PSEG Nuclear LLC
P.O. Box 236, Hancocks Bridge, New Jersey 08038-0236

PSEG
Nuclear LLC

10 CFR 50.90

LR-N06-0413
LCR H05-01, Rev. 1
October 10, 2006

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

Hope Creek Generating Station
Facility Operating License No. NPF-57
NRC Docket No. 50-354

Subject: Supplement to License Amendment Request for Extended Power Uprate

Reference: 1) PSEG letter LR-N06-0286, Request for License Amendment: Extended Power Uprate, September 18, 2006

In Reference 1, PSEG Nuclear LLC (PSEG) requested an amendment to Facility Operating License NPF-57 and the Technical Specifications (TS) for the Hope Creek Generating Station to increase the maximum authorized power level to 3840 megawatts thermal (MWt).

In a telephone conference call on October 3, 2006, the NRC staff expressed concern that the margins to alternating stress limits for some locations on the steam dryer appear to be insufficient for EPU operation. Attachment 1 to this letter provides PSEG's evaluation of conservatisms that are included in the loads inputted into the HCGS steam dryer finite element model (FEM). The evaluation concludes that when conservatisms introduced in the load assumptions are considered and estimated, the calculated alternating stress ratios remain above 1.0.

As noted in the "EPU Power Ascension Test Plan Overview" (Attachment 23 to Reference 1), steam dryer performance will be monitored during power ascension through the monitoring of Main Steam Line strain gauges, piping accelerometers, and moisture carryover. Strain gauge data will be evaluated by comparison against limit curves developed from steam dryer finite element analysis.

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The NRC staff also stated that some of the documents listed as references in the "Steam Dryer Evaluation" (Attachment 7 to Reference 1) would be required to be submitted for NRC review. In response, CDI Technical Note 06-26, "Use of One-eighth Scale Data to Evaluate Substitution of Failed Strain Gages in In-Plant Data," is provided in Attachment 2 to this letter.

PSEG has determined that the information contained in this letter and attachments does not alter the conclusions reached in the 10CFR50.92 no significant hazards analysis previously submitted.

Should you have any questions regarding this submittal, please contact Mr. Paul Duke at 856-339-1466.

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

Executed on 10/10/06
(date)

George P. Barnes
Site Vice President – Hope Creek

Attachments (2)
1. Technical Evaluation - Hope Creek Steam Dryer Conservatism
2. CDI Technical Note 06-26 "Use of One-eighth Scale Data to Evaluate Substitution of Failed Strain Gages in In-Plant Data," Revision 0, dated September 2006.

cc: S. Collins, Regional Administrator – NRC Region I
S. Bailey, Project Manager - Hope Creek, USNRC
NRC Senior Resident Inspector - Hope Creek
K. Tosch, Manager IV, NJBNE

Technical Evaluation
Hope Creek Steam Dryer Conservatism

Technical Evaluation Hope Creek Steam Dryer Conservatism
Eval Number: 80090626 Dated October 7, 2006

1. Reason for Technical Evaluation:

The finite element analysis (FEA) done for the Hope Creek Generating Station (HCGS) steam dryer using the $1/8^{th}$ scale model test (SMT) data for the Extended Power Uprate (EPU), which is 115% of the current licensed thermal power (CLTP), reports three welds that have stress ratios[1] below 1.0 when the load frequency is adjusted by as much as plus or minus 10%.

Reference 1 is an overview of the analyses performed to verify the steam dryer structural integrity at EPU conditions. In the overview two conservatisms in the loading inputted into the acoustic circuit model (ACM) are specifically delineated, and approximations of their magnitude are provided. This technical evaluation examines in more detail these two conservatisms, and it quantifies their impact on the predicted stress ratios to support a conclusion that the actual stress ratios are expected to remain above 1.0. This information is extracted from documentation submitted as part of the EPU LCR, unless otherwise stated.

2. Detailed Evaluation:

a. Baseline (at CLTP) Stress Ratios from Plant Data

The steam dryer FEA results for the baseline condition (100% CLTP) using plant data are summarized in Reference 1 pages 11 and 12. Reference 2 is the FEA of the HCGS steam dryer using loading information obtained from plant data (strain gages) at CLTP. Table 6.3 of Reference 2 provides the calculated stress ratios for this baseline case. It shows that the minimum alternating stress ratios at CLTP are all above 2.0 when plant data is used. The following three locations are reported in this subsection since they are the three locations that the EPU FEM reports as low stress ratios.

Table A

Location	Alternating Stress Ratio at CLTP from Plant Data
Middle hood / end plate weld	42.3[2]
Steam outlet end plate for middle hood weld	2.64
Drain channel to skirt weld	2.81

These values include a conservatism not normally added to the acoustic circuit model (ACM) load prediction. During in-plant data acquisition at Hope Creek, strain gage failures resulted in the loss of data on main steam lines C and D. An algorithm, described in Reference 3, was developed to provide conservative loads on the dryer without this missing data. Briefly, the missing C and D data were replaced with the data from their

[1] Stress ratio is defined as the allowable stress divided by the calculated stress.

[2] This information was obtained from the plant data CLTP FEA; however, the value was not reported in Reference 2 since it was not a limiting location. CDI provided the value for the purposes of this evaluation thru Reference 6.

mirror image main steam line (B and A, respectively). The time signals on the C and D lines were individually adjusted until the maximum low resolution load on the dryer was achieved. This load was inputted into the FEM. As reported in Reference 3, two evaluations were done to determine the conservatism from the algorithm. One evaluation used the Susquehanna plant data and the other used HCGS SMT results. Both provided similar results. The conservatism from this algorithm calculated using Susquehanna data is 33% as stated in Reference 3, Section 4.2, page 22. Reference 7, Figure 5 page 11 provided the results using the HCGS SMT at various power runs. The average was 41%, and the minimum conservatism at any power was 29%. As stated on page 15 of Reference 1, the strain gages will be repaired prior to EPU power ascension. Accordingly, this bounding conservatism can be removed for EPU stress ratio projections. The lowest value, 29%, is used in this evaluation.

Since the assumption affects only the magnitude of the differential pressure and does not modify the frequency, it is judged that the increase in differential pressure would have an increase in the calculated stresses by the same amount. Therefore, the actual stress ratios for the baseline case are 1.29 times the reported value.

b. Benchmark of Scale Model Test (SMT) Results Against Plant Data

As stated in Reference 1, the purpose of the SMT was to obtain as much information on the steam dryer loading at powers above CLTP as available technology could provide. The primary goals were to determine the safety relief valve (SRV) acoustic resonance frequency, the on-set reactor power, and an estimate of the loading. The SMT was not intended to replace either plant data at CLTP or the EPU power ascension data acquisition. Rather, it was intended to reduce the risk during EPU power ascension by providing SRV acoustic resonance information before power ascension above CLTP.

The SMT results were summarized in Reference 1 page 14. The detailed SMT results were provided in Reference 4. However, it should be recognized that the SMT results have limitations. The key limitation is the correlation of the load predicted by the SMT against the actual load. For that reason, a benchmark analysis was done at CLTP conditions. Specifically, the CLTP loads predicted by the SMT were compared against the actual CLTP plant data loads. The comparison is summarized in Sections 3.3 and 4.3 of Reference 3. The key points on the magnitude of the peak and root mean square (RMS) differential pressure predictions across the steam dryer are:

- Section 3.3: "It may be seen that the CLTP RMS pressure values from subscale, corrected back to full scale, are on average double the CLTP RMS pressure values from the in-plant data."[3]

- Section 4.3: "It may be seen that the peak differential pressure from in-plant CLTP prediction is 0.18 psid, while the peak differential pressure from the subscale CLTP, corrected to full scale, is 0.76, an increase of over a factor of 4."

[3] The term subscale means SMT.

It should be noted that the above comparisons are based on the plant data CLTP that includes the 29% conservatism in differential pressures. Without this conservatism the difference between SMT results and plant data would be greater.

Another result of the SMT testing was the relative increase in magnitude between CLTP and EPU. The key points are:

- Section 3.3: "In addition, the EPU RMS pressure values from subscale, corrected back to full scale, are on the average 37% larger than the CLTP RMS pressure values from subscale, also corrected back to full scale."

- Section 4.3: "Also, the peak differential pressure from the subscale EPU, corrected to full scale, is 1.19, an increase of 57% over the corrected subscale CLTP value..."

It is important to note that the SMT predicts a relative increase of 37% on the RMS pressure going from CLTP to EPU whereas the CLTP SMT results are already, on an average, 100% higher than obtained from CLTP plant data. Thus, using the SMT loads will predict higher stresses (lower stress ratios) than anticipated with actual plant data.

The first explanation for the difference between the SMT and plant data is that the SMT already has a significant[4] SRV acoustic resonance signal at the 90% CLTP run (run hc-24, pages 57 thru 59 of Reference 4). As expected, the SRV acoustic resonance increases further with the higher power runs. On the other hand as explained in Reference 1, the 100% CLTP plant data does not have indication of SRV acoustic resonance. It follows that the SMT data at 100%, 105%, 112%, and 115% CLTP would compound this conservative bias on the 118 Hz loading since SRV acoustic resonance loading is expected to increase at a rate much higher than the square of the power increase.

The second explanation is that the SMT has lower damping than the plant since the SMT does not have the damping from the water and high density steam.

The net result is that the SMT has produced a very conservative pressure loading. This conservatism is most pronounced on the largest single peak, 118 Hz. This fact was recognized by both PSEG and CDI. Nevertheless, the highly conservative loads from the SMT were inputted into two FEAs. These were the CLTP and EPU FEAs. The former used the data from the 1.0 x CLTP run, and the latter used the data from the 1.15 x CLTP run. This conservatism will be estimated in the following two sections.

c. FEAs Based on SMT Runs

The SMT output data for CLTP and EPU conditions, which were used as input to the SMT FEAs, were not reduced to account for the known conservatisms in the CDI 1/8th

[4] Specifically, the spike at ~ 118 Hz on the normalized power spectral density (PSD) plot is ~two orders of magnitude higher than the background loads.

SMT with the exception of eliminating the 80 Hz non-physical load, as explained in Reference 1, page 14.

Table 7a of Reference 5 provides the minimum stress ratios calculated from the SMT CLTP loads. The stress ratios for the three components of particular concern are tabulated below, along with the corresponding value from the Plant Data CLTP FEA (Table A). The last column provides an estimate of the conservatism introduced for that component by the SMT.

Table B

Location	Alternating Stress Ratio CLTP from SMT (A)	Alternating Stress Ratio CLTP from Plant Data (B)	Conservatism at that location from using SMT (B/A -1)
Middle hood / end plate weld	2.58[5]	42.3	15.40
Steam outlet end plate for middle hood weld	2.18	2.64	0.21
Drain channel to skirt weld	1.96	2.81	0.43

It is apparent that the conservatism introduced by the SMT testing is not a consistent value. A reasonable assumption is that a significant portion of the difference in magnitude is attributable to the 118 Hz load and this load, as expected, impacts components differently depending on their fundamental frequencies.

Tables 7b, c, and d of Reference 5 provide the minimum stress ratio on the dryer using the SMT results for EPU at nominal frequency, EPU at -10% frequency, and EPU at +10% frequency, respectively. No location was below 1.00 at the nominal frequency case, but three locations were tabulated as below 1.00 when the frequency sensitivity analysis was done. They are listed in Table C of this evaluation. Section 5.3 of Reference 5 provides additional evaluation of these limiting areas showing that the SRV acoustic resonance load is the largest load affecting these components.

Note that the conclusion section of Reference 5 acknowledges that the conservatisms were not factored in and it states "it is expected that when all factors are accounted for that the stress ratios will increase significantly (by approximately a factor of 2) so that all the minimum stress ratios will be well within allowables during both CLTP and EPU operation."

d. Anticipated Minimum Alternating Stress Ratios at EPU

One method for estimating the minimum anticipated alternating stress ratio is outlined below.

[5] As with the Baseline CLTP FEA, this value was not reported for the SMT CLTP FEA since it was not a limiting stress ratio. This value was provided by Reference 6.

$$SR_{EPU} = SR_M \times (1 + C_{PD}) \times (1 + C_{SMT})$$

Where

SR_{EPU} = estimate of anticipated minimum alternating stress ratio

SR_M = minimum alternating stress ratio on the dryer as reported in the FEA.

C_{PD} = conservatism in the HCGS plant data at CLTP conditions. As explained in section 2a of this evaluation, this value is 29% and accounts for the conservatism added by the algorithm to maximize the calculated load with only data from two main steam lines.

C_{SMT} = conservatism in the SMT data as tabulated in Table B for the three limiting components.

Table C

Location	SR_M	C_{PD}	C_{SMT}	SR_{EPU}
Middle hood / end plate weld	0.832 @EPU, +10% frequency	0.29	15.40	17.60
Steam outlet end plate for middle hood weld	0.984 @EPU, -10% frequency	0.29	0.21	1.54
Drain channel to skirt weld	0.990 @EPU, -10% frequency	0.29	0.43	1.83

As tabulated in the last column of Table C, all SR_{EPU} values are well above 1.0.

3. Summary and Conclusions

This evaluation demonstrates that when the conservatism introduced on the load assumptions are considered and estimated, the calculated alternating stress ratios remain above 1.0.

The conservatisms considered in this evaluation are:

- The strain gage data replacement algorithm
- Benchmarking of the SMT against plant data at CLTP

This evaluation did not consider other conservatisms in the load definition or in the FEA.

4. **References:**

1. EPU LCR Attachment 7. "Steam Dryer Evaluation", PSEG letter LR-N06-0286, Request for License Amendment: Extended Power Uprate, September 18, 2006.
2. EPU LCR Attachment 19. CDI Report No. 06-24 "Stress Analysis of the Hope Creek Unit 1 Steam Dryer for CLTP," Revision 3, September 2006. VTD 430120.
3. EPU LCR Attachment 18. CDI Report 06-17 "Hydrodynamic Loads on Hope Creek Unit 1 Steam Dryer to 200 Hz," Revision 2, September 2006. VTD 430121.
4. EPU LCR Attachment 22. CDI Report 06-16 "Estimating High Frequency Flow Induced Vibration in the Main Steam Lines at Hope Creek Unit 1; A Subscale Four Line Investigation of Standpipe Behavior." Revision 1, dated September 2006. VTD 430113.
5. EPU LCR Attachment 21. CDI Report No. 06-27 "Stress Analysis of the Hope Creek Unit 1 Steam Dryer Using 1/8th Scale Model Pressure Measurement Data," Revision 0, dated September 2006.
6. CDI Transmittal dated 10/5/06, "Comparison of the Stress Ratio at the location of minimum stress ratio at EPU Conditions".
7. CDI Technical Note 06-26 "Use of One-eighth Scale Data to Evaluate Substitution of Failed Strain Gages in In-Plant Data," Revision 0, dated September 2006.

5. **Signatures, review, and approvals**

Prepared by: Harold Trenka _____ Date: 10/07/06

Independent/Peer Reviewer: Guy DeBoo _____ Date: 10/10/06

Approved: Shelly Kugler _____ Date: 10/10/06