This letter forwards proprietary information in accordance with 10 CFR 2.390. The balance of this letter may be considered non-proprietary upon removal of Attachment 3.

Thomas A. Lynch
Plant General Manager

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CENG
a joint venture of
Constellation Energy · eDF

NINE MILE POINT
NUCLEAR STATION

May 7, 2010

U. S. Nuclear Regulatory Commission
Washington, DC 20555-0001

ATTENTION: Document Control Desk

SUBJECT: Nine Mile Point Nuclear Station
Unit No. 2; Docket No. 50-410

Response to Request for Additional Information Regarding Nine Mile Point Nuclear Station, Unit No. 2 – Re: Steam Dryer Review of the License Amendment Request for Extended Power Uprate Operation (TAC No. ME1476)

REFERENCES:

(a) Letter from K. J. Polson (NMPNS) to Document Control Desk (NRC), dated May 27, 2009, License Amendment Request (LAR) Pursuant to 10 CFR 50.90: Extended Power Uprate

(b) Letter from R. V. Guzman (NRC) to S. L. Belcher (NMPNS), dated March 10, 2010, Request for Additional Information Regarding Nine Mile Point Nuclear Station, Unit No. 2 – Re: The License Amendment Request for Extended Power Uprate Operation (TAC No. ME1476)

(c) Email from R. Guzman (NRC) to T. H. Darling (NMPNS), dated April 14, 2010, Follow-up Question – EPU Vessels & Internals Integrity

Nine Mile Point Nuclear Station, LLC (NMPNS) hereby transmits revised and supplemental information in support of a previously submitted request for amendment to Nine Mile Point Unit 2 (NMP2) Renewed Operating License (OL) NPF-69. The request, dated May 27, 2009 (Reference a), proposed an amendment to increase the power level authorized by OL Section 2.C.(1), Maximum Power Level, from 3467 megawatts-thermal (MWt) to 3988 MWt. By letter dated March 10, 2010 (Reference b), the NRC staff requested additional information to support its review.

A001
NRR

This letter forwards proprietary information in accordance with 10 CFR 2.390. The balance of this letter may be considered non-proprietary upon removal of Attachment 3.

The requested information is provided in the attachments to this letter, with the exception of requests NMP2-EMCB-SD-RAI - 6, 7, 8, 9, 11, 12, 20, 21, and 24. The responses to these remaining requests will be submitted by June 30, 2010. Attachment 1 provides a non-proprietary version of the information provided in Attachments 3. Attachment 3 is considered to contain proprietary information exempt from disclosure pursuant to 10 CFR 2.390. Therefore, on behalf of Continuum Dynamics Incorporated (CDI), NMPNS hereby makes application to withhold this attachment from public disclosure in accordance with 10 CFR 2.390(b)(1). An affidavit from CDI detailing the reason for the request to withhold the proprietary information is provided in Attachment 2.

Additionally, in response to Reference (c), NMPNS commits to submit a revised relief request for elimination of the circumferential reactor vessel weld inspection a full year before the currently approved fluence limit is reached. A list of the regulatory commitments made in this submittal is provided in Attachment 4.

Should you have any questions regarding the information in this submittal, please contact T. F. Syrell, Licensing Director, at (315) 349-5219.

Very truly yours,

TLynch

STATE OF NEW YORK :
: **TO WIT:**
COUNTY OF OSWEGO :

I, Thomas A. Lynch, being duly sworn, state that I am Plant General Manager, and that I am duly authorized to execute and file this response on behalf of Nine Mile Point Nuclear Station, LLC. To the best of my knowledge and belief, the statements contained in this document are true and correct. To the extent that these statements are not based on my personal knowledge, they are based upon information provided by other Nine Mile Point employees and/or consultants. Such information has been reviewed in accordance with company practice and I believe it to be reliable.

TLynch
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Subscribed and sworn before me, a Notary Public in and for the State of New York and County of Onondaga, this 7th day of May, 2010.

WITNESS my Hand and Notarial Seal: Dennis E. V
Notary Public

My Commission Expires:

3/17/2012
Date

DENNIS E. VANDEPUTTE
Notary Public, State of New York
No. 01VA6183401
Qualified in Onondaga County
Certificate Filed in Oswego County
Commission Expires 3/17/2012

TAL/RJC

Attachments:

1. Response to Request for Additional Information Regarding License Amendment Request for Extended Power Uprate Operation (Non-Proprietary)

2. Affidavit Justifying Withholding Proprietary Information From Continuum Dynamics Incorporated (CDI)

3. Response to Request for Additional Information Regarding License Amendment Request for Extended Power Uprate Operation (Proprietary)

4. List of Regulatory Commitments

cc: NRC Regional Administrator, Region I
NRC Resident Inspector
NRC Project Manager
A. L. Peterson, NYSERDA (w/o Attachment 3)

ATTACHMENT 1

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION REGARDING LICENSE AMENDMENT REQUEST FOR EXTENDED POWER UPRATE OPERATION (NON-PROPRIETARY)

Certain information, considered proprietary by Continuum Dynamics Incorporated (CDI), has been deleted from this Attachment. The deletions are identified by double square brackets.

ATTACHMENT 1

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION REGARDING LICENSE AMENDMENT REQUEST FOR EXTENDED POWER UPRATE OPERATION (NON-PROPRIETARY)

By letter dated May 27, 2009 (reference a), as supplemented on August 28, 2009, December 23, 2009, February 19, 2010, and April 16, 2010, Nine Mile Point Nuclear Station, LLC (NMPNS) submitted for Nuclear Regulatory Commission (NRC) 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 2 (NMP2). This attachment provides supplemental information in response to the request for additional information (RAI) provided by NRC letter dated March 10, 2010. The NRC request is repeated (in italics), followed by the NMPNS response.

NMP2-EMCB-SD-RAI-10

Table 2.1 of CDI Report No. 08-08P, Rev. 3: "Acoustic and Low Frequency Hydrodynamic Loads at CLTP (Current Licensed Thermal Power) Power Level on Nine Mile Point Unit 2 Steam Dryer to 250 Hz," dated December 2009, contains the locations of the strain gage arrays on the four main steam lines as listed below:

[[

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[[

]]

a. *[[* *]]*

b. *[[* *]]*

c. *[[* *]]*

d. *[[* *]]*

NMPNS Response

a. The locations of the strain gages (SG) were limited because of restricted access in the NMP2 drywell (Mark II containment design) and because of main steam line (MSL) whip restraints and snubbers. The available locations were evaluated and determined to be acceptable based on theory and comparison to the Quad Cities Unit 2 (QC2) benchmark.

Strain gage locations for NMP2 and QC2 may be compared as shown in the following table:

Main Steam Line	Length to First SG on QC2 (ft)	Length to First SG on NMP2 (ft)	Length to Second SG on QC2 (ft)	Length to Second SG on NMP2 (ft)
A	9.50	13.6	41.0	26.2
B	9.50	14.5	41.33	19.9
C	9.50	22.1	41.33	27.5
D	9.50	20.4	41.0	25.8

[[

]]

d. The ACM model requires as input the specific geometric locations on the main steam lines where data are collected. The only restriction is that these data be collected upstream of the acoustic standpipe sources. There is no restriction on locations where data are collected with regard to the ACM model. However, signal-to-noise considerations dictate the approach with regard to spacing discussed in Response 10.a above, and position uncertainty is accounted for as described in Response 10.c above.

NMP2-EMCB-SD-RAI-13

SIA Calculation No. NMP-26Q-302 states that 14 of the 64 MSL strain gages used to measure the CLTP data in the NMP2 plant failed during the April 2008 test. The licensee is requested to explain whether Constellation Energy Group (CEG) plans to repair those strain gages prior to power ascension. The licensee is also requested to address the minimum number of strain gages required, and their circumferential locations, for estimating the acoustic pressure loads on the steam dryer during power ascension.

NMPNS Response

NMPNS replaced the failed strain gages during the recent spring 2010 outage to ensure adequate working strain gages during power ascension. The minimum number of strain gages per location is two pair (four strain gages) per location. However, NMPNS plans to maintain the maximum number of strain gages to the extent practical. The additional pairs of strain gages allow for redundancy and help to reduce the effects of bending in the MSL. Each pair of strain gages are separated by 180° on the MSL and are connected to a Wheatstone Bridge circuit, such that the signals from diametrically opposing gages are additive. Such an arrangement, in which two active strain gages are connected, is referred to as a ½-Bridge configuration. This arrangement is intended to minimize the effect of bending in the MSLs, such that the measured hoop strain is predominantly due to dynamic pressure changes inside the pipe. Eight strain gages are installed at each MSL location. The strain gage pairs are ideally located 90° apart for optimum cancelation of bending modes; but alternative configurations are considered acceptable as they are conservative.

NMP2-EMCB-SD-RAI-14

SIA Calculation No. NMP-26Q-302 indicates that [[ ]] were recorded for all strain gages. CEG is requested to clarify whether or not the [[ ]] were filtered out from the strain gage data provided in Figs 1 to 10, and the subsequent spectra and waterfall plots of the same calculation.

NMPNS Response

The [[ ]] were used to identify the frequencies that are purely electrical in nature. The frequency content at the electrical peaks, identified by the EIC data, were filtered out from the strain gage data provided in Figures 1 through 10 and the subsequent spectra and waterfall plots. The frequencies listed in SI Calculation NMP-26Q-302 Table 4 plus 60 Hz and its multiples were filtered out from the data presented in SI Calculation No. NMP-26Q-302.

NMP2-EMCB-SD-RAI-15

The Scale Model Tests (SMTs) of the main steam piping are described in CDI Report No. 08-13P, Rev 1: "Flow-Induced Vibration in the Main Steam Lines at Nine Mile Point Unit 2 and Resulting Steam Dryer Loads." [[

]]

NMPNS Response

Scale model geometry at the main steam line inlet for NMP2 is identical to that of other scale model geometries, without pipe reducers or expanders fitted at the pipe inlets. In the NMP2 subscale tests (CDI Report No. 08-13P, Rev. 1), [[

]]

The full-scale NMP2 main steam line is 26 inch Schedule 80 (ID = 23.5 in), while QC2 is 18 inch Schedule 80 (ID = 17.94 in). [[
]]

[[

]]

Figure 4.1 of CDI Report No. 08-13P, Rev. 1 shows the [[ ]], and is reproduced here as Figure 15.1.

[[

]]

NMP2-EMCB-SD-RAI-16

The scale model tests are described in CDI Report No. 08-13P, Rev 1: "Flow-Induced Vibration in the Main Steam Lines at Nine Mile Point Unit 2 and Resulting Steam Dryer Loads." On page 24 of the report, it is stated that the standpipes in the scale model were made, [[

]] The licensee is requested to provide a comparison between the standpipe geometries in the scale model and the full size plant, and explain the effect of [[ ]] on the SMT results, including the bump-up factor.

NMPNS Response

As noted in CDI Report No. 08-13P, Rev. 1, the standpipe lengths of the NMP2 scale model were fabricated with [[

]]. The actual full-scale lengths are shown in Table 16.1.

Standpipe Length (in)	Standpipe Location
23.02	MSL A: 1, 2, 3, 4 MSL C: 1 MSL D: 1, 2, 3, 4
23.14	MSL B: 1
23.27	MSL B: 2
23.33	MSL C: 3, 4
23.40	MSL C: 5
23.52	MSL C: 2
23.58	MSL B: 3
23.77	MSL B: 4
23.94	MSL B: 5

Table 16.1: NMP2 Standpipe Lengths

Standpipe location in Table 16.1 identifies the main steam line and the position of the standpipe away from the steam dome. [[ ]].

[[

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NMP2-EMCB-SD-RAI-17

Fig. 9.1 of CDI Report No. 08-13P, Rev 1, "Flow-Induced Vibration in the Main Steam Lines at Nine Mile Point Unit 2 and Resulting Steam Dryer Loads," provides the bump-up factor which should be used to estimate the EPU loading from the measured CLTP loading. [[

]]

NMPNS Response

The NMP2 steam dryer evaluation was performed in accordance with NRC approved BWRVIP-182. This guidance provides a flow chart to screen for acoustic resonance conditions. Provided the screening meets the margins required by BWRVIP-182, the application of velocity squared is justified and scale model testing or other methods such as MSIV closure testing to define the bump is factor are not required. The NMP2 performance of the CDI proprietary 1/8th scale testing is above the guidance and was performed as a conservative measure to confirm the conclusions of the BWRVIP-182 resonance screening calculations. The conclusions reached from the scale model testing remain that the appropriate scaling for NMP2 is velocity squared based on the average bump-up factor across the 0 to 250 Hz frequency band.

Figure 9.1 of CDI Report No. 08-13P Rev. 1 is reproduced here as Figure 17.1, with the mean value of the bump-up factor shown. Standpipe excitation is not predicted to occur until well above EPU conditions (at a Mach number of 0.160, compared to the EPU Mach number of 0.110). [[

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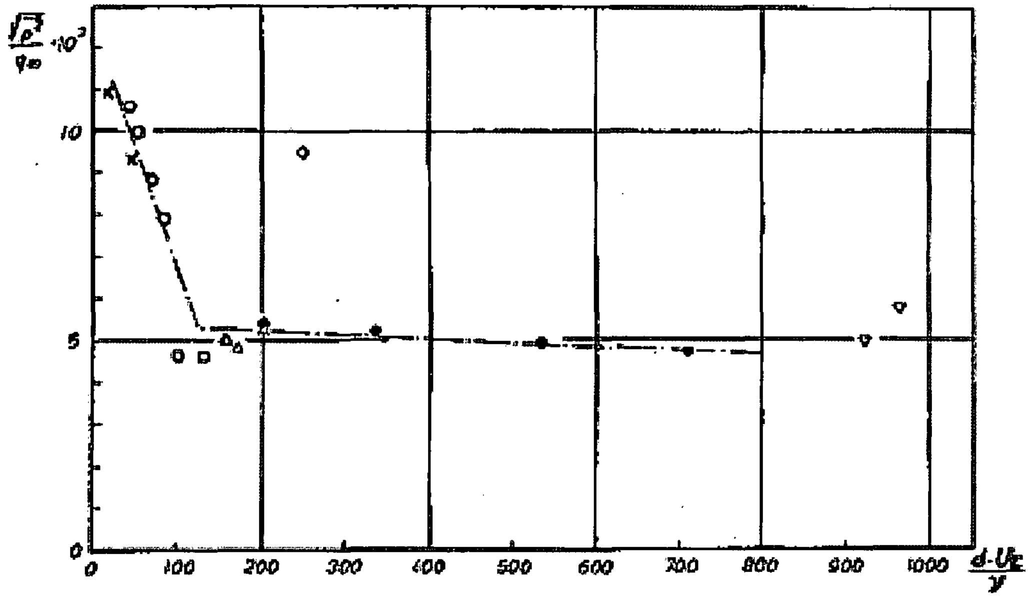

Figure 5 Dependence of the measured root-mean-square wall pressure fluctuation upon the dimensionless pressure transducer diameter; ○, Blake (1970); ×, Emmerling (1973); □, Schloemer (1966); △, Bull (1967); ●, Willmarth & Roos (1965); ▽, Bull & Willis (1961), and ◇, Harrison (1958); from Emmerling (1973).

Figure 17.2 (from Reference 17.1)

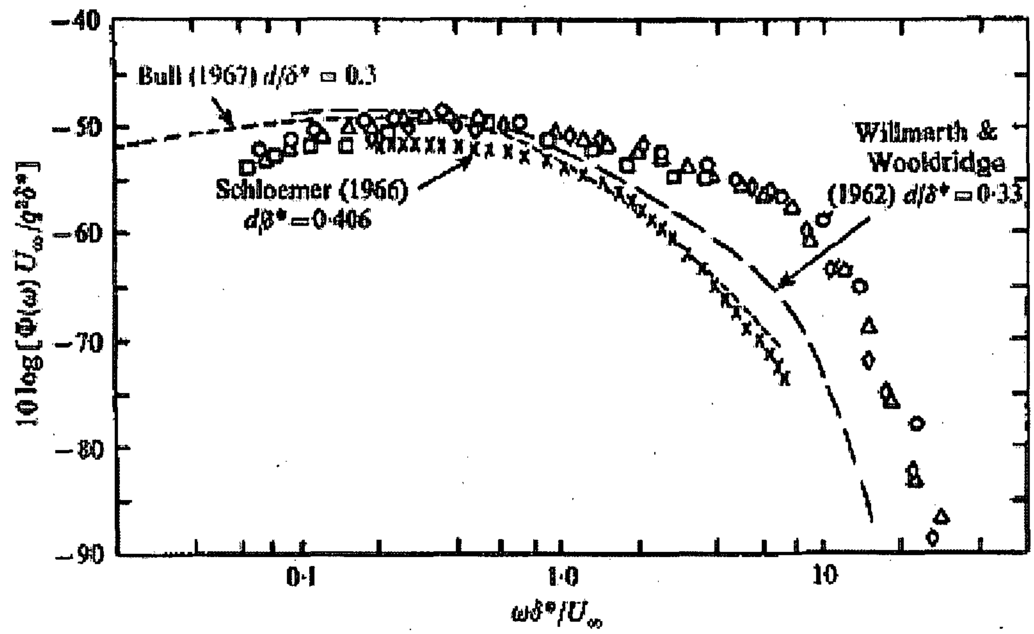

Figure 4 Smooth wall pressure spectra, outer variables; flagged points denote where $\omega d/2U_c \approx 1$. Values of U_∞ (ft/sec) and d/δ^*: □, 164, 0.112; ○, 124, 0.110; △, 94, 0.109; ◇, 73, 0.101; from Blake (1970).

Figure 17.3 (from Reference 17.1)

Reference 17.1: W. W. Willmarth, 1975, Pressure Fluctuations beneath Turbulent Boundary Layers, Annual Review of Fluid Mechanics, 7:13-38

NMP2-EMCB-SD-RAI-18

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 a factor of 4 in accordance with the ASME Code, Section III, Table NG-3352-1. The staff finds this approach acceptable; however, 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. Therefore, the licensee is requested to use the nominal stress at the weld for estimating the fatigue stresses at the fillet weld.

NMPNS Response

The alternating stresses at welds are generally evaluated in the manner described in Section 4.4 of Reference 18.1 using the weld factor of 1.8. Under this approach (Approach 1), the finite element stresses σ_{FE}, calculated at a weld, are multiplied by 1.8 to obtain the weld stresses $\sigma_w = 1.8 \times \sigma_{FE}$, taking into account the effects of weld variability and stress concentration. The alternative approach (Approach 2) advocated for a limited number of locations is to calculate a nominal stress σ_{nom} and instead estimate the weld stress $\sigma_w = f \times \sigma_{nom}$, where $f = 4.0$ in accordance with the ASME Code (Table NG-3352-1). The issue here centers on the evaluation of σ_{nom}. The intent of the code is that σ_{nom} represents the stresses in the neighboring plates without the localized stress concentrations due to reinforcements or discontinuities. Since with sufficient mesh resolution the finite element method does reproduce the local stress concentrations, the nominal stress σ_{nom} is instead evaluated one mesh point away to diminish the contribution from such localized effects.

Note that if σ_{nom} were evaluated using the stresses at the node, then Approach 2 would produce overly conservative predictions. In that case one would have $\sigma_{nom} = \sigma_{FE}$ and the weld stress evaluated under Approach 2 would be $\sigma_w = f \times \sigma_{FE} = 4\ \sigma_{FE}$. This result will always be greater, by a factor of 2.22 = 4.0/1.8, than the one obtained under the general Approach 1, which estimates $\sigma_w = 1.8 \times \sigma_{FE}$. The reason for the excessive conservatism is that using σ_{FE} for σ_{nom} results in an effective double-counting of local stress concentration, as reflected in both the local stress value σ_{FE} and in the higher weld factor of $f = 4.0$.

Approach 2 (with σ_{nom} evaluated one element away from the weld), was only used in Reference 18.1 for the middle hood reinforcement strip. The estimated weld stress using Approach 2 is found to produce a limiting alternating stress ratio of SR-a = 3.09 for nodes on the reinforcement strip weld when all frequency shifts are considered. When Approach 1 is used instead, the limiting stress ratio at any frequency shift on the hood reinforcement strip using the same MSL pressure signals as in Reference 18.1 (specifically, with noise left in) is determined to be SR-a = 3.38, so that the dryer still meets the allowable stress margin.

Reference 18.1: Continuum Dynamics, Inc. (2009), *Stress Assessment of Nine Mile Point Unit 2 Steam Dryer at CLTP and EPU Conditions, Rev. 1*, CDI Report No. 09-16P (Proprietary), August

NMP2-EMCB-SD-RAI-19

The licensee is requested to provide the size and locations of any undersized fillet welds in the NMP2 steam dryer, and explain how the fatigue stresses are calculated at those welds.

NMPNS Response

Two locations on the NMP2 steam dryer contain undersized welds. Table 19-1 lists these locations together with the component thicknesses and undersize weld factors (USWF). The locations are also depicted in Figure 19-1. Fatigue stresses at these locations are conservatively calculated by multiplying the alternating stress intensities (S_{alt}) by the square of the USWF before comparing to allowable stresses.

The usual weld factor (i.e., 1.8 for fillet welds) is also applied together with a factor of 1.1 to account for the temperature variation of the Young's modulus for stainless steel to obtain the final alternating stress ratio, SR-a. This approach is conservative since using the square of the USWF is only required for the bending stress components; for membrane stresses using the USWF (i.e., not the square of this quantity) is permissible. However, the approach is straightforward to implement computationally. The limiting alternating stresses and alternating stress ratios at these locations are also listed in Table 19-1 for CLTP operation using the current steam dryer configuration.

For both locations the alternating stress ratios are above 5.0 so that fatigue stresses in the weld are well below allowable levels.

Description	Part Thickness (in.)	Weld Size (in.)	USWF	S_{alt} (psi)	SR-a
Weld connecting inner base plate to diagonal gusset (see Figure 19-1a)	0.5	0.25	2.00	343	5.01
Weld joining lifting lug brace to collar (see Figure 19-1b)	0.375	0.25	1.50	532	5.74

Table 19-1: List of Locations with Currently Undersized Welds and Limiting Alternating Stresses at CLTP

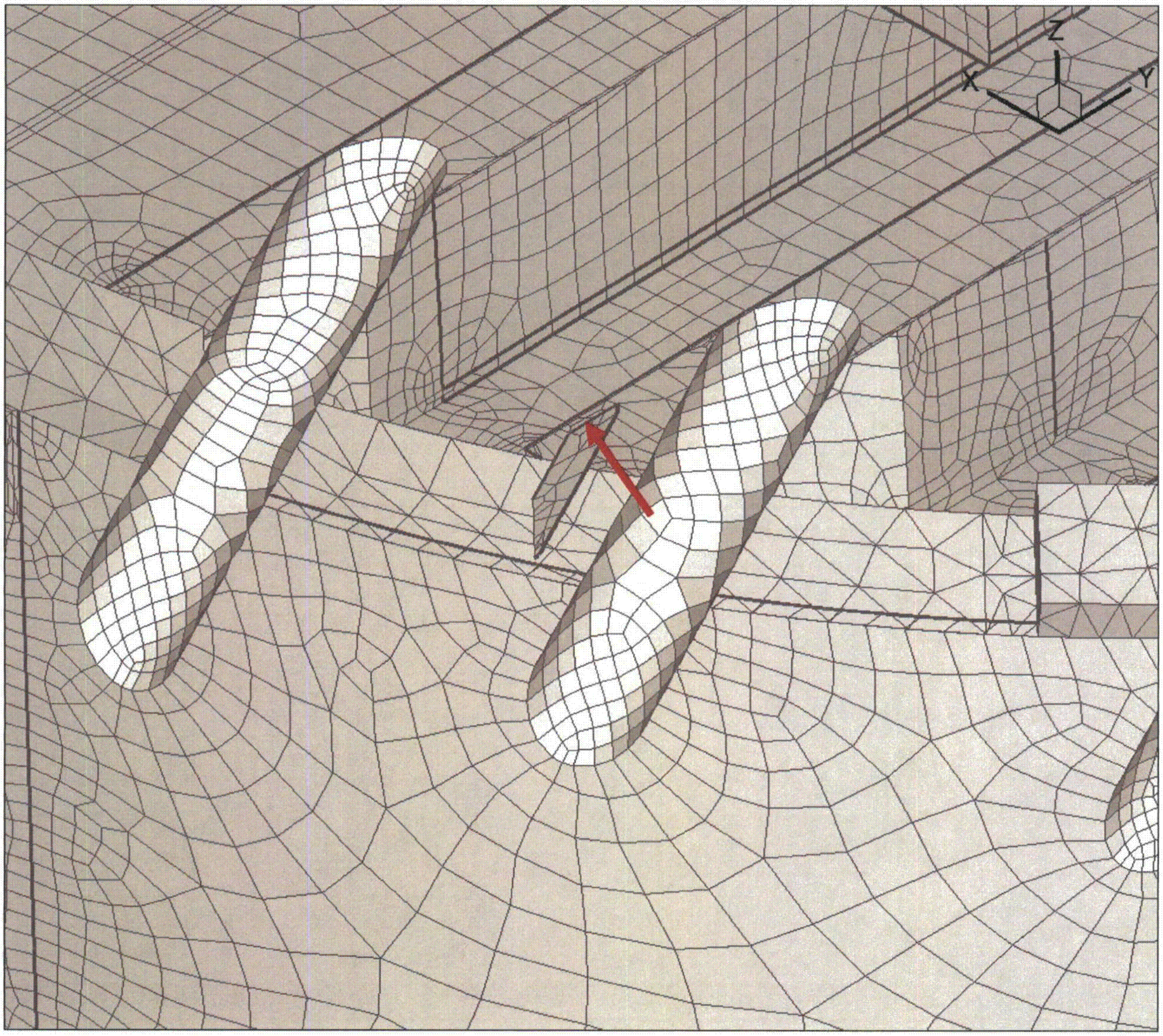

Figure 19.1a: Weld Connecting Diagonal Gusset to Inner Base Plate (viewed from underneath the steam dryer)

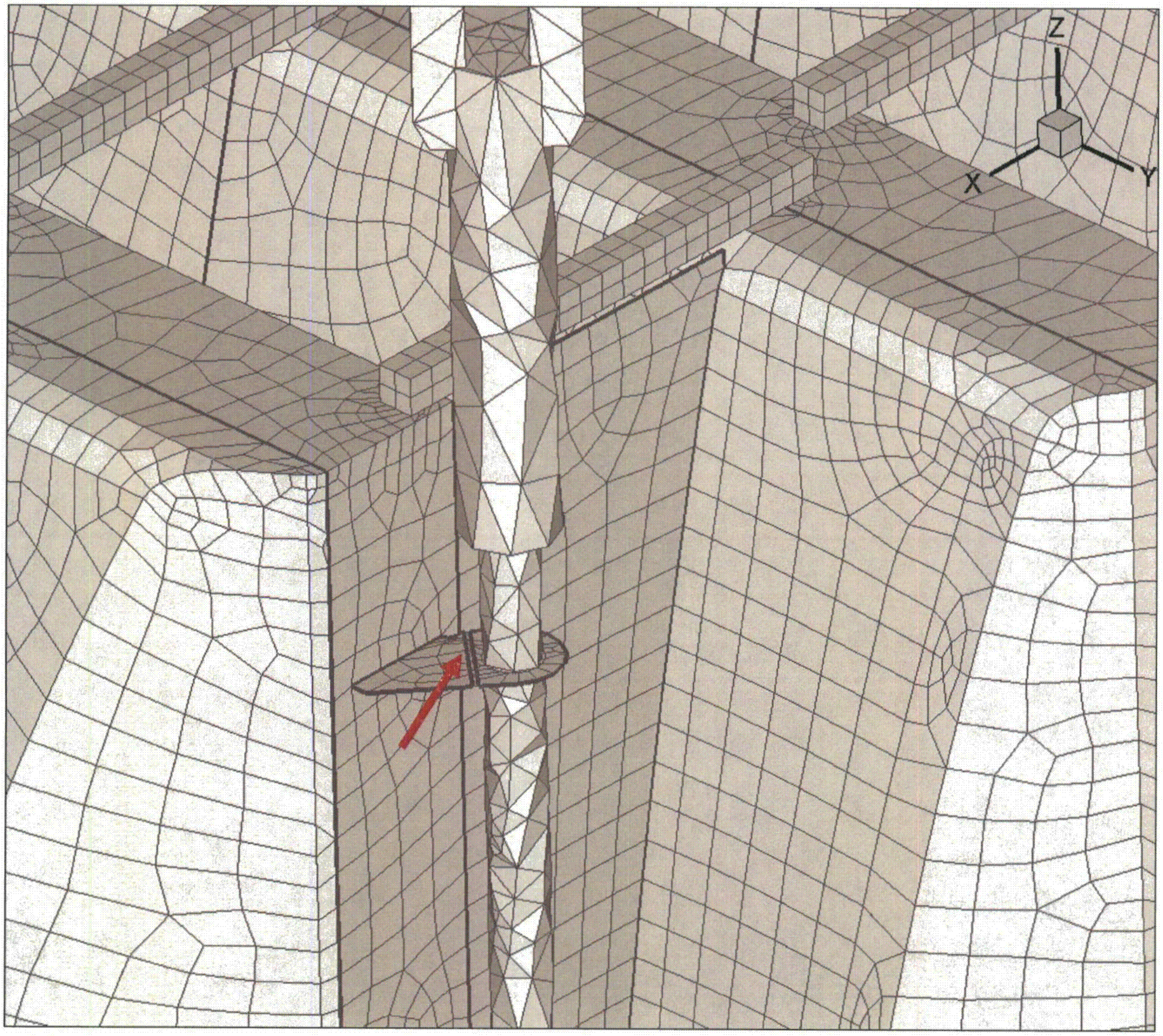

Figure 19.1b: Undersize Weld Connecting Lifting Lug Brace to Collar

NMP2-EMCB-SD-RAI-22

The licensee is requested to provide a detailed description of the 'overlay welds' that will be used to repair the cracks in the tie bar of the NMP2 dryer due to inter-granular stress corrosion cracking (IGSCC). The licensee is requested to explain how any changes in stiffness caused by the overlay welds have been included in the NMP2 dryer finite element (FE) stress model.

NMPNS Response

Six tie bar locations have small IGSCC flaws located in the heat affected zone (HAZ) in the base plate as depicted in Figures 2-6 and 2-7 of Report No. 0801273.401, Rev 1. The IGSCC cracking is anticipated to be shallow based on Ultrasonic Testing (UT) of similar IGSCC cracking on the dryer ring, see note below, such that removal is considered an option with a supplemental fillet weld, 1/8" or 1/4" if warranted. The tie bar attaches to the vane banks at a location that is rigid in the FE; i.e., the weld flexibility is not modeled at this level. The flaw removal and supplemental fillet weld overlay does not change the stiffness of this location.

Note: UT of the steam dryer ring IGSCC was performed in April 2010. The UT has confirmed the cracking is very shallow, typically below 0.2" with a maximum depth of 0.29", with no growth observed for three repeat inspections over 6 years. This UT confirms the steam dryer UT ring flaw assessment.

NMP2-EMCB-SD-RAI-23

In Section 4.2 of the SIA report on flaw evaluation (Report No. 0801273.401, Rev. 1), the applicant presents the fatigue crack growth of the 1.08-in. long flaw present in the NMP2 drain channel. It assumes an R-ratio (stress intensity factor ratio K_{min}/K_{max}) of 1 to account for the high mean stress, refers to Reference Fatigue Crack Growth Curves from the ASME Boiler and Pressure Vessel Code, Section XI (Figure 4.1), and concludes that the expected fatigue crack growth is minimal. The staff requests the following additional information in order to confirm this conclusion.

Figure 4.1 provides reference crack growth curves for R=0.0, 0.79 and 0.9. Provide the extrapolated crack growth curve for R=1.0 and a temperature of 550° F. Please estimate the crack growth rate for the range of stress intensity factor ΔK_I=2.75 ksi-in$^{0.5}$, which is the bounding range of K_I for the flaws in the drain channel, for R=1.0 and a temperature of 550° F. In addition, please estimate the projected crack growth during one fuel cycle.

NMPNS Response

NMPNS obtained ultrasonic inspection data of the steam dryer support skirt indications during the 2010 Refueling Outage. This information is relevant to the evaluation and conclusions presented in Report No. 0801273.401, Rev. 1 and to the RAI addressed here. Consequently, this RAI response includes the results of a revised flaw evaluation performed to incorporate the detailed indication sizing information obtained during the recent outage.

The two drain channel indications examined using UT are reported to have depths of 0.15 inches and 0.16 inches; thus, the flaw depth will be taken as:

a = 0.16 inches

Revised flaw length measurements were not reported in the UT examination report; therefore, the flaw length will be taken as the flaw length considered in the original flaw evaluation (Table 2-1 of Report No. 0801273.401, Rev. 1):

2c = 1.64 inches

The same methodology as described in the original flaw evaluation will be used here except that the linear elastic fracture mechanics (LEFM) model for a semi-elliptical surface crack in a plate under uniform tension, presented in Reference 23.1, is used since this solution is more appropriate for the flaw configuration. This is conservative since the plate is expected to be loaded in bending; however, this conservative assumption simplifies the analysis. Reference 23.1 presents normalized K_I results for various flaw aspect ratios and flaw depth to plate thickness ratios as well as analytical expressions for the mode I stress intensity factor, K_I. The range of stress intensity factors resulting from the EPU flow induced vibration (FIV) loading, excluding the conservatisms described below, is:

a/c = 0.16/(1.64/2) =	0.195	Flaw aspect ratio
a/t = 0.16/0.25 =	0.64	Flaw depth to plate thickness ratio
$\Delta\sigma_{EPU\_FIV}$ =	0.215 ksi	Peak-to-Peak EPU FIV stress intensity in the skirt

From Table I of Reference 23.1, for a/c = 0.2, a/t = 0.6, the normalized stress intensity factor at the surface and at the deepest part of the crack (ϕ = 0°, ϕ = 90°) is:

$$\phi = 0^\circ \qquad \frac{K_I}{S_T\sqrt{\dfrac{\pi a}{Q}}} = 0.899$$

$$\phi = 90^\circ \qquad \frac{K_I}{S_T\sqrt{\dfrac{\pi a}{Q}}} = 1.642$$

Where:

S_T	is a uniform membrane stress, ksi
a	is the flaw depth, in
Q	is the flaw shape factor given by $Q = 1 + 1.464\left(\frac{a}{c}\right)^{1.65}$

For the drain channel flaw evaluated here, the shape factor is:

$$Q = 1 + 1.464\left(\frac{a}{c}\right)^{1.65} = 1.099$$

Thus, the ΔK_I at the surface and deepest point of the flaw is:

$$\phi = 0^\circ \qquad \Delta K_I = 0.899 S_T \sqrt{\frac{\pi a}{Q}} = 0.899(0.215)\sqrt{\frac{\pi(0.16)}{1.099}} = 0.13\ ksi\sqrt{in}$$

$$\phi = 90^\circ \qquad \Delta K_I = 1.642 S_T \sqrt{\frac{\pi a}{Q}} = 1.642(0.215)\sqrt{\frac{\pi(0.16)}{1.099}} = 0.24\ ksi\sqrt{in}$$

If the same overlapping conservatisms applied in the original flaw evaluation are retained here, then the following ΔK_I is calculated for the semi-elliptical surface crack:

<u>Drain Channel Stress</u>

$\phi = 90$	degrees
a = 0.16	inches
c = 1.04	inches
t = 0.25	inches
$\Delta\sigma = 0.846$	ksi
Weld Factor = 1.8	
a/c = 0.154	
a/t = 0.64	
Q = 1.067	
ΔK_I = 1.72	**ksi-in$^{0.5}$**

<u>Skirt Stress</u>

$\phi = 90$	degrees
a = 0.16	inches
c = 1.04	inches
t = 0.25	inches
$\Delta\sigma = 0.215$	ksi
Weld Factor = 1.8	
a/c = 0.154	
a/t = 0.64	
Q = 1.067	
ΔK_I = 0.44	**ksi-in$^{0.5}$**

Equation (1) of C-3210, Flaw Growth due to Fatigue (Reference 23.2), gives the following relationship for fatigue crack growth (FCG):

$$\frac{da}{dn} = C_0(\Delta K_I)^n$$

Where:

da/dn	is the incremental crack growth per load cycle, in/cycle
C_o	is a parameter dependant on material and environment
n	is a parameter dependant on material and environment
ΔK_I	is the range of mode I stress intensity factor

For austenitic steels in air, n is given as 3.3 and C_o is given by ASME Section XI Appendix C, C-8410, Eq. (16):

$$n = 3.3$$

$$C_0 = CS = 10^{\left[-10.009+8.12E-4(T)-1.13E-6(T)^2+1.02E-9(T)^3\right]}(-43.35+57.97R)$$

Taking T = 550 °F and conservatively assuming R=1 gives:

$$C_0 = CS = 10^{\left[-10.009+8.12E-4(550)-1.13E-6(550)^2+1.02E-9(550)^3\right]}(-43.35+57.97) = 2.694E-9$$

Since the indication is wholly contained in the skirt, the EPU FIV stress reported for the skirt material and associated ΔK_I are used for the crack growth calculation. The incremental crack growth rate for this indication using the appropriate stresses reported in Report No. 0801273.401, Rev. 1 and retaining all of the conservatisms described in Report No. 0801273.401, Rev. 1 is:

$$\frac{da}{dn} = 2.694E-9(0.44)^{3.3} = 1.79E-10\ in/cycle$$

If no credit it taken for the empirically observed FCG threshold range of stress intensity factor for austenitic stainless steel (Reference 23.3) and considering a FIV frequency of 100 Hz, the anticipated FCG from FIV over the next two year operating period would be:

$$da = 1.79E-10\ in/cycle \cdot 100\ cycles/\text{sec.} \cdot 3600\ \text{sec}/hr \cdot 24\ hr/day \cdot 365\ days/yr \cdot 2\ yr = 1.13\ inches$$

This gives an end of evaluation period flaw size of:

$$2c = 2(1.13+1.04) = 4.34\ inches$$

It is important to note that the range of ΔK_I predicted for these indications is well within the range of the threshold stress intensity factor for FCG of austenitic stainless steels (Reference 23.3). Reference 23.3 presents experimental data which shows a ΔK_{TH} for austenitic stainless steel which approaches 2 ksi-in$^{0.5}$ for R ratios approaching 1.0. The ΔK_I for the flaw in the drain channel is shown to be less than the ΔK_{TH} reported in the literature for stainless steel; therefore, no FCG is predicted for FIV loads at EPU operating conditions. Further, the evaluation contained in Report No. 0801273.401, Rev. 1, and documented above, includes substantial conservatisms, including the following:

1. The range of peak stress intensity, obtained from the shell model, is applied as a membrane stress acting on the crack face. Review of the detailed finite element analysis (FEA) stress results for each shell element provide a stress intensity at the upper surface, mid-plane, and bottom surface of each element. The appropriate stresses to be used for a fracture mechanics analysis of a

cracked shell is the stress intensity at the mid-plane of the element since this represents, essentially, the average or membrane stress acting on the crack. The stresses on either side of the shell element will be higher and lower, respectively, than the stress at the midplane; therefore, from a crack growth perspective, the overall crack growth is a function of the average stress. Review of the stress results for the drain channel location show that the peak stress intensity on the outside surface of the element is 847 psi, as reported in Report No. 0801273.401, Rev. 1, and the peak stress intensity for the element midplane location is 139 psi. Consideration of the more appropriate element midplane location stress intensity would result in a reduction of the applied stress intensity factor by a ratio of 847/139 = 6. This alone would reduce the conservatively calculated ΔK_I cited in the RAI above to approximately 0.44 ksi-in$^{0.5}$ and the ΔK_I calculated above, considering the recent UT data, to approximately 0.29 ksi-in$^{0.5}$.

2. The ΔK_I=1.72 ksi-in$^{0.5}$ is calculated using the peak stress intensity predicted in the drain channel material. The SI calculation in Report No. 0801273.401, Rev. 1 acknowledges and the inspection notification form (INF) shows that the indication exists in the skirt material. The peak stress intensity for the skirt material is 215 psi, which results in a ΔK_I = 0.44 ksi-in$^{0.5}$. Further, if the element mid-plane stress intensity were to be used for this location, similar to Item 1 above, then the ΔK_I will be even lower.

3. The peak stress, which occurs only at the weld, is applied in the flaw evaluation as a uniform membrane stress over the entire length of the crack face. The true stress distribution exhibits rapid attenuation away from the weld; therefore, a more accurate representation of the traction on the crack face is a linear ramp or a nonlinear curve. Consideration of this type of distribution would result in further reduction in the calculated ΔK_I.

4. The stress concentration factor (SCF), which is applicable only for the discontinuity at the weld location, is applied for the stress distribution along the entire crack face. This is very conservative since the peak stress effects are by definition limited to a region local to the geometric discontinuity which caused them. Removal of the SCF from the stress distribution applied on the crack face, or use of a more accurate representation of the attenuation of the stress concentration effect away from the weld, would result in further reduction in the ΔK_I.

5. The SI calculation in Report No. 0801273.401, Rev. 1 identifies that the variation in the visual indication reported dimensions is within the anticipated accuracy of the method used; therefore, there is not considered to be any apparent crack growth between the measurements taken in 2006 and 2008. To be conservative, the flaw evaluation applied the largest change in measurement between 2006 and 2008, for any flaw, as an "apparent" crack growth. This was then added to the 2008 dimension and evaluated. Further, the 2010 examination data showed no apparent crack growth from the 2008 examination data. Consideration of the actual bounding crack length identified in 2008 and confirmed in 2010 (1.64 inches (2a)) in the flaw evaluation would result in a ΔK_I further reduced by a factor of $(1.64/2.08)^{0.5} = 0.89$.

The above conservatisms will have a similar effect on the revised flaw evaluation presented in this RAI response. Even considering the substantial and overlapping methodological conservatisms purposefully applied for this flaw evaluation it is apparent that FCG is expected to be negligible for this location. Minimizing the conservatisms identified in Items 1 through 5 above, considering the 2010 UT examination results, and performing a more precise calculation of ΔK_I gives the range of applied stress intensity factor equal to 0.13 to 0.24 ksi-in$^{0.5}$. As stated above, the ΔK_I for the flaw in the drain channel is shown to be less than the ΔK_{TH} reported in the literature for stainless steel; therefore, no FCG is predicted for FIV loads at EPU operating conditions.

Reference 23.1: Newman, J. C., Raju, I. S., "Analyses of Surface Cracks in Finite Plates Under Tension or Bending Loads," NASA Technical Paper 1578, 1979

Reference 23.2: ASME Boiler and Pressure Vessel Code, Section XI, Appendix C, 2004 Edition

Reference 23.3: Barsom, J. M., and Rolfe, S. T., "Fracture and Fatigue Control in Structures – Applications of Fracture Mechanics," Prentice-Hall, Inc., 2nd Edition, 1987

ATTACHMENT 2

AFFIDAVIT JUSTIFYING WITHHOLDING PROPRIETARY INFORMATION FROM CONTINUUM DYNAMICS INCORPORATED (CDI)

Continuum Dynamics, Inc.

(609) 538-0444 (609) 538-0464 fax 34 Lexington Avenue Ewing, NJ 08618-2302

AFFIDAVIT

Re: 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)

I, Alan J. Bilanin, being duly sworn, depose and state as follows:

1. I hold the position of President and Senior Associate of Continuum Dynamics, Inc. (hereinafter referred to as C.D.I.), and I am authorized to make the request for withholding from Public Record the Information contained in the documents described in Paragraph 2. This Affidavit is submitted to the Nuclear Regulatory Commission (NRC) pursuant to 10 CFR 2.390(a)(4) based on the fact that the attached information consists of trade secret(s) of C.D.I. and that the NRC will receive the information from C.D.I. under privilege and in confidence.

2. The Information sought to be withheld, as transmitted to Constellation Energy Group as attachments to C.D.I. Letter No. 10069 dated 5 May 2010, 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).

3. The Information summarizes:

   (a) a process or method, including supporting data and analysis, where prevention of its use by C.D.I.'s competitors without license from C.D.I. constitutes a competitive advantage over other companies;
   (b) Information which, if used by a competitor, would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing of a similar product;
   (c) Information which discloses patentable subject matter for which it may be desirable to obtain patent protection.

   The information sought to be withheld is considered to be proprietary for the reasons set forth in paragraphs 3(a), 3(b) and 3(c) above.

4. The Information has been held in confidence by C.D.I., its owner. The Information has consistently been held in confidence by C.D.I. and no public disclosure has been made and it is not available to the public. All disclosures to third parties, which have been limited, have been made pursuant to the terms and conditions contained in C.D.I.'s Nondisclosure Secrecy Agreement which must be fully executed prior to disclosure.

5. The Information is a type customarily held in confidence by C.D.I. and there is a rational basis therefore. The Information is a type, which C.D.I. considers trade secret and is held in confidence by C.D.I. because it constitutes a source of competitive advantage in the competition and performance of such work in the industry. Public disclosure of the Information is likely to cause substantial harm to C.D.I.'s competitive position and foreclose or reduce the availability of profit-making opportunities.

I declare under penalty of perjury that the foregoing affidavit and the matters stated therein are true and correct to be the best of my knowledge, information and belief.

Executed on this 5th day of May 2010.

Alan J. Bilanin
Continuum Dynamics, Inc.

Subscribed and sworn before me this day: May 5, 2010

Eileen P. Burmeister, Notary Public

EILEEN P. BURMEISTER
NOTARY PUBLIC OF NEW JERSEY
MY COMM. EXPIRES MAY 6, 2012

ATTACHMENT 4

LIST OF REGULATORY COMMITMENTS

ATTACHMENT 4

LIST OF REGULATORY COMMITMENTS

The following table identifies actions committed to in this document by Nine Mile Point Nuclear Station, LLC (NMPNS). Any other statements in this submittal are provided for information purposes and are not considered to be regulatory commitments.

REGULATORY COMMITMENT	DUE DATE
Submit the responses to requests NMP2-EMCB-SD-RAI - 6, 7, 8, 9, 11, 12, 20, 21 and 24.	June 30, 2010
Submit a revised relief request for elimination of the circumferential reactor vessel weld inspection a full year before the currently approved fluence limit is reached.	A full year before the currently approved fluence limit is reached.