NO. 50-255

1.0 INTRODUCTION

By letter dated February 26, 2014 (Agencywide Documents and Access Management System (ADAMS) Accession No. ML14057A766), and supplement dated March 5, 2014 (ADAMS Accession No. ML14064A475), Entergy Nuclear Operations, Inc. (the licensee) requested relief from the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, IWA-4000, at Palisades Nuclear Plant (PNP). The proposed alternative is documented in Relief Request RR 4-19 for the repair of degraded weld PCS-6-PRS-1C1-1 of pressurizer safety relief valve, RV-1041, for the fourth 10-year inservice inspection (ISI) interval.

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(a)(3)(ii), the licensee requested relief from article IWA-4000 of Section XI of the ASME Code to permit the use of modified ASME Code Case N-638-4 to repair the dissimilar metal butt weld of pressurizer safety relief valve, RV-1041, on the basis that complying with the specified ASME Code requirement would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

On March 6, 2014, the NRC staff verbally authorized the use of Relief Request Number RR 4-19 at PNP (ADAMS Accession No. ML14066A130) for the fourth 10-year ISI interval which ends on December 12, 2015. This safety evaluation documents the NRC staff's detailed technical basis for the verbal authorization.

Enclosure

2.0 REGULATORY EVALUATION

In Relief Request RR 4-19, the licensee requests authorization of an alternative to the requirements of article IWA-4000 of Section XI of the ASME Code pursuant to Title 10, *Code of Federal Regulations*, Part 50 (10 CFR 50), paragraph 55a(a)(3)(ii).

Adherence to article IWA-4000 of 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 requirements, except the design and access provisions and the pre-service examination requirements set forth in the ASME Code, Section XI. 10 CFR 50.55a(a)(3) states, in part, that alternatives to the requirements of paragraph (g) of 10 CFR 50.55a may be used, when authorized by the NRC, if the licensee demonstrates that: (i) the proposed alternative provides 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.

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

3.0 TECHNICAL EVALUATION

3.1 Relief Request RR 4-19

3.1.1 Description

The affected component is the dissimilar metal weld, number PCS-6-PRS-1C1-1, of the pressurizer safety relief valve, RV-1041. During the current 1R23 refueling outage, the licensee detected two axial indications in the root area of weld PCS-6-PRS-1C1-1 which is located between the pressurizer shell nozzle and the flange for the safety relief valve. The licensee reported that these two indications did not meet applicable acceptance criteria under the ASME Code, Section XI, Table IWB-3410, "Acceptance Standards," and require a repair/replacement activity to return the weld to an acceptable condition.

By letter dated February 26, 2014, the licensee describes the existing design of the affected components:

> In the existing design, the pressurizer safety relief valve nozzle configuration contains [Alloy 600/82/182] materials that are susceptible to primary water stress corrosion cracking (PWSCC). First, the safety relief valve weld neck flange was manufactured from SB-166, UNS N06600 (Alloy 600) nickel alloy while the DMW [dissimilar metal weld] attaching the flange to the vessel nozzle was fabricated from Alloy 82/182 filler metal. The nozzle was manufactured from low alloy steel A-508, Class 2 material, and the pressurizer upper head is low alloy steel A-533, Grade B Class 1.

3.1.2 Licensee's Proposed Alternative and Bases for Use

The code of record is ASME, Section XI, 2001 Edition through 2003 Addenda as amended by 10 CFR 50.55a. As stated in the licensee's supplemental information dated March 5, 2014:

> ASME Section XI, IWA-4411 requires that welding and installation activities be performed in accordance with the original Construction Code of the component or item. IWA-4411 also includes the following alternatives:
>
> - As an alternative to the original Construction Code, IWA-4411(a) allows use of later Editions/Addenda of the Construction Code. However, if welding is performed in accordance with the Construction Code regardless of which Edition or Addenda is used, conventional PWHT [post-weld heat treatment] would be required.
>
> - IWA-4411(e) also allows use of the temper bead welding requirements of IWA-4600 as an alternative to the PWHT requirements of the Construction Code. However, in this case, the IWA-4600 temper bead rules require application of an elevated preheat temperature and a post weld soak.

As an alternative to the welding provisions of IWA-4411, to repair the subject weld, the licensee requests to use ASME Code Case N-638-4, "Similar and Dissimilar Metal Welding Using Ambient Temperature Machine GTAW Temper Bead Technique, Section XI, Division 1," modified so that it can be used for a through-wall butt weld.

As stated in Relief Request RR 4-19 dated February, 26, 2014:

> Code Case N-638-4 allows for ambient temperature temper bead welding of ferritic materials without the requirement for elevated preheat or post weld heat treatment. In addition, Code Case N-638-4, paragraph 1(b), requires that "the depth of the weld shall not be greater than one-half of the ferritic base metal thickness".
>
> The NRC approved Code Case N-638-4 in Regulatory Guide (RG) 1.147, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1," (Reference 5) with the following conditions:
>
> (1) Demonstration for ultrasonic examination of the repaired volume is required using representative samples which contain construction type flaws.
>
> (2) The provisions of 3(e)(2) or 3(e)(3) [of the code case] may only be used when it is impractical to use the interpass temperature measurement methods described in 3(e)(1), such as in situations where the weldment area is inaccessible (e.g., internal bore welding) or when there are extenuating radiological conditions.

> The RG 1.147 conditions do not apply to the planned repair/replacement activity at Palisades as discussed in Sections 3 and 4 below. Condition (1) [of RG 1.147] does not apply because radiography will be used for the required volumetric examination per the Construction Code (Reference 7). The use of radiography as a volumetric examination method complies with paragraph 4(a) of N-638-4. Condition (2) [of RG 1.147] does not apply because interpass temperature measurement will be performed by direct measurement using the provision of 3(e)(1) [of the code case] and will not be performed using the provisions of either 3(e)(2) or 3(e)(3).

The licensee will completely remove the original Alloy 82/182 DMW, install a new Alloy 52M DMW, and examine it in accordance with the 1992 Edition of ASME Section III, Subsection NB. However, in lieu of the preheat and post-weld heat treatment requirements of the Construction Code, the licensee plans to install the Alloy 52M weld buttering across the face and full circumference of the weld end preparation of the A-508, Class 2 nozzle using the ambient temperature temper bead provisions of Code Case N-638-4.

By letter dated February 26, 2014, the licensee proposed the following alternative:

> Pursuant to 10 CFR 50.55a(a)(3)(ii), ENO proposes an alternative to the provision in paragraph 1(b) of N-638-4 that limits the depth of the weld to "one-half the ferritic base metal thickness." More specifically, ENO proposes to use the new alternative provision in paragraph 1(b)(1) of N-638-5 which states:
>
> (1) Through-wall circumferential welds are permitted if the following restrictions are met:
>
> (a) For repair/replacement activities associated with existing welds, the existing weld (including any associated buttering) shall be removed in its entirety.
>
> (b) Temper bead buttering shall be applied across the entire face of the weld preparation area on the base materials requiring tempering, and shall extend around the full circumference of the joint.
>
> ENO will replace the existing nozzle/flange assembly with a modified design. The modification will replace the existing SB-166, Alloy 600 weld neck flange with an SA-182 F316 austenitic stainless steel flange, which is less susceptible to PWSCC. Alloy 82/182 weld material will be removed and the nozzle cut back slightly to assure that all of the original weld metal is removed. The new DMW between the stainless steel weld neck flange and low alloy steel nozzle will be made with ERNiCrFe-7A (Alloy 52M) weld metal [which is less susceptible to PWSCC than Alloy 82/182 weld metal]. The weld neck flange will be slightly longer to make up for the removal of the original weld metal, but the overall length from the vessel to the safety valve bolted flanged joint will remain the same. The change is essentially like-for-like in its geometry, with only the materials being changed.

The welding operation for the DMW, as shown in Figure 2, includes the following basic steps:

1. Install Alloy 52M weld buttering across the entire face and circumference of the weld end preparation of the A-508, Class 2 nozzle.

2. Install ER308L buffer layer and Alloy 52M buttering across the entire face circumference of the weld end preparation of the SA-182, F316 stainless steel flange.

3. Complete the Alloy 52M groove weld.

Code Case N-638-4 and [N-638-]5 specify requirements for performing ambient temperature temper bead welding using the machine gas Tungsten Arc Welding (GTAW) process. Research by the Electric Power Research Institute (EPRI) and other organizations on the use of an ambient temperature temper bead welding operation using the machine GTAW process is documented in EPRI Report GC-111050, "Ambient Temperature Preheat for Machine GTAW Temper Bead Applications." According to the EPRI report, repair welds performed with an ambient temperature temper bead procedure utilizing the machine GTAW welding process exhibit mechanical properties equivalent or better than those of the surrounding base material. Laboratory testing, analysis, successful procedure qualifications, and successful repairs have all demonstrated the effectiveness of this process. EPRI Report GC-111050, Section 6.0 concluded the following:

> "Repair of RPV components utilizing machine GTAW temper bead welding at ambient temperature produces mechanical properties that are commonly superior to those the service-exposed substrate. The risk of hydrogen delayed cracking is minimal using the GTAW process. Cold stress cracking is resisted by the excellent toughness and ductility developed in the weld HAZ (heat affected zone). Process design and geometry largely control restraint considerations, and these factors are demonstrated during weld procedure qualification."

ENO plans to deposit the Alloy 52M butter layers to the weld end preparation of the low alloy steel A-508, Class 2 nozzle using Code Case N-638-4. However, paragraph 1(b) of N-638-4 limits the depth of the weld to one-half the ferritic base material thickness. The incorporation of this weld depth limitation is likely the result of concerns related to the high restraint that a repaired weld would experience if a localized or partial-depth weld repair was performed. As stresses build under a high degree of restraint, cracking may occur at defect locations. It should be noted that paragraph 1(b) of N-638-5 also limits the depth of weld repairs to one-half the thickness of the ferritic base material. While paragraph 1(b)(1) does allow through-wall circumferential welds to be made, the following two requirements must be met:

a) The existing weld (including any associated buttering) shall be removed in its entirety.

b) Temper bead buttering shall be applied across the entire face of the weld preparation area on the base materials requiring tempering, and shall extend around the full circumference of the joint.

The restrictions in paragraphs 1(b)(1) of N-638-5 preclude the high restraint associated with localized and partial-depth weld repairs. Regarding the PNP pressurizer nozzle DMW, only the weld butter will be deposited with the ambient temperature temper bead rules of [Code Case] N-638-4 [since only the weld with the ferritic nozzle requires post weld heat treatment by the ASME Code]. Upon completion of all welding, the DMW will be nondestructively examined in accordance with paragraph 4(a) of Code Case N-638-4. These nondestructive examinations will be performed at least 48 hours after completing the third temper bead layer and will include liquid penetrant and radiographic examinations.

The provisions of Code Case N-638, and its revisions, ensure that the impact properties of the ferritic heat affected zone (HAZ) are not adversely affected when using the ambient temperature temper bead welding process.

That said, utilization of paragraph 1(b)(1) of Code Case N-638-5 has no effect on the impact properties established during welding procedure qualification or create any adverse metallurgical conditions in the ferritic HAZ. Rather, as noted above, utilization of machine GTAW temper bead welding at ambient temperature produces mechanical properties that are commonly superior to those of the service-exposed substrate.

In addition, by letter dated March 5, 2014, the licensee stated that prior to welding the flange to the temper bead buttering, both a visual examination and a liquid penetrant examination will be conducted after the temper bead butter is installed. Also, pre-service ultrasonic examination, as required by IWA-4530, will be performed in accordance with ASME Section XI, Appendix VIII.

The proposed alternative applies to the remainder of the fourth ISI interval for PNP, scheduled to end on December 12, 2015.

3.1.3 Hardship

By letter dated February 26, 2014, the licensee stated the following when describing the hardship of performing the repair replacement:

If this repair/replacement activity was exclusively performed in accordance with the Construction Code [ASME Code, Section III], then conventional post-weld heat treatment, as prescribed in the Construction Code for this repair/replacement activity, would have to be performed in the field, and would result in unnecessary radiological exposure to maintenance personnel.

This process would result in approximately 1 Rem [roentgen equivalent man] of added dose as compared to the [proposed] alternative.

3.2 NRC Staff Evaluation

The licensee proposed using Code Case N-638-4 as an alternative to the ASME Code, Section III post weld heat treatment requirements of the carbon steel pressurizer nozzle for repair of the axial indications in the subject weld. The licensee requested relief from the weld depth limitation of paragraph 1(b) in the Code Case and proposed completely removing the degraded Alloy 82/182 weld, replacing the stainless steel valve flange, and installing a new weld using Alloy 52M filler metal. The new weld will be installed following the requirements of the ASME Code, Section III and the modified ASME Code Case N-638-4.

The NRC staff noted that the weld depth limitations imposed by Code Case N-638-4 are meant to alleviate concerns related to the high restraint that a repaired weld would experience if a localized or partial-depth weld repair was performed. Stresses from the welding process may lead to cracking under a high degree of restraint. However, the licensee has proposed to remove the Alloy 82/182 weld entirely and perform the Alloy 52M buttering using the machine GTAW temper bead process around the full circumference of the joint, reducing the concerns of high restraint in the weld. Furthermore, replacement of all of the Alloy 82/182 material with Alloy 52M weld metal will produce a joint that is less susceptible to PWSCC. The staff further notes that the buttering will be examined both visually and by liquid penetrant examination prior to welding the flange to the temper bead buttering. The completed butt weld will be radiographic and liquid penetrant examined per NB-5222 of the ASME Code, Section III, and a pre-service ultrasonic examination will be performed in accordance with Appendix VIII of the ASME Code, Section XI. Therefore, the NRC staff determines that the proposed repair will provide reasonable assurance of the structural integrity and leak tightness of the new weld at the pressurizer safety relief valve nozzle.

Furthermore, the NRC staff concludes that complying with the specified ASME Code, Section III requirement for post weld heat treatment of the dissimilar metal nozzle weld would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety due to the added radiological dose associated with the post weld heat treatment.

4.0 CONCLUSION

As set forth above, the NRC staff concludes that the proposed alternative provides reasonable assurance of structural integrity of the subject weld. The staff concludes that complying with the specified ASME Code requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. Accordingly, the NRC staff concludes that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(a)(3)(ii) 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 RR 4-19 at the PNP for the fourth 10-year ISI interval which ends on December 12, 2015.

Once the proposed alternative is installed during the fourth 10-year ISI interval, the installed alternative may remain in place for the life of the plant. Should the licensee desire to install the alternative during a subsequent 10-year ISI interval, the licensee must seek authorization from the NRC staff for that 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: Joshua Kusnick

Date: August 13, 2014

If you have any questions, please contact the Project Manager, Jennivine Rankin at 301-415-1530 or via e-mail at Jennivine.Rankin@nrc.gov.

Sincerely,

/RA/

David Pelton, Chief
Plant Licensing Branch III-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-255

Enclosure:
Safety Evaluation

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