August 28, 2007

Mr. William Levis
President & Chief Nuclear Officer
PSEG Nuclear LLC - N09
Post Office Box 236
Hancocks Bridge, NJ 08038

SUBJECT: SALEM NUCLEAR GENERATING STATION, UNIT NOS. 1 AND 2, REQUEST FOR ADDITIONAL INFORMATION, AMENDMENT REQUEST RE: STEAM GENERATOR FEEDWATER PUMP TRIP, FEEDWATER ISOLATION VALVE CLOSURE RESPONSE TIMES, AND CONTAINMENT FAN COIL UNIT COOLING WATER FLOW RATE (TAC NOS. MD4843 AND MD4844)

Dear Mr. Levis:

By letter dated March 16, 2007, PSEG Nuclear LLC (PSEG) submitted an amendment request for Salem Nuclear Generating Station, Unit Nos. 1 and 2. The proposed amendment would add new Technical Specification (TS) requirements for the response times associated with a steam generator feedwater pump (SGFP) trip and feedwater isolation valve (FIV) closure. The amendment would also revise the TS requirements for the containment fan cooler unit (CFCU) cooling water flow rate. These changes are associated with a revised containment response analysis that credits an SGFP trip and FIV closure (on a feedwater regulator valve failure) to reduce the mass/energy release to the containment during a main steam line break. The containment analysis also credits a reduced heat removal capability for the CFCUs, allowing a reduction in the required service water flow to the CFCUs.

The Nuclear Regulatory Commission (NRC) staff is reviewing your submittal and has determined that additional information is needed to complete its review. The specific questions are found in the enclosed request for additional information (RAI). The RAI questions were previously provided in draft form to PSEG via e-mails on July 3, July 17, August 2, and August 22, 2007. The draft questions were sent to ensure that the questions were understandable, the regulatory basis for the questions was clear, and to determine if the information was previously docketed. Conference calls between the NRC staff and the PSEG staff to discuss the questions were held on July 30, August 14, and August 22, 2007.

During the call on August 22, 2007, Mr. Robert Hoffman of your staff agreed to provide a response by September 14, 2007. Please note that if you do not respond to this letter within 30 days or provide an acceptable alternate date in writing, we may reject your application for amendment under the provisions of Title 10 of the *Code of Federal Regulations*, Section 2.108. If you have any questions, I can be reached at (301) 415-1420.

Sincerely,

/RA/

Richard B. Ennis, Senior Project Manager
Plant Licensing Branch I-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-272 and 50-311

Enclosure:
Request for Additional Information

cc w/encl: See next page

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cc w/encl: See next page

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REQUEST FOR ADDITIONAL INFORMATION

REGARDING PROPOSED LICENSE AMENDMENT

STEAM GENERATOR FEEDWATER PUMP TRIP,

FEEDWATER ISOLATION VALVE CLOSURE RESPONSE TIMES,

AND CONTAINMENT FAN COIL UNIT COOLING WATER FLOW RATE

SALEM NUCLEAR GENERATING STATION, UNIT NOS. 1 AND 2

DOCKET NOS. 50-272 AND 50-311

By letter dated March 16, 2007, PSEG Nuclear LLC (PSEG or the licensee) submitted an amendment request for Salem Nuclear Generating Station (Salem), Unit Nos. 1 and 2. The proposed amendment would add new Technical Specification (TS) requirements for the response times associated with a steam generator feedwater pump (SGFP) trip and feedwater isolation valve (FIV) closure. The amendment would also revise the TS requirements for the containment fan cooler unit (CFCU) cooling water flow rate. These changes are associated with a revised containment response analysis that credits a SGFP trip and FIV closure (on a feedwater regulator valve failure) to reduce the mass/energy release to the containment during a main steam line break (MSLB). The containment analysis also credits a reduced heat removal capability for the CFCUs, allowing a reduction in the required service water (SW) flow to the CFCUs.

The Nuclear Regulatory Commission (NRC) staff is reviewing your submittal and has determined that additional information is needed to complete its review. The specific information requested is addressed below.

EMCB-1: PSEG's letter dated May 8, 1998, provided a response to an NRC staff request for additional information (RAI) regarding Generic Letter (GL) 96-06. The GL RAI response indicated that, for Salem Unit 2 penetrations M22A, M27, and M45, relief valves would be installed to protect these penetrations from thermally-induced pressurization. However, based on the discussion in Section 6.8 of Enclosure 2 to PSEG's application dated March 16, 2007, regarding the impact of the proposed amendment on these penetrations, it does not appear that relief valves were installed. Please clarify if these penetrations are protected by relief valves as indicated in the submittal dated May 8, 1998.

SBPB-1: The proposed change would reduce the minimum cooling water flow rate to each CFCU from $\geq$ 2550 gallons per minute (gpm) to $\geq$1300 gpm. The reduction in required SW flow rate to the CFCUs would reduce its heat removal capability in the containment. The minimum flow rate requirements in the accident analyses for loss-of-coolant accident (LOCA) and MSLB are based on clean-tube flow rate. Explain how the accident analysis was performed with consideration of tube fouling, and what safety margin was assumed in the analysis for tube fouling.

SBPB-2: In considering the effects of surface fouling of the water side of the CFCUs and the residual heat removal heat exchangers, explain how you treat water side surface fouling of the CFCU in the analysis.

SBPB-3: Cooling water systems serving the containment air coolers may experience two-phase flow conditions during postulated LOCA and MSLB scenarios. However, the heat removal assumptions for design-basis accident scenarios were based on single-phase flow conditions. In GL 96-06, the NRC requested licensees to evaluate cooling water systems that serve containment air coolers to assure that the systems are not vulnerable to water-hammer and two-phase flow conditions. The staff has previously approved the licensee's evaluations and corrective actions to resolve this issue in a letter dated June 2, 2003. Please provide additional evaluations on this issue based on new parameters in the proposed TS changes.

EEEB-1: Page 4 of Attachment 1 to the application states that the duration of the analyses for the new LOCA cases were extended to approximately 120 days to support the environmental qualification (EQ) bases for the critical components. Please confirm that all EQ equipment are qualified for the new LOCA cases for 120 days.

EEEB-2: Section 6.5 of Engineering Evaluation S-C-CBV-MEE-1982 (Enclosure 2 to the application) indicates that Salem Unit 2 bounding profiles are used to qualify safety-related equipment in containment. Please confirm that the Unit 1 profiles are bounded by the Unit 2 bounding temperature and pressure profiles.

EEEB-3: Section 6.5 of Enclosure 2 of the application states that the "EQPro" profile has been used to evaluate the EQ equipment for an unrelated EQ Program update. Please clarify what this statement means.

EEEB-4: Please clarify whether "EQPro" input curves are used as bounding profiles for EQ.

EEEB-5: Section 6.5 of Enclosure 2 of the application states that "The EQ analyses of critical equipment are based on composite curves that envelope the estimated temperature, pressure and radiation environments during a design basis event. These composite curves are defined in the Salem Environmental Design Criteria EDC (Reference 15)." Please confirm that these composite curves are bounded by EQPro input curves. If not, then explain the impact of these composite curves on the EQ program.

EEEB-6: Section 6.5 of Enclosure 2 of the application states that the containment temperatures exceed the current analysis of record (AOR). Please provide detailed explanation on how the EQ equipment are qualified where the AOR is exceeded.

EEEB-7: Please confirm that the radiation dose for the proposed changes remain unchanged. If not, then provide its impact on the EQ Program.

EEEB-8: If EQ equipment are requalified or replaced due to the proposed changes, please provide the details on requalification or replacement of the EQ equipment and confirm that the EQ and maintenance programs reflect these changes.

EEEB-9: The application states that the EQ analysis is performed for "critical equipment." Please define/clarify this term.

SCVB-1: It was stated in several places of the license change request that the AOR for the single failure scenario of the faulted loop feedwater regulating valve (FRV) failing open is overly conservative as it assumed full feedwater (FW) flow to the faulted steam generator (SG) for 32 seconds, until the FIV is fully shut. The revised modeling with WCAP-16503 credits reduced flow when the SGFP is tripped. It further reduces the flow as FIV closure increasingly throttles the flow from the condensate pumps. In addition, the revised modeling assumes that during the SGFP coast-down, FW flow will decrease linearly to the flowrate provided by the condensate pumps through freewheeling SGFPs. The revised modeling has broken down the 32 second closing time of the FIV and the 14 second time for the SGFP to come to a stop from freewheeling as follows:

FIV: Two-second electronic time delay before initiation of the valve closure, 20-seconds of valve closure that have no impact on the FW flowrate, and a linear flowrate reduction during the final 10-seconds of the valve stroke.

SGFP: Seven seconds for tripping of the SGFPs (instrument and mechanical delays), and 7 seconds for coast down.

The NRC staff requests the following clarifications:

a) How does the FW flow to the faulted SG differ between the AOR and the revised model?

b) Provide, in quantitative terms, flow considered in the AOR for the entire 32 seconds FIV closure and a breakdown of flow in the revised model during the 7 seconds of the SGFP trip, 7 seconds of SGFP coast down, the time remaining (8 seconds) prior to the linear flowrate reduction, and the final 10 seconds of the FIV stroke during which flowrate is reduced linearly.

SCVB-2: The proposed amendment includes: (1) new TS requirements for the response times associated with a SGFP trip and FIV closure; and (2) revised TS requirements for the CFCU cooling water flow rate. However, new TS requirements for SGFP coast-down time was not included in the proposed amendment. Justification for non-inclusion of the pump coast down in the TS was provided in Section 5.4 of Engineering Evaluation S-C-CBV-MEE-1982 (Enclosure 2 to the application). It is stated in the evaluation that a survey of other plants that have credited FW pump coast-down in their MSLB containment response analysis has identified a range of values between 5 and 10 seconds and that none of the plants have included the coast-down values in their TSs.

Additional pump coast-down information from two plants, Indian Point and Diablo Canyon, was provided in the Engineering Evaluation, including a comparison of turbine/pump sets between Diablo Canyon and Salem.

The NRC staff requests responses to the following questions:

a) What is the context in which the pump coast-down information was used in the analysis pertaining to other plants?

b) Was it used for a similar purpose as for Salem (i.e., to perform a refined analysis in order to justify a significant reduction in cooling water flow to the CFCUs)?

c) What is the sensitivity of the Salem analysis if the SGFP takes longer than 7 seconds to coast-down?

SCVB-3 Section 5.5 of Engineering Evaluation S-C-CBV-MEE-1982 provides a discussion of the flow characteristics during FIV closure. This section recognizes that FW flow to the faulted SG may be higher than what was considered in the WCAP analysis, however, it provides a discussion as to why the results of the analysis will not be significantly affected. The NRC staff has the following observations and is requesting additional clarifications:

a) The first and second paragraphs seem to be contradicting. In reference to the WCAP analysis, the first paragraph (page 12 of 54) states that "...instead of decreasing the flow over the full 30 second design basis stroke of the valve, the FIV is only credited to close with a linear flow ramp over the last 10 seconds of the 30-second stroke time. The WCAP analysis assumes a full open valve resistance coefficient for the first 20 seconds of the stroke, even though the valve will have completed about 66% of its closing stroke (i.e., valve will only be approximately 33% open when the model begins the linear decrease in flow)." However, in the second paragraph (page 13 of 54) it states that "[i]n general, gate valves do not significantly affect system flow until they are less than 50% open. Pages 44 thru 50 of the original BF13 MOV Calc S-1-CN-MDC-0881 Sheet 001 (Reference 13) evaluates the effect of BF13 closure on feedwater flow and concludes that the linear flow decrease assumption during the final 5% of the stroke is not valid for the BF-13 operating conditions during a MSLB event. In particular, pages 49 and 50 of MDC-0881 (Reference 13) identify high flow through BF13 (>5000 gpm) even down to 5% open because of the choked flow effects - i.e., it specifically states the valve Cv does not change in a linear manner." Clarify the intent of the above statements and how they can be construed as supporting the intent.

b) Figure 5.5-1 of Engineering Evaluation S-C-CBV-MEE-1982 shows a plot of the FW mass flow rate as a function of the FIV stroke time. In a discussion related to FW flow in this figure (page 13 of 54), it was stated that "Note: Case 8 represented feedwater flow with 0 psia SG pressure and MFW [main feedwater] pumps off (Condensate pumps only)." The NRC staff requests

confirmation that the actual flow used in the WCAP analysis is higher in the first 7 seconds due to the fact that the SGFP would not have tripped until that time, as well as the next 7 seconds when the SGFP is coasting down.

c) In the first paragraph of page 14 of 54 of Engineering Evaluation S-C-CBV-MEE-1982, it states that "[t]he as-tested BF-13 stroke time of 26 seconds (Reference 13) provides additional rationale for concluding that the actual feedwater mass injected into a faulted steam generator will be less than the assumed value from WCAP-16503." Since: (1) the proposed TS includes a 32 second response time (consisting of 2 seconds of electronic delay and 30 seconds of stroke time); (2) the associated surveillance procedure will only verify the 30 second stroke time; and (3) the 26 second stroke time is based on a test performed in 1995; the NRC staff has concerns regarding the impact on the licensee's analyses, if the actual stroke time is greater than 26 seconds. Please clarify.

d) In the first paragraph of page 14 of 54 of Engineering Evaluation S-C-CBV-MEE-1982, it states that "[c]onsidering the conservatism in flow assumed during the first 20 seconds of the valve stroke, assuming a linear flow reduction in the total system flow over the final 10 seconds of BF-13 valve stroke time is considered to be a reasonable assumption." What is the conservatism in the first 20 seconds, considering that gate valves do not significantly affect system flow until they are less than 50 percent open?

SCVB-4: In Section 6.1 of Engineering Evaluation S-C-CBV-MEE-1982 (page 18 of 54), it states that "[t]he revised peak containment temperature is 349.6 °F vs 348.2 °F (difference of +1.4 °F)." The NRC staff requests clarification of the discrepancy between the referenced numbers and those given in Table 6.1-1 of the Engineering Evaluation.

SCVB-5: Engineering Evaluation S-C-CBV-MEE-1982 Section 7.2 (page 40 of 54) acknowledges that increasing the normal SW flowrate to the CFCUs from 700 gallons per minute (gpm) to 1300 gpm also has the additional advantage of improving containment cooling for operations during the summer months. Has any analysis been conducted to quantify the improved cooling in terms of normal containment temperatures? If so, what are the results?

SCVB-6: In Attachment 2, "Technical Specification Pages with Proposed Changes," there are some inconsistencies in how the notes are called out in Table 3.3-5. In some cases the note number is in parentheses, in some cases the note number is in parentheses in supercript and in some cases the table says "Note x." The licensee may want to consider making these consistent.

SCVB-7: In Attachment 3, "Proposed Changes to TS Bases Pages," on page B 3/4 3-1a (for both Unit 1 and Unit 2), it states that "SGFP trip and **FIV failure** are credited in the containment analysis for LOCA and MSLB in case an FRV fails open." It is suggested that "FIV failure" be changed to "FIV closure" or to "FIV isolation."

SRXB-1: Please discuss the SG tube rupture analysis for the replacement SGs, or describe why such analysis is not needed, or that it is bounded by the analysis of record.