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SEP 7 2010

10 CFR 50
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U.S. Nuclear Regulatory Commission
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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: Response to NRC Request for Additional Information dated August 9, 2010, Related to CASS Materials; and, Response to NRC Request for Additional Information dated August 19, 2010 Pertaining to CASS Safety Injection Valves, both associated with the Salem Nuclear Generating Station, Units 1 and 2 License Renewal Application

Reference:

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 (TAC NOS. ME1834 AND ME1836)," dated August 9, 2010

2. Letter from Ms. Bennett Brady (USNRC) to Mr. Thomas Joyce (PSEG Nuclear, LLC) "REQUEST FOR ADDITIONAL INFORMATION REGARDING THE SALEM NUCLEAR GENERATING STATION, UNITS 1 AND 2, LICENSE RENEWAL APPLICATION (TAC NO. ME1834 AND ME1836), dated August 19, 2010

In Reference 1, the NRC requested additional information related to management of stress corrosion cracking of cast austenitic stainless steel (CASS) materials, associated with the Salem Nuclear Generating Station, Units 1 and 2 (Salem) License Renewal Application. Reference 2 requested information pertaining to the Salem Safety Injection system cold leg CASS injection check valves. Enclosed are the responses to these requests for additional information.

This letter and its enclosure contain no regulatory commitments.

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

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

Executed on 9/7/10

Sincerely,

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

Enclosure: Responses to Requests for Additional Information Related to CASS Materials and Components

cc: 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

Responses to Requests for Additional Information Related to CASS Materials and Components, associated with the Salem Nuclear Generating Station, Units 1 and 2 License Renewal Application (LRA)

RAI 3.1.2.2.7.2-01
RAI 3.2.1.47-01

RAI 3.1.2.2.7.2-01

Background:

License renewal application (LRA) Section 3.1.2.2.7.2 addresses the aging management of cracking due to stress corrosion cracking (SCC) of Class 1 cast austenitic stainless steel (CASS) piping and piping components exposed to reactor coolant. LRA Table 3.1.1 item 3.1.1-24, which also refers to LRA Section 3.1.2.2.7.2, addresses the applicant's aging management of SCC in the CASS components. The applicant stated that the aging effect will be managed by implementing the Water Chemistry Program (LRA Section B.2.1.2) and Thermal Aging Embrittlement of Cast Austenitic Stainless Steel Program (LRA Section B.2.1.6).

LRA Section B.2.1.6 states that the Thermal Aging Embrittlement of CASS Program is consistent with GALL AMP XI.M12, "Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)," with no exception or enhancement. LRA Section B.2.1.6 also indicates that the applicant's program includes the inspections, flaw evaluations, and repairs and replacements in accordance with the ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD Program.

Issue:

The staff noted that the material screening criteria used to manage the thermal aging embrittlement of CASS, as described in GALL AMP XI.M12, are different from the material screening criteria used to further evaluate and manage the SCC of CASS as described under GALL Report item IV.C2-3.

In order to adequately manage the SCC of CASS components under GALL Report item IV.C2-3, the GALL Report recommends further evaluation for CASS that has carbon content greater than 0.035 percent or ferrite content less than 7.5 percent. In contrast, the material screening criteria of the Thermal Aging Embrittlement of CASS Program are based on the combinations of molybdenum content, different threshold levels of ferrite content (14 percent and 20 percent) and casting methods (static casting and centrifugal casting). Therefore, the staff found the need to clarify whether the applicant's material screening criteria used to manage the SCC applicant's aging management method are consistent with GALL Report item IV.C2-3.

Request:

1. Clarify how the applicant's material screening criteria used to further evaluate and manage the SCC of CASS are consistent with GALL Report item IV.C2-3 which recommends that SCC of CASS with carbon content greater than 0.035 percent or ferrite content less than 7.5 percent be further evaluated and adequately managed.

2. Clarify whether the SCC in the CASS components is managed by the inspections, flaw evaluations, and repairs and replacements in accordance with the ASME Section XI Inservice Inspection, Subsections IWB, IWC and IWD Program. If the ASME Section XI Inservice Inspection, Subsections IWB, IWC and IWD Program is not used to manage the aging effect, justify why the applicant's program is adequate to manage the aging effect.

PSEG Response:

1. The material screening criteria used to further evaluate and manage the aging effect and mechanism of cracking due to stress corrosion cracking (SCC) of Class 1 cast austenitic stainless steel (CASS) components are consistent with Generic Aging Lessons Learned (GALL) Report item IV.C2-3. The recommended aging management program for this aging effect and mechanism is the Water Chemistry Program (Salem LRA Appendix B, Section B.2.1.2). For CASS components that do not meet the NUREG-0313 guidelines of carbon content of less than or equal to 0.035 percent and ferrite content of greater than or equal to 7.5 percent, then GALL item IV.C2-3 recommends a plant-specific aging management program is to be evaluated. Salem reviewed the chemical compositions of the CASS components exposed to reactor coolant, and it was identified that these CASS components do not meet the NUREG-0313 guidelines. Salem LRA inappropriately credited the Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS) aging management program (Salem LRA Appendix B, Section B.2.1.6) as the plant-specific program in LRA Table 3.1.2-1.

   Salem will instead credit the ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD aging management program (Salem LRA Appendix B, Section B.2.1.1) to manage the aging effect and mechanism of cracking due to SCC for the Class 1 CASS components exposed to reactor coolant. In addition, as shown in the Salem LRA Table 3.1.2-1, Salem appropriately credits the Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS) aging management program to manage the aging effect and mechanism of loss of fracture toughness due to thermal aging embrittlement.

2. The aging effect and mechanism of cracking due to SCC for the Class 1 CASS components exposed to reactor coolant will be managed by the ASME Section XI Inservice Inspection, Subsections IWB, IWC and IWD aging management program as revised per this RAI response. As discussed in Salem LRA Section B.2.1.1, the ASME Section XI Inservice Inspection, Subsections IWB, IWC and IWD aging management program uses inspections, flaw evaluations, and repairs and replacements, as required.

As a result of the above RAI response, LRA Table 3.1.1, Item Number 3.1.1-24, LRA Table 3.1.2-1, and LRA Section 3.1.2.2.7.2 are revised as shown below. Revisions are indicated with bolded italics for inserted text and strikethroughs for deleted text.

Table 3.1.1 Summary of Aging Management Evaluations for the Reactor Vessel, Internals, and Reactor Coolant System

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.1.1-24	Class 1 cast austenitic stainless steel piping, piping components, and piping elements exposed to reactor coolant	Cracking due to stress corrosion cracking	Water Chemistry and, for CASS components that do not meet the NUREG-0313 guidelines, a plant specific aging management program	Yes, plant specific	Consistent with NUREG-1801. Salem will implement the Water Chemistry program, B.2.1.2, to manage cracking due to stress corrosion cracking in the Class 1 cast austenitic stainless steel (CASS) reactor coolant system ***components and*** valve bodies exposed to reactor coolant. Components in the Reactor Coolant System have been aligned to this item number based on material, environment and aging effect. ***The ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD program, B.2.1.1,*** ~~Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS) program, B.2.1.6,~~ will be ***used*** ~~added~~, along with the Water Chemistry program, B.2.1.2, to manage cracking due to stress corrosion cracking in the Class 1 cast austenitic stainless steel (CASS) reactor coolant system components exposed to reactor coolant. See Subsection 3.1.2.2.7.2.

Table 3.1.2-1 **Reactor Coolant System**

Component Type	**Intended Function**	**Material**	**Environment**	**Aging Effect Requiring Management**	**Aging Management Programs**	**NUREG-1801 Vol. 2 Item**	**Table 1 Item**	**Notes**
Reactor Coolant Pressure Boundary Components (hot leg and cold leg piping)	Pressure Boundary	Cast Austenitic Stainless Steel (CASS)	Reactor Coolant (Internal)	Cracking/Stress Corrosion Cracking	~~Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)~~ ***ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD***	IV.C2-3	3.1.1-24	~~A~~ ***E, 9***

Plant Specific Notes:

9. NUREG-1801 specifies a plant-specific program. The ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD program is used to manage the aging effect applicable to this component type, material, and environment combination.

3.1.2.2.7 <u>Cracking due to Stress Corrosion Cracking</u>

2. *Cracking due to SCC could occur in Class 1 PWR cast austenitic stainless steel (CASS) reactor coolant system piping, piping components, and piping elements exposed to reactor coolant. The existing program relies on control of water chemistry to mitigate SCC; however SCC could occur for CASS components that do not meet the NUREG-0313 guidelines with regard to ferrite and carbon content. The GALL Report recommends further evaluation of a plant specific program for these components to ensure that this aging effect is adequately managed. Acceptance criteria are described in Branch Technical Position RLSB-1.*

   Salem will implement the Water Chemistry program, B.2.1.2, ***and the ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD program, B.2.1.1,*** to manage cracking due to stress corrosion cracking in the Class 1 cast austenitic stainless steel (CASS) reactor coolant system ***components and*** valve bodies exposed to reactor coolant. ~~Salem will implement Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS) program, B.2.1.6, and the Water Chemistry program, B.2.1.2, to manage cracking due to stress corrosion cracking in the Class 1 cast austenitic stainless steel (CASS) reactor coolant system components exposed to reactor coolant.~~ The ***ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD*** ~~Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)~~ program includes condition monitoring activities of reactor coolant system CASS components susceptible to cracking due to stress corrosion cracking ~~thermal aging embrittlement~~ to ensure that there is no loss of intended function. ***The ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD*** ~~Thermal Aging Embrittlement of Cast Austenitic Stainless Steel (CASS)~~ program and the Water Chemistry program are described in Appendix B.

RAI 3.2.1.47-01

Background:

Standard Review Plan for Reviewed License Renewal Applications (SRP LR) Table 3.2-1, item 47 addresses loss of fracture toughness due to thermal aging embrittlement in cast austenitic stainless steel (CASS) piping, piping components, and piping elements exposed to treated water (borated or unborated) with temperature greater than 250°C (>482°F). License renewal application item 3.2.1-47 states that this line item is not applicable because there are no CASS piping, piping components or piping elements, subject to treated water greater than 482°F in the engineered safety features systems. Final Safety Analysis Report Table 6.3-14 states that valves in the emergency core cooling system are constructed of austenitic stainless steel.

Issue:

The staff does not have enough information to determine if the safety injection (SI) cold leg check valves (at the reactor coolant system (RCS) to SI boundary) are constructed from CASS. Also, given the valve's position, it's not evident if they're subject to an environment exceeding 482°F.

Request:

Are the safety injection cold leg check valves (at the RCS to SI boundary) valves constructed of CASS and are they exposed to an environment exceeding 482°F?

PSEG Response:

The Safety Injection cold leg check valves at the Reactor Coolant System to Safety Injection system boundary are constructed of CASS material, and are assumed to be exposed to an environment of treated borated water > 482°F. As such, the Salem LRA should have included the Generic Aging Lessons Learned (GALL) Report item IV.C2-6 in LRA Table 3.2.2-3 for the component type Class 1 Valve Body for the Safety Injection cold leg check valves at the Reactor Coolant System to Safety Injection System boundary.

During normal operations, heat is transferred from the Reactor Coolant System cold leg (550°F) to the Safety Injection cold leg check valves through a stagnant vertical leg of piping. It can be assumed that the internal temperature of the Safety Injection System cold leg check valves at the Safety Injection System and Reactor Coolant System boundary is greater than 482°F. Since these check valves are exposed to an internal environment of reactor coolant (treated borated water > 482°F), LRA Table 3.2.2-3 is revised to add the GALL Report item IV.C2-6 to the Safety Injection System component type Class 1 Valve Body. The corresponding aging effect and mechanism of loss of fracture toughness due to thermal aging embrittlement will be managed by the ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD aging management program (Salem LRA, Appendix B, Section B.2.1.1). The ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD aging management program is adequate to manage the aging effect of loss of fracture toughness due to thermal aging embrittlement.

The GALL Report item IV.C2-6 further states that "screening for susceptibility to thermal aging is not necessary" for pump casings and valve bodies.

As a result of the above response, LRA Table 3.1.1, Item Number 3.1.1-55; LRA Table 3.2.1, Item Number 3.2.1-47; LRA Table 3.2.2-3, and LRA Section 3.2.2.1.3 are revised as shown below. Revisions are indicated with bolded italics for inserted text and strikethroughs for deleted text.

Table 3.2.2-3 Safety Injection System

Component Type	Intended Function	Material	Environment	Aging Effect Requiring Management	Aging Management Programs	NUREG-1801 Vol. 2 Item	Table 1 Item	Notes
Valve Body (Class 1)	*Pressure Boundary*	*Cast Austenitic Stainless Steel (CASS)*	*Treated Borated Water >482°F (Internal)*	*Loss of Fracture Toughness/Thermal Aging Embrittlement*	*ASME Section XI Inservice Inspection, Subsections IWB, IWC, and IWD*	*IV.C2-6*	*3.1.1-55*	*A*

Table 3.1.1 Summary of Aging Management Evaluations for the Reactor Vessel, Internals, and Reactor Coolant System

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.1.1-55	Cast austenitic stainless steel Class 1 pump casings, and valve bodies and bonnets exposed to reactor coolant >250°C (>482°F)	Loss of fracture toughness due to thermal aging embrittlement	Inservice inspection (IWB, IWC, and IWD). Thermal aging susceptibility screening is not necessary, inservice inspection requirements are sufficient for managing these aging effects. ASME Code Case N-481 also provides an alternative for pump casings.	No	Consistent with NUREG-1801. The ASME Section XI Inservice Inspection program, Subsections IWB, IWC, and IWD, B.2.1.1, will be used to manage the loss of fracture toughness due to thermal aging embrittlement in cast austenitic stainless steel Class 1 pump casings and valve bodies exposed to reactor coolant ***and treated borated water > 482°*** in the Chemical & Volume Control***,*** ~~and~~ Reactor Coolant ~~Systems.~~ ***and Safety Injection Systems.***

Table 3.2.1 Summary of Aging Management Evaluations for the Engineered Safety Features

Item Number	Component	Aging Effect/Mechanism	Aging Management Programs	Further Evaluation Recommended	Discussion
3.2.1-47	Cast austenitic stainless steel piping, piping components, and piping elements exposed to treated borated water >250°C (>482°F)	Loss of fracture toughness due to thermal aging embrittlement	Thermal Aging Embrittlement of CASS	No	Not Applicable. There ***are*** ~~is no~~ cast austenitic stainless steel piping, piping components, and piping elements exposed to treated borated water greater than 482°F in the Engineered Safety Features systems. The cast austenitic stainless steel valves exposed to treated borated water >482°F in the Chemical & Volume Control ~~System~~***, and the Safety Injection Systems*** have been included in Table 3.1, Item Number 3.1.1-55.

3.2.2.1.3 Safety Injection System

Environments

The Safety Injection System components are exposed to the following environments:

- ***Treated Borated Water > 482 °F***

Aging Effects Requiring Management

The following aging effects associated with the Safety Injection System components require management:

- ***Loss of Fracture Toughness/Thermal Aging Embrittlement***