



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

July 1, 2019

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

SUBJECT: JOSEPH M. FARLEY NUCLEAR PLANT, UNITS 1 AND 2 – INSERVICE
INSPECTION ALTERNATIVES REGARDING IWL EXAMINATIONS FOR
TENDON ANCHORHEAD REPLACEMENT (EPID L-2019-LLR-0020)

Dear Ms. Gayheart:

By letter dated March 8, 2019, as supplemented by letter dated June 11, 2019, Southern Nuclear Operating Company (SNC, the licensee), submitted a proposed alternative to the inservice inspection (ISI) requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (BPV) Code, Section XI, for the Joseph M. Farley Nuclear Plant (Farley), Units 1 and 2, for the Fifth 10-year ISI interval that commenced on December 1, 2017, and ends on November 30, 2027.

The licensee proposed to perform the Table IWL-2500-1 examination approximately 10 months sooner than the regularly scheduled IWL examination for the 45th Unit 1 and 40th Unit 2 containment IWL examinations. The licensee proposed to defer the Unit 1 examination frequency requirement in Table IWL-2521-2 to July 2021, the next regularly scheduled IWL examination.

The licensee submitted the alternative request pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, Section 50.55a(z)(1), for which the licensee requested to use the proposed alternatives on the basis that they provide an acceptable level of quality and safety.

The U.S. Nuclear Regulatory Commission (NRC) staff reviewed the subject request and has determined, as set forth in the enclosed safety evaluation, that the alternatives provide an acceptable level of quality and safety. 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 alternatives until the end of the Fifth 10-year ISI interval for Farley, Units 1 and 2.

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

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

Sincerely,

/RA/

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

Docket Nos. 50-348 and 50-364

Enclosure:
Safety Evaluation

cc: Listserv

SUBJECT: JOSEPH M. FARLEY NUCLEAR PLANT, UNITS 1 AND 2 – INSERVICE
INSPECTION ALTERNATIVES REGARDING IWL EXAMINATIONS FOR
TENDON ANCHORHEAD REPLACEMENT (EPID L-2019-LLR-0020)
DATED JULY 1, 2019

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION
PROPOSED ALTERNATIVE FOR THE FIFTH INTERVAL INSERVICE INSPECTION

FNP-ISI-ALT-05-04, VERSION 1.0

SOUTHERN NUCLEAR OPERATING COMPANY, INC.

JOSEPH M. FARLEY NUCLEAR PLANT, UNITS 1 AND 2

DOCKET NOS. 50-348 AND 50-364

1.0 INTRODUCTION

By letter dated March 8, 2019 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML19067A213), as supplemented by letter dated June 11, 2019 (ADAMS Accession No. ML19162A120) Southern Nuclear Operating Company (SNC), the licensee, submitted proposed alternative FNP-ISI-ALT-05-04, Version 1.0, to the inservice inspection (ISI) requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (BPV) Code, Section XI, "Rules for inservice inspection of nuclear power plant components," at Joseph M. Farley Nuclear Plant (Farley), Units 1 and 2.

The licensee proposed to perform the Table IWL-2500-1 examination approximately 10 months sooner than the regularly scheduled IWL examination for the 45th Unit 1 and 40th Unit 2 IWL examinations. The licensee proposed to defer the Unit 1 examination frequency requirement in Table IWL-2521-2 to the next regularly scheduled IWL examination. These alternatives are requested for the remainder of the current Fifth 10-year ISI interval, which began December 1, 2017, and is scheduled to end on November 30, 2027.

The licensee submitted the alternatives pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, Section 50.55a(z)(1), for which the licensee requested to use the proposed alternatives on the basis that they provide an acceptable level of quality and safety.

2.0 REGULATORY EVALUATION

Pursuant to 10 CFR 50.55a(g)(4), throughout the service life of a pressurized water-cooled nuclear power facility, components that are classified as ASME Code Class 1, 2, and 3 must meet the requirements, except the design and access provisions and preservice examination requirements, set forth in the ASME BPV Code, Section XI, to the extent practical, within the limitations of design, geometry, and materials of construction of the components.

Further, these regulations require that inservice examination of components and system pressure tests conducted during the First 10-year interval, and subsequent intervals, comply

with the requirements in the latest edition and addenda of Section XI of the ASME BPV Code, incorporated by reference in paragraph (b) of 10 CFR 50.55a, on the date 12 months prior to the start of the 120 month interval, subject to the limitations and modifications listed therein.

Alternatives to requirements under 10 CFR 50.55a(g) may be authorized by the U.S. Nuclear Regulatory Commission (NRC) pursuant to 10 CFR 50.55a(z)(1) or 10 CFR 50.55a(z)(2). In proposing alternatives or requests for relief, the licensee must demonstrate that: (1) the proposed alternatives would provide an acceptable level of quality and safety; or (2) compliance with the specified requirements would result in hardship or unusual difficulty, without a compensating increase in the level of quality and safety.

ASME Code Section XI, 2007 Edition including Addenda through 2008, Subsection IWL-2500, "Examination Requirements," states that examination shall be performed in accordance with the requirements of Table IWL-2500-1.

ASME Code Section XI, 2007 Edition including Addenda through 2008, Subsection IWL-2521.2 "Tendons Affected by Repair/Replacement Activities," requires augmented examination of tendons affected by post-tensioning system repair/replacement activities. Table IWL-2521-2 requires an initial examination of tendons affected by post-tensioning system repair/replacement activities within one year (+/- 3 months) following the completion of repair/replacement activities.

Subsection IWL-2420 describes the inservice inspection schedule for unbonded post-tensioning systems and requires their examination at 1, 3, and 5 years following the completion of the Structural Integrity Test and every 5 years thereafter.

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 proposed alternative requested by the licensee.

3.0 TECHNICAL EVALUATION

3.1 Background

The Farley containment building post-tensioning system consists of horizontal, dome, and vertical tendons. A total of one hundred thirty-five (135) horizontal tendons are anchored at three vertical buttresses. Three groups of dome tendons, for a total of ninety-three (93) tendons, are anchored at the vertical face of the dome ring girder. One hundred thirty (130) vertical tendons are anchored at the top surface of the ring girder and at the bottom of the base slab. One horizontal tendon was not installed on Unit 2 during construction; therefore, there are only one hundred thirty-four (134) horizontal tendons in the Unit 2 containment building.

The licensee stated, in part:

On May 3, 2012, the Unit 1 field end anchorhead on horizontal tendon H7AB failed. On April 14, 2017, the Unit 1 field end anchorhead on horizontal tendon H11AB failed. The failed tendons are part of the post-tensioning system for the Unit 1 FNP [Farley] reactor containment building. A causal evaluation was performed due to the anchorhead failure and determined that H7AB and H11AB were both part of the same heat treatment certification lot. Of the certification lot, twelve anchorheads remain that are currently installed on Unit 1 containment. Based on the ALTRAN analysis, hydrogen embrittlement along with improper heat treatment is the most likely cause of the anchorhead failures.

Per ASME BPV Code, Section XI, Subsection IWL-2500, Table IWL-2500-1, and IWL-2420 the next regularly scheduled IWL examinations for the FNP [Farley], Unit 1 and Unit 2, for the containment tendons is July 2021 +/- 1 year and every five years thereafter (+/- 1 year). However, the Unit 1 containment is scheduled to undergo the tendon anchorhead replacement project starting in June 2019 and end as soon as September 2019. The IWL examinations are proposed to begin once the tendon anchorhead replacement project is complete, which is approximately 10 months sooner than the regularly scheduled IWL examinations. The alternative request, if approved, will allow SNC to complete the anchorhead replacement and immediately enter the IWL examinations utilizing the same mobile crane and staging examination areas.

3.2 Alternative No. 1 - 45th Unit 1 and 40th Unit 2 Concrete and Tendon IWL Examinations

3.2.1 Applicable ASME Code Requirements

The applicable ASME BPV Code is Section XI, 2007 Edition through the 2008 Addenda, Subsection Table IWL-2500-1, Examination Category L-A, Concrete and Examination Category L-B, Unbonded Post-Tensioning System

3.2.2 ASME Code Components Affected

ASME Code Class: Concrete Containment, Post-Tensioning Horizontal Tendons

The affected components for the proposed approximately 10-month early IWL examination are:

- eighteen (18) randomly selected tendons (3 vertical, 3 dome, and 3 hoop tendons per unit).
- one (1) hoop tendon for Unit 1 randomly selected from the augmented repair/replacement scope related to the 2012 failure, i.e., from the first augmented examination group.
- the containment concrete for the 45th Unit 1 and 40th Unit 2 IWL surveillances.

3.2.3 Licensee Proposed Alternative

As an alternative to the requirements in the ASME BPV Code, Section XI, 2007 Edition through the 2008 Addenda, Subsection IWL-2500, and Table IWL-2500-1, the licensee proposed the concrete and tendon IWL examinations be performed up to ten months sooner than the regularly scheduled IWL examination of July 2021 +/- 1 year. The licensee stated that the subsequent IWL examination would return to the next regularly scheduled examination of July 2026 +/- 1 year.

The licensee provided the following to justify that the alternative provides an acceptable level of quality and safety per the requirements of 10 CFR 50.55a(z)(1).

In its letter dated March 8, 2019, the licensee stated, "Moving the regularly scheduled IWL examinations up by ten months or less would not have a detrimental effect in evaluating that the minimum pre-stress for the containment system is meeting the required values. Because the tendon prestress loss has shown minimum change over the last two inspections, performing the next regularly scheduled IWL examination as scheduled (July 2026 +/- 1 year) would also not be detrimental."

Specific to the Unit 1 containment anchorhead project, the licensee explained that twelve anchorheads remain from the same heat treatment certification lot of the two failed tendons (H7AB and H11AB). Of these remaining twelve tendons, one (H11BC) will not be replaced during the spring 2019 anchorhead project due to its location in the Penetration Room Filter barrier. The licensee stated, "Based on the failure trend and the ALTRAN analyses performed, the replacement of the remaining eleven field end anchorheads within this lot will reduce the likelihood of future failures. Tendon H11BC may be de-tensioned to lessen the likelihood of its failure. SNC analysis demonstrates that containment operability will not be affected if H11BC is de-tensioned."

The anchorhead replacement project is scheduled to begin in June 2019. The concrete and tendon IWL examinations are proposed to begin approximately September 2019. The licensee explained the reason to perform the IWL examinations approximately 10 months earlier than the regularly scheduled IWL examinations is to utilize the same large mobile crane and staging examination areas, thus, reducing the inherent risks of multiple rigging and lifting activities.

3.2.4 NRC Staff Evaluation

The NRC staff reviewed the proposed alternative to perform the Table IWL-2500-1 concrete and tendon IWL examinations for Unit 1 and Unit 2 up to ten months sooner than the regularly scheduled IWL examination of July 2021 +/- 1 year. The NRC staff's review focused on the ability of the proposed alternative to provide an acceptable level of quality and safety of the containment post-tensioning system.

Ten ISI IWL examinations of the Unit 1 and 2 containments have been completed to date resulting in the horizontal tendons meeting all the post-tensioning test and examination acceptance criteria. In addition, the licensee stated that the tendon prestress loss has shown a minimum change over the last two inspections. In addition, for Unit 1, the licensee performed an ALTRAN analyses and concluded that the replacement of the remaining eleven field end anchorheads will reduce the likelihood of future failures.

Based on the information in the application, the NRC staff finds that the licensee's proposed alternative to perform Table IWL-2500-1 concrete and tendon IWL examinations for Unit 1 and Unit 2 up to ten months sooner than the regularly scheduled IWL examination of July 2021 +/- 1 year provides an acceptable level of quality and safety, consistent with the regulatory requirements in 10 CFR 50.55a(z)(1).

3.3 Alternative No. 2 – Unit 1 Only, IWL-2521-2 Examination

3.3.1 Applicable ASME Code Requirements

The applicable ASME BPV Code is Section XI, 2007 Edition through the 2008 Addenda, Subsection Table IWL-2521-2, Augmented Examination Requirements following Post-Tensioning System Repair/Replacement Activities.

3.3.2 ASME Code Components Affected

ASME Code Class: Concrete Containment, Post-Tensioning Horizontal Tendons

- Up to 15 hoop (horizontal) tendons on Unit 1, as stated in the application.

3.3.3 Licensee Proposed Alternative

As an alternative to the requirements in the ASME BPV Code, Section XI, 2007 Edition through the 2008 Addenda, Table IWL-2521-2, the licensee proposed a one-time exception to the examination frequency to defer the initial IWL examination from 1 year +/- 3 months to the next regularly scheduled IWL examination in July 2026 +/- 1 year. This would align the IWL examinations of the augmented group of tendons with the regularly scheduled IWL examination.

The licensee provided the following information to justify that the alternative provides an acceptable level of quality and safety per the requirements of 10 CFR 50.55a(z)(1):

The licensee stated that since the number of Unit 1 horizontal tendons affected by the anchorhead replacement project (at least twelve, up to fifteen) is greater than 5% of the total number of horizontal tendons (i.e., 135), the required sample size for augmented IWL examination, per Table IWL-2521-2, is one horizontal tendon.

The licensee noted the following key points: (1) the replacement anchorhead project requires that the new anchorheads be manufactured with a lower Rockwell "C" hardness number to improve resistance to hydrogen embrittlement failure; (2) the horizontal tendons that are affected by the anchorhead replacement project utilize the same prestressing system, and will be exposed to, or protected from, the same outside environment as the existing tendons, which have been in service for the last forty-plus years, and (3) the replacement activities that impact the horizontal tendons will not result in any unique condition that may subject the horizontal tendons to a different potential for structural or tendon deterioration.

The licensee stated that the main reason for performing the Table IWL-2521-2 IWL Examination within 1 year +/- 3 months is to benchmark the tendon pre-stress losses shortly after the original containment structural integrity test when pre-stress losses occur at the highest rate. The licensee explained how each pre-stress loss (elastic shortening, creep, relaxation, and shrinkage) for the Unit 1 re-tensioned tendons will be smaller than for the original tendons.

The licensee further justified the alternative by stating that the Unit 1 affected tendons will be re-tensioned to a value above the predicted losses but less than 70 percent of the specified ultimate tensile strength of the tendon per IWL- 2523.3(a). Since the losses in the re-tensioned horizontal tendons is less than the original design losses, the licensee asserted that there is an additional safety margin in the Unit 1 post-tensioning system.

The licensee explained that Table IWL-2521-2 examination requires the same large mobile crane and staging examination area as the regularly scheduled IWL examination and, thus, performing the examinations together would reduce the inherent risks of multiple rigging and lifting activities.

3.3.4 NRC Staff Evaluation

The NRC staff reviewed the proposed alternative to defer the Unit 1 initial IWL examination prescribed in Table IWL-2521-2 from 1 year +/- 3 months (from approximately September 2019) to the next regularly scheduled IWL examination (July 2026 +/- 1 year), which corresponds up to approximately 7 years. The NRC's staff's review focused on the ability of the proposed alternative to provide an acceptable level of quality and safety of the Unit 1 containment post-tensioning system.

The new anchorheads are manufactured with a lower Rockwell “C” hardness number to improve resistance to hydrogen embrittlement failure and utilize the same pre-stressing system, and will be exposed to, or protected from, the same outside environment as the existing tendons, which have been in service for the last forty-plus years. The licensee performed an ALTRAN analyses and concluded the replacement of the remaining eleven field end anchorheads within will reduce the likelihood of future failures. In the license amendment request, the licensee explained how each pre-stress loss (elastic shortening, creep, relaxation, and shrinkage) for the Unit 1 re-tensioned tendons will be smaller than for the original tendons. The NRC staff finds this as an additional safety margin since the Unit 1 affected tendons will be re-tensioned to a value above the predicted losses but less than 70 percent of the specified ultimate tensile strength of the tendon per IWL- 2523.3(a).

The NRC staff acknowledges that per Table IWL-2521-2, the required sample size would result in only one deferred IWL examination for the horizontal tendons affected by the anchorhead replacement project.

As the licensee indicated, ten ISI examinations have been completed to date for Unit 1 and the existing horizontal tendons have met all the post-tensioning test and examination acceptance criteria. The NRC staff identified areas in which additional information was necessary to complete the evaluation of the licensee's proposed alternative. On May 29, 2019 (ADAMS Accession No. ML19150A102), the NRC staff issued a request for additional information (RAI) to obtain further information relative to the magnitude of the tendon prestressing force of the affected horizontal tendons. Specifically, the NRC staff requested that SNC provide the required horizontal tendon force, according to the Farley Unit 1 current licensing basis (CLB), along with the minimum predicted tendon force values expected at the next regularly scheduled ASME IWL examination scheduled for July 2026 and July 2027. If SNC utilized the +/- 1 year grace period permitted by ASME Section XI, IWL-2420(c) for schedule optimization, this would ensure that the minimum predicted tendon force would remain greater than the required CLB values.

In its letter dated June 11, 2019, the licensee provided the required horizontal tendon force of 6.01 kips/wire or 1021.7 kips total for one tendon, based on a 170 wire tendon, and the minimum predicted force for the population of the affected horizontal tendons at the time of the next regularly scheduled IWL tendon surveillance (July 2026 +/- 1 year). The licensee stated that work for the tendon anchorhead project for 2019 has not yet started; and that the purchase order requires the project contractor to set the lock-off force at 1200 kips within a tolerance of minus 0% and plus 5%. The measured prestress force of a Farley Unit 1 horizontal tendon that was re-tensioned in 2013 was 1123.58 kips and upon recheck in 2017 had a prestress force of 1116.60 kips, a decrease of 0.155% per year. Applying the measured prestress decrease to predict prestress forces for the similar tendons discussed in the staff's RAI, and assuming a re-tension in July 2013, yields a predicted prestress value of 1187.0 for July 2026, and 1185.1 kips for July 2027. Both values of predicted force are above the minimum value of 1021.7 kips for horizontal tendons thereby satisfying the containment structure design basis requirements.

The NRC staff also acknowledges that by letter dated July 11, 2014 (ADAMS Accession No. ML14169A195), the NRC approved a similar request for Farley Unit 1 to delay the Table IWL-2521-2 examination from September 2014 +/- 3 months to July 2016 (+/- 1 year), up to approximately 3 years after the prescribed date.

Based on the above, the NRC staff finds that the licensee's proposed alternative to defer the Unit 1 initial IWL examination prescribed in Table IWL-2521-2 from 1 year +/- 3 months to the next regularly scheduled IWL examination in July 2026 +/- 1 year, provides an acceptable level of quality and safety, consistent with the regulatory requirements in 10 CFR 50.55a(z)(1).

4.0 CONCLUSION

Based on the information provided in licensee submittal dated March 8, 2019, the NRC staff concludes that the proposed alternatives in Farley FNP-ISI-ALT-05-04, Version 1.0, are acceptable because the licensee demonstrated that its proposed alternatives provide 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 Farley FNP-ISI-ALT-05-04, Version 1.0, for the remainder of the current Fifth 10-year ISI interval, which began December 1, 2017, and is scheduled to end on November 30, 2027.

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

Principal Contributors: Dan Hoang, NRR
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Date: July 1, 2019