ATTACHMENT 6

SIA 100632.301, REVISION 0, "MAY 2010 NINE MILE POINT UNIT 2 MAIN STEAM LINE STRAIN GAGE DATA REDUCTION" (NON-PROPRIETARY)

Nine Mile Point Nuclear Station, LLC
June 30, 2010

Structural Integrity Associates, Inc.

CALCULATION PACKAGE

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Nine Mile Point, Unit 2 (NMP2)

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May 2010 Nine Mile Point Unit 2 Main Steam Line Strain Gage Data Reduction

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Does Not Contain Vendor Proprietary Information

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1.0 INTRODUCTION

Nine Mile Point Unit 2 (NMP2) intends to implement Extended Power Uprate (EPU) in the near future. The EPU task reports typically conclude that the main steam and feedwater piping vibration levels could increase by as much as 50% as a result of power uprate from levels corresponding to current licensed thermal power (CLTP). Due to the increased flow rates, steam dryer failures have occurred at other BWR plants that implemented EPU. These failures have been attributed to an acoustic resonance, which is the result of flow-induced dynamic pressure fluctuations in the Main Steam Lines (MSLs).

Prior to EPU implementation, it is necessary to identify the critical frequencies and flow conditions at which the acoustic resonance phenomenon may occur. The dynamic pressure in the MSLs can be indirectly obtained by measuring the pressure-induced hoop strain around the circumference of the pipe. Consequently, all four MSLs at NMP2 have been instrumented with strain gages (SGs) oriented in the hoop direction. Strain measurements were obtained during the May 2010 power ascension that followed refueling outage 2R12, covering a range of power levels from 0% to 100% of NMP2's CLTP [2].

The objective of this calculation is to review and process the dynamic strain data for subsequent use in a comprehensive stress analysis for NMP2's steam dryer. The processed data includes a summary of overall values, frequency spectra, and trend plots indicating the strain response over a range of reactor power (RP) levels.

2.0 DATA ACQUISITION AND REDUCTION METHODOLOGY

2.1 Sensor Locations

2.1.1 Strain Gages

For each MSL, two locations (upper and lower) are instrumented as shown in Figure 1 and as listed in Table 1. At each location, there are four pairs of strain gages (8 total) that are spaced in 45° increments around the outside diameter of the main steam pipe in the hoop direction. 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 steam lines, such that the measured hoop strain is predominantly due to the dynamic pressure experienced inside the pipe. Each of these ½-Bridge configurations comprised a single channel, totaling 32 channels for the 64 installed gages. If a single gage fails, the Wheatstone Bridge circuit can be reconfigured to a ¼-Bridge, consisting of just one active gage. Channels modified to ¼-Bridge configurations are denoted in the comments column of Table 1.

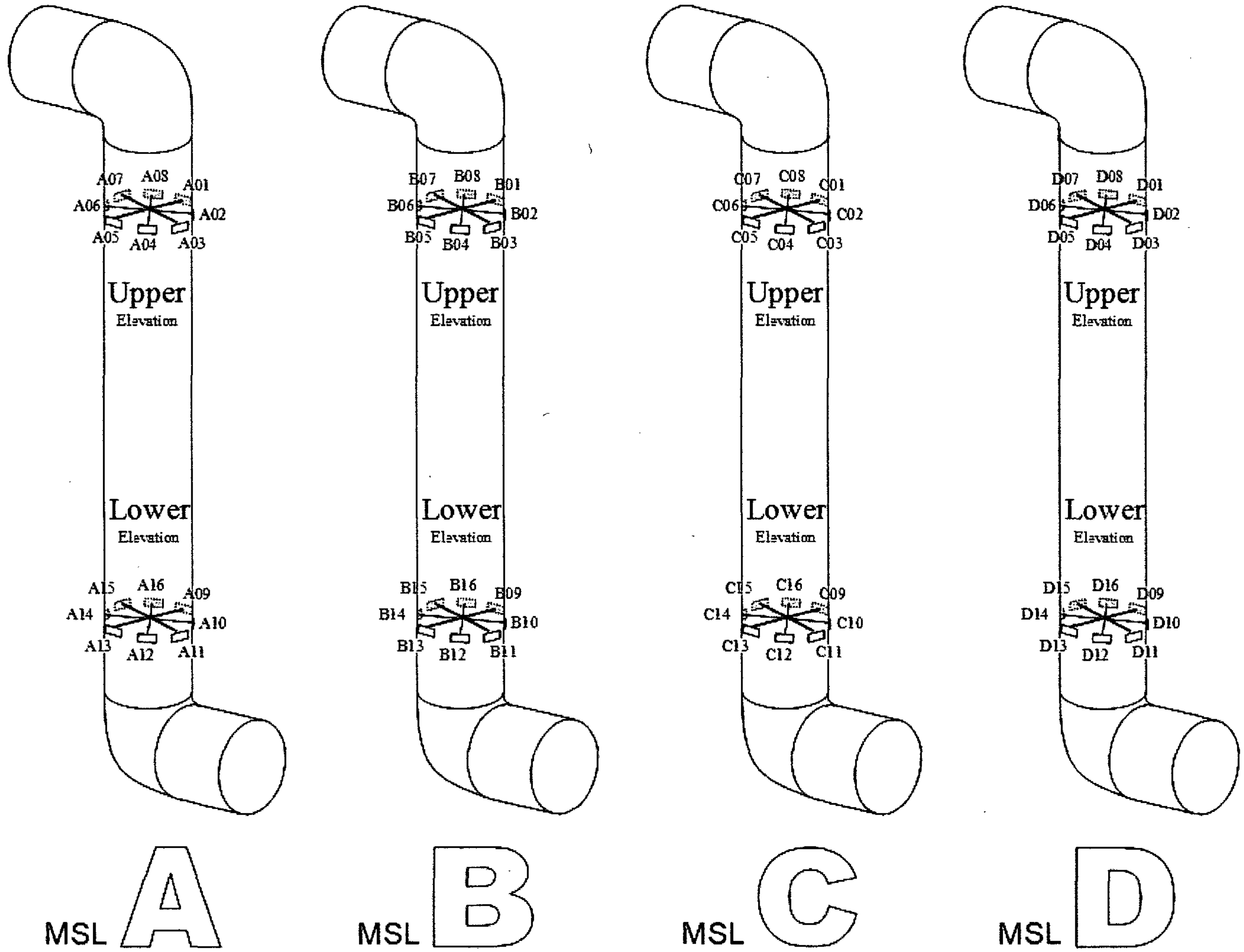

Figure 1. Strain Gage Layout Diagram

Table 1: Strain Gage Channel Names and Locations [2, 3]

DAS Channel	Sensor Group Location	Channel Name	Strain Gage Orientations [Deg]	Comment
1	MSL-A UPPER ELEVATION 315' 9-7/8"	2MSS-SGA01A/05A	0/180	
2		2MSS-SGA02A/06A	45/225	
3		2MSS-SGA03A/07A	90/270	
4		2MSS-SGA04A/08A	135/315	
5	MSL-A LOWER ELEVATION 303' 2-7/16"	2MSS-SGA09A/013A	0/180	
6		2MSS-SGA10A/14A	45/225	
7		2MSS-SGA11A/15A	90/270	Gage 15A is inoperational starting at 90% power
8		2MSS-SGA12A/16A	135/315	
9	MSL-B UPPER ELEVATION 314' 10-5/16"	2MSS-SGB01B/05B	0/180	
10		2MSS-SGB02B/06B	45/225	Gage 02B is inoperational starting at 0% power
11		2MSS-SGB03B/07B	90/270	Gage 07B is inoperational starting at 0% power
12		2MSS-SGB04B/08B	135/315	
13	MSL-B LOWER ELEVATION 309' 6"	2MSS-SGB09B/013B	0/180	
14		2MSS-SGB10B/14B	45/225	Gage 14B is inoperational starting at 21% power
15		2MSS-SGB11B/15B	90/270	
16		2MSS-SGB12B/16B	135/315	
17	MSL-C UPPER ELEVATION 307' 3-5/16"	2MSS-SGC01C/05C	0/180	
18		2MSS-SGC02C/06C	45/225	Gage 06C is inoperational starting at 90% power
19		2MSS-SGC03C/07C	90/270	
20		2MSS-SGC04C/08C	135/315	
21	MSL-C LOWER ELEVATION 301' 11"	2MSS-SGC09C/013C	0/180	
22		2MSS-SGC10C/14C	45/225	
23		2MSS-SGC11C/15C	90/270	
24		2MSS-SGC12C/16C	135/315	
25	MSL-D UPPER ELEVATION 309'	2MSS-SGD01D/05D	0/180	Gage 05D not used starting at 0% Power
26		2MSS-SGD02D/06D	45/225	
27		2MSS-SGD03D/07D	90/270	
28		2MSS-SGD04D/08D	135/315	
29	MSL-D LOWER ELEVATION 303' 7-11/16"	2MSS-SGD09D/013D	0/180	Gage 09D not used starting at 0% Power
30		2MSS-SGD10D/14D	45/225	
31		2MSS-SGD11D/15D	90/270	
32		2MSS-SGD12D/16D	135/315	

2.2 Data Acquisition

2.2.1 Strain Gages

The strain gage data [2] was recorded on Structural Integrity's Versatile Data Acquisition System (SI-VersaDAS™), running VDAS Version 4.5 software. As previously described, 64 installed strain gages terminate at the data acquisition system and are combined appropriately into 32 channels. The SI-VersaDAS™ houses hardware including signal conditioning, an analog-to-digital (A/D) converter, and anti-aliasing filters to produce reliable raw data.

Data sets were recorded at eleven RP levels from cold conditions to 100% CLTP. Each data set contains 120 seconds of raw data for each of the 32 channels, recorded at 2,500 samples per second in binary format. The following approximate RP levels were captured: 0%, 9%, 21%, 55%, 64%, 75%, 85%, 90%, 95%, 97.5%, and 100% [2]. Immediately following each recording of raw data, an additional set of data was taken without any excitation voltage provided to the Wheatstone Bridge circuit. In this configuration, the strain gages effectively behave as antennae, capturing only electrical interference. By identifying particular frequencies that appear in both data sets, it is possible to attribute some peaks in the actual data to electrical interference or system noise. This technique is referred to as the Electric Interference Check (EIC). Filenames for each data set and EIC are listed in Table 2. Each file name is unique, and contains the year, date, and time that each set of data was recorded.

Plant parameters other than RP level play an important role in identifying the characteristics of the vibration signals. For this reason, plant parameters were provided at each recorded RP level and can be found in Reference [4].

At several points during plant startup, select strain gage signals were lost, or their quality was reduced to an unusable state. When a strain gage signal became unusable, it was lifted from the DAS and the corresponding channel was wired into a ¼-Bridge configuration as described in Section 2.1.1. The particular channels and gages affected, along with the RP level at which they were henceforth reconfigured, are listed in Table 1.

2.2.2 *Quarter Bridge Collection*

After data at 100% RP was collected, the strain gages associated with the MSL-A Upper and Lower locations (Channels 1-8) were re-wired into individual ¼-Bridge configurations. A data set was then collected for the 16 ¼-Bridge channels; the SI-VersaDAS™ file name is "20100506124508.dta." The intent of the reconfiguration is to evaluate the effects of other sources of mechanical strain such as bending. These strains will not contribute to the pressure fluctuations measured inside the pipe, and could produce overly-conservative results.

Table 2: Strain Gage Data Set Filenames and Dates

Power [% CLTP]		File Name	Date and Time	Comments
0%	DATA	20100502170828.dta	5/2/2010 17:08	
	EIC	20100502171154.dta	5/2/2010 17:11	
9%	DATA	20100503130645.dta	5/3/2010 13:06	Ch. 7, 14, 18 Invalid
	EIC	20100503131029.dta	5/3/2010 13:10	
21%	DATA	20100503205447.dta	5/3/2010 20:54	Ch. 7, 26 Invalid
	EIC	20100503205757.dta	5/3/2010 20:57	
55%	DATA	20100504160448.dta	5/4/2010 16:04	RR Pump Motor Upshift to 60Hz; Ch. 7, 22, 26, 30 Invalid
	EIC	20100504160746.dta	5/4/2010 16:07	
64%	DATA	20100505102523.dta	5/5/2010 10:25	Ch. 18, 22, 26 Invalid
	EIC	20100505102832.dta	5/5/2010 10:28	
75%	DATA	20100505134713.dta	5/5/2010 13:47	Ch. 18, 22, 26 Invalid
	EIC	20100505135006.dta	5/5/2010 13:50	
85%	DATA	20100505210141.dta	5/5/2010 21:01	Ch. 7, 18, 20, 26 Invalid
	EIC	20100505210435.dta	5/5/2010 21:04	
90%	DATA	20100506225502.dta	5/6/2010 22:55	
	EIC	20100506225753.dta	5/6/2010 22:57	
95%	DATA	20100507005743.dta	5/7/2010 0:57	
	EIC	20100507010037.dta	5/7/2010 1:00	
97.5%	DATA	20100507021043.dta	5/7/2010 2:10	Ch. 26 Invalid
	EIC	20100507021339.dta	5/7/2010 2:13	
100%	DATA	20100506111925.dta	5/6/2010 11:19	
	EIC	20100506112240.dta	5/6/2010 11:22	

2.3 Data Reduction

2.3.1 Strain Gages

Each set of data was reduced using UniPro 2.6.2, which is a custom software package developed in MATLAB [1].

In addition to the 32 physical channels in each data set, 8 virtual channels were created to calculate the averaged dynamic hoop strain at each measurement location. For instance, Channel 33 (Virtual Channel 1) contains data from physical channels 1-4, and represents the upper location on MSL-A. Channel combinations were performed in the time domain, so out-of-phase data was minimized. Channels with a ¼-Bridge configuration were excluded from the virtual channel compilations, to prevent the effects of pipe bending from influencing the pressure fluctuation measurements.

By following this approach, a total of 40 channels were processed (32 physical channels and 8 virtual channels). The 8 virtual channels (Channels 33-40) are identified by name (i.e. MSL-A-Upper, MSL-A-Lower, MSL-B-Upper, etc.).

2.4 Dynamic Pressure Estimates

Pressure conversion factors (PCFs) were developed in Reference [3] to determine the conversion from microstrain (με) to internal pressure (psi). Table 3 summarizes the PCFs for each MSL location.

Table 3: Pressure Conversion Factors [3]

Channel	MSL	Elevation	Mean PCF [psi/με]
1	A	Upper 315' 9-7/8"	3.82
2			
3			
4			
5		Lower 303' 2-7/16"	3.84
6			
7			
8			
9	B	Upper 314' 10-5/16"	3.84
10			
11			
12			
13		Lower 309' 6"	3.81
14			
15			
16			
17	C	Upper 307' 3-5/16"	3.85
18			
19			
20			
21		Lower 301' 11"	3.81
22			
23			
24			
25	D	Upper 309'	3.92
26			
27			
28			
29		Lower 303' 7-11/16"	3.94
30			
31			
32			

3.0 RESULTS

3.1 Strain Gages

The highest level of strain recorded at upper RP levels appears on Channel 23 (MSL-C-Lower) at 97.5% RP, reporting 0.2139 $\mu\varepsilon$-RMS.

3.2 Quarter Bridge Comparison

The collected ¼-Bridge data (see Section 2.2.2) was processed similarly to the SG data at 100% power. The individual ¼-Bridge channels for MSL-A Upper location were compared to the MSL-A-Upper virtual channel at 100% RP. Results show that, on average, the noise floor is reduced by using only channels in a ½-Bridge configuration (excluding ¼-Bridge configurations) for the virtual channels. The difference in noise floors can be partially attributed to the manner in which the ½-Bridge configuration minimizes bending strains and out-of-phase data.

3.3 Noise Floor Comparison

In Reference [5], a noise floor comparison test was performed between laboratory data and field data in order to show that the noise floor levels are low enough to avoid potentially interfering with real strain gage data. Comparing noise floors is also an excellent method by which to prove the quality of the strain gage and field cable installation, since additional noise can be generated from anything along the signal path such as cabling and interference through the penetration.

From the results, it is clear that 2010 EIC noise floors are extremely comparable to the 2008 data in terms of overall amplitude. Also, noise floors in the data for 100% and 21% RP remain slightly above the noise floors from the lab test. By observing these results, it is clear that no observable degradation has occurred in the noise floors between the 2008 and 2010 data collections; in addition, the noise floor from the 2010 data is comparable to the noise floor from the lab test, ensuring that the general amplitude of signal noise is not interfering with real strain gage data.

4.0 SUMMARY

Dynamic strain data was collected from 64 strain gages attached directly to MSLs A through D at NMP2 directly following the Unit 2 refueling outage. Data collection spanned 0% to 100% RP with more frequent data sets collected as Unit 2 approached 100% RP.

Observations:

1. The maximum overall strain at any RP level never exceeded 0.25 $\mu\varepsilon$-RMS. The highest recorded overall strain was 0.2139 $\mu\varepsilon$-RMS, occurring on Channel 23 at 97.5% RP.
2. Low-frequency content grows with increasing RP level. Most of this low-frequency content is below 50 Hz.
3. At 9% and 85% RP levels, Channel 25 experiences what appear to be brief disconnections. For this reason, the 9% data was only processed from 0-115 seconds, and the 85% data was only processed from 45-120 seconds in order to avoid processing the bad portion of the signal.
4. An unidentified electrical peak at 135.3 Hz was visible for all RP levels.
5. Channel 30 appears to have occasional spikes in the data, which are most likely electrical in nature. Spikes were noted at 64%, 90%, 95%, 97.5%, and 100% RP in the time history. These spikes do not significantly skew the results. The lone exception is at 55% RP, where large electrical spikes are present throughout the recording.
6. MSL-C-Lower reports the largest overall strain values.

5.0 REFERENCES

1. MATLAB, Version 7.5.0.342 (R2007b), Mathworks, September 1, 2007.
2. Nine Mile Point Unit 2 Strain Gage Data, May 2010, SI File No. 1000632.202.
3. SI Calculation No. NMP-26Q-301, Rev. 0, "Nine Mile Point Unit 2 Strain Gage Uncertainty Evaluation and Pressure Conversion Factors," SI File No. NMP-26Q-301.
4. Plant Parameters and FW Pump Information, "Strain Gages Summary Table," SI File No. 1000632.201.
5. SI Calculation No. NMP-26Q-302, Rev. 0, "Nine Mile Point Unit 2 Main Steam Line Strain Gage Data Reduction," SI File No. NMP-26Q-302.

ATTACHMENT 7

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

Nine Mile Point Nuclear Station, LLC
June 30, 2010

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

AFFIDAVIT

Re: C.D.I. Report No. 10-09P – "ACM Rev. 4.1: Methodology to Predict Full Scale Steam Dryer Loads from In-Plant Measurements," Rev. 1;
C.D.I. Report No. 10-10P – "Acoustic and Low Frequency Hydrodynamic Loads at CLTP Power Level on Nine Mile Point Unit 2 Steam Dryer to 250 Hz Using ACM Rev. 4.1," Rev. 1;
C.D.I. Report No. 10-11P – "Stress Assessment of Nine Mile Point Unit 2 Steam Dryer Using the Acoustic Circuit Model Rev. 4.1," Rev. 0;
C.D.I. Report No.10-06P – "Development and Qualification of Instrumentation to Determine Unsteady Pressures in Piping," Rev. 0; and
Structural Integrity Associates, Inc. Calculation Package File No. 1000632.301 "May 2010 Nine Mile Point Unit 2 Main Steam Line Strain Gage Data Reduction"

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. 10103 dated 28 June 2010, C.D.I. Report No. 10-09P – "ACM Rev. 4.1: Methodology to Predict Full Scale Steam Dryer Loads from In-Plant Measurements," Rev. 1; C.D.I. Report No. 10-10P – "Acoustic and Low Frequency Hydrodynamic Loads at CLTP Power Level on Nine Mile Point Unit 2 Steam Dryer to 250 Hz Using ACM Rev. 4.1," Rev. 1; C.D.I. Report No. 10-11P – "Stress Assessment of Nine Mile Point Unit 2 Steam Dryer Using the Acoustic Circuit Model Rev. 4.1," Rev. 0; C.D.I. Report No. 10-06P – "Development and Qualification of Instrumentation to Determine Unsteady Pressures in Piping," Rev. 0; and Structural Integrity Associates, Inc. Calculation Package File No. 1000632.301 "May 2010 Nine Mile Point Unit 2 Main Steam Line Strain Gage Data Reduction"

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 28 day of JUNE 2010.

Alan J. Bilanin
Continuum Dynamics, Inc.

Subscribed and sworn before me this day: June 28. 2010

Eileen P. Burmeister, Notary Public

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