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

December 10, 2018

Ms. Cheryl A. Gayheart
Regulatory Affairs Director
Southern Nuclear Operating Company, Inc.
3535 Colonnade Parkway
Birmingham, AL 35243

SUBJECT: JOSEPH M. FARLEY NUCLEAR PLANT, UNIT 2 - PROPOSED INSERVICE INSPECTION ALTERNATIVE FNP-ISI-ALT-05-03 (EPID L-2018-LLR-0062)

Dear Ms. Gayheart:

By letter dated April 18, 2018, Southern Nuclear Operating Company, Inc. (SNC, the licensee), requested approval to use an alternative to the inservice inspection requirements of the American Society of Mechanical Engineers (ASME) Code Case N-770-2 for the Reactor Pressure Vessel cold-leg nozzle dissimilar metal welds for the Joseph M. Farley Nuclear Plant (Farley, FNP), Unit 2. The proposed alternative would allow deferral of the examinations from the Farley, Unit 2, refueling outage (2R26), which is currently scheduled to start spring 2019, to the following refueling outage (2R27), which is scheduled to start fall 2020.

The licensee submitted the proposed alternative pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.55a(z)(2), on the basis that the ASME Code requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality of safety.

The U.S. Nuclear Regulatory Commission (NRC) staff has completed its review of alternative FNP-ISI-ALT-05-03. As set forth in the enclosed safety evaluation, the NRC staff has determined that the licensee has adequately addressed all of the regulatory requirements set forth in 10 CFR 50.55a(z)(2). Accordingly, the NRC staff concludes that complying with the specified requirement would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. Therefore, the NRC staff authorizes the use of alternative FNP-ISI-ALT-05-03 at Farley, Unit 2, up to and including refueling outage 2R27, currently scheduled to start in fall 2020.

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

If you have any questions, please contact the Project Manager, Shawn Williams, at 301-415-1009 or by e-mail at Shawn.Williams@nrc.gov.

Sincerely,

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

Docket No. 50-364

Enclosure:
Safety Evaluation

cc: Listserv

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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

PROPOSED ALTERNATIVE FNP-ISI-ALT-05-03

PROPOSED ALTERNATIVE TO REACTOR VESSEL NOZZLE WELD EXAMINATION FREQUENCY REQUIREMENTS

SOUTHERN NUCLEAR OPERATING COMPANY

JOSEPH M. FARLEY NUCLEAR PLANT, UNIT 2

DOCKET NO. 50-364

1.0 INTRODUCTION

By letter dated April 18, 2018 (Agencywide Documents Access and Management System Accession No. ML18108A070), Southern Nuclear Operating Company, Inc., (SNC, the licensee) requested approval to use an alternative to the inservice inspection (ISI) requirements of the American Society of Mechanical Engineers (ASME) Code Case N-770-2 for the Reactor Pressure Vessel (RPV) cold-leg nozzle dissimilar metal welds for the Joseph M. Farley Nuclear Plant (Farley, FNP), Unit 2. The proposed alternative would allow deferral of the examinations from the Farley, Unit 2, refueling outage (2R26), which is currently scheduled to start spring 2019, to the following refueling outage (2R27), which is schedule to start fall 2020.

Pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR), Paragraph 50.55a(z)(2), the licensee requested to use the alternative on the basis that complying with the specified requirement would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

2.0 REGULATORY EVALUATION

Adherence to Section XI of the ASME Code is mandated by 10 CFR 50.55a(g)(4), *Inservice inspection standards requirement for operating plants*, which states, in part:

> Throughout the service life of a boiling or pressurized water-cooled nuclear power facility, components (including supports) that are classified as ASME Code Class 1, Class 2, and Class 3 must meet the requirements, except design and access provisions and preservice examination requirements, set forth in Section XI ... to the extent practical within the limitations of design, geometry, and materials of construction of the components.

Pursuant to 10 CFR 50.55a(g)(6)(ii), *Augmented ISI program*, the U.S. Nuclear Regulatory (NRC) may require licensees to follow an augmented ISI program for systems and components for which the Commission deems that added assurance of structural reliability is necessary.

Pursuant to 10 CFR 50.55a(g)(6)(ii)(F)(1), *Augmented ISI requirements: Examination requirements for Class 1 piping and nozzle dissimilar-metal butt welds—(1) Implementation,* licensees shall implement the requirements of ASME BPV Code Case N-770-2 instead of ASME BPV Code Case N–770–1, subject to the conditions specified in paragraphs (g)(6)(ii)(F)(2) through (13) of Section, by the first refueling outage starting after August 17, 2017.

Pursuant to 10 CFR 50.55a(z), *Alternatives to codes and standards*, states that alternatives to the requirements of paragraphs (b) through (h) of this section 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 (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.

Based on the above, and subject to the following technical evaluation, the NRC staff finds that regulatory authority exists for the licensee to request and the NRC to authorize the licensee's proposed alternative for Farley, Unit 2.

3.0 TECHNICAL EVALUATION

3.1 ASME Code Components Affected by the Proposed Alternative

The licensee's request is applicable to the following RPV inlet nozzle-to-safe end Dissimilar Metal Butt Welds (DMBWs) for Farley, Unit 2:

Component ID	Description
APR1-4100-14DM	Inlet Nozzle DM Weld at 335 degrees
APR1-4200-14DM	Inlet Nozzle DM Weld at 215 degrees
APR1-4300-14DM	Inlet Nozzle DM Weld at 95 degrees

3.2 Applicable Code Edition, Addenda, and Requirement

Paragraph 10 CFR50.55a(g)(6)(ii)(F) requires licensees of pressurized-water reactors to implement the requirements of ASME Code Case N-770-2 subject to conditions specified in paragraphs (g)(6)(ii)(F)(2) through (13) of that section. ASME Code Case N-770-2, Inspection Item 8 requires unmitigated butt weld at Cold Leg operating temperatures between 525 degree Fahrenheit (°F) and 580°F to be volumetrically examined every second inspection period not to exceed 7 years.

The applicable Code edition and addenda is the 2007 Edition with Addenda through 2008 of ASME Code Section XI.

3.3 Licensee's Proposed Alternative

The licensee's proposed alternative is to extend the weld examination frequency required by 10 CFR 50.55a(g)(6)(ii)(F) for the Farley, Unit 2 RPV inlet nozzle DMBWs listed in Section 3.1 of this safety evaluation for an additional operating cycle to allow examination during refueling outage 2R27 which is scheduled to begin in fall 2020.

3.4 Licensee's Bases for Use

The licensee is seeking NRC authorization of the proposed alternative in accordance with 10 CFR 50.55a(z)(2) on the basis that compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. The licensee is requesting the deferral of the volumetric examination of the subject welds to limit the number of core barrel removals to facilitate inspection and mitigation of the subject welds and align the single core barrel removal with the required inspections of four other components during refueling outage 2R27, which is currently scheduled in fall of 2020. The licensee estimates the hardship associated with the additional core barrel lift will be between 152.7 millirem and 495.5 millirem radiological dose, based on previous operating experience. Also, the licensee notes the increased burden due to core barrel removal and the risk associated with a heavy equipment lifting operation to personnel and components.

Additionally, the licensee indicated that its proposed alternative does not adversely impact the level of safety or quality and provides reasonable assurance that the structural integrity and the leak tightness of the subject weld will be maintained for several reasons, including but not limited to:

- The most recent volumetric examinations in 2010 were performed in accordance with procedures and personnel qualified to Section XI, Appendix VIII, Supplement 10 requirements and included eddy current examinations of the weld surface. These examinations achieved essentially 100 percent coverage for both circumferential and axial flaws, with no relevant indications noted during the examination.

- Plant-specific crack growth evaluation concluded that more than 10.5 years of effective full power years (EFPY) is required for the most limiting flaw growth of an axial flaw from the standard volumetrically qualified detection limit to the allowable size per the ASME Section XI IWB-3640 flaw evaluation procedure. The licensee's request requires a projected EFPY of 9.7 (6.8 actual through 2R25 plus 2.9 EFPY projected to the start of 2R27), which is less than the hypothetical flaw growth with a margin of almost one year.

3.5 Duration of Proposed Alternative

The licensee requested that the NRC authorize this alternative to extend the volumetric inspection interval for examination of the subject welds up to and including refueling outage 2R27, currently scheduled to start in fall 2020.

3.6 NRC Staff's Technical Evaluation

The NRC staff has reviewed and evaluated the licensee's request on the basis that compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. The applicable requirement is the qualified volumetric inspection of the subject welds within 7 years of the previous qualified

volumetric inspection. This requirement is based on a general assessment of the necessary qualified volumetric inspection frequency for all cold leg operating temperature DMBWs, of any size, in the reactor coolant system to maintain structural integrity. Under this inspection requirement, the welds are expected to have no previous indications of Primary Water Stress Corrosion Cracking (PWSCC). The licensee stated in their submittal that no PWSCC has been found in these welds. The NRC staff verified this information and confirms that the licensee-identified DMBWs that are the subject of this proposed alternative are applicable to this inspection category and technical basis for qualified volumetric inspection frequency.

The licensee identified a hardship associated with the performance of the qualified volumetric inspection frequency within the current requirements. The licensee noted that the current required volumetric inspection frequency would require an additional core barrel removal to facilitate inspection and planned mitigation of the subject welds, as well as, required inspections of four other components. Based on previous outages, the licensee estimates the occupational dose to be between 152 millirem and 495 millirem for removal and reinstallation of the core barrel. The NRC staff finds the licensee's estimate of radiological dose is reasonable based on previous operational experience for the Farley units. Also, the licensee noted the increased burden due to core barrel removal and the risk associated with a heavy equipment lifting operation to personnel and components. The NRC staff finds the licensee has provided sufficient basis to demonstrate a hardship associated with the current required volumetric inspection frequency of the subject welds. Therefore, the NRC staff finds the licensee meets the hardship requirement of 10 CFR 50.55a(z)(2).

The NRC staff reviewed the level quality and safety of the licensee's proposed alternative to allow an approximately two and one half year delay in the qualified volumetric examination, beyond the original regulatory requirement of 7 years. As part of this analysis, the NRC staff reviewed the licensee's technical basis regarding past operating history and plant specific flaw analysis. Furthermore, the NRC staff performed an independent flaw evaluation for the subject welds to verify the conclusions of the licensee's analysis. Based on the above, the NRC finds sufficient justification for the requested duration.

The licensee provided the results of the most recent volumetric examinations of the welds, which show no reportable PWSCC indications. The original 7-year frequency requirement for a volumetric inspection is only valid for welds with no previous indications of PWSCC. Therefore, the results of the most recent volumetric examinations of these welds was to necessary to ensure the correct classification of the inspection category of the welds. However, these results alone did not provide sufficient basis to support the proposed alternative. The additional eddy current inspections, although not required by ASME Code Section XI, are more effective than the required volumetric examinations for finding shallow flaws. Thus, the NRC staff finds that the combined results of the volumetric examinations and the eddy current inspections provide sufficient basis to support the proposed alternative.

The licensee performed both an axial and circumferential flaw analysis to support the extension of the required volumetric inspection frequency. The purpose of these analyses is to demonstrate that a hypothetical PWSCC flaw will not grow to an unacceptable size within the period of extended inspection frequency. The NRC staff reviewed the licensee's flaw analyses' inputs and found the licensee's inputs are acceptable. The licensee's analysis documented the time for a flaw to meet an ASME BPV Code limit of 75 percent through-wall depth of the weld. The licensee's most limiting analysis found that an axial flaw would take 10.5 EFPY to reach 75 percent through-wall depth. The NRC staff notes that this time is the limiting analysis as a circumferential flaw would take longer to reach these conditions, and longer still to cause failure

of the structural integrity of the weld. The NRC staff also notes that only the growth of a circumferential flaw could result in a loss of structural integrity, because a circumferential flaw can grow around the weld, which could lead to a guillotine break in the pipe. Alternatively, given that PWSCC does not propagate through either the stainless steel or low alloy steel adjacent to the weld, the NRC staff recognizes that axial flaws cannot grow sufficiently in length to cause a rupture of the weld and adjacent piping system in a DMBW. The NRC staff's review of the licensee's flaw analysis finds its methodology acceptable for circumferential and axial flaw growth. Given these failure mechanisms, the NRC staff finds that the conclusions of the licensee's flaw analysis demonstrate structural integrity of the subject DMBWs will be maintained if the volumetric inspection frequency is extended per the licensee's proposed alternative.

The NRC staff performed a series of independent flaw evaluations. The NRC staff completed several sensitivity analyses to determine the margin to leakage and rupture of the subject DMBWs. The NRC staff recognizes that there are significant uncertainties in the performance of these flaw analyses. Conservative assumptions are used to address these uncertainties. The level of conservatism applied can significantly affect the results. As a result, variations in results should not be viewed as either correct or incorrect but rather as an input to the overall assessment of the licensee's proposed alternative. The NRC staff's calculations utilize the same guidelines as the licensee used, Electric Power Research Institute (EPRI) Report, "Materials Reliability Program: Primary Water Stress Corrosion Cracking (PWSCC) Flaw Evaluation Guidance (MRP-287)," dated December 2010. The NRC endorsed EPRI Report MRP-287 in a letter dated February 28, 2011 (ADAMS Accession No. ML110620628). The NRC staff flaw analysis used the NRC accepted licensee inputs, and industry inputs for sensitivity analyses. The NRC staff calculation results confirm the conclusions of the licensee's flaw analysis for circumferential flaw growth. The NRC staff calculations for circumferential flaws confirmed the licensee's conclusion that structural integrity would be maintained during the period of the licensee's requested volumetric inspection extension. Furthermore, the NRC staff's sensitivity analysis confirmed significant margin for time to rupture beyond this time frame even under earthquake loading conditions.

The NRC staff conducted extensive crack growth analysis using a range of weld residual stresses, initial crack sizes based on the minimum qualified volumetric inspection detection capability, and a range of crack growth rates. These analysis found some cases where axial flaws could potentially grow to exceed the ASME Code allowable limit of 75 percent through-weld within the period of extended inspection frequency of the licensee's proposed alternative. However, based on the NRC staff confirmatory flaw analysis results that structural integrity would be maintained by the subject DMBWs with significant margin for the licensee's proposed inspection interval, the NRC staff finds the proposed alternative acceptable.

Therefore, the NRC staff concludes that the licensee's proposed volumetric inspection frequency extension provides reasonable assurance of structural integrity of the subject welds. The NRC staff concludes that the licensee's proposed alternative is acceptable on the basis that compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

4.0 CONCLUSION

As set forth above, the NRC staff concludes that the licensee has demonstrated the proposed alternative in Relief Request No. FNP-ISI-ALT-05-03, Version 1.0, provides reasonable assurance of structural integrity of the subject components and that complying with the specified

ASME BPV 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(z)(2). Therefore, the NRC staff authorizes the licensee the use of Relief Request FNP-ISI-ALT-05-03, Version 1.0, at Farley, Unit 2 up to and including refueling outage 2R27, currently scheduled to start in fall 2020.

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

Principal Contributor: J. Collins, NRR

Date: December 10, 2018

SUBJECT: JOSEPH M. FARLEY NUCLEAR PLANT, UNIT 2 - PROPOSED INSERVICE INSPECTION ALTERNATIVE FNP-ISI-ALT-05-03 (EPID L-2018-LLR-0062) DATED DECEMBER 10, 2018

DISTRIBUTION:
PUBLIC
PM Reading File
RidsNrrLAKGoldstein Resource
RidsACRS_MailCTR Resource
RidsRgn2MailCenter Resource
RidsNrrDorlLpl2-1 Resource
RidsNrrDmlrMphb Resource
RidsNrrPMFarley Resource
JCollins, NRR

ADAMS Accession No. ML18334A228 ***via email**

OFFICE	NRR/DORL/LPLII-1/PM	NRR/DORL/LPLII 1/LA	NRR/DMLR/MPHB/(A)BC*
NAME	SWilliams	KGoldstein	SCumblidge (A)BC for SRuffin
DATE	12/07/18	11/30/18	11/21/18
OFFICE	NRR/DORL/LPLII-1/BC	NRR/DORL/LPLII-1/PM	
NAME	MMarkley	SWilliams	
DATE	12/10/18	12/10/18	

OFFICIAL RECORD COPY