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

August 31, 2022

CATAWBA NUCLEAR STATION, UNIT 2 – PROPOSED ALTERNATIVE REQUEST RA-21-0144 TO USE REACTOR VESSEL HEAD PENETRATION EMBEDDED FLAW REPAIR METHOD (EPID L-2022-LLR-0010)

LICENSEE INFORMATION

Recipient's Name and Address: Mr. Tom Simril
Site Vice President
Catawba Nuclear Station
Duke Energy Carolinas, LLC
4800 Concord Road
York, SC 29745

Licensee: Duke Energy Carolinas, LLC (the licensee)

Plant Name and Unit: Catawba Nuclear Station, Unit 2

Docket No.: 50-414

APPLICATION INFORMATION

Submittal Date: January 20, 2022

Submittal Agencywide Documents Access and Management System (ADAMS) Accession No.: ML22020A283 (Non-Proprietary), ML22020A284 (Proprietary)

Supplement Date(s): July 7, 2022

Supplement ADAMS Accession No.: ML22188A236 (Non-Proprietary), ML22188A237 (Proprietary)

Applicable Inservice Inspection Program Interval and Interval Start/End Dates:

The alternative is applicable to the Fourth ISI (Inservice Inspection) Program Interval for Catawba Nuclear Station (CNS), Unit 2, starting August 19, 2015, and ending February 24, 2026.

Alternative Provision: The applicant requested an alternative for CNS, Unit 2, in accordance with Title 10 of the *Code of Federal Regulations* (10 CFR), paragraph 50.55a(z)(1), on the basis that the alternative provides an acceptable level of quality and safety.

ISI Requirement and Affected Components: Section XI, of American Society of Mechanical Engineers (ASME) Code, IWA-4000, contains requirements for the removal of defects from and welded repairs performed on ASME Code components. Paragraph IWA-4421 states, in part, that defects be removed or mitigated in accordance with the requirements in IWA-4461 (by thermal methods), IWA-4462 (by mechanical processing) or IWA-4411 (by welding or brazing). Specifically, paragraph IWA-4411 requires that welding, brazing, fabrication, and installation

shall be performed in accordance with the Owner's Requirements and the Construction Code of the item, with additional provisions allowing the use of later editions or addenda of the Construction Code.

Section III, of ASME Code, paragraph NB-4451, provides the general requirements for removal and repair of weld metal defects. In addition, ASME Code, Section III, paragraph NB-4452 and subparagraph NB-4453.1 specify the requirements for eliminating weld surface defects and the requirements for excavating weld defects for repair activities, respectively.

The affected component is ASME Code Class 1, RVCH penetration #74.

Applicable Code Edition and Addenda: The applicable ASME Code, Section XI, Edition and Addenda for the fourth 10-year ISI at CNS, Unit 2, is the 2007 Edition through the 2008 Addenda. Examinations of the reactor vessel closure head (RVCH) penetrations are performed in accordance with 10 CFR 50.55a(g)(6)(ii)(D), which specifies the use of ASME Code Case N-729-6, with conditions.

The Construction Code applicable to the repair of weld defects on the RVCH is the 1989 Edition of ASME Code, Section III, and the RPV Construction Code is ASME Code, Section III, 1971 Edition through Winter 1972 Addenda.

Brief Description of the Proposed Alternative: The licensee proposes to repair the J-groove weld of RVCH penetration #74 using an embedded flaw repair process in accordance with the U.S. Nuclear Regulatory Commission (NRC) approved Westinghouse Topical Report WCAP-15987-P-A, "Technical Basis for the Embedded Flaw Process for Repair of Reactor Vessel Head Penetrations," Revision 2 (ML040290246), as modified by the proposed alternative.

NRC STAFF EVALUATION

During the spring 2021 refueling outage (C2R24) at CNS, Unit 2, the licensee detected an indication which required repair in the J-groove weld of RVCH penetration #74. The licensee used the embedded flaw repair process, in accordance with the NRC-approved WCAP-15987-P-A report, with some modifications, to repair the weld. On April 24, 2021 (ML21117A129), the NRC provided verbal authorization for the licensee's proposed alternative repair for one cycle of operation and by letter dated September 20, 2021 (ML21253A082), the NRC provided its follow-up safety evaluation for the verbal relief request. By letter dated January 20, 2022, as supplemented by letter dated July 7, 2022, the licensee provided additional technical basis to support the continued use of the repair for the remaining life of the plant. The licensee made this request in accordance with 10 CFR 50.55a(z)(1) on the basis that the proposed alternative repair will provide an acceptable level of quality and safety.

The NRC staff reviewed the following information: (1) the proposed embedded flaw repair method; (2) consistency of the repair, examination, and flaw evaluation methods with those described in the NRC-approved WCAP 15987-P-A report and current NRC regulations under 10 CFR 50.55a(g)(6)(ii)(D); (3) corrosion resistance of repair weld material (Alloy 52/52M) exposed to reactor coolant; and (4) flaw assessment for continued operation.

The NRC approved WCAP-15987-P, Revision 2 by letter dated July 3, 2003 (ML031840237), as a topical report to be used for referencing in licensing applications to request implementation of the embedded flaw repair process. The process embeds primary water stress corrosion cracking (PWSCC) flaws found in Alloy 600 RVCH penetration nozzles and J-groove welds under a non-structural seal weld which is more resistant to PWSCC. The licensee's proposal

identified Alloy 52/52M as the seal weld material to be used. The NRC has performed extensive testing to verify the increased resistance to PWSCC of these materials over the past 10 years at Argonne National Laboratory and Pacific Northwest National Laboratory and finds them acceptable for use in this application. Consistent with the original 2003 safety evaluation, NRC finds that seal weld repair technique of flaws of the type identified by the licensee in the J-groove weld of RVCH penetration #74 would provide an acceptable level of safety and quality.

The licensee's proposed alternative modifies the original embedded flaw repair process to address changes in non-destructive examination (NDE) requirements since the 2003 approval of the WCAP. The licensee provided updated examination requirements to be consistent with the NRC regulations in 10 CFR 50.55a(g)(6)(ii)(D), which mandates the use of ASME Code Case N-729-6, with conditions, for the examination of RVCH penetration nozzles and welds. The NRC staff verified that the examination types and frequencies were consistent with the current regulatory requirement and latest approvals of use of the embedded flaw repair process for other licensees. The NRC staff finds these examinations will provide reasonable assurance of the structural integrity of the RVCH through the requested duration of the licensee's proposed alternative.

The licensee included the Westinghouse Report WCAP-18708, "Technical Basis for Westinghouse Embedded Flaw Repair of Catawba Unit 2 Reactor Vessel Head Penetration Nozzles and Attachment Welds," as part of their submittal. This report provides a technical basis for the design life of the embedded flaw repair for head penetration #74 for the remainder of the plant license at CNS, Unit 2. Given that the flaw remains in the structural material of the head penetration, WCAP-18708 provides an analysis of the flaw in the possible growth mechanisms to ensure structural integrity of the component and leak tight integrity of the embedded flaw repair. The NRC staff agrees that fatigue is the only reasonable mechanism for growth. Due to the inability of NDE to size the flaw in the J-groove weld, the licensee assumed a hypothetical flaw that covers the entire attachment J-groove weld. The NRC staff finds this to be a conservative flaw assessment.

The NRC staff finds the licensee's methodology of assessment of structural integrity to be in compliance per the ASME Code and Regulatory Guide 1.161 (ML003740038) and, therefore, find it acceptable. WCAP-18708 states the limiting flaw path is fatigue growth through the embedded flaw repair thickness itself, but that structural integrity of the repaired weld layer would be maintained for 47 years of service life. The NRC staff finds this result is consistent with previous reviews of head penetration flaw repairs. Given the NDE is performed in accordance with 10 CFR 50.55a(g)(6)(ii)(D), the examinations proposed in this alternative, and the conservative flaw assessment, the NRC staff finds reasonable assurance of structural integrity of the embedded flaw repaired head penetration #74 for the licensee's calculated 47 years of service life.

The NRC staff finds that the licensee's repair, examination, and flaw assessment methods are consistent with the guidance in the NRC-approved WCAP-15987-P-A report and the inspection requirements specified in ASME Code Case N-729-6, as conditioned in 10 CFR 50.55a(g)(6)(ii)(D). The NRC staff finds that the embedded flaw repair restored the primary system pressure boundary and provides reasonable assurance of structural integrity of the reactor vessel closure head and repaired penetration #74. Therefore, the NRC staff concludes the licensee's proposed alternative provides an acceptable level of quality and safety for the remainder of the current fourth 10-year ISI interval.

CONCLUSION

The NRC staff has determined that the proposed alternative in the licensee's request referenced above would provide an acceptable level of quality and safety. The NRC staff concludes that the licensee has adequately addressed the regulatory requirements set forth in 10 CFR 50.55a(z)(1). The NRC staff authorizes the use of proposed alternative RA-21-0144 at Catawba Nuclear Station, Unit 2, for the remainder of the current fourth 10-year inservice inspection interval, scheduled to end on February 24, 2026.

All other ASME BPV Code, Section XI requirements for which an alternative was not specifically requested and authorized remain applicable, including third party review by the Authorized Nuclear Inservice Inspector.

Principal Contributor: Collins, Jay

Date: August 31, 2022

Shawn A. Williams

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