



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

January 19, 2021

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 5-8 RELATED TO ASME
CODE CASE N-729-4 SUPPLEMENTAL EXAMINATION REQUIREMENTS OF
REACTOR VESSEL CLOSURE HEAD PENETRATION NOZZLES
(EPID L-2020-LLR-0128)

Dear Sir or Madam:

By letter dated September 23, 2020 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML20267A386), as supplemented by letter dated September 28, 2020 (ADAMS Accession No. ML20272A162), Entergy Nuclear Operations, Inc. (Entergy, or the licensee) submitted Relief Request (RR) 5-8, to the U.S. Nuclear Regulatory Commission (NRC) for the use of an alternative to certain requirements in the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," and Code Case N-638-7 "Similar and Dissimilar Metal Welding Using Ambient Temperature Machine GTAW Temper Bead Technique," related to the repair of degraded reactor vessel closure head (RVCH) penetration numbers 17 and 34 at Palisades Nuclear Plant (PNP).

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, Section 50.55a(z)(1), "Acceptable level of quality and safety," the licensee requested to use the proposed alternative in RR 5-8 on the basis that the proposed alternative will provide an acceptable level of quality and safety.

On October 1, 2020 (ADAMS Accession No. ML20275A343), the NRC verbally authorized the use of RR 5-8 at PNP for one cycle of operation, not to exceed 20 months of operation or May 31, 2022, when PNP will permanently cease power operations. The enclosed safety evaluation (SE) describes the technical basis for the NRC's verbal authorization.

The NRC staff has reviewed the subject request and concludes, as set forth in the enclosed SE, that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(z)(1). Therefore, the NRC staff authorizes the proposed alternative in RR 5-8 for one cycle of operation, not to exceed 20 months of operation or May 31, 2022, when the PNP will permanently cease power operations.

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

If you have any questions, please contact Scott P. Wall, at 301-415-2855 or via e-mail at Scott.Wall@nrc.gov.

Sincerely,

Nancy L. Salgado, Chief
Plant Licensing Branch III
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-255

Enclosure:
Safety Evaluation

cc: Listserv

SUBJECT: PALISADES NUCLEAR PLANT - RELIEF REQUEST 5-8 RELATED TO ASME CODE CASE N-729-4 SUPPLEMENTAL EXAMINATION REQUIREMENTS OF REACTOR VESSEL CLOSURE HEAD PENETRATION NOZZLES (EPID L-2020-LLR-0128) DATED JANUARY 19, 2021

DISTRIBUTION:

PUBLIC

PM File Copy

RidsACRS_MailCTR Resource

RidsNrrDorlLpl3 Resource

RidsNrrDnrINphp Resource

RidsNrrLASRohrer Resource

RidsNrrLAJBurkhardt Resource

RidsNrrPMPalisades Resource

RidsRgn3MailCenter Resource

JCollins, NRR

ADAMS Accession No. ML20365A001

OFFICE	NRR/DORL/LPL3/PM	NRR/DORL/LPL3/LA	NRR/DNRL/NPHP/BC	NRR/DORL/LPL3/BC
NAME	SWall	SRohrer	MMitchell	NSalgado
DATE	01/14/21	01/04/21	01/13/21	1/19/21

OFFICIAL RECORD COPY



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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELIEF REQUEST 5-8 REGARDING ALTERNATIVE REPAIR OF

REACTOR VESSEL CLOSURE HEAD PENETRATION NOZZLES

ENTERGY NUCLEAR OPERATIONS, INC.

PALISADES NUCLEAR PLANT

DOCKET NO. 50-255

1.0 INTRODUCTION

By letter dated September 23, 2020 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML20267A386), as supplemented by letter dated September 28, 2020 (ADAMS Accession No. ML20272A162), Entergy Nuclear Operations, Inc. (Entergy, or the licensee) submitted Relief Request (RR) 5-8, to the U.S. Nuclear Regulatory Commission (NRC) for the use of an alternative to certain requirements in the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," and Code Case N-638-7 "Similar and Dissimilar Metal Welding Using Ambient Temperature Machine GTAW Temper Bead Technique," related to the repair of degraded reactor vessel closure head (RVCH) penetration numbers 17 and 34 at Palisades Nuclear Plant (PNP).

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, Section 50.55a(z)(1), "Acceptable level of quality and safety," the licensee requested authorization of its proposed alternative on the basis that the proposed alternative will provide an acceptable level of quality and safety.

On October 1, 2020 (ADAMS Accession No. ML20275A343), the U.S. Nuclear Regulatory Commission (NRC) staff verbally authorized the use of RR 5-8 at PNP for one cycle of operation, not to exceed 20 months of operation, or May 31, 2022, when the PNP will permanently cease power operations. The enclosed safety evaluation describes the technical basis for the NRC's verbal authorization

2.0 REGULATORY EVALUATION

Repair and Replacement activities for ASME Code Class 1, 2, and 3 components is to be performed in accordance with ASME Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," and applicable editions and addenda as required by 10 CFR 50.55a(g), "Preservice and inservice inspection requirements," except where specific written relief has been granted by the NRC.

Section 50.55a(z), "Alternatives to codes and standards requirements," of 10 CFR states, in part, that "Alternatives to the requirements of [paragraph (g) of 10 CFR 50.55a] or portions thereof may be used, when authorized by the Director, Office of Nuclear Reactor Regulation. A proposed alternative must be submitted and authorized prior to implementation." The licensee must demonstrate that: (1) the proposed alternatives provide an acceptable level of quality and safety, or (2) compliance with the specified requirements of this section 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 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

The RVCH penetration numbers 17 and 34. The nozzles were examined in accordance with ASME Code Case N-729-4, "Alternative Examination Requirements for PWR [Pressurized Water Reactor] Reactor Vessel Upper Heads with Nozzles Having Pressure-Retaining Partial-Penetration Welds Section XI, Division 1."

3.2 ISI Interval and Applicable Code Edition and Addenda

PNP is currently in its fifth 10-year ISI interval, which began December 13, 2015, and was originally scheduled to end on December 12, 2025. The ASME Code of record for the fifth 10-year ISI interval is the 2007 Edition through the 2008 Addenda.

3.3 Code Requirement for Which Relief is Requested

ASME Code, Section III, "Rules for Construction of Nuclear Facility Components," Paragraph NB-5245 and subparagraph NB-5331(b).

ASME Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," subsubarticle IWB-3420 and subparagraph IWB-3132.3.

ASME Code Case N-638-7, "Similar and Dissimilar Metal Welding Using Ambient Temperature Machine GTAW [Gas Tungsten Arc Welding] Temper Bead Technique, Section XI, Division 1."

3.4 Licensee's Proposed Alternative

The licensee is proposing to perform a modified half-nozzle repair of the RVCH penetration numbers 17 and 34. The proposed alternative uses inside-diameter temper bead (IDTB) welding in accordance with the requirements of the ASME Code, Sections III and XI, and ASME Code Case N-638-7, and Code alternatives discussed below.

Proposed alternative RR 5-8 has the following deviations from ASME Code:

- 1) Alternate in-process examination requirements of ASME Code, Section III, paragraph NB-5245 and subparagraph NB-5331(b);

- 2) Alternate acceptance criteria of ASME Code, Section XI, subsubarticle IWB-3420 and subparagraph IWB-3132.3; and,
- 3) Alternate materials requirements of ASME Code Case N-638-7.

Specific details are provided in the September 23, 2020, application, as supplement by letter dated September 28, 2020.

3.5 Licensee's Basis for the Proposed Alternative

The licensee has developed alternative examination methods, flaw acceptance criteria, materials requirements, flaw evaluation methods, welding methods, and to implement the IDTB repairs.

The modified examination methods are based on the use of a final penetrant testing (PT) and ultrasonic testing (UT) in lieu of progressive penetrant testing. The combination of performing PT and UT examinations depicted in during the IDTB repair provides assurance of structural integrity.

The alternate acceptance criteria for a possible triple-point anomaly is based on a fracture mechanics analysis that was performed for the design configuration to provide justification, in accordance with ASME Code, Section XI, for operating with the postulated triple point anomaly. The anomaly is modeled as a 0.10-inch-deep crack-like defect, initiating at the triple point location, considering the most susceptible material for propagation.

The basis for the alternative materials requirements, i.e., the lack of fine-grain practice, is based on the EPRI Report 1014351, "Repair and Replacement Applications Center: Topical Report Supporting Expedited NRC Review of Code Cases for Dissimilar Metal Weld Overlay Repairs." This report provides a comparison of the chemical and mechanical properties, heat treatment, and grain refinement practices of SA-302, Grade B Modified to SA-533, Grade B Class 1 materials.

The duration of the proposed alternative is based on the most limiting life predicted by three evaluations: the weld anomaly analysis, the as-left J-groove analysis, and the primary water stress corrosion cracking (PWSCC) evaluation of the original Alloy 600 nozzle. The life expectancy for the IDTB repair is conservatively estimated by the licensee to be 21.8 effective full power months (EFPM).

3.6 Licensee's Proposed Duration of Relief Request

The licensee proposed this alternative one cycle of operation, not to exceed 20 months of operation, or May 31, 2022, when the PNP will permanently cease power operations.

3.7 NRC Staff Review

The NRC staff evaluated the licensee's proposed alternative RR 5-8, including the weld design, flaw evaluations, welding, and examinations in accordance with ASME Code, Sections III and XI, and ASME Code Case N-638-7. The NRC staff also evaluated the proposed deviations from the applicable ASME Code requirements included in the proposed alternative. Verbal authorization for proposed alternative RR 5-8 was given on October 1, 2020 (ADAMS Accession No. ML20275A343). This safety evaluation documents the technical basis for the NRC's verbal authorization.

The licensee proposed to use a half-nozzle repair method with IDTB welding to repair and restore the pressure boundary of the degraded nozzle penetrations. To support its repair

option, the licensee is proposing an alternative to: (1) the in-process examination requirements of ASME Code, Section III; (2) the flaw acceptance criteria of ASME Code, Section XI; and, (3) certain materials requirements of ASME Code Case N-638-7. The specific details regarding the above are provided in the submittal dated September 23, 2020. Given the short duration of the proposed alternative, the licensee will also not perform rotary peening on the inner diameter of the repaired nozzles.

3.7.1 Deviations from ASME Code, Section III

The use of the construction code for several aspects of repairs and replacement activities is required by ASME Code, Section XI. The licensee requested relief from the ASME Code, Section III, Article NB-5000 so that potential anomalies at the triple point location may remain in service. ASME Code, Section III, subparagraph N-5331(b), prohibits the existence of indications that are characterized as cracks, lack of fusion, or incomplete penetration regardless of length. As an alternative to subparagraph NB-5331(b), the licensee analyzed a postulated crack-like anomaly at the triple point in accordance with the ASME Code, Section XI, sub article IWB-3600, to justify operating with the anomaly left in service. The results of the licensee's analyses demonstrate that a postulated 0.10-inch weld anomaly is acceptable for 27 years. The NRC staff finds that the licensee has adequately demonstrated by analysis and by mockup testing that the triple point weld anomaly is acceptable to remain in service without affecting structural integrity of the repaired nozzle and agrees with the licensee's analysis.

ASME Code, Section III, 2001 Edition including Addenda through 2003, Paragraph NB-5245, specifies progressive surface examination of partial-penetration welds. The licensee opted to instead perform an ultrasonic volumetric examination of the modified configuration described in ASME Code Case N-638-7. In addition to the UT [ultrasonic testing] examinations, a surface PT [penetrant testing] examination was performed on the entire weld. The NRC staff find that this alternative combination of UT and PT examinations is at least as effective as the required progressive PT examinations and is acceptable.

3.7.2 Deviations from ASME Code, Section XI

ASME Code, Section XI, Subsection IWA-3300 specifies requirements for characterization of flaws detected by inservice examination. Subsubsection IWB-3420 states, "Each detected flaw or group of flaws shall be characterized by the rules of subarticle IWA-3300 to establish the dimensions of the flaws. These dimensions shall be used in conjunction with the acceptance standards of subarticle IWB-3500." IWB-3132.3 states, "A component whose volumetric or surface examination detects flaws that exceed the acceptance standards of Table IWB-3410-1 is acceptable for continued service without a repair/replacement activity if an analytical evaluation, as described in subarticle IWB-3600, meets the acceptance criteria of subarticle IWB-3600. The area containing the flaw shall be subsequently reexamined in accordance with IWB-2420(b) and (c)."

In a typical half-nozzle repair the exposed surface undergoes a surface stress improvement via peening. With stress improvement a half-nozzle repair can be expected to last for decades. As this proposed alternative only covers one operating cycle, peening was not performed. Lack of peening reduces the expected lifetime of the repair. A typical flaw analysis for a nickel-alloy weld is to perform a PWSCC growth calculation assuming an initial flaw too small for nondestructive analysis to detect is present. This flaw is sized at 10 percent of the thickness of the component with a variety of aspect ratios. The licensee performed a flaw analysis, which is

detailed in their submittal, and found that the life expectancy of the repair to be 21.8 full power months, or 1.8 years. The proposed alternative covers a period of 20 months.

The NRC staff performed independent flaw evaluations in the roll-expanded region and near the repair weld. Using conservative assumptions, the NRC flaw analyses found that any undetected flaws would reach 75 percent through-wall in depth in times ranging from 22 months to 84 months, depending on the flaw location and flaw aspect ratios. Any possible leakage from these postulated flaws would occur several months later. The NRC has confirmed that the licensee's proposed repair method supports 20 months of operation.

3.7.3 Deviations from ASME Code Case N-638-7

Paragraph 1(a) of Code Case N-638-7 prohibits the use of the code case to repair SA-302, Grade B material unless the material has been modified to include 0.4 percent to 1.0 percent nickel, quenching and tempering, and application of fine grain practice. The use of SA-302 Grade B material, modified to include 0.4 percent to 1.0 percent nickel, was originally permitted by ASME Code via ASME Code Case 1339. However, quenching and tempering and fine grain practice was not a requirement of this code case. SA-302 Grade B material specification called for a heat treatment of normalized with or without accelerated cooling. The RVCH is SA-302 Grade B and the licensee stated that the Certified Material Test Reports show that the materials used have been modified to include 0.4 percent to 1.0 percent nickel and have been quenched and tempered. However, there is no conclusive evidence that fine grain practice was used.

The ambient temperature temper bead welding method involves the formation of martensite in the heat affected zone which is tempered by subsequent weld layers. Qualification of the welding procedure in accordance with Code Case N-638-7 ensures that the welding variables used during field weld repairs produce martensite in the HAZ which is later transformed to tempered martensite by subsequent weld passes. There is no technical reason that would prevent the successful application of temper bead welding on SA-302 Grade B modified material that was not manufactured with the application of fine grain practice. In addition, nozzles previously repaired by the licensee have received a UT examination every refueling outage, since their installation in 2004, without the detection of any RVCH base material flaws. The NRC staff therefore finds that proposed alternative to Paragraph 1(a) acceptable.

Additionally, the licensee performed an analysis of loose parts from the degraded J-groove weld and corrosion of the bore of the RVCH penetration which will be exposed to primary reactor coolant. These evaluations address the safety concerns which could be raised by the licensee's proposed alternatives to ASME Code requirements and help to provide reasonable assurance that the proposed repair will provide for protection of public health and safety.

Reasonable assurance of the materials properties is provided by the testing requirements in ASME Code Case N-638-7. If any leakage does occur during operation the licensee has leakage monitoring and radiation air monitoring that would detect significant leakage through the repaired nozzles. The NRC finds the licensee's proposed alternative and supporting analyses to be acceptable for the proposed 20-month duration.

3.7.4 Technical Evaluation Summary

Based on the above evaluation, the NRC staff finds that the licensee's proposed alternative meets the requirements for authorization under 10 CFR 50.55a(z)(1) and provides reasonable assurance of structural integrity of the RVCH and repaired nozzle numbers 17 and 34 at PNP will be maintained for the next operating cycle, not to exceed 20 months of operation, or May 31, 2022, when the PNP will permanently cease power operations.

4.0 CONCLUSION

As set forth above, the NRC staff finds that the proposed alternative described in RR 5-8 provides an acceptable level of quality and safety. Accordingly, the NRC staff concludes that the licensee has adequately addressed all the regulatory requirements set forth in 10 CFR 50.55a(z)(1). Therefore, the NRC staff authorizes the proposed alternative in RR 5-8, for the next operating cycle, not to exceed 20 months of operation, or May 31, 2022, when the PNP will permanently cease power operations.

All other ASME Code requirements for which relief was not specifically requested and approved in the subject requests for relief remain applicable.

Principal Contributor: S. Cumblidge

Date: January 19, 2021