



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

April 16, 2018

Ms. Cheryl A. Gayheart
Regulatory Affairs Director
Southern Nuclear Operating Company, Inc.
P.O. Box 1295 / Bin - 038
Birmingham, AL 35201-1295

SUBJECT: EDWIN I. HATCH NUCLEAR PLANT, UNIT NOS. 1 AND 2 – PROPOSED
INSERVICE INSPECTION ALTERNATIVE HNP-ISI-ALT-05-05
(CAC NOS. MF9812 AND MF9813; EPID L-2017-LLR-0053)

Dear Ms. Gayheart:

By letter dated June 5, 2017, as supplemented by letters dated October 26, 2017, and February 20, 2018, Southern Nuclear Operating Company (the licensee), proposed an alternative to the requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (BPV), Section XI, regarding inservice inspection (ISI) of the reactor pressure vessel nozzle-to-vessel shell welds and nozzle inner radius at Edwin I. Hatch Nuclear Plant, Units 1 and 2 (Hatch). The proposed alternative is based on ASME Code Case N-702, "Alternative Requirements for Boiling Water Reactor (BWR) Nozzle Inner Radius and Nozzle-to-Shell Welds."

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(z)(1), the licensee requested to use the proposed alternative, HNP-ISI-ALT-05-05, on the basis that the proposed alternative would provide an acceptable level of quality and safety.

The U.S. Nuclear Regulatory Commission (NRC) staff has completed its review of the proposed alternative HNP-ISI-ALT-05-05. As set forth in the enclosed safety evaluation, the NRC staff finds that the licensee adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(z)(1). Accordingly, the NRC staff concludes that the proposed alternative provides an acceptable level of quality and safety. Therefore, the NRC staff authorizes the use of HNP-ISI-ALT-05-05 at Hatch for the fifth 10-year inservice inspection program interval, which ends on December 31, 2025.

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

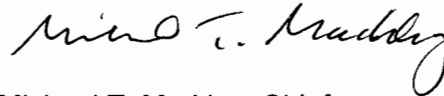
Proposed alternative HNP-ISI-ALT-05-06 was also submitted in the June 5, 2017, letter. Proposed alternative HNP-ISI-ALT-05-06 was authorized by the NRC staff on February 8, 2018.

C. Gayheart

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If you have any questions, please contact the Project Manager, Randy Hall, at 301-415-4032 or by e-mail at Randy.Hall@nrc.gov.

Sincerely,

A handwritten signature in black ink, appearing to read "Michael T. Markley". The signature is written in a cursive style with a large, looping final letter.

Michael T. Markley, Chief
Plant Licensing Branch II-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-321 and 50-366

Enclosure:
Safety Evaluation

cc: Listserv



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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

PROPOSED ALTERNATIVE HNP-ISI-ALT-05-05

REGARDING THE USE OF ASME CODE CASE N-702

EDWIN I. HATCH NUCLEAR PLANT, UNIT NOS. 1 AND 2

SOUTHERN NUCLEAR OPERATING COMPANY

DOCKET NOS. 50-321 AND 50-366

1.0 INTRODUCTION

By letter dated June 5, 2017 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML17156A831), as supplemented by letters dated October 26, 2017, and February 20, 2018 (ADAMS Accession Nos. ML17303A073 and ML18051A170, respectively), Southern Nuclear Operating Company (the licensee), proposed an alternative to the requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (BPV Code), Section XI, regarding inservice inspection (ISI) of the reactor pressure vessel (RPV) nozzle-to-vessel shell welds and nozzle inner radius at Edwin I. Hatch Nuclear Plant, Units 1 and 2 (Hatch). The alternative is based on ASME Code Case N-702, "Alternative Requirements for Boiling Water Reactor (BWR) Nozzle Inner Radius and Nozzle-to-Shell Welds."

Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(z)(1), the licensee requested to use the proposed alternative, HNP-ISI-ALT-05-05, for the fifth 10-year ISI program interval at Hatch on the basis that the proposed alternative would provide an acceptable level of quality and safety.

Proposed alternative HNP-ISI-ALT-05-06 was also submitted in the licensee's letter of June 5, 2017. Proposed alternative HNP-ISI-ALT-05-06 was authorized on February 8, 2018 (ADAMS Accession No. ML18033B739).

2.0 REGULATORY EVALUATION

The regulations in 10 CFR 50.55a(g) require that the ISI of ASME Code Class 1, 2, and 3 components be performed in accordance with Section XI of the ASME BPV Code and applicable addenda.

Section 50.55a(z) of 10 CFR states that alternatives to the requirements of paragraphs (b) through (h) 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 applicant or licensee must demonstrate that (1) the proposed alternative would 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.

The ASME BPV Code, Section XI, requires that all RPV nozzles to be inspected during each 10-year ISI interval. The volumes in each nozzle required to be inspected are 100 percent of the nozzle-to-vessel shell weld volume and 100 percent of the nozzle inner radius section volume, as shown in the applicable figure in Figures IWB-2500-7(a) through (d) "Nozzle in Shell or Head," of the ASME BPV Code, Section XI. However, Code Case N-702 provides an alternative that would reduce the number of RPV nozzles of each type required to be inspected from 100 percent to 25 percent during each 10-year ISI interval. The volumes required to be inspected in each nozzle remains 100 percent of the applicable nozzle-to-vessel shell weld volume and nozzle inner radius section volume. Code Case N-702 is conditionally approved in Regulatory Guide (RG) 1.147, Revision 18, "Inservice Inspection Code Case Acceptability, Section XI, Division 1," dated March 2017 (ADAMS Accession No. ML16321A336). For the application of Code Case N-702, the licensee is required to address the conditions specified in RG 1.147, Revision 18, for ASME Code Case N-702 that state, in part:

The applicability of Code Case N-702 must be shown by demonstrating that the criteria in Section 5.0 of NRC Safety Evaluation regarding BWRVIP-108 dated December 19, 2007 ([ADAMS Accession No.] ML073600374) or Section 5.0 of NRC Safety Evaluation regarding BWRVIP-241 dated April 19, 2013 ([ADAMS Accession No.] ML13071A240) are met. The evaluation demonstrating the applicability of the Code Case shall be reviewed and approved by the NRC prior to the application of the Code Case.

BWRVIP-108, "Technical Basis for the Reduction of Inspection Requirements for the Boiling Water Reactor Nozzle-to-Vessel Shell Welds and Nozzle Inner Radii" (proprietary, non-public) and BWRVIP-241, "Probabilistic Fracture Mechanics [PFM] Evaluation for the Boiling Water Reactor Nozzle-to-Vessel Shell Welds and Nozzle Blend Radii" (ADAMS Accession No. ML11119A043) contain PFM analysis results supporting Code Case N-702. Both reports are for 40 years of operation. BWRVIP-241 contains additional PFM results supporting revision of the evaluation criteria under "Conditions and Limitations" in the safety evaluation (SE) for BWRVIP-108. The NRC staff has accepted the revised criteria in the SE for BWRVIP-241.

Recently, the NRC issued an SE, dated April 26, 2017 (ADAMS Accession No. ML17114A096), on a supplemental document for license renewal, BWRVIP-241, Appendix A, "BWR Nozzle Radii and Nozzle-to-Vessel Welds Demonstration of Compliance with the Technical Information Requirements of the License Renewal Rule (10 CFR 54.21)." BWRVIP-241, Appendix A, extends the applicability of the BWRVIP-108 and BWRVIP-241 methodologies, and therefore, Code Case N-702, from 40 years to the period of extended operation.

The ASME BPV Code of record for Hatch for the fifth 10-year ISI interval is the 2007 Edition of the ASME BPV Code, Section XI, through the 2008 Addenda.

3.0 TECHNICAL EVALUATION

3.1 Licensee Evaluation

Component(s) for which Alternative is Requested (ASME Code Class 1)

Nozzle-to-vessel shell welds and nozzle inside radius section volume of RPV nozzles N1, N2, N3, N5, N6, N7, N8, as specified in Enclosure 1 "Alternative HNP-ISI-ALT-05-05" of the submittal dated June 5, 2017

Examination Category

B-D, "Full Penetration Welded Nozzles in Vessels"

Examination Item Number

B3.90, "Nozzle-to-Vessel Welds" and B3.100, "Nozzle Inside Radius Section"

ASME Code Requirement for which Alternative is Requested

ASME BPV Code, Section XI, 2007 Edition with the 2008 Addenda, Table IWB-2500-1, Examination Category B-D, for Item Numbers B3.90 and B3.100 requires a volumetric examination of all nozzles with full penetration welds to the vessel shell (or head) and integrally cast nozzles each 10-year ISI interval.

Licensee's Proposed Alternative to the ASME Code

Pursuant to 10 CFR 50.55a(z)(1), the licensee proposes an alternative to performing the required examinations on 100 percent of the RPV nozzles identified as Item Nos. B3.90 (welds) and B3.100 (inner radius sections). This alternative is in accordance with Code Case N-702, and proposes that a minimum of 25 percent of the RPV nozzles (the nozzle-to-vessel welds and nozzle inner radius sections of these nozzles), including at least one nozzle from each system and nominal pipe size, be volumetrically examined. The number of nozzles to be examined for each RPV nozzle group is listed in Table 1 of Enclosure 1 of the submittal.

Volumetric examination is the licensee's preferred method for examining the nozzle inner radius sections. However, if a visual examination (VT-1) is performed in lieu of a volumetric examination, the licensee stated that it has implemented ASME Code Case N-648-1, "Alternative Requirements for Inner Radius Examination of Class 1 Reactor Vessel Nozzles, Section XI Division 1." Code Case N-648-1 has associated required conditions specified in RG 1.147, Revision 18.

Licensee's Bases for Alternative

The alternative is based on the PFM results documented in BWRVIP-108 and BWRVIP-241. The licensee selected the evaluation criteria in the SE for BWRVIP-241, as shown in the following:

(1) Max RPV Heatup/Cooldown Rate

First criterion: the maximum RPV heatup/cooldown rate is limited to < 115 degrees Fahrenheit (°F)/hr.

Hatch meets the first criterion, as stated in Enclosure 1 of the submittal, dated June 5, 2017.

HNP Unit 1 and Unit 2, Reactor Coolant System heatup and cooldown rates provided in the respective units' Pressure and Temperature Limits Reports (which is referenced in Technical Specification 3.4.9.1) are limited to a maximum of 100°F when averaged over any one hour period and thus meets the requirement of condition 1.

(2) Recirculation Inlet (N2) Nozzles

Second criterion: $(pr/t) / C_{i-RPV} < 1.15$, where

p = RPV normal operating pressure (psig),
r = RPV inner radius (inch),
t = RPV wall thickness (inch), and
 $C_{i-RPV} = 19332$

Hatch meets the second criterion, based on the input parameters for this nozzle in Enclosure 1 of the June 5, 2017, submittal as summarized in the calculation below:

$$[(1058 \times 110.375) / 6.875] / 19332 = 0.88 < 1.15$$

(3) Recirculation Inlet (N2) Nozzles

Third criterion: $[p(r_o^2 + r_i^2) / (r_o^2 - r_i^2)] / C_{i-NOZZLE} < 1.47$, where

p = RPV normal operating pressure (psig),
 r_o = nozzle outer radius (inch),
 r_i = nozzle inner radius (inch), and
 $C_{i-NOZZLE} = 1637$

Hatch meets the third criterion, based on the input parameters for this nozzle in Enclosure 1 of the June 5, 2017, submittal as summarized in the calculation below:

$$[1058(10.219^2 + 6.187^2) / (10.219^2 - 6.187^2)] / 1637 = 1.39 < 1.47$$

(4) Recirculation Outlet (N1) Nozzles

Fourth criterion: $(pr/t) / C_{o-RPV} \leq 1.15$, where

p = RPV normal operating pressure (psig),
r = RPV inner radius (inch),
t = RPV wall thickness (inch), and
 $C_{o-RPV} = 16171$

Hatch meets the fourth criterion, based on the input parameters for this nozzle in Enclosure 1 of the June 5, 2017, submittal as summarized in the calculation below:

$$[(1058 \times 110.375)/6.875]/16171 = 1.05 < 1.15$$

(5) Recirculation Outlet (N1) Nozzles

Fifth criterion: $[p(r_o^2 + r_i^2)/(r_o^2 - r_i^2)]/C_{o-NOZZLE} \leq 1.59$, where

p = RPV normal operating pressure (psig),

r_o = nozzle outer radius (inch),

r_i = nozzle inner radius (inch), and

$C_{o-NOZZLE} = 1977$

Hatch meets the fifth criterion, based on the input parameters for this nozzle in Enclosure 1 of the June 5, 2017, submittal as summarized in the calculation below:

$$[1058(19.75^2 + 12.75^2)/(19.75^2 - 12.75^2)]/1977 = 1.30 < 1.59$$

Period of application

The licensee requests the proposed alternative for the duration of the fifth 10-year ISI interval of Hatch, Units 1 and 2, which ends on December 31, 2025.

3.2 NRC Staff Evaluation

The conditions for Code Case N-702 specified in RG 1.147, Revision 18, require that the applicability of Code Case N-702 be shown by demonstrating that the criteria in Section 5.0 of the SE for BWRVIP-108 or the criteria in Section 5.0 of the SE for BWRVIP-241 are met. These criteria were developed to ensure that the probabilities of failure (PoFs) from the supporting PFM results for RPV nozzles are less than the NRC safety goal of 5×10^{-6} per reactor-year. The criteria in the SE for BWRVIP-241 are more relaxed than the criteria in the SE for BWRVIP-108. This relaxation is supported by additional PFM results documented in BWRVIP-241 for limiting RPV nozzles. The licensee selected the criteria in the SE for BWRVIP-241 and demonstrated that Hatch meets all criteria, as shown in Section 3.1 of this SE.

The SE for BWRVIP-108 established that: (1) the fracture toughness-related reference temperature (RT_{NDT}) used in the PFM analyses were based on data from the entire fleet of BWR RPVs, making the PFM analyses bounding with respect to fracture resistance and leaving the driving force of the underlying PFM analyses the only item to be evaluated; and (2) except for the RPV heatup/cool-down rate, the plant-specific criteria are for the recirculation inlet and outlet nozzles because the conditional PoF for other nozzles are an order of magnitude lower. These fundamentals remain true for BWRVIP-241.

The licensee's evaluation discussed in Section 3.1 of this SE indicated that all RPV nozzle-to-shell welds and nozzle inner radii sections meet the criteria for applying Code Case N-702. The NRC staff used the licensee's input geometric parameters provided in Enclosure 1 of the submittal to verify the licensee's calculations, and arrived at the same plant-specific results shown in the enclosure. Therefore, the NRC staff finds the licensee's calculations acceptable. However, the licensee's evaluation is valid for only 40 years of operation because the underlying PFM results in BWRVIP-108 are for 40 years. Since the licensee proposes the alternative for the

fifth 10-year ISI interval, beyond the original 40-year operation, the licensee included a plant-specific PFM analysis in Attachment 1 to Enclosure 1 of the submittal to justify application of Code Case N-702 in the fifth 10-year ISI interval. In the October 26, 2017, supplement, the licensee confirmed that, with respect to the plant-specific PFM analysis: (1) that fatigue cycles were grouped into selected bounding transients; (2) that fatigue cycles were projected to 60 years of operation; and (3) that the location selected for fluence values were closer to the reactor core than the RPV inlet and outlet nozzles.

The SE for BWRVIP-108 addressed PoF for a low-temperature overpressure (LTOP) event and normal operating conditions. The licensee demonstrated in the plant-specific PFM analysis that the PoF per year for a LTOP event for 60 years of operation is less than the NRC safety goal of 5×10^{-6} per reactor-year. In the supplement dated February 20, 2018, the licensee provided PoF values per year for the Hatch normal operating conditions showing that the values were less than the NRC safety goal of 5×10^{-6} per reactor-year with significant margins. Since the calculated PoFs are specific to Hatch, the NRC staff concludes that the underlying PFM analysis in BWRVIP-108 is applicable to 60 years for the subject Hatch RPV nozzles, and, therefore, is applicable during the fifth 10-year ISI interval.

Additionally, ASME Code Case N-702 stipulates that VT-1 examination may be used in lieu of the volumetric examination for the nozzle inner radii. However, the NRC staff has not endorsed the use of Code Case N-702 for VT-1 examinations. Code Case N-648-1 may be used with the associated required conditions specified in RG 1.147, Revision 18, if a VT-1 examination is performed in lieu of a volumetric examination. The licensee stated that it has implemented Code Case N-648-1 when using VT-1, and the NRC staff finds this action acceptable.

4.0 CONCLUSION

The NRC staff reviewed the submittal regarding the licensee's proposed alternative to use ASME Code Case N-702. The licensee addressed the conditions for using ASME Code Case N-702 specified in RG 1.147, Revision 18. The conditions require evaluation of the plant-specific RPV nozzle information against the five evaluation criteria specified in the SEs for BWRVIP-108 or BWRVIP-241. The NRC staff finds that the licensee has adequately addressed the conditions in RG 1.147, Revision 18, for ASME Code Case N-702 for the subject RPV nozzles of Hatch for the fifth 10-year ISI interval. Therefore, the NRC staff finds that the licensee's proposed alternative is in compliance with the ASME BPV Code requirements and provides an acceptable 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(z)(1) and authorizes the licensee's proposed alternative for inspection of nozzle-to-vessel shell welds and nozzle inner radius sections for the requested RPV nozzles at Hatch for the fifth 10-year ISI interval that ends on December 31, 2025.

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

Principal Contributor: D. Dijamco, NRR

Date: April 16, 2018.

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