

PSEG Nuclear LLC

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OCT 05 2016

LR-N16-0127

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Salem Generating Station, Units 1 and 2
Renewed Facility Operating License Nos. DPR-70 and DPR-75
NRC Docket Nos. 50-272 and 50-311

Subject: Response to Request for Additional Information, RAI-8 – RAI-11, Re: Aging Management Program Plan for Reactor Vessel Internals (CAC Nos. MF5149 and MF5150)

Reference: NRC letter to PSEG, "Salem Nuclear Generating Station, Unit Nos. 1 and 2 – Request for Additional Information Re: Aging Management Program Plan for Reactor Vessel Internals (CAC Nos. MF5149 and MF5150)," dated July 7, 2016 (ADAMS Accession No. ML16188A415)

In the referenced letter, the Nuclear Regulatory Commission (NRC) requested PSEG Nuclear LLC (PSEG) to provide additional information in order to assess the reactor vessel internals (RVI) aging management program (AMP). Attachment 1 provides a detailed response to the request for additional information.

There are no regulatory commitments contained in this letter.

Should you have any questions regarding this submittal, please contact Ms. Tanya Timberman at 856-339-1426.

Sincerely,

A handwritten signature in black ink, appearing to read "Eric Carr", with a long horizontal flourish extending to the right.

Eric Carr
Acting Site Vice President
Salem Generating Station

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Attachment 1: Response to Request for Additional Information

cc: Mr. D. Dorman, Administrator, Region I, NRC
Ms. C. Parker, Project Manager, NRC
NRC Senior Resident Inspector, Salem
Mr. P. Mulligan, Chief, NJBNE
Salem Commitment Tracking Coordinator
Corporate Commitment Tracking Coordinator

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Attachment 1

Response to Request for Additional Information

**Response to Request for Additional Information Regarding
Aging Management Program Plan for Reactor Vessel Internals
Salem Generating Station, Units 1 and 2
Docket Nos. 50-272 and 50-311**

By letter dated August 11, 2014,¹ PSEG Nuclear, LLC (the licensee) submitted to the U.S. Nuclear Regulatory Commission (NRC) two reports that document the Salem Nuclear Generating Station (Salem), Unit Nos. 1 and 2, reactor vessel internals (RVI) aging management program (AMP). Topical Report MRP-227-A, "Pressurized Water Reactor Internals Inspection and Evaluation Guidelines," December 2011,² and its supporting reports, were used as the technical bases for developing the Salem, Unit Nos. 1 and 2, AMPs. By letter dated March 31, 2015,³ the NRC staff issued a request for additional information (RAI) regarding the AMPs. By letters dated May 28, 2015, and March 23, 2016,⁴ the licensee provided responses to the staff's RAI.

The NRC has staff determined that additional information, as described below, is required to complete its review of the Salem, Unit Nos. 1 and 2, AMPs. Note that the RAI numbering scheme is continued from the March 31, 2015, RAI.

RAI-8

By letter dated May 28, 2015, the licensee indicated in its response to **RAI-7(b)** that the industry is investigating an alternate primary link for the lower support column bodies (LSCs). The current primary link for the LSCs is the control rod guide tube (CRGT) lower flanges. Because the CRGT lower flanges receive a lower neutron fluence than the LSCs, the CRGT lower flanges, as a primary link for the LSCs, is not a good indicator of the amount of irradiation assisted stress corrosion cracking and irradiation embrittlement (IE). Since only irradiation assisted stress corrosion cracking and IE are addressed, pursuing an alternate primary link is not an adequate resolution to demonstrating functionality of the LSCs through the period of extended operation (PEO) if the LSCs are made of cast austenitic stainless steel (CASS). In Section 6.2.7, "SE Applicant/Licensee Action Item 7: Plant-Specific Evaluation of CASS Materials," of Attachment 1 of its submittal, the licensee assumed that 73 of the Salem, Unit No. 1, CASS LSCs are susceptible to thermal embrittlement (TE) because the certified material test reports for those LSCs could not be located. Because the LSCs are assumed to be susceptible to TE, the functionality of the LSCs that addresses TE (and irradiation embrittlement) through the PEO must be demonstrated.

The NRC staff determined in a summary assessment⁵ that the flaw tolerance analysis contained in report PWROG-14048-P, Revision 0, "Functionality Analysis: Lower Support Columns," utilized conservative assumptions to demonstrate that the likelihood of failure of LSCs is low during the PEO. Accordingly, it is reasonable to infer that the functionality of the LSCs will be maintained during the PEO if the likelihood of failure of the LSCs is shown to be low.

¹ Agencywide Documents Access and Management System (ADAMS) Accession No. ML14224A667

² ADAMS Package Accession No. ML120170453

³ ADAMS Accession No. ML15069A181

⁴ ADAMS Accession Nos. ML15148A426 and ML16083A194, respectively

⁵ ADAMS Accession No. ML15334A462

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Therefore, the NRC staff requests the licensee to demonstrate how the flaw tolerance analysis in PWROG-14048-P is applicable to the 73 Salem, Unit No. 1, CASS LSCs that are assumed to be susceptible to TE using plant-specific parameters (such as LSC geometry and number of LSCs) and conditions (such as loading conditions and LSC stresses). If the licensee determines that PWROG-14048-P is not applicable to the 73 Salem, Unit No. 1, CASS LSCs, or chooses not to apply it, please identify the approach used to demonstrate that the functionality of the LSCs will be maintained during the PEO.

PSEG Response to RAI-8

PSEG is an active participant in a Pressurized Water Reactor Owners Group (PWROG) program to address Lower Support Column (LSC) functionality analysis on a generic basis. The final phase of this program, currently in progress, uses the methodology documented in PWROG-14048-P, and is intended to provide justification of plant-specific applicability for all participating plants, including Salem Units 1 and 2. This phase also considers the conclusions documented in the NRC Staff Assessment of PWROG-14048-P (ADAMS Accession No. ML15334A462). Upon completion of this final phase of the program, a revision to PWROG-14048-P will be submitted to the NRC Staff, currently scheduled to be submitted by June 30, 2017. This program will consider Salem Unit Nos. 1 and 2 specific parameters and will provide the applicability justification necessary to address RAI-8. PSEG will update this RAI response within sixty (60) days of the submittal of the revision of PWROG-14048-P to document the applicability of the flaw tolerance analysis to the Salem Units 1 and 2 LSCs.

RAI-9

Table 6-2 of Attachments 1 and 2 in the licensee's submittal lists RVI components that are made of (or potentially made of) CASS. The licensee stated in its submittal that the following RVI components are potentially made of CASS, and therefore, are conservatively assumed as CASS.

1. 17 x 17 Guide Tube Lower Guide Plates/Cards
2. Upper Instrumentation Conduit and Supports - Gussets, Clamps, Supports, and Thermocouple Stop
3. Upper Support Column - Mixing Bases

Items 1 and 2 above are addressed in the licensee's evaluation of Applicant/Licensee Action Items 1 and 2 of MRP-227-A in the licensee's submittal (please note that there is an additional staff concern regarding the "17 x 17 Guide Tube Lower Guide Plates/Cards," as discussed in **RAI-10** below). However, the licensee has not addressed the "Upper Support Column – Mixing Bases" (Item 3). Furthermore, the NRC staff noted that "Upper Support Column – Mixing Bases" is not an RVI component listed in MRP-191 (Reference 1), which is the basis for the MRP-227-A component categorization methodology. The staff is aware, however, that Table 7-2, "Categorization of Westinghouse Reactor Internals Components," of MRP-191 lists a component called "Column bases" in the upper support column assembly.

Please state whether the Salem, Unit Nos. 1 and 2, "Upper Support Column - Mixing Bases" are equivalent to "Column bases" in Table 7-2 of MRP-191. If they are equivalent, no further response is required. If not, the staff requests the licensee to address the CASS "Upper Support

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Column - Mixing Bases" by indicating the MRP-227-A component category it belongs to ("Primary," "Expansion," "Existing," or "No Additional Measures") and the basis for this determination. If the resulting category is "Primary," "Expansion," or "Existing," please indicate the Examination Method, Examination Cover, and appropriate link consistent with Tables C-1, C-2, or C-3 of Attachments 1 and 2 in the licensee's submittal.

PSEG Response to RAI-9

The Salem Unit Nos. 1 and 2 Upper Support Column - Mixing Bases are equivalent to Upper Support Column - Column Bases in Table 7-2 of MRP-191. There was a typographical error contained in Table 6-2 in each of the two Inspection Plans submitted to the NRC by PSEG Letter No. LR-N14-0183, dated August 11, 2014, "Submittal of PWR Vessel Internals Inspection Plans for Aging Management of Reactor Internals at Salem Generating Station, Unit Nos. 1 and 2 (ADAMS Accession No. ML14224A667). Instead of "Upper Support Column – Mixing Bases", the correct nomenclature for this component is "Upper Support Column – Column Bases".

RAI-10

In Section 6.2.7 of Attachments 1 and 2 of the licensee's submittal, the licensee determined that the Salem, Unit Nos. 1 and 2, CRGT guide cards could potentially be made of CASS material, and therefore, the CRGT guide cards were conservatively assumed as CASS. Furthermore, the ferrite content was assumed to be above the threshold for TE screening established in the Grimes letter (Reference 2). Although the MRP-227-A component categorization places the CRGT guide cards in the "Primary" inspection category, MRP-227-A presumes that the CRGT guide cards are made of wrought stainless steel material, consistent with MRP-191, and are, therefore, inspected only for wear in the MRP-227-A inspection program for "Primary" components. Since the Salem, Unit Nos. 1 and 2, CRGT guide cards were assumed as CASS, and therefore, potentially susceptible to TE, they could be susceptible to non-ductile cracking due to lower fracture toughness resulting from TE.

The NRC staff requests the licensee to evaluate the susceptibility of the Salem, Unit Nos. 1 and 2, CRGT guide cards to non-ductile cracking due to lower fracture toughness and discuss how the functionality of the Salem, Unit Nos. 1 and 2, CRGT guide cards will be maintained during the PEO. Please include a discussion of the effects of IE on the assumed CASS CRGT guide cards, taking into account the neutron exposure limits for embrittlement established in the staff guidance issued on June 11, 2014,⁶ since wrought stainless steel CRGT guide cards do not screen in for IE in MRP-191. If the licensee determines that the VT-3 examination in Table C-1, "MRP-227-A Primary Inspection and Monitoring Recommendations for Westinghouse-Designed Internals," of Attachments 1 and 2 of the submittal is adequate for managing the Salem, Unit Nos. 1 and 2, CRGT guide cards that are assumed to be susceptible to non-ductile cracking, please provide the explanation.

PSEG Response to RAI-10

PSEG will review the forthcoming NRC staff assessment of PWROG-15032-NP, "PA-MS-C-1288, Statistical Assessment of PWR RV Internals CASS Materials" on the appropriate screening levels for Cast Austenitic Stainless Steel (CASS) Control Rod Guide

⁶ ADAMS Accession No. ML14163A112

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Tube (CRGT) Guide Cards for susceptibility to Thermal Embrittlement (TE) and Irradiation Embrittlement (IE) that may supercede the screening methodology established in the Staff guidelines issued on June 11, 2014 (ADAMS Accession No. ML14163A112). PSEG will update this RAI response to document the evaluation of susceptibility of the Salem Unit Nos. 1 and 2, CRGT Guide Cards to non-ductile cracking due to lower fracture toughness based on this Staff assessment of the approach provided in PWROG-15032-NP, and will discuss how their functionality will be maintained during the period of extended operation (PEO) for each Unit, within sixty (60) days of the Staff communication of the Staff assessment of PWROG-15032-NP.

RAI-11

In Section 5.10, "GALL Revision 2 Element 10: Operating Experience," of Attachments 1 and 2 of the licensee's submittal, the licensee provided a summary of the operating experience of RVI degradation at Salem, Unit Nos. 1 and 2. The AMP element in Section 5.10 of Attachments 1 and 2 of the licensee's submittal indicates that licensees are expected to review subsequent operating experience for impact on its AMP. With respect to the recent degraded baffle-former bolts at Salem, Unit No. 1, reported in accordance with Title 10 of the *Code of Federal Regulations*, Section 50.72 (Event Notification No. 51902; May 3, 2016), please discuss the following:

- a) The impact on the MRP-227-A inspection implementation schedule for the Salem, Unit No. 1, baffle-former bolts in Section 7, "Program Enhancement and Implementation Schedule," of Attachment 1 of the licensee's submittal. Please include a discussion of the re-inspection schedule and the justification of the re-inspection frequency, the re-inspection method, and the re-inspection coverage.
- b) The potential impact on MRP-227-A inspection program planned for the Salem, Unit No. 2, baffle-former bolts in Section 7, "Program Enhancement and Implementation Schedule," of Attachment 2 of the licensee's submittal. If there is no impact, please provide the justification.

PSEG Response to RAI-11

- a) PSEG completed ultrasonic examination (UT) volumetric inspection of the full population of baffle-former bolts (as accessible) during refueling outage 24 (spring 2016). As a result of these inspections, 189 baffle-former bolts were replaced with new bolts. PSEG is currently reviewing further bolt replacement and inspection options (and requirements) for future refueling outage(s). EPRI letter MRP 2016-021 (communicated to the NRC in EPRI letter MRP 2016-022) includes interim guidance that all plants identified as Tier 1a plants (including Salem Unit 1 and Salem Unit 2) in Westinghouse NSAL 16-1 shall perform an ultrasonic examination (UT) volumetric inspection of the full population of baffle-former bolts at the next scheduled refueling outage. This requirement was satisfied for Salem Unit 1 during refueling outage 24. MRP 2016-21 also notes that the industry's baffle former bolt focus group will continue its work on the development of additional guidance where appropriate. PSEG will also continue to evaluate operating experience from other plants performing baffle-former bolt inspections, recommendations of the industry focus group, and implement industry guidance. These efforts will support PSEG re-inspection schedule/frequency, inspection method, and re-inspection coverage considerations for baffle-former bolts.

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- b) PSEG is planning to complete ultrasonic examination (UT) volumetric inspection of the full population of baffle-former bolts (as accessible) during refueling outage 22 (spring 2017) for Salem Unit 2. This is consistent with interim guidance provided within EPRI letter MRP 2016-021.

References

1. Electric Power Research Institute Technical Report, November 2006, "Materials Reliability Program: Screening, Categorization, and Ranking of Reactor Internals Components for Westinghouse and Combustion Engineering PWR Design (MRP-191)" (ADAMS Accession No. ML091910130).
2. Letter from Christopher I. Grimes (NRC) to Douglas J. Walters (Nuclear Energy Institute), May 19, 2000, "License Renewal Issue No. 98-0030, 'Thermal Aging Embrittlement of Cast Austenitic Stainless Steel Components' " (ADAMS Accession No. ML003717179).