CDI Technical Memo 06-23P (Non-Proprietary)
Comparison of the Hope Creek and Quad Cities Steam Dryer
Loads at EPU Conditions
Revision 0, dated September 2006

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C.D.I. Technical Memorandum No. 06-23P

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Revision 0

Prepared by

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

September 2006

Introduction

Steam flow in the main steam lines can excite oscillations in main steam line standpipes by a flow induced instability over the inlet to the standpipes. These standpipes connect safety and relief valves to the main steam lines to provide pressure relief capability. Quad Cities Units 1 and 2 (QC1 and QC2, respectively) appear to be the only domestic nuclear power plants where this excitation leads to large loads. In the Quad Cities units these oscillations – which originate in the main steam lines – propagate upstream into the steam dome and result in large steam dryer pressure loads at discrete frequencies. These loads for QC2 are now well documented (although the data remain proprietary) and are now reasonably understood (although prediction of amplitudes of these loads from first principles is not possible). A steam dryer load definition for the Hope Creek Nuclear Power Station (HC1) was developed by C.D.I. from subscale tests (Ref. 1), and the purpose of this note is to compare the measured steam dryer loads at QC2 (Ref. 2) with that measured/predicted for HC1 at EPU conditions. This memo documents a limited comparison of these data.

Quad Cities Unit 2 and Hope Creek Unit 1 Selected PSDs

Shown in Figure 1 are the Power Spectral Density functions for the measured differential pressure load on the QC2 steam dryer and the measured/predicted load for the HC1 dryer at EPU conditions. Nodes 7 (HC1) and 17 (QC2) are on the centerline between MSL C and D at the intersection of the cover plate with the outer bank hood. Nodes 99 (HC1) and 133 (QC2) are on the centerline between MSL A and B at the intersection of the cover plate with the outer bank hood. [[

_____ (3)]]. It is noted in passing that the standpipe resonant frequency for HC1 was predicted to be at 120 Hz and a peak can be seen in the PDS plots for HC1 at 120 Hz. [[

_____ (3)]].

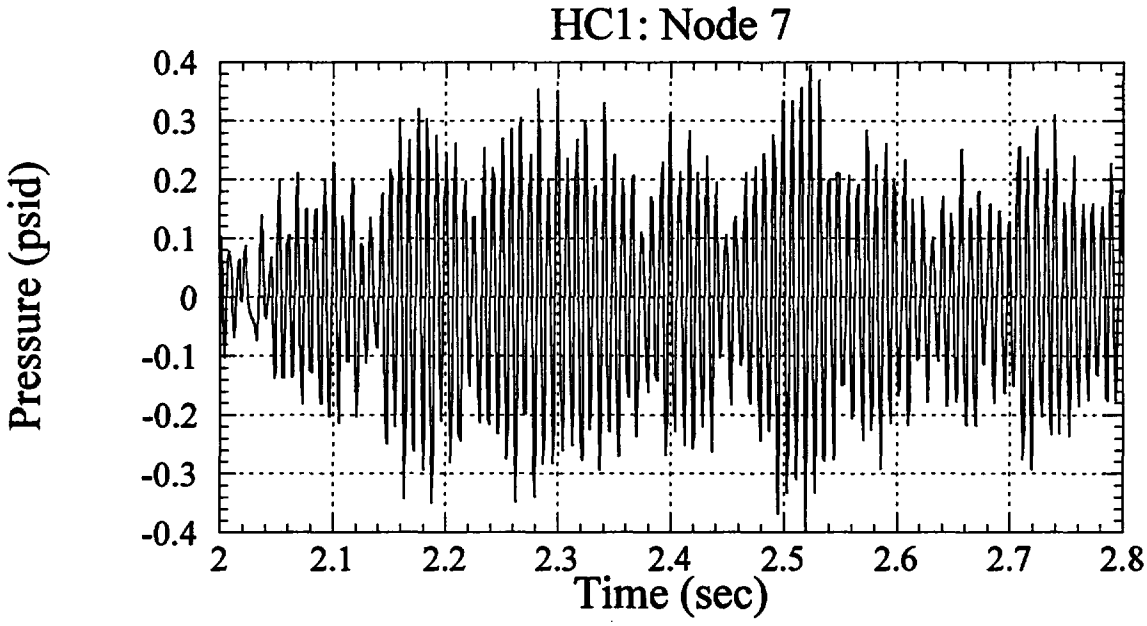
Time histories of the pressure differences are shown in Figure 2 and Figure 3 to compare HC1 and QC2 differential pressure loads. [[

_____ (3)]].

[[

]][3]

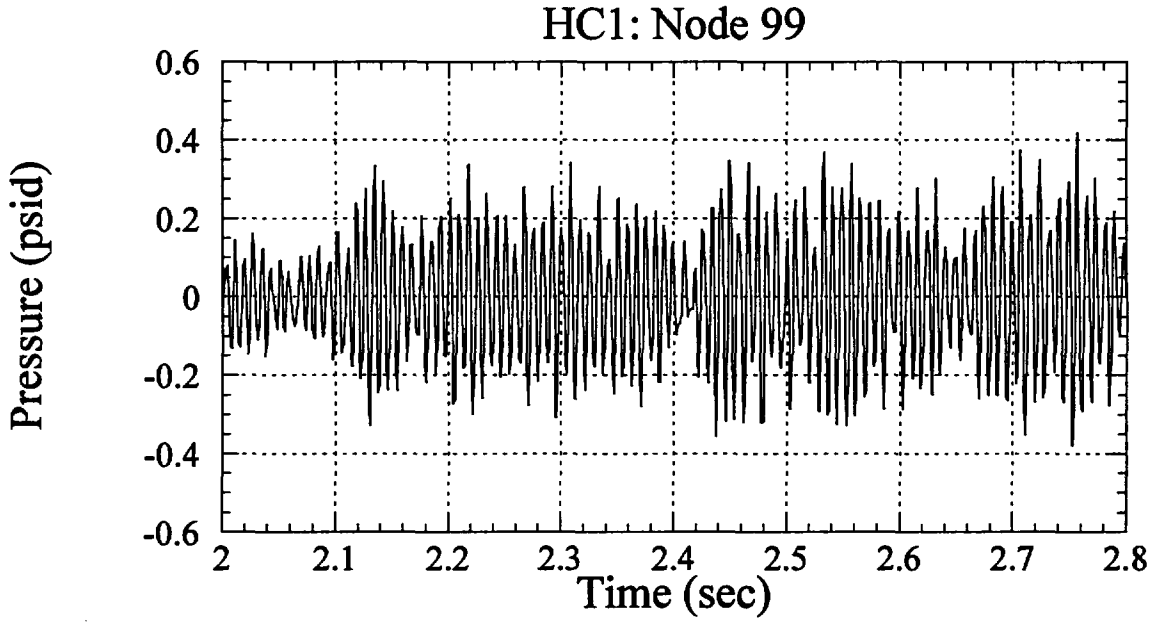
Figure 1. Comparison of PSDs of pressure difference at EPU conditions for Hope Creek Unit 1 (scaled from subscale experiments) and Quad Cities Unit 2.



[[

[3]]

Figure 2. Time histories of pressure difference across the dryer at nodes 7 (HC1) and 17 (QC2) at EPU conditions. [[[3]]



[[

(3)]]

Figure 3. Time histories of pressure difference across the dryer at nodes 99 (HC1) and 133 (QC2) at EPU conditions. [[(3)]].

Quantitative Comparison of the Loads

Tabulated below is a quantitative comparison of the two loads for HC1 and QC2.

	Minimum Pressure (psid)	Maximum Pressure (psid)	RMS (psid)
HC1: Node 7	-0.42	0.39	0.12
[[			[3]]]
HC1: Node 99	-0.45	0.42	0.13
[[			[3]]]

[[

_____.[3]]] This evaluation does not take credit for the fact that the HC1 EPU load is conservative and has been discussed elsewhere.

References

1. Continuum Dynamics, Inc. 2006. Estimating High Frequency Flow Induced Vibration in the Main Steam Lines at Hope Creek Unit 1: A Subscale Four Line Investigation of Standpipe Behavior. C.D.I. Report No. 06-16 (Revision 1).

2. Continuum Dynamics, Inc. 2006. Bounding Methodology to Predict Full–Scale Steam Dryer Loads from In-Plant Measurements. C.D.I. Proprietary Report No. 05-28P (Revision 1).

3. Continuum Dynamics, Inc. 2006. High and Low Frequency Steam Dryer Loads by Acoustic Circuit Methodology. C.D.I. Proprietary Technical Memorandum No. 06-25P.