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

July 17, 2017

Mr. Peter P. Sena, III
President and Chief Nuclear Officer
PSEG Nuclear LLC – N09
P.O. Box 236
Hancocks Bridge, NJ 08038

SUBJECT: SALEM NUCLEAR GENERATING STATION, UNIT NO. 1 – SAFETY EVALUATION OF RELIEF REQUEST S1-I4R-160 REGARDING THE FOURTH 10-YEAR INTERVAL OF THE INSERVICE INSPECTION PROGRAM (CAC NO. MF9149)

Dear Mr. Sena:

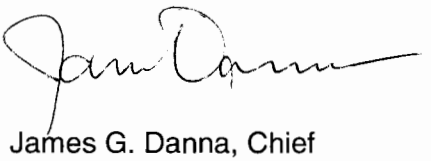
By letter dated January 31, 2017, PSEG Nuclear LLC (PSEG, the licensee) submitted Relief Request S1-I4R-160 to the U.S. Nuclear Regulatory Commission (NRC). PSEG proposed an alternative to certain inservice inspection requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code) for Salem Nuclear Generating Station (Salem), Unit No. 1. Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(z)(2), PSEG requested to extend the required reactor pressure vessel cold leg nozzle inspections by approximately 6 months (until the spring 2019 refueling outage). The subject relief request is for the fourth 10-year interval of the inservice inspection program at Salem Unit No. 1, which began on May 20, 2011, and is currently scheduled to end on December 31, 2020.

The NRC staff has completed its review of the subject relief request as documented in the enclosed safety evaluation. Our safety evaluation concludes that the proposed alternative provides reasonable assurance of the structural integrity of the subject components, and that complying with the ASME 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 use of the proposed alternative, for Salem, Unit No. 1, until startup from the spring 2019 refueling outage (S1R26).

All other ASME 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.

If you have any questions concerning this matter, please contact the Salem Project Manager, Mr. Richard Ennis, at (301) 415-1420 or Rick.Ennis@nrc.gov.

Sincerely,



James G. Danna, Chief
Plant Licensing Branch I
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-272

Enclosure:
Safety Evaluation

cc w/encl: Distribution via Listserv

UNITED STATES
NUCLEAR REGULATORY COMMISSION
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO RELIEF REQUEST S1-I4R-160

FOURTH 10-YEAR INTERVAL OF THE INSERVICE INSPECTION PROGRAM

PSEG NUCLEAR LLC

SALEM NUCLEAR GENERATING STATION, UNIT NO. 1

DOCKET NO. 50-272

1.0 INTRODUCTION

By letter dated January 31, 2017 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML17031A278), PSEG Nuclear LLC (PSEG, the licensee) submitted Relief Request S1-I4R-160 to the U.S. Nuclear Regulatory Commission (NRC). PSEG proposed an alternative to certain inservice inspection (ISI) requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code) for Salem Nuclear Generating Station (Salem), Unit No. 1. Specifically, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(z)(2), PSEG requested to extend the required reactor pressure vessel (RPV) cold leg nozzle inspections by approximately 6 months (until the spring 2019 refueling outage). The subject relief request is for the fourth 10-year interval of the ISI program at Salem, Unit No. 1, which began on May 20, 2011, and is currently scheduled to end on December 31, 2020.

2.0 REGULATORY EVALUATION

In this relief request, the licensee proposes to use an alternative inspection frequency to the requirements of Table 1 of ASME Code Case N-770-1 as referenced in 10 CFR 50.55a(g)(6)(ii)(F).

Pursuant to 10 CFR 50.55a(g)(4), throughout the service life of a boiling or pressurized water-cooled nuclear power facility, components that are classified 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 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 Code incorporated by reference in paragraph (a) 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 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.

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 Commission to authorize the proposed alternative requested by the licensee. Accordingly, the NRC staff has reviewed and evaluated the licensee's request pursuant to 10 CFR 50.55a(z)(2).

3.0 TECHNICAL EVALUATION

3.1 Licensee Relief Request S1-I4R-160

3.1.1 Component Identification

The proposed alternative applies to the four RPV cold leg nozzle to safe-end alloy 600 butt welds, numbered as follows:

Loop 11 - 27.5-RC-1110-5
Loop 12 - 27.5-RC-1120-5
Loop 13 - 27.5-RC-1130-5
Loop 14 - 27.5-RC-1140-5

3.1.2 Applicable Code Edition and Addenda

The applicable ASME Code of Record for the fourth 10-year ISI interval, for Salem, Unit No. 1, is the 2004 Edition with no Addenda.

3.1.3 Code Requirements for Which Relief is Requested

As discussed in 10 CFR 50.55a(g)(6)(ii)(F), licensees of existing, operating pressurized-water reactors (PWRs) as of July 21, 2011, must implement the requirements of ASME Code Case N-770-1, subject to the conditions specified in paragraphs (g)(6)(ii)(F)(2) through (10) of 10 CFR 50.55a. Table 1 of ASME Code Case N-770-1, in part, establishes the inspection frequency of the RPV inlet dissimilar metal butt welds. These welds at Salem, Unit No. 1, are categorized as Inspection Item D welds, which have been mitigated with the Mechanical Stress Improvement Process (MSIP) with no previous indication of cracking. Paragraph (g)(6)(ii)(F)(9) of 10 CFR 50.55a states the following regarding Inspection Item D welds:

> Replace the first two sentences of Extent and Frequency of Examination for Inspection Item D in Table 1 of Code Case N-770-1 with, "Examine all welds no sooner than the third refueling outage and no later than 10 years following stress improvement application." Replace the first two sentences of Note (11)(b)(2) in Code Case N-770-1 with, "The first examination following weld inlay, onlay, weld overlay, or stress improvement for Inspection Items D through K must be performed as specified."

Therefore, the inspection frequency for the first followup examination following the application of the MSIP process is no sooner than the third refueling outage, and no later than 10 years

following the application of the MSIP. The licensee stated that the MSIP application was performed in the fall 2008 refueling outage. Therefore, the RPV cold leg nozzle to safe-end welds volumetric examinations are currently required to be completed by fall 2018. This would require the examinations to be completed during the Salem, Unit No. 1, fall 2017 refueling outage (S1R25) since the S1R26 refueling outage in the spring of 2019 would be 6 months beyond the 10-year inspection interval.

3.1.4 Licensee's Proposed Alternative

PSEG requested a one-time 6-month extension to the 10-year volumetric examination interval required by Table 1 of Code Case N-770-1, as conditioned by 10 CFR 50.55a(g)(6)(ii)(F)(9), for Item D (uncracked butt welds mitigated with stress improvement). The 6-month extension to the 10-year examination interval would allow the four RPV cold leg nozzle to safe-end weld examinations to be performed during the Salem, Unit No. 1, spring 2019 refueling outage (S1R26).

This interval extension is being requested in accordance with 10 CFR 50.55a(z)(2) as a hardship, without a compensating increase in quality and safety.

3.1.5 Licensee's Duration of Relief Request

The duration for the proposed alternative is through the spring 2019 refueling outage (S1R26).

3.1.6 Licensee's Basis for Relief

As discussed above in Section 3.1.3, without the relief request, the examinations would be required to be completed during the Salem, Unit No. 1, fall 2017 refueling outage (S1R25), since the S1R26 refueling outage in the spring of 2019 would be 6 months beyond the required 10-year inspection interval.

The licensee stated that during refueling outage S1R26, examinations in accordance with the Reactor Vessel Internals Materials Reliability Program (MRP-227) and other scheduled ASME Section XI RPV examinations will require removal of the core barrel and, therefore, provide access for remote volumetric examinations of the RPV cold leg nozzle to safe-end welds from the inside surface of the pipe. The licensee further stated that performance of the RPV cold leg nozzle to safe-end welds examinations during refueling outage S1R25 would require the examinations to be performed from the outside surface of the pipe.

Due to the location of the welds, the licensee estimated that the volumetric inspections during S1R25 would cause a radiological dose exposure of approximately 3.5 roentgen equivalent man (rem). PSEG stated that performing the inspections from the inside surface of the pipe during S1R26 would reduce the overall exposure of the weld examinations since the inspection technique is performed remotely. The licensee stated that performing the examinations during S1R25 would result in unnecessary personnel radiation exposure, without a compensating increase in quality or safety.

PSEG cited information to show that a 6-month delay in the volumetric inspection requirement would continue to provide an adequate level of quality and safety. The licensee noted that NUREG/CR-7187, "Managing PWSCC in Butt Welds by Mitigation and Inspection," published November 2014 (ADAMS Accession No. ML14329A085), states that "it is reasonable to conclude that MSIP provides effective mitigation against the initiation of PWSCC and against

the growth of any existing PWSCC that has been detected and allowed to remain in service." As all of the subject welds have been mitigated with MSIP and were previously found to have no indications of cracking, the licensee also stated that the volumetric examinations were considered more of a defense-in-depth monitoring measure and not for management of primary water stress corrosion cracking (PWSCC) degradation. The licensee cited information in Section 4.5 of NUREG/CR-7187, which supports this position.

In summary, PSEG believes that imposition of the 10-year inspection requirement would create a hardship in that personnel would unnecessarily receive additional radiation exposure, in the order of 3.5 rem, if the volumetric examinations were performed during the fall 2017 refueling outage, without an increase in quality or safety. As such, the licensee requested that the inspection of the four RPV cold leg nozzle to safe-end welds be performed during the spring 2019 refueling outage.

3.2 NRC Staff's 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 NRC staff finds that the licensee's identified hardship of the radiological dose of approximately 3.5 rem is technically reasonable. If an outside diameter examination is performed, the examination and required equipment setup, including scaffolding and temporary shielding, would be in a radiation area next to the RPV. Further, the estimated radiological dose is based on previous examinations performed at Salem, Unit No. 1, rather than a simple assessment. Therefore, the NRC staff finds that the licensee has demonstrated a hardship in performing the volumetric examinations from the outside versus the inside surface.

The NRC staff reviewed the quality and safety impact of the licensee's proposed alternative to allow a 6-month delay in the volumetric examination, beyond the current regulatory requirement of 10 years. The NRC staff finds that the volumetric inspections of the subject welds can be performed with qualified methods, both from the outside and inside surfaces of the welds, so there is no reduction in inspection quality.

From a safety perspective, the NRC staff notes that the degradation mechanism of concern is PWSCC. The MSIP mitigation technique, when effectively implemented, prevents new flaw initiation and growth of existing shallow flaws by removing the tensile stress necessary for both. The NRC staff notes that after hundreds of applications of the MSIP process in U.S. nuclear power plants, no MSIP mitigated weld has identified leakage or a structurally significant flaw. Additionally, PWSCC initiation and flaw growth is significantly affected by temperature, typically by a factor of 5, between the average hot leg and cold leg temperatures at a PWR. Further, the NRC staff acknowledges that no significant cracking has been identified in similar sized cold leg temperature welds at any U.S. PWR. Therefore, the NRC staff finds it is unlikely that a flaw would have initiated, or if it had, would grow, to a size to challenge structural integrity during the period of inspection frequency extension.

The purpose of the initial inspection following the application of MSIP is as a defense-in-depth inspection to verify the effectiveness of the application of the MSIP on each weld. This is a one-time inspection. Once completed, and if no flaws or growth of existing flaws is verified, the volumetric inspection requirement is a 25 percent sample of all MSIP mitigated welds each 10-year ISI period. The purpose of the NRC condition in 10 CFR 50.55a(g)(6)(ii)(F)(9) for MSIP mitigated welds is to ensure that sufficient time has transpired to allow initiation or growth of any

existing flaws and to prevent the first volumetric examination from being deferred to possibly 20 years. The NRC staff finds that the licensee's proposed extension of only 6 months does not challenge the technical basis of the time period for effectiveness of the first volumetric examination after MSIP application. Further, the NRC staff notes that this is not the only method of assurance. Plant walkdowns and plant leakage monitoring systems also provide defense-in-depth measures. Therefore, the NRC staff finds that the licensee's proposed alternative has an insignificant, if any, impact on safety.

Given the licensee's identified hardship and the NRC staff's assessment of the volumetric inspection frequency extension of 6 months, the NRC finds 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 determines that the proposed alternative provides reasonable assurance of the structural integrity of the subject components, and that complying with the ASME 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 use of the proposed alternative for Salem, Unit No. 1, until startup from the spring 2019 refueling outage (S1R26).

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

Principal Contributors: J. Collins
R. Ennis

Date: July 17, 2017

SUBJECT: SALEM NUCLEAR GENERATING STATION, UNIT 1 – SAFETY EVALUATION OF RELIEF REQUEST S1-I4R-160 REGARDING THE FOURTH 10 YEAR INTERVAL OF THE INSERVICE INSPECTION PROGRAM (CAC NO. MF9149) DATED JULY 17, 2017

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