June 7, 2007

Mr. William Levis
Senior Vice President & Chief Nuclear Officer
PSEG Nuclear LLC-X04
Post Office Box 236
Hancocks Bridge, NJ 08038

SUBJECT: HOPE CREEK GENERATING STATION - REQUEST FOR ADDITIONAL INFORMATION REGARDING REQUEST FOR EXTENDED POWER UPRATE (TAC NO. MD3002)

Dear Mr. Levis:

By letter dated September 18, 2006, as supplemented on October 10, 2006, October 20, 2006, February 14, February 16, February 28, March 13, April 18, 2007, April 30, 2007, May 10, 2007, and May 18, 2007, PSEG Nuclear, LLC (PSEG or licensee) submitted an amendment request for an extended power uprate (EPU) for Hope Creek Nuclear Generating Station (Hope Creek). The proposed amendment would increase the authorized maximum power level by approximately 15%, from 3339 megawatts thermal (MWt) to 3840 MWt.

The Nuclear Regulatory Commission (NRC) staff has been reviewing the 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. The questions were sent by e-mail to you to ensure that the questions were understandable, the regulatory basis was clear and to determine if the information was previously docketed. In subsequent discussions with your staff, some questions were deleted as noted or revised for further clarification. Mr. Jamie Mallon of your staff agreed to respond by June 22, 2007, for the balance of plant questions 7.16-7.18, and the health physics branch questions, 11.10-11.13, and Mr. Mallon agreed to respond to the mechanical branch questions, 14.65 -14.110, by July 23, 2007.

In letters dated September 30, 2006 (ML062690044) and January 31, 2007 (ML070680315) you made requests to withhold proprietary information. These questions may potentially contain proprietary information, thus non-proprietary (public Enclosure 1) and proprietary (non-public, Enclosure 2) versions of these questions are enclosed.

W.Levis

Please note that if you do not respond to this letter within the prescribed response times 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) 415-1388.

Sincerely,

/ra/

James J. Shea, Senior Project Manager
Project Directorate I-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-354

Enclosures:
As stated

cc w/encl 1 only: See next page

W.Levis

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Hope Creek Generating Station

cc: w/Encl 1 only

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REQUEST FOR ADDITIONAL INFORMATION

REGARDING TECHNICAL SPECIFICATION CHANGES FOR

ENCLOSUREEXTENDED POWER UPRATE

HOPE CREEK GENERATING STATION

DOCKET NO. 50-354

By letter dated September 18, 2006 (Agencywide Documents and Management System (ADAMS) Accession No. ML062680451), as supplemented on October 10, 2006 (Accession No. ML062920092), October 20, 2006 (Accession No. ML063110163), February 14, (Accession No. ML070530099), February 16, (Accession No. ML070590178), February 28, (Accession No. ML070680314), March 13 (Accession No. ML071140157), April 18, 2007 (Accession No. ML071160121), April 30, 2007, (Accession No. ML071290559), May 10, 2007, (Accession No. ML071360375), and May 18, 2007, (Accession No. ML071160121), PSEG Nuclear, LLC (PSEG or licensee) submitted an amendment request for an extended power uprate (EPU) for Hope Creek Nuclear Generating Station (Hope Creek). The proposed amendment would increase the authorized maximum power level by approximately 15%, from 3339 megawatts thermal (MWt) to 3840 MWt.

The Nuclear Regulatory Commission (NRC) staff has been reviewing the submittal and has determined that additional information is needed to complete its review.

14) Mechnical & Civil Engineering Br (EMCB) (additional question)

14.65 **Question deleted**, information superseded by PSEG new steam dryer data.

14.66 In regard to the PSEG response to request for additional information (RAI) 14.2, discussed in attachment 1 to the licensee submittal dated April 30, 2007, PSEG addresses RAI 14.2a by exploring the accuracy of the ANSYS finite element computer program used to compute dryer stresses. In its study, **[[**

]]. PSEG is requested to provide the bias error and uncertainty of the Hope Creek dryer finite element (FE) model transfer function amplitudes (RAI 14.2a). Also, the main uncertainties in the response functions of a welded, built up structure are the boundary conditions of the plating (the welds, gussets, and other joints). PSEG should elaborate on their error analysis by quantifying the accuracy of their plate joint models and the corresponding accuracy of the overall model transfer functions. Have any measurements been made on the abandoned HC2 dryer that would quantify the FE model accuracy? Also, what modeling convergence studies have been conducted to ensure the high strain and stress regions have converged meshes?

14.67 **Draft question was revised as follows**:

PSEG is requested to compute the frequency-dependent bounding pressure acoustic circuit model (ACM) bias errors and uncertainties based on the Quad Cities Unit 2 (QC2) data for dryer hood sensors P1-P12 which should be applied to any power ascension limits and/or limit curves. Frequency ranges are: **[[**

]].

14.68 **Question deleted and replaced by Q 14.67.**

14.69 **Question deleted and replaced by Q 14.67.**

14.70 In regard to the PSEG response to RAI 14.11, discussed in attachment 1 to the licensee submittal dated April 30, 2007, PSEG states that a better comparison of scale model test (SMT) vs. plant data for the Hope Creek steam dryer is available in Continuum Dynamics Inc (CDI) Report 07-01P. Figure 4.4 of that report compares dryer pressures simulated using the ACM at two locations, based on both January 2007 in-plant data and SMT data. **[[**

]]. As a follow-up to this RAI, PSEG is asked to clearly define how the limit curves for the in-plant main steam line (MSL) pressure measurements are derived. Are the limit curves based on the upper bounds of the sub-scale and January 2007 MSL measurements? If any parts of the MSL limit curves are based on SMT data which **[[**

]], what bias errors and uncertainties are applied to the limit curves? Also, provide the Hope Creek MSL limit curves for the 8 specified locations.

14.71 **Question deleted,** due to NRC staff decision to not allow stress curves to be developed based on SMT results.

14.72 **Question deleted,** due to NRC staff decision to not allow stress curves to be developed based on SMT results.

14.73 **Draft question was revised as follows**: PSEG is requested to plot the distribution of the acoustic pressure **[[**

]].

14.74 In the response to RAI 14.19, PSEG states that during power ascension, it is planned to add accelerometers to four safety relied valves (SRVs) to monitor the vibration levels in comparison to predetermined acceptable limits. PSEG is requested to provide information regarding the acceptable limits for valve vibration, which will be implemented in the Power Ascension Test Plan.

14.75 PSEG responds to RAI 14.28 in Attachment 1 to a letter (LR-N07-0099/LCR H05-01, Rev. 1) from G. P. Barnes (PSEG) to NRC dated April 30, 2007. PSEG asserts that **[[**

]].

14.76 In response to RAI 14.29, PSEG states that there are no Hope Creek steam dryer mode shapes or frequencies to compare with the corresponding FE results. A **[[**

]]. Explain the simplifications made in the Hope Creek dryer FE analysis and provide justifications for these simplifications.

14.77 In response to RAI 14.30, PSEG explains how the alternating weld stresses are determined for the plates of two different thicknesses welded by a fillet weld. **[[**

]].

14.78 In response to RAI 14.32, PSEG states that for the FE analyses for all different frequency shifts **[[**

]].

14.79 In regard to the PSEG response to RAI 14.34, discussed in attachment 1 to the licensee submittal dated April 30, 2007, PSEG lists the model regions with the highest stresses and the corresponding peak frequencies:

[[

]].

14.80 In regard to the PSEG response to RAI 14.35, discussed in attachment 1 to the licensee submittal dated April 30, 2007, **[[**

]]

14.81 **Question deleted**, requested limit curves were submitted on May 10, 2007, by the licensee.

14.82 In response to RAI 14.39, PSEG discusses vibration monitoring for EPU operation. Discuss the consideration of operating experience at QC regarding valve actuator vibration for cantilevered components.

14.83 PSEG asserts that the Susquehanna Steam Electric Station (SSES) is similar to Hope Creek. In the 1980's, the Susquehanna steam dryers cracked due to the coincidence of localized dryer structural resonances and the tone(s) emitted from the recirculation pumps at their vane passing frequencies. SSES and GE stated that the pump tones excited the dryer not with acoustic pulsations, but through structure-borne transmission paths between the pumps and the dryer (presumably with structural vibrations entering the dryer through the dryer feet). PSEG does not account for the loading due to recirculating pump vane passing frequency in the stress analysis of the Hope Creek dryer under EPU conditions as presented in CDI Report No. 06-27. PSEG was asked in RAI 14.57 how it planned to monitor dryer loading caused by tones at the recirculation pump vane passing frequency. In regard to the PSEG response to RAI 14.57, discussed in attachment 1 to the licensee submittal dated April 30, 2007, PSEG states that GE analyzed **[[**

]]. PSEG is requested to demonstrate that the structure borne loads caused by recirculation pump vane passing frequency tones do not excite resonances of steam dryer components that might respond strongly and, therefore, do not need to be accounted for.

14.84 In RAI 14.63, PSEG was asked to submit measurements made of the acoustic pressures within the reactor pressure vessel (RPV) to confirm that no strong 80 Hz tone exists in the Hope Creek reactor. In regard to the PSEG response to RAI 14.63, discussed in attachment 1 to the licensee submittal dated April 30, 2007, PSEG references Structural Integrity Associates (SIA) Report HC-31Q-301, which was attached. The SIA report explains that a dynamic pressure transducer was attached to a level sensing line in the Hope Creek RPV and pressures were measured at CLTP conditions. Figure A2b in the report shows that a resonance at 80 Hz exists in the RPV steam volume, but that its amplitude is small compared to other tones, like the high amplitude peaks at 18 Hz and near 105 Hz. The 18 Hz peak is not explained, but the 105 Hz peak is attributed to the vane passing frequency of the recirculation pumps (the potential effects of vane passing frequency tones on the steam dryer were addressed in RAI 14.57). **[[**

]].

RAIs based on the revised documents submitted by PSEG

14.85 PSEG claims that data in CDI Report No. 07-01P, submitted as part of attachment 1 to the licensee submittal dated April 30, 2007, confirms that the dryer loading based on the mirrored MSL inputs from May 2006 is conservative. PSEG, therefore, states in Section 4 of Attachment 7 Rev. 1 to LR-N06-0286, LCR H05-01, Rev. 1, dated April 2007, that their original FE stress analysis of the Hope Creek dryer using dryer loads based on mirrored MSL in-plant inputs (CDI Report No. 06-24, Rev. 3, Sep 2006) is also conservative. PSEG has not conducted additional FE stress analyses using the 2007 in-plant MSL measurements (without mirrored inputs). **[[**

]]. PSEG is requested to provide a rigorous demonstration that their 2006 stress analysis results based on mirrored MSL inputs is actually conservative, particularly for peak stresses below 60 Hz.

14.86 PSEG discusses updated dryer stress uncertainties in Section 5.2 of Attachment 7 Rev. 1 to LR-N06-0286, LCR H05-01, Rev. 1, dated April 2007. PSEG divides the loading uncertainty into frequency and amplitude components. Dryer stresses are calculated at several time-shifted conditions, where the loads are expanded or contracted in time between +/-10% in intervals of 2.5%. The ratios between the highest computed stresses and those at the nominal (no time shift) conditions are computed and termed uncertainties. The overall loading amplitude uncertainty, based entirely on ACM uncertainties discussed in Section 4.2.1, is 27.2%. No uncertainty or bias error is associated with the FE model used to compute stresses (separate RAIs question the lack

of FE model uncertainties and bias errors). PSEG then asserts that it is appropriate to combine the frequency and amplitude uncertainties by the Square Root of the Sum of the Squares (SRSS) approach to compute the overall uncertainty of the dryer stresses computed at nominal loading conditions. The SRSS approach in computing overall uncertainty is not appropriate because the increase in the stresses resulting from frequency shifts represents bias error (and not uncertainty) and, therefore, should be combined with the ACM uncertainty by absolute sum (and not SRSS). The Vermont Yankee plant, cited by PSEG in its application, reported the worst-case stresses due to frequency shifting, which were then combined with the ACM and FE model uncertainties by absolute sum approach to compute their limit curves. PSEG is requested to treat the increase in the stresses due to frequency shifts as bias error or provide rigorous justification for treating it as uncertainty.

14.87 **Question deleted,** information superseded by PSEG new 2007 steam dryer data.

14.88 CDI Report 07-01, Fig. 3.4 shows that the PSDs of subscale pressure pulsations in MSLs **[[**

]].

14.89 In CDI Report 07-01, there is an apparent disagreement between the PSDs shown in **[[**

]]; and

c) **Question deleted,** due to NRC staff decision to not allow stress curves to be developed based on SMT results.

14.90 **Question deleted,** due to NRC staff decision to not allow stress curves to be developed based on SMT results.

14.91 **Question deleted**, requested CDI report was submitted on May 24, 2007, by the licensee.

14.92 **Question deleted,** due to NRC staff decision to not allow stress curves to be developed based on SMT results.

14.93 **Question deleted,** due to NRC staff decision to not allow stress curves to be developed based on SMT results.

14.94 **Question deleted,** due to NRC staff decision to not allow stress curves to be developed based on SMT results.

14.95 In CDI Report No. 06-16, Rev. 2, the Mach number values given in Table 8.2 **[[**

]].

14.96 In Section 2.3, "Pressure Loading," of CDI Report 06-27, Rev. 2, the applicant describes how it selected a two-second pressure time history loading for the FE analysis. PSEG explains that for the selected time history, the pressure ranges summed over the nodes of a low-resolution grid of the dryer (including only corners and edges, a total of 104 locations) achieved a maximum steam dryer stess. The explanation is not clear. The applicant is requested to provide further explanation for how the 2-second pressure time history loading for the FE stress analysis is selected. PSEG is also requested to justify why the selection method it has used would provide the maximum stresses in the steam dryer and what may be the uncertainty associated with it.

14.97 In Appendix A of CDI Report 06-27, PSEG discusses a correction of weld fatigue factor for the multi-component weld between the inner hood and side panel. As shown in the figure of this appendix, the weld has three components: a full penetration groove-weld butt joint (Weld A), a fillet weld connecting the reinforcing strip to the plates (Weld B), and a fillet weld connecting two plates (Weld C). Please respond to the following concern:

a) This is a complex weldment for which PSEG provides a simplified analysis. It is not clear to the NRC staff whether such a simplified analysis represents the actual stress concentrations present in this weld. For example, it is not clear how the presence of Welds A and B might be affecting the stress concentration at the toe of Weld C connecting the side panel. PSEG is requested to perform a finite element analysis of this weldment to determine the actual weld fatigue factor.

b) **Draft question was deleted and superseded by new question 14.108.**

14.98 **No question**, typographical error in the Draft RAI question 14.97.

14.99 **Draft question was deleted and superseded by a new question 14.108.**

14.100
Question deleted and replaced by Q 14.67.

14.101
Question deleted and replaced by Q 14.67.

14.102

Question deleted and replaced by Q 14.67.

14.103

Attachment 8 to PSEG's submittal dated April 30, 2007, discusses the power ascension test plan. Provide the proposed license conditions and commitments regarding potential adverse flow effects for the power ascension. See, for example, the Vermont Yankee EPU license amendment.

14.104

PSEG bases its Level 1 (13,600 psi) and Level 2 (80% of 13,600 psi) MSL pressure PSD limit curves on a previous FE stress analysis of the Hope Creek steam dryer using loads generated with the ACM based on inputs from subscale testing at EPU conditions.
[[

]].

14.105

Figures 4.1 and 4.2 of CDI Technical Note No. 07-19P compare the proposed Hope Creek MSL limit curves to pressure PSDs at the MSL inlets of the Hope Creek plant at CLTP.

a) **[[**

]].

d) Provide the calculated stress that could be achieved in the Hope Creek steam dryer if the 80% limit curve pressures were reached, and discuss the margin to the allowable limits.

14.106

PSEG states on page 7 of CDI Technical Note No. 07-19P that "Upon achieving TPU [Target Power Uprate] of 111.5% for the next operating cycle, PSEG may elect to perform a complete finite element calculation." Discuss the basis for not committing to perform a complete final finite element calculation.

14.107

Compare the MSL pressure PSDs for all locations for Hope Creek at CLTP, projected EPU power levels of 111.5% of CLTP and 115% CLTP, and the QC2 values at original limiting thermal power [OLTP]. Include the 118 Hz projected increases based on SMT data, including uncertainties in the Mach number which affect those increases.

14.108

According to reference 4 to CDI Report 06-27, Revision 2, the fatigue strength reduction factor for the root of a fillet weld is between 3 and 4. PSEG is requested to explain why the fatigue strength reduction factors for the root of fillet welds are not considered in the stress analysis of the Hope Creek steam dryer?

14.109

If in-plant data at CLTP will be used to form new dryer stress limits and MSL pressure PSD limit curves (and not SMT data), the dryer stress analyses should be updated based on MSL in-plant measurements made in 2007. Updated analyses are required since there is no conclusive way to determine whether the CLTP stresses computed with 2006 in-plant data, where the A and B MSL inputs were mirrored to the C and D MSLs are conservative. Also, the analyses must be conducted at frequency shifts between +- 10% to establish the peak stresses that will be used to establish the updated limit curves.

14.110
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]].

7 Balance of Plant Branch (SBPB)

7.16 Your response to RAI 7.13 for reactor feed pumps (RFP) stated that the trip of a reactor feed pump at CPPU was analyzed and is documented in attachment 6 to LCR H05-01. Figure 3.2-2 of Attachment 6 shows the reactor vessel level as a function of time for this transient.

Your response also stated that the THOR-BOP model is benchmarked against both plant data and the 110% CPPU thermal kit and that the THOR-BOP results were supplemented by empirical plant data to confirm the adequacy of the THOR-BOP conclusions.

a) Considering the benchmarking of your model and design analysis with actual plant data, explain what the level of uncertainty is and how it was determined for your dynamic analysis (including measurement uncertainties associated with the plant data that is used), particularly in predicting RFP and (secondary condensate pump) SCP suction pressures.

b) If not previously included in Figure 3.2-2 of Attachment 6 to LCR H05-01, resubmit Figure 3.2-2 to include the following additional conditions and information:

1) the effects of the bounding worst-case assumptions (e.g. amount of delay for Reactor Recirculation (RR) runback (loop-logic time delay), delay in RFP speed reduction, reactor vessel level at the start of the transient),

2) model and dynamic analysis uncertainties as determined in a) above,

3) the reactor pressure drop caused by the RR runback (originally neglected in Vermont Yankees' analysis)

4) a graph of RFP suction pressure versus time for the transient, and identify the time and value of the minimum suction pressure.

c) Explain how the results of this analysis as presented in b) above confirm that the loss of an RFP at CPPU power will not cause a loss of feed water and subsequent reactor scram, including a discussion of how much margin is available.

7.17 Your response to RAI 7.13 for the loss of an SCP stated that with a more realistic delay in RFP speed reduction and runback effectiveness, RFP suction pressure may momentarily drop below the 230 psig RFP trip setpoint but will recover well within the existing 10-second time delay.

a) For a trip of an SCP at CPPU, show the time dependent reactor vessel level and RFP suction pressure curves (identify the time and value of the minimum suction pressure) and compare them to the 230 psig RFP suction pressure trip and the 10 sec time delay, including in your analysis the following if not already considered:

1) the effects of the bounding worst-case assumptions (e.g. amount of delay for RR runback (loop-logic time delay), delay in RFP speed reduction, reactor vessel level at the start of the transient),

2) model and dynamic analysis uncertainties (as referred to in 7.16),

3) the reactor pressure drop caused by the RR runback (originally neglected in Vermont Yankees' analysis)

b) Do the results confirm that a trip of an SCP will not result in a loss of feedwater and subsequent reactor scram? Explain and include a discussion of how much margin is available.

7.18 Your response to RAI 7.13 for primary condensate pumps (PCP) stated that with a 4-second delay imposed on RR runback, SCP suction pressure dropped to 39 psig (only 9 psi above the 30 psig trip setpoint) following a PCP trip. Therefore, the SCP trip setpoint time delay will be increased to less than or equal to 15 seconds for CPPU.

a) For a trip of a PCP at CPPU, show the time dependent reactor vessel level and the RFP suction pressure and SCP suction pressure curves (identify the time and value of the minimum suction pressure) and compare them to their respective pump suction pressure trip setpoints and time delays. Include in your analysis the following if not already considered:

1) the effects of the bounding worst-case assumptions (e.g. amount of delay for RR runback (loop-logic time delay), delay in RFP speed reduction, reactor vessel level at the start of the transient),

2) model and dynamic analysis uncertainties (as referred to in 7.16),

3) the reactor pressure drop caused by the RR runback (originally neglected in Vermont Yankees' analysis)

b) Do the results confirm that a trip of a PCP will not result in a loss of feedwater and subsequent reactor scram? Explain and include a discussion of how much margin.

c) Based on the analysis that was completed, including the cases described in 7.16 and 7.17 above, explain what the minimum allowable SCP suction pressure trip delay is for CPPU, including the basis for this determination.

11) Health Physics Branch (IHPB)

11.10 In response to RAI 11.7, explain the basis for the dose rates (Column A and B), mission times (first column), and the resultant dose for each vital mission function (Column C) given in Table 11.7.a-1 of your response. Clarify how the mission times are calculated for each required vital area to include time to perform each activity and access to and egress from a vital area.

a) Include in your discussion what source term assumptions were used, any factors that were used, an explanation of any conservative assumptions used, for what power level these calculations are based on, (include in your discussion where these radiation sources (i.e., RCS piping) are coming from for each vital area).

b) Include in your discussion a detailed explanation of any unshielded systems carrying reactor water in any of the vital areas and if there are any unshielded systems carrying reactor water that the operators will have to come into proximity for access and egress to each vital area.

c) Include in your discussion an explanation of why the mission time for the filtration, recirculation, and ventilation system (FRVS) radiation monitoring system (RMS) skid changed from 0.9 hrs identified in In the Hope Creek Power Uprate Safety Analysis Report (PUSAR) Table 8-1, to 1.5 hrs.

11.11 Describe in detail the basis for calculations used for the percent increase in N-16 activity in the steam turbine equipment and condenser components as a result of this EPU (increase in N-16 concentration in reactor vessel, change of N-16 concentration in steam piping based on steam mass-flow-rate, decrease in decay time of N-16 concentration due to transit time, and increase in N-16 concentration at the steam turbine equipment and condenser components).

a) Include in your discussion the basis for the change in N-16 source strength at the reactor vessel, in the steam piping, and the resultant change in the turbine equipment at EPU conditions and an explanation of any assumptions or factors used.

b) Include in your discussion the pre-EPU radiation dose rates and post-EPU radiation dose rates near the steam turbine equipment and condenser components based on the percent change of N-16 concentration determined above.

11.12 Describe in detail the basis for the estimated doses to members of the public based on the calculated increase of N-16 concentration in the turbine equipment and condenser components and the resulting skyshine.

a) Include in your discussion the dose rate at CLTP to members of the public onsite and offsite, the basis for calculating the expected post-EPU dose rates for members of the public onsite and offsite, the actual value of the post-EPU dose rate to the member of the public onsite and offsite, and a description of any occupancy factors used for your calculations.

b) Include in your discussion the dose contributions from skyshine and other radiation sources to members of the public at offsite locations, where these locations are located, and demonstrate that the maximum exposed member of the public offsite meets the requirements of Title 40 of the *Code of Federal Regulations*, Part 190 (40 CFR Part 190).

c) Include in your discussion the dose contributions from skyshine and other radiation sources to members of the public at onsite locations, where these locations are located, and demonstrate that the maximum exposed member of the public onsite meets the requirements of 10 CFR Part 20.

d) Include in your discussion whether these changes continue to meet the requirements of the offsite dose calculation manual 6.9.1.8 and 6.9.1.7.

11.13 Demonstrate based on the values described above, that a member of the public which includes a member of the New Jersey National Guard working a 40-hour week inside the site boundary for 12 months, meets the requirements of 10 CFR Part 20.

a) Include in your discussion explanations of any assumptions or factors used.