ATTACHMENT 4

Hope Creek Generating Station

Facility Operating License NPF-57
Docket No. 50-354

Limit Curves with ACM Rev. 4 for
111.5% Power Level Basis at Hope Creek Unit 1
C.D.I. Technical Note No. 08-20NP, Revision 1

This Document Does Not Contain Continuum Dynamics, Inc. Proprietary Information

C.D.I. Technical Note No. 08-20NP

Limit Curves with ACM Rev. 4 for 111.5% Power Level Basis at Hope Creek Unit 1

Revision 1

Prepared by

Continuum Dynamics, Inc.
34 Lexington Avenue
Ewing, NJ 08618

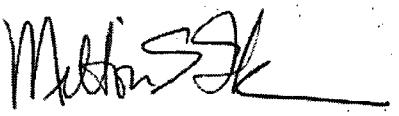
Prepared under Purchase Order No. 4500400038 for

Nuclear Business Unit, PSEG Nuclear LLC
Materials Center, Alloway Creek Neck Road
Hancocks Bridge, NJ 08038

Approved by

Alan J. Bilanin

Prepared by



Milton E. Teske

August 2008

Table of Contents

1. Introduction

During power ascension of Hope Creek Unit 1 (HC1), from Current Licensed Thermal Power (CLTP) to Extended Power Uprate (EPU), PSEG is required to monitor the dryer stresses at plant power levels that have not yet been achieved. Limit curves provide an upper bound safeguard against the potential for dryer stresses becoming higher than allowable, by estimating the not-to-be-exceeded main steam line pressure levels. In the case of HC1, in-plant main steam line data have been analyzed at 111.5% power conditions to provide steam dryer hydrodynamic loads. A finite element model stress analysis has been undertaken on these loads at all dryer nodal locations [1]. These loads provide the basis for generation of limit curves to be used during further HC1 power ascension.

Limit curves allow PSEG to monitor dryer stress levels, by comparing the main steam line pressure readings – represented in Power Spectral Density (PSD) format – with the upper bound PSD derived from existing in-plant data.

This technical note summarizes the limit curves generated from the 111.5% power data, utilizing Rev. 4 of the ACM [2].

2. Approach

The limit curve analysis for HC1 parallels the approach followed by Entergy Vermont Yankee (VY) in its power uprate [3]. In the VY analysis, two levels of steam dryer performance criteria were described: (1) a Level 1 pressure level based on maintaining the ASME allowable alternating stress value on the dryer, and (2) a Level 2 pressure level based on maintaining 80% of the allowable alternating stress value on the dryer. Should Level 2 be reached or exceeded (under the rules discussed below), reactor power ascension was to be suspended until an engineering evaluation concluded that further power ascension was justified. Should Level 1 be reached or exceeded, reactor power was to be returned to a previously acceptable power level while an engineering evaluation was undertaken.

To develop the limit curves upon which Level 1 and Level 2 were based, VY calculated the stress levels in the dryer corresponding to the current plant acoustic signature, and then determined how much the acoustic signature could be increased while maintaining stress levels below the 13,600 psi stress fatigue limit. A Level 1 limit curve was then constructed by scaling up the current plant acoustic signature at each point along the frequency spectrum of interest by this overall factor. A Level 2 limit curve was produced in the same manner except at 80% of the fatigue limit, or 10,880 psi, arbitrarily selected by VY, to determine the overall factor. During power ascension, the Level 2 limit curve was reached at discrete frequencies at three power levels. In each case VY stopped the power ascension, determined the impact of the new acoustic signature on the dryer stresses, and developed revised Level 2 limit curves to use at higher power steps. Their Level 1 limit curve was never reached. The VY approach is summarized in [4].

HC1 steam dryer data and evaluations will be performed as required per Attachment 3 "Dryer Data Collection" (Test No. 101) of HC.OP-FT.ZZ-0004(Q), "Extended Power Uprate Power Ascension Testing" (PSEG).

The finite element analysis using the HC1 111.5% power data found a lowest/minimum alternating stress ratio of 2.69, as summarized in Table 1. The minimum stress ratios include the model bias and uncertainties for specific frequency ranges as suggested by the NRC [5]. The results of the ACM Rev. 4 analysis (based on Quad Cities Unit 2, or QC2, in-plant data) are summarized in Table 2 (a negative bias is conservative). Note that the standpipe excitation frequency in HC1 is anticipated to be 118 Hz, and that the uncertainty determined around the QC2 excitation frequency of 155 Hz has been applied to the 116 to 120 Hz frequency interval. The additional bias and uncertainties, as identified in [6 – 11], are shown in Table 3. SRSS of the uncertainties, added to the ACM bias, results in the total uncertainties shown in Table 4. These uncertainties were applied to the finite element analysis, resulting in the minimum alternating stress ratio of 2.69.

Table 1. Alternating Stress Limit Summary

ASME Code Stress Limit	13,600 psi (Level 1)	10,880 psi (Level 2)
Minimum Alternating Stress Ratio	2.69	2.15

Table 2. Bias and uncertainty for ACM Rev. 4

[[

[3]]]

Table 3. HC1 additional uncertainties (with references cited)

[[

[3]]]

Table 4. HC1 total uncertainty

[[

[3]]]

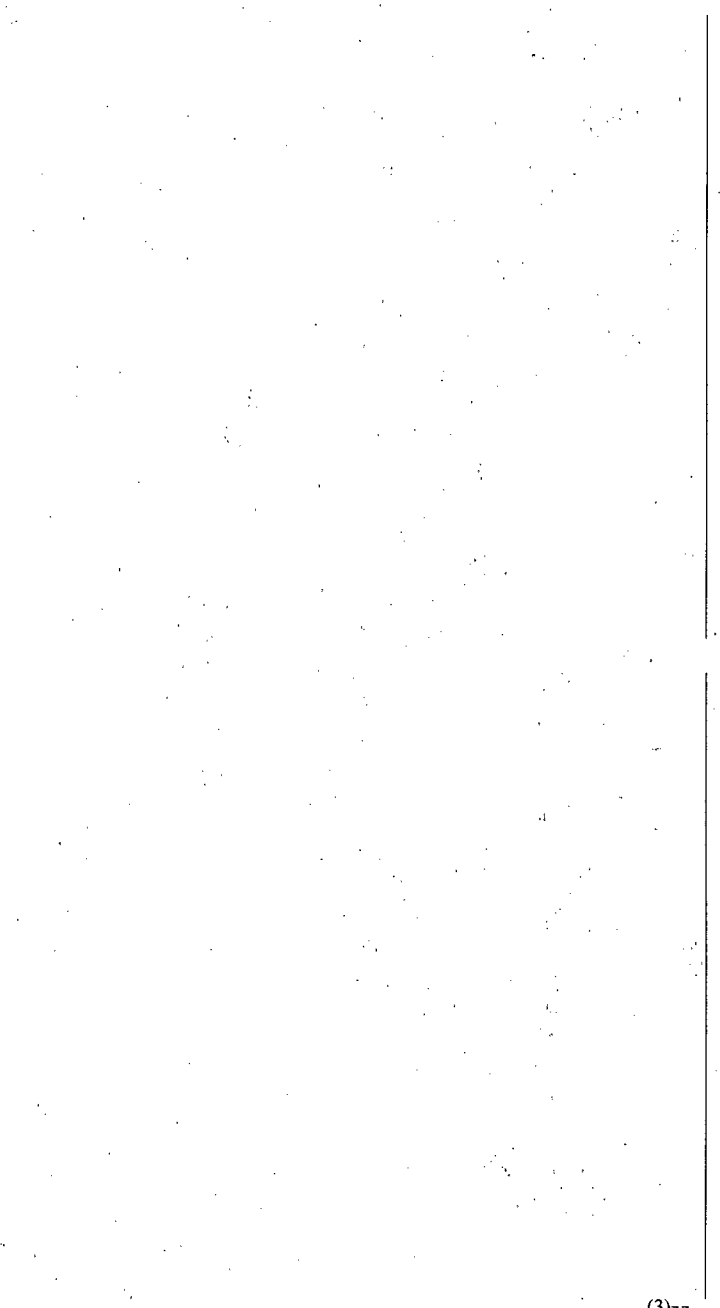
3. Limit Curves

Limit curves were generated from the in-plant 111.5% power level strain gage data collected in June 2008. These data were filtered across the frequency ranges shown in Table 5 to remove noise and extraneous signal content. The resulting PSD curve for each of the eight strain gage locations was then used to develop the limit curves, shown in Figures 1 to 4. Level 1 limit curves are found by multiplying the 111.5% power level main steam line pressure PSD traces by the square of the minimum alternating stress ratio, while the Level 2 limit curves are found by multiplying the 111.5% PSD traces by 0.64 of the square of the minimum alternating stress ratio, as PSD is related to the square of the pressure. The minimum alternating stress ratio for Hope Creek is 2.69.

Table 5. Exclusion frequencies for HC1 at 111.5% power

Frequency Interval (Hz)	Exclusion Cause
0.0 to 2.0	Mean
59.8 to 60.2	60 Hz Line Noise
119.8 to 120.2	120 Hz Line Noise
179.8 to 180.2	180 Hz Line Noise
116.65 to 116.85	A Recirculation Pump
118.7 to 118.95	B Recirculation Pump

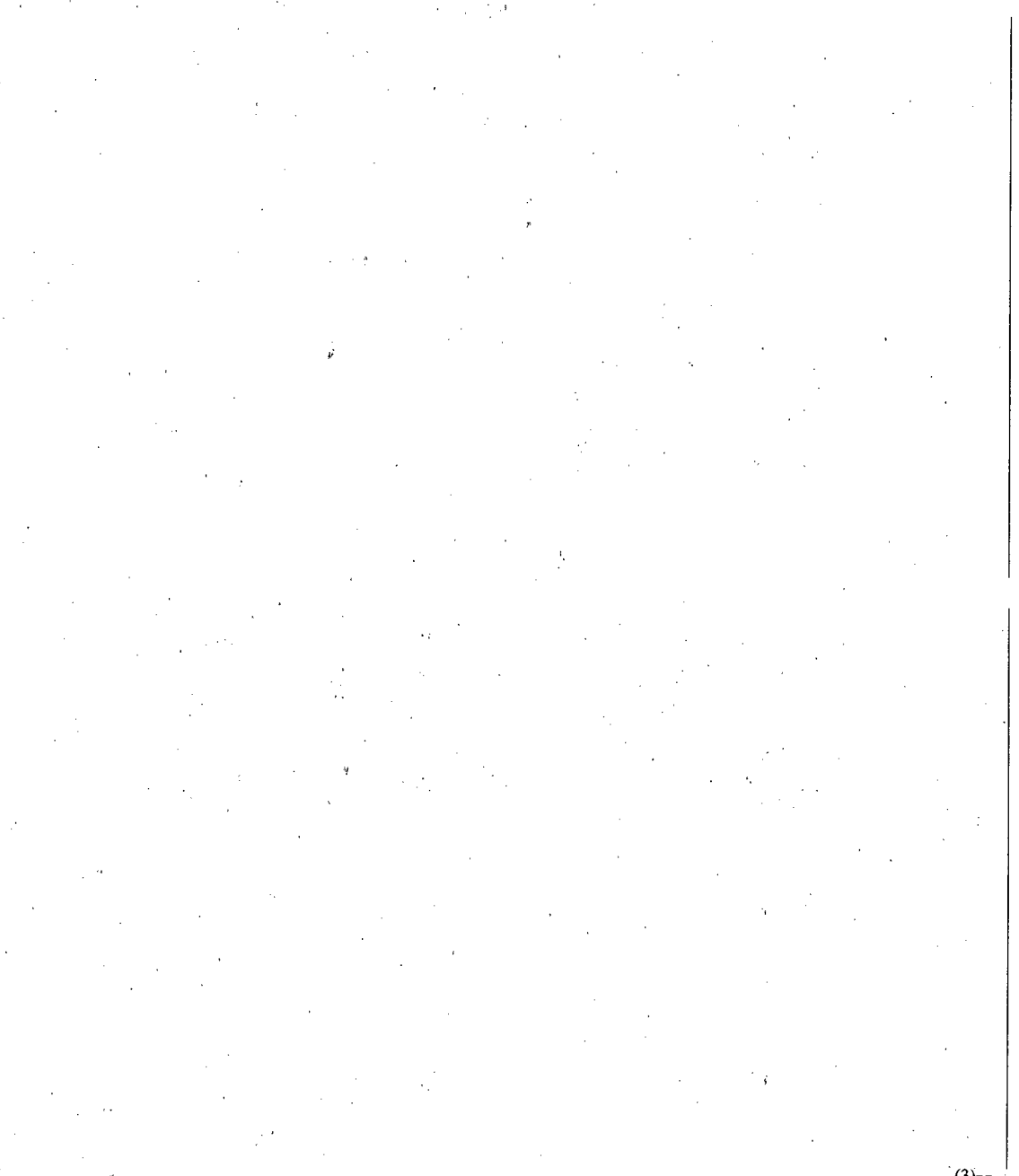
[[



[3]]]

Figure 1. Level 1 (black) and Level 2 (red) limit curves for main steam line A, compared against the base curves (blue) over the frequency range of interest: A upper strain gage location (top); A lower strain gage location (bottom).

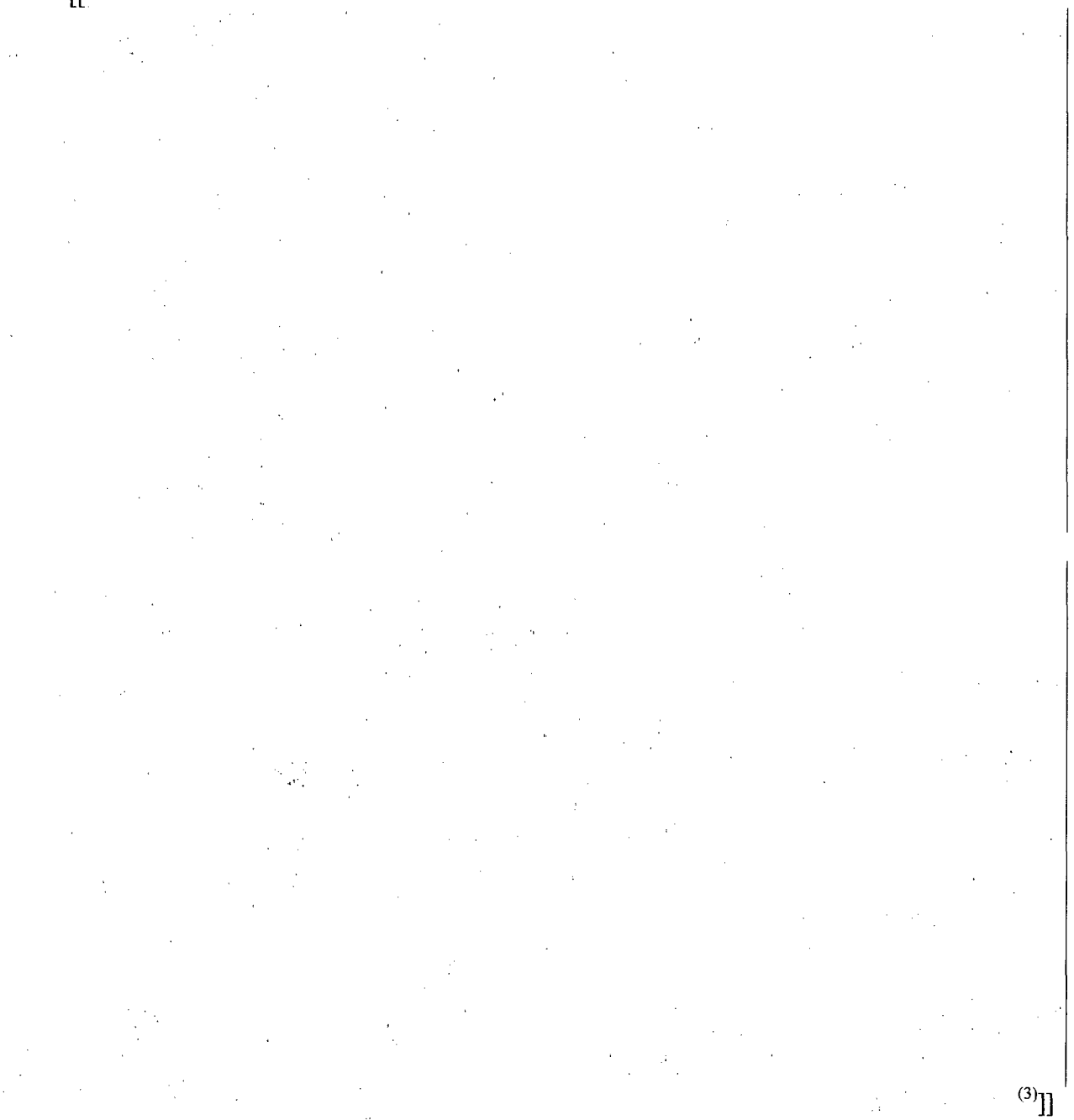
[[



(3)]]

Figure 2. Level 1 (black) and Level 2 (red) limit curves for main steam line B, compared against the base curves (blue) over the frequency range of interest: B upper strain gage location (top); B lower strain gage location (bottom).

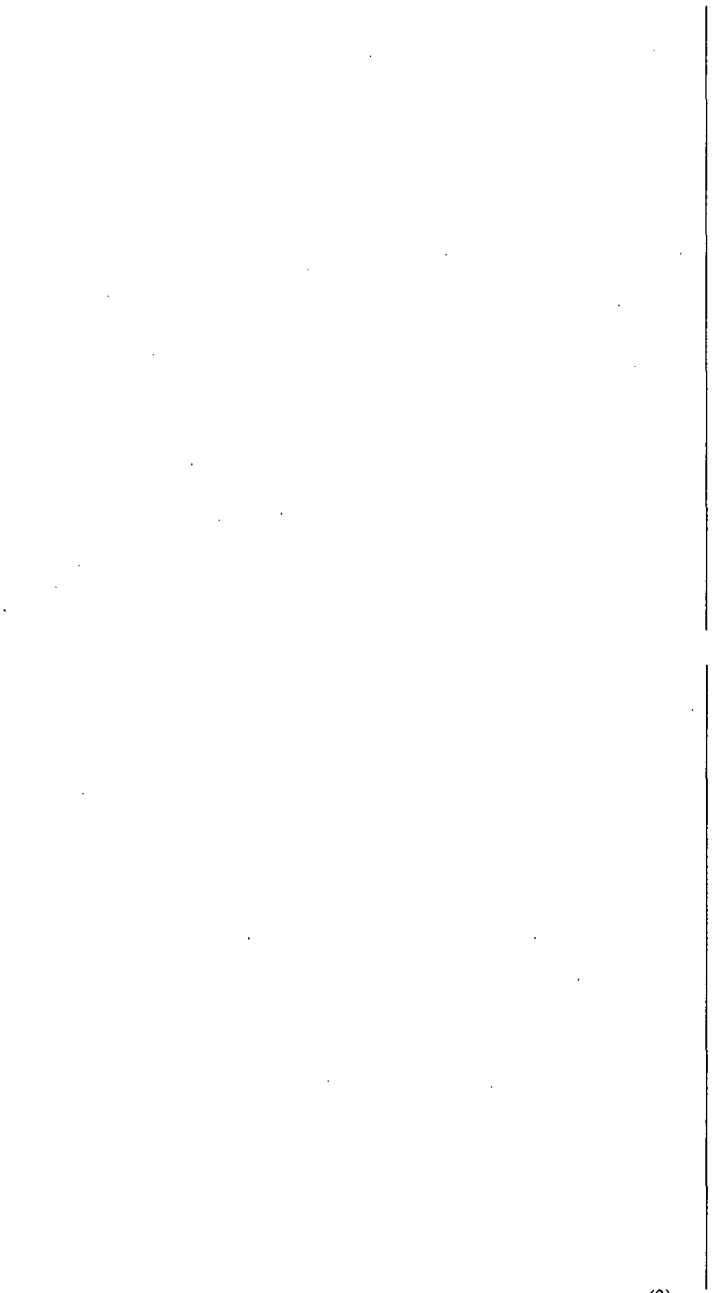
[[



]][3]

Figure 3. Level 1 (black) and Level 2 (red) limit curves for main steam line C, compared against the base curves (blue) over the frequency range of interest: C upper strain gage location (top); C lower strain gage location (bottom).

[[



]][3]

Figure 4. Level 1 (black) and Level 2 (red) limit curves for main steam line D, compared against the base curves (blue) over the frequency range of interest: D upper strain gage location (top); D lower strain gage location (bottom).

4. References

1. Continuum Dynamics, Inc. 2008. Final Stress Assessment of Hope Creek Unit 1 Steam Dryer at 111.5% CLTP Conditions (Rev. 0). C.D.I. Report No. 08-29 (Proprietary).

2. Continuum Dynamics, Inc. 2007. Methodology to Predict Full Scale Steam Dryer Loads from In-Plant Measurements, with the Inclusion of a Low Frequency Hydrodynamic Contribution (Rev. 1). C.D.I. Report No. 07-09 (Proprietary).

3. Entergy Nuclear Northeast. 2006. Entergy Vermont Yankee Steam Dryer Monitoring Plan (Rev. 4). Docket 50-271. No. BVY 06-056. Dated 29 June 2006.

4. State of Vermont Public Service Board. 2006. Petition of Vermont Department of Public Service for an Investigation into the Reliability of the Steam Dryer and Resulting Performance of the Vermont Yankee Nuclear Power Station under Uprate Conditions. Docket No. 7195. Hearings held 17-18 August 2006.

5. NRC Request for Additional Information on the Hope Creek Generating Station, Extended Power Uprate. 2007. TAC No. MD3002. RAI No. 14.67.

6. Szasz, G. 2007. Strain Gage Uncertainty Analysis. Email Dated 06 July 2007.

7. Continuum Dynamics, Inc. 2005. Vermont Yankee Instrument Position Uncertainty. Letter Report Dated 01 August 2005.

8. Exelon Nuclear Generating LLC. 2005. An Assessment of the Effects of Uncertainty in the Application of Acoustic Circuit Model Predictions to the Calculation of Stresses in the Replacement Quad Cities Units 1 and 2 Steam Dryers (Revision 0). Document No. AM-21005-008.

9. Continuum Dynamics, Inc. 2007. Finite Element Modeling Bias and Uncertainty Estimates Derived from the Hope Creek Unit 2 Dryer Shaker Test (Rev. 0). C.D.I. Report No. 07-27 (Proprietary).

10. NRC Request for Additional Information on the Hope Creek Generating Station, Extended Power Uprate. 2007. RAI No. 14.79.

11. NRC Request for Additional Information on the Hope Creek Generating Station, Extended Power Uprate. 2007. RAI No. 14.110.