**Enclosure 2 Contains Sensitive Proprietary Information**

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

October 6, 2010

Mr. Samuel L. Belcher
Vice President Nine Mile Point
Nine Mile Point Nuclear Station, LLC
P.O. Box 63
Lycoming, NY 13093

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION REGARDING NINE MILE POINT NUCLEAR STATION, UNIT NO. 2 – RE: THE STEAM DRYER REVIEW OF THE LICENSE AMENDMENT REQUEST FOR EXTENDED POWER UPRATE OPERATION (TAC NO. ME1476)

Dear Mr. Belcher:

By letter dated May 27, 2009, as supplemented on August 28 and December 23, 2009, February 19, April 16, May 7, June 3, June 30, and July 30, 2010, Nine Mile Point Nuclear Station, LLC, submitted for Nuclear Regulatory Commission (NRC) staff review and approval, a proposed license amendment requesting an increase in the maximum steady-state power level from 3467 megawatts thermal (MWt) to 3988 MWt for Nine Mile Point Unit No. 2 extended power uprate operation.

The NRC staff is reviewing the information provided in that letter and has determined that additional information is needed to support its review. Enclosed is the NRC staff's request for additional information (RAI). The RAI was discussed with your staff on September 23 and October 1, 2010, and it was agreed that your response would be provided within 30 days from the date of this letter.

Pursuant to 10 CFR 2.390, we have determined that the enclosed RAI contains proprietary information. The NRC staff has prepared a non-proprietary version of the RAI (Enclosure 1) that does not contain proprietary information. The proprietary information is indicated in brackets and underlined in Enclosure 2.

Sincerely,

Richard V. Guzman

Richard V. Guzman, Senior Project Manager
Plant Licensing Branch I-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-410

Enclosures:
As stated

cc w/o Encl 2: Distribution via Listserv

**Enclosure 2 Contains Sensitive Proprietary Information**

REQUEST FOR ADDITIONAL INFORMATION (RAI)

NINE MILE POINT NUCLEAR STATION, UNIT NO. 2 (NMP2)

RE: STEAM DRYER REVIEW OF LICENSE AMENDMENT REQUEST (LAR)

FOR EXTENDED POWER UPRATE

DOCKET NO. 50-410

The Nuclear Regulatory Commission (NRC) staff is reviewing the Nine Mile Point Nuclear Station (NMPNS or the applicant) license amendment request (LAR) application dated May 27, 2009 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML091610103, as supplemented on August 28 (ML092460550) and December 23, 2009 (ML100190072), February 19 (ML100550599), April 16 (ML101120658), May 7 (ML101380307), June 3 (ML101610168), June 30 (ML101900447), and July 30, 2010 (ML102170184).

Based on the NRC staff's review of the LAR and the supplemental information, the NRC staff identified areas for which additional information was needed regarding the NMP2 steam dryer (SD). Specifically, the applicant provided responses to the NRC staff's requests for additional information (RAIs) by letters dated May 7, June 30, and July 30, 2010. The NRC staff completed its review of the RAI responses and identified the need for additional information and, therefore, has prepared a list of supplemental RAIs. A response to the enclosed RAI is needed before the NRC staff can complete its review.

**Supplementary RAIs**

Supplemental RAIs as follow-up to RAIs 6, 7, 8, 17, 18, 20, 21, 23, and 24 (ADAMS Accession No. ML100630108 (non-proprietary version) and ML100630110 (proprietary version)) are provided, below, requesting additional information from the applicant. The most critical follow-up RAIs are under RAI 8, and are associated with the new acoustic circuit model (ACM) Revision 4.1. The NRC staff has determined that the information provided by NMPNS for the current ACM Rev. 4.1 procedure is not acceptable for use in estimating conservative steam dryer loads.

**NMP2-EMCB-SD-RAI-6 S01 (a)**

The applicant is requested to provide updated NMP2 main steam line (MSL) data and dryer loads in a revision to Continuum Dynamics, Inc. (CDI) Report No. 10-10P, "Acoustic and low frequency hydrodynamic loads at CLTP [current licensed thermal power] level on Nine Mile Point Unit 2 Steam Dryer to 250 hertz (Hz) using ACM Rev. 4.1," following resolution of the follow-up RAI NMP2-EMCB-SD-RAI-8 S01.

**NMP2-EMCB-SD-RAI-6 S01 (b)**

As described in CDI Report 10-11P, "Stress Assessment of Nine Mile Point Unit 2 Steam Dryer Using the Acoustic Circuit Model Rev. 4.1," dated June 30, 2010, and CDI Report 10-12P, "Design and Stress Evaluation of Nine Mile Point Unit 2 Steam Dryer Modifications for EPU Operation," dated July 30, 2010, the applicant considered several modifications at high-stress locations and showed that the corresponding minimum alternating stress ratio (SR-a) for the dryer with all the modifications implemented is 2.85 at CLTP power level. With velocity-square bump-up factor [[ ]], the stress ratio at EPU would be greater than 2.0. However, as discussed in supplementary RAI NMP2-EMCB-SD-RAI-17 S01, the bump-up factor may be higher than velocity-square. Therefore, the minimum alternating stress ratio at EPU power level for some of the locations identified in the above three groups may be less than 2.0. The licensee is requested to reevaluate the alternating stress ratios for the high-stress locations (Groups 1-4 locations) after the supplementary RAI NMP2-EMCB-SD-RAI-17 S01 related to bump-up factor and RAI NMP2-EMCB-SD-RAI-8 S01(a) related to coherence estimates are resolved.

**NMP2-EMCB-SD-RAI-6 S01 (c)**

The stress analysis results presented in CDI Report 10-11P, "Stress Assessment of Nine Mile Point Unit 2 Steam Dryer Using the Acoustic Circuit Model Rev. 4.1," Rev. 0, dated June 30, 2010, show that a group of locations (referred to as Group 4) has the minimum alternating stress ratio of 2.65 at CLTP. As discussed in Section 6 of the report, the applicant states that structural modifications are not warranted for these locations because it believes that the ratio would be 2.76 or higher under the following two considerations: (i) use of Fatigue Curve B instead of A of Fig. I-9.2.2, Appendix I, American Society of Mechanical Engineers (ASME) Section III, and (ii) use of [[ ]]. The applicant further states that power ascension testing will demonstrate substantial margin without any modification of the Group 4 locations. The NRC staff has several technical concerns for not accepting the applicant's reasons for not making any modifications to Group 4 locations. However, it appears that the applicant has changed its position and decided to make needed modifications to Group 4 locations. In CDI Report 10-12P, "Design and Stress Evaluation of Nine Mile Point Unit 2 Steam Dryer Modifications for EPU Operation," Rev. 0, dated July 30, 2010, the applicant considers additional structural modifications at Group 4 locations and the corresponding stress analysis results show that the minimum alternating stress ratio for the dryer with all the modifications implemented is 2.85. Since the CDI Report 10-12P was submitted to the NRC as an attachment to the licensee's letter dated July 30, 2010, and the response to RAI NMP2-EMCB-SD-RAI-6 was submitted as an attachment to the licensee's letter dated June 30, 2010, it appears that the report supersedes the RAI response. The applicant is requested to confirm whether the CDI Report 10-12P supersedes the response to RAI NMP2-EMCB-SD-RAI-6.

**NMP2-EMCB-SD-RAI-7 (b) S01**

In their response to part (b) of RAI NMP2-EMCB-SD-RAI-7, the applicant provides the approximate recirculation pump frequencies of 126 and 129 Hz in CDI Report No. 10-09P, "ACM Rev. 4.1: Methodology to predict full-scale steam dryer loads from in-plant measurements," Rev. 1, June 2010, but does not show the signal amplitudes at those frequencies. Therefore, the applicant is requested to provide modified Figures 5.2a-b in CDI Report No. 10-09P to include signals at the recirculation pump frequencies.

**NMP2-EMCB-SD-RAI-8 S01 (a)**

CDI Report No. 10-09P, "ACM Rev. 4.1: Methodology to predict full-scale steam dryer loads from in-plant measurements," Rev. 1, June 2010, states that a new version of the ACM, Rev. 4.1, is being used to simulate the NMP2 fluctuating steam dryer loads. The ACM 4.1 uses a [[ ]] applied to both the NMP2 data, as well as the QC2 benchmark data, as described in Section 5.1 of the report. The NRC staff has reviewed this [[ ]] and concludes that [[

]]. Also, coherence uncertainties can be computed for very low coherences. Therefore, there is [[

]]. In addition, there is [[

]]. The NRC staff requests the applicant to determine the [[ ]] such that they are conservative and provide the technical basis for the estimates.

**NMP2-EMCB-SD-RAI-8 S01 (b)**

The procedure used to estimate [[ ]] is based on the assumption that the [[ ]]. The applicant is requested to provide plots of the [[

]] at the low power level used in the Quad Cities Unit No. 2 (QC2) benchmark. If the [[ ]] are not nearly zero, the applicant should justify their assumption that the low power measurements are [[ ]]. The applicant is requested to provide the same information for the NMP2 calculations.

**NMP2-EMCB-SD-RAI-8 S01 (c)**

The applicant is requested to provide the signal processing and time record parameters, such as time record length, window length, window type, number of averages, and any other parameters of interest, used to compute the QC2 benchmark MSL spectra and coherences. The applicant should also explain whether the same time record and signal processing parameters are used for the NMP2 MSL measurements and calculations. If the parameters are

different, then the applicant is requested to establish the effects of the differences on the estimated dryer loads and stresses.

**NMP2-EMCB-SD-RAI-8 S01 (d)**

It is well established that the accuracy and uncertainty of complex dynamic fluid-structure simulation tools are frequency dependent. The applicant is requested to provide a table of bias errors and uncertainties for the ACM 4.1 over frequency ranges consistent with those used for the ACM 4.0.

**NMP2-EMCB-SD-RAI-17 S01**

In the licensee's response to RAI-17, which is included in Attachment 3 of the RAI response letter dated May 7, 2010, NMPNS states that the [[
]]. This value is larger than the velocity-squared factor of [[ ]] used by CDI in the stress analysis at EPU. NMPNS states that since the acoustic resonance of the safety relief valve standpipes is not expected to occur at EPU, it is appropriate to use the velocity-squared factor as the bump-up factor. To substantiate this position, NMPNS cites pressure measurements in the literature taken on surfaces exposed to turbulent boundary layers and refers to Boiling Water Reactor Vessel and Internals Project (BWRVIP) Report 182, which includes a guidance flow chart to screen for acoustic resonance conditions. First, the flow in the reactor dome includes turbulent free jets issuing from the dryer vanes, separated flow over the dryer sides, and swirl flow at the steam lines inlets. These flow types are much more complex than turbulent flow along a flat surface, which is referred to by NMPNS. Secondly, BWRVIP-182 recommends using the velocity squared ratio as a "*minimum value*" for the bump-up factor when the scale model test results yield lower values. This procedure was agreed upon and confirmed by the BWRVIP in its response to NRC RAI 8 on Report BWRVIP-182. In its response, the BWRVIP stated that, "*At any frequency, the factor used to increase the in-plant CLTP pressures shall not be less than the ratio of flow velocities squared.*" Therefore, since the measured mean value of the bump-up factor (Fig. 9.1 of CDI Report No. 08-13P, Rev. 1) is consistently higher than the velocity-squared factor over the whole frequency range of interest (0-250 Hz), the applicant is requested to use the [[
]] in the dryer stress analysis at EPU conditions. The NRC staff's evaluation of the dryer stress ratio at EPU will be based on a [[ ]] over the frequency range of interest.

**NMP2-EMCB-SD-RAI-18 S01**

It appears that the applicant has misunderstood the RAI. The RAI does not suggest that the stress at the node on the weld be treated as nominal stress. Therefore, this RAI provides additional clarification.

In Section 4.4 of the CDI Report 09-26P, "Stress Assessment of Nine Mile Point Unit 2 Steam Dryer at CLTP and EPU Conditions", the fatigue stresses at a limited number of fillet welds are calculated by estimating the nominal stress at the weld and multiplying it by factor of 4 in accordance with the ASME Code, Section III, Table NG-3352-1. The NRC staff finds this approach acceptable, but the procedure used in estimating the nominal stress does not follow the intention of the ASME Code. The Code intention is to use the nominal stress at the weld and not at an element away from the weld. One way to follow the ASME Code intention is to calculate the nominal stresses at one, two, and three elements away from the weld line and then extrapolate these stresses to the weld line. This extrapolated stress may be treated as nominal stress at the weld for estimating the fatigue stresses. The licensee is requested to use the nominal stress at the weld for estimating the fatigue stresses at the fillet weld.

**NMP2-EMCB-SD-RAI-20 S01**

As mentioned in Appendix A of the CDI Report 09-26P, the closure plate modification includes the addition of stiffening ribs on the plate. In the finite element analysis, the modified closure plate is modeled by a thicker closure plate, which is dynamically equivalent for the fundamental mode of in-plane vibrations. The fundamental frequency of the modified plate is 256.0 Hz. The applicant develops [[

]]. Since the frequencies representing bending, and torsional modes of the modified closure plate will be [[ ]], in the development of the unit solutions considered here, the modified closure plate will behave statically as far as bending and torsional deformation of the closure plate is concerned. However, the finite element model of the modified closure plate is statically not equivalent to the closure plate modified with ribs. The licensee is requested to evaluate the errors introduced by this inconsistency in the steam dryer stresses at CLTP.

**NMP2-EMCB-SD-RAI-21 S01**

The applicant states that the submodeling procedure, which is applied to the modified closure plate, is designed to produce more accurate estimates of the stress field in the vicinity of the weld location of interest. The applicant further states that as one moves away from this location, the stress field in the submodel including the portion along its intersection lines (cut boundaries) deviates from the global model for two reasons: (1) cut boundary is near another structural discontinuity, and (2) the matching between the stress components in the global model and submodel is carried out near the weld location rather than near the submodel perimeter including cut boundaries. The applicant also states that locating the cut boundaries too far away will compromise the validity of the linearly varying body force distribution used to account for inertial effects and acoustic loads. While the NRC staff notes the difficulties involved in applying submodeling approach in this specific case, it is obvious that the approach used here is not a valid one because the stress field at the cut boundaries deviates as the mesh is refined and, therefore, the accuracy of the stress results obtained cannot be assessed. The

cut boundaries shall be taken sufficiently far enough away from the high-gradient, localized stress locations (such as weld) to ensure the accuracy of the stress results obtained using the refined mesh. The applicant is requested to evaluate the applicability of its submodeling approach to the subject weld. The approach, if used, may be revised such that (1) the mesh refinement at the weld produces local changes to stresses and strains, while stresses and displacement at the cut boundaries remain unchanged, and (2) the body force distribution is properly considered.

**NMP2-EMCB-SD-RAI-23 S01**

In its previous RAI response, the applicant conservatively shows that the drain channel flaw will not experience fatigue crack growth during EPU operation because the fatigue stresses acting at the flaw location are not high. However, the NRC staff requests the applicant to re-evaluate its response to this RAI, in light of addressing the supplementary RAIs above related to the ACM 4.1 code and bump-up factor.

**NMP2-EMCB-SD-RAI-24 S01**

The applicant states that the inspection and the stress analysis results show that the indication in the drain channel-to-skirt vertical weld is not related to flow-induced vibration (FIV) fatigue because (1) the stresses at this weld are low, and (2) the multiple inspections have not shown any growth. The NRC staff requests the applicant to re-evaluate its response to this RAI, in light of addressing the supplementary RAIs above to show that the stress analysis results for the NMP2 steam dryer at CLTP are acceptable. In addition, the applicant should note the frequency of the fatigue stresses, with amplitude greater than 13,600 pounds per square-inch, can be lower than 1 Hz, and it may take several operating cycles for crack initiation.

October 6, 2010

Mr. Samuel L. Belcher
Vice President Nine Mile Point
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***/RA/***
Richard V. Guzman, Senior Project Manager
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Office of Nuclear Reactor Regulation

Docket No. 50-410

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