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LR-N10-0438

U.S. Nuclear Regulatory Commission
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Washington, DC 20555-0001

Salem Nuclear Generating Station, Unit No. 1 and Unit No. 2
Facility Operating License Nos. DPR-70 and DPR-75
NRC Docket Nos. 50-272 and 50-311

Subject: Revision to Response to NRC Request for Additional Information, dated November 4, 2010, related to Steam Generator Tube-To-Tubesheet Welds associated with the Salem Nuclear Generating Station, Units 1 and 2 License Renewal Application

References: 1. Letter from Ms. Bennett Brady (USNRC) to Mr. Thomas Joyce (PSEG Nuclear, LLC) "REQUEST FOR ADDITIONAL INFORMATION FOR SALEM NUCLEAR GENERATING STATION, UNITS 1 AND 2, LICENSE RENEWAL APPLICATION ON PRIMARY WATER STRESS CORROSION CRACKING IN STEAM GENERATOR TUBE-TO-TUBESHEET WELDS INSPECTION PROGRAM (TAC NOS. ME1834 AND ME1836)", dated November 4, 2010
2. PSEG Nuclear Letter, "Response to NRC Request for Additional Information, dated November 4, 2010, related to Steam Generator Tube-To-Tubesheet Welds associated with the Salem Nuclear Generating Station, Units 1 and 2 License Renewal Application," dated December 1, 2010

In Reference 1, the NRC requested additional information related to the potential for primary water stress corrosion cracking in steam generator tube-to-tubesheet welds associated with the Salem Nuclear Generating Station, Units 1 and 2 (Salem) License Renewal Application (LRA). Reference 2 provided PSEG Nuclear's response to that RAI.

As a result of Staff review of Reference 2, it was determined that the inspections of the Salem Steam Generators should be conducted after those components have been in service for 20 years. Therefore, this letter revises the timing associated with those planned inspections.

Enclosure A contains the revised response to this request for additional information.

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Enclosure B provides an update to License Renewal Commitment 51, made as a result of this revised RAI response. There are no other new or revised regulatory commitments contained in this letter.

If you have any questions, please contact Mr. Ali Fakhar, PSEG Manager - License Renewal, at 856-339-1646.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on 12/15/10

Sincerely,

Robert C. Braun
Senior Vice President, Operations
PSEG Nuclear LLC

Enclosures: A. Revised Response to Request for Additional Information RAI 3.1.1-03
B. Update to License Renewal Commitment List

cc: William M. Dean, Regional Administrator – USNRC Region I
B. Brady, Project Manager, License Renewal – USNRC
R. Ennis, Project Manager - USNRC
NRC Senior Resident Inspector – Salem
P. Mulligan, Manager IV, NJBNE
L. Marabella, Corporate Commitment Tracking Coordinator
Howard Berrick, Salem Commitment Tracking Coordinator

Enclosure A

Revised Response to Request for Additional Information RAI 3.1.1-03 Related to the Potential for PWSCC in Steam Generator Tube-to-Tubesheet Welds associated with the Salem Nuclear Generating Station, Units 1 and 2 License Renewal Application

RAI 3.1.1-03 (Revised)

Note: For clarity, the original response to this RAI is repeated in this Enclosure, shown in normal font. Additions are shown in ***bold italics*** and deletions are shown with ~~strikethrough~~ text.

RAI 3.1.1-03

Background:

Standard Review Plan License Renewal (SRP-LR) Section 3.1.2.2.16 states that cracking due to primary water stress corrosion cracking (PWSCC) could occur on the primary coolant side of pressurized water reactor steel steam generator (SG) tube-to-tube sheet welds made or clad with nickel alloy. The Generic Aging Lessons Learned (GALL) Report recommends American Society of Mechanical Engineers (ASME) Code Section XI inservice inspection and control of water chemistry to manage this aging and recommends no further aging management review for PWSCC of nickel alloy if the applicant complies with applicable U.S. Nuclear Regulatory Commission (NRC or the Staff) Orders and provides a commitment in the Updated Final Safety Analysis Report (UFSAR) supplement to implement applicable (1) Bulletins and Generic Letters and (2) staff-accepted industry guidelines. In GALL Report, Revision 1 Volume 2, this aging is addressed in Item IV.D2-4, applicable only to once-through SGs, but not to recirculating SGs.

The staff notes that ASME Code Section XI does not require any inspection of the tube-to-tubesheet welds. In addition, no NRC Orders or bulletins require examination of this weld. However, the staff's concern is that, if the tubesheet clad is Alloy 600, the tube-to-tubesheet weld region may not have sufficient chromium content to prevent initiation of PWSCC, even when the SG tubes are made from Alloy 690TT. Consequently, such a PWSCC crack initiated in this region, close to a tube, could propagate into/through the weld, causing a failure of the weld and of the reactor coolant pressure boundary, for both recirculating and once-through steam generators.

In license renewal application (LRA) Table 3.1.1, the applicant stated that item number 3.1.1-35 is not applicable because they do not have once-through SGs and therefore, do not have the components associated with this model of SGs.

In UFSAR Section 5.5.2.2.2, the applicant described that the Unit 1 Model-F steam generator tubes are fabricated from Alloy 600TT and are welded to the Inconel cladding on the primary face of the tube plate. In UFSAR Section 5.5.2.2.1, the applicant stated that the Unit 2 replacement steam generator tubes are fabricated from Alloy 690TT, and that the primary side of the tube sheet is weld clad with Alloy 600. Therefore, despite the fact that it is not an aging effect identified in GALL Revision 1, the staff is concerned that there may exist a similar aging effect of the SGs at Salem, given the similar material and environment of the SGs.

Issue:

Unless the NRC has approved a redefinition of the pressure boundary in which the autogenous tube-to-tubesheet weld is no longer included, or the tubesheet cladding and welds are not susceptible to PWSCC, the staff considers that the effectiveness of the primary water chemistry program should be verified to ensure PWSCC cracking is not occurring.

Request:

(1a) For Unit 1 SGs, clarify whether the tube-to-tubesheet welds are included in the reactor coolant pressure boundary or alternate repair criteria have been permanently approved.

(1b) If the SGs do not have permanently approved alternate repair criteria, provide a plant-specific aging management program (AMP) that will complement the primary water chemistry program, in order to verify the effectiveness of the primary water chemistry program and ensure that cracking due to PWSCC is not occurring in tube-to-tubesheet welds.

(2) For Unit 2 SGs tube-to-tubesheet welds, provide either a plant-specific AMP that will complement the primary water chemistry program, in order to verify the effectiveness of the primary water chemistry program and ensure that cracking due to PWSCC is not occurring in tube-to-tubesheet welds, or a rationale for why such a program is not needed.

PSEG Response:

Salem will develop a plan prior to Unit 1 and Unit 2 entering its period of extended operation (PEO). The plan will consist of an analysis option and an inspection option.

Salem Unit 1

1a. The Salem Unit 1 Technical Specifications were amended in March 29, 2010 which approved a one-time change to Technical Specification Section 6.8.4.i, "Steam Generator (SG) Program", (ADAMS Accession No. ML100570452). This amendment is an approval for alternate repair criteria (ARC) and limits the required inspection (and repair if degradation is found) to the portions of the SG tubes passing through the upper 13.1 inches of the approximate 21-inch tubesheet region. Therefore, the bottom 7.9 inches of the tube, including the tube-to-tubesheet weld are not presently considered part of the reactor coolant pressure boundary. The Technical Specification amendment was used in the Spring 2010 refueling outage and is valid until the next scheduled steam generator tube inspections presently scheduled for the Spring 2013 refueling outage.

However, since this ARC approval expires by the Spring 2013 refueling outage, which is prior to the PEO, Salem Unit 1 will develop a plan to address potential cracking of the steam generator primary to secondary pressure boundary due to Primary Water Stress Corrosion Cracking (PWSCC) of tube-to-tubesheet welds. The plan will consist of two options. Option 1 (analysis) is described as follows.

Option 1

For Salem Unit 1, obtain permanent NRC approval for ARC, which re-defines the reactor coolant pressure boundary to no longer include the autogenous tube-to-tubesheet welds. Note: Salem anticipates obtaining permanent approval for ARC at Salem Unit 1 prior to its PEO.

1b. If permanent approval for ARC has not been granted by the NRC prior to Salem Unit 1 entering its PEO, Salem Unit 1 will implement the second option (inspection) as described below.

Option 2

Perform a One-Time inspection of a representative number of tube-to-tubesheet welds in each of the four (4) steam generators to determine if PWSCC is present. This One-Time inspection would verify the effectiveness of the Water Chemistry aging management program (Salem LRA, Appendix B, Section B.2.1.2). If weld cracking is identified:

a) The condition will be resolved through repair or engineering evaluation to justify continued service, as appropriate, and

b) A periodic monitoring program will be established to perform routine tube-to-tubesheet inspections for the remaining life of the steam generators

Salem Unit 1 replaced its steam generators ***during the extended shutdown that concluded*** in April 1998. The tube-to-tubesheet welds have been in service for approximately twelve (12) years. Considering this limited service time, if Option 1 is not implemented, Salem Unit 1 will implement Option 2 of the plan that includes tube-to-tubesheet welds inspections for the presence of PWSCC. These inspections will be performed ~~prior to the Salem Unit 1 steam generators reaching twenty (20) years of service life, or by April 2018~~ ***between April 2018 and April 2023, such that the steam generators will have been in service between 20 and 25 years.***

Salem Unit 2

2. The plan for Salem Unit 2 will also address potential failure of the steam generator reactor coolant pressure boundary due to PWSCC of tube-to-tubesheet welds. The plan will consist of two options:

Option 1

Salem Unit 2 will perform an analytical evaluation of the steam generator tube-to-tubesheet welds in order to establish a technical basis for either determining that the tubesheet cladding and welds are not susceptible to PWSCC, or redefining the pressure boundary in which the autogenous tube-to-tubesheet weld is no longer included, therefore, not required for the reactor coolant pressure boundary function. The redefinition of the reactor coolant pressure boundary will be submitted as part of a license amendment request requiring approval from the NRC. An approved analytical evaluation would supercede the need to develop a

plant-specific AMP to verify the effectiveness of the Water Chemistry aging management program.

-or-

Option 2

Perform a One-Time inspection of a representative number of tube-to-tubesheet welds in each of the four (4) steam generators to determine if PWSCC is present. This One-Time inspection would verify the effectiveness of the Water Chemistry aging management program. If weld cracking is identified:

a) The condition will be resolved through repair or engineering evaluation to justify continued service, as appropriate, and

b) A periodic monitoring program will be established to perform routine tube-to-tubesheet inspections for the remaining life of the steam generators

Salem Unit 2 replaced its steam generators in April 2008. The tube-to-tubesheet welds have been in service for less than three years. Considering this limited service time, if Option 1 is not implemented, Salem Unit 2 will implement Option 2 of the plan, including tube-to-tubesheet weld inspections for the presence of PWSCC. These inspections will be performed ~~prior to the Salem Unit 2~~ ***between April 2028 and April 2033, such that the*** steam generators ***will have been in service between 20 and 25 years.*** ~~reaching twenty (20) years of service life, or by April 2028.~~

As a result of this RAI response, commitment #51 is added to LRA Table A.5, License Renewal Commitment List, as shown in Enclosure B of this letter.

Enclosure B
Update to License Renewal Commitment List

As a result of this RAI response, the commitment discussed above is added to LRA Table A.5, License Renewal Commitment List, as commitment number 51 as shown below. Any other actions described in this letter are not regulatory commitments and are described for the NRC staff's information:

A.5 License Renewal Commitment List

No.	Program or Topic	Commitment	UFSAR Supplement Location (LRA App. A)	Enhancement or Implementation Schedule	Source
51	Steam Generator Tube to Tubesheet Weld Cracking	Salem will develop a plan for each Unit to address the potential for cracking of the primary to secondary pressure boundary due to PWSCC of tube-to-tubesheet welds. Each plan will consist of two options: <u>Salem Unit 1</u> Option 1 (Analysis): Salem Unit 1 will obtain permanent approval for Alternate Repair Criteria from the NRC, **or** Option 2 (Inspection):	Not Applicable	Develop a plan prior to the Period of Extended Operation for each Unit. ***If the analysis option is chosen,*** ~~I~~mplement the requirements of the plan, including obtaining any required NRC approval, by April 2018 for Unit 1, and by April 2028 for Unit 2. ***If steam generator inspections are to be performed, they will***	Salem Letter LR-N10-0421 RAI 3.1.1-03 ***Salem Letter LR-N10-0438*** ***Revised Response to RAI 3.1.1-03***

No.	Program or Topic	Commitment	UFSAR Supplement Location (LRA App. A)	Enhancement or Implementation Schedule	Source
		Salem Unit 1 will perform a One-Time inspection of a representative number of tube-to-tubesheet welds in each of the four (4) steam generators to determine if PWSCC is present. If weld cracking is identified, a) the condition will be resolved through repair or engineering evaluation to justify continued service, as appropriate, and b) a periodic monitoring program will be established to perform routine tube-to-tubesheet inspections for the remaining life of the steam generators. <u>Salem Unit 2</u> Option 1 (Analysis): Salem Unit 2 will perform an analytical evaluation either determining that the tubesheet cladding and welds are not susceptible to PWSCC, or redefining the pressure boundary of the tubes, where the steam generator tube-to-tubesheet welds are not required for the reactor coolant pressure boundary function. The redefinition of the reactor coolant pressure boundary will be submitted as part of a		***be performed between April 2018 and April 2023 for Unit 1, and April 2028 and April 2033 for Unit 2.***	

No.	Program or Topic	Commitment	UFSAR Supplement Location (LRA App. A)	Enhancement or Implementation Schedule	Source
		license amendment request requiring approval from the NRC, **or** Option 2 (Inspection): Salem Unit 2 will perform a One-Time inspection of a representative number of tube-to-tubesheet welds in each of the four (4) steam generators to determine if PWSCC is present. If weld cracking is identified, a) the condition will be resolved through repair or engineering evaluation to justify continued service, as appropriate, and b) a periodic monitoring program will be established to perform routine tube-to-tubesheet inspections for the remaining life of the steam generators.			