FORM-1
VENDOR INFORMATION

PSEG NUCLEAR LLC VTD NUMBER: 326560

- [x] ACTIVE — Approved Documentation
- [ ] APCP — Approved, Pending Change Package (May only be used for Rev. 1)
- [ ] CAN — Canceled, Not Required
- [ ] VOID — No longer applicable, superseded by :____________

Discipline Selection

[ ] Electrical [ ] I&C [ ] Mechanical [x] Other Specify: PIPE STRESS

Safety Related: [x] Yes [ ] No

UNIT APPLICABILITY

[ ] Salem 1
[ ] Salem 2
[ ] Salem 3
[ ] Salem Common
[x] Hope Creek
[ ] Hope Creek & Salem
[ ] PSEG Nuclear LLC

System / Title: REACTOR RECIRCULATION SAP Sys Code: BB

Vendor Name: VIBRALIGN INC.

Vendor Code: 121V Vendor No.: REPORT 040555BP

Vendor Category: 438 (Category Codes are listed in DCRMS.)

Purchase Order No. 4500246510

Material Master: N/A

Originator: J. BARKHAMER Dept: DESIGN ENG Group: CIVIL

Date: 06/16/04 Ext: 1996

If changes are made to this form, initial and date the change and document in the revision summary.

ORM-2
REVISION SUMMARY

PSEG NUCLEAR LLC VTD No. 326560

PS REV	DOC REV	DATE	EVALUATOR *	SUPERVISOR *	DISCIPLINE INTERFACE *	REVISION DESCRIPTION
1	0	6/16/04	J. BARKHAMER (signature)	A Johnson (signature)	NA	ORIGINAL ISSUE

* SIGN & PRINT NAME

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Evaluation and Vibration Testing of Recirc. and RHR Piping Instrumentation 12-14 May, 2004

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Report Date:
16 May, 2004

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VibrAlign Job Number:
040555BP

1.0 Introduction

VibrAlign, Inc. was commissioned by PSEG Nuclear LLC to assist in the evaluation of vibration data collected on the Recirculation and RHR piping lines. Prior to VibrAlign's involvement, a vibration monitoring system had been installed to monitor selected locations on the RHR and Recirculation lines located within the Hope Creek Drywell. During plant startup an unexplained step increase in vibration level occurred. The step increase was noted on all monitored channels. While the increase was not believed to be due to an actual change in level, the specific cause of the increase could not be identified. VibrAlign was specifically requested to review collected vibration data, verify data acquisition system installation for potential "noise" sources, and collect an independent set of vibration data comparable to that being collected by the data acquisition system. Results of this testing is documented in the following sections of this report.

Secondly, we were requested to assist the plant in identifying the source of an audible noise which could be heard on the A RHR piping within the North Pipe Chase. For this portion of the project, we worked in conjunction with a service engineer from Framatome who was contracted by the plant to assist in the "noise" evaluation. The Framatome engineer had already collected a significant portion of the data required to adequately evaluate the potential sources of the noise. Comments contained in this report pertaining to the audible noise are based on limited data collected by Vibralign along with a system walk down and review of the Framatome collected data.

2.0 Test Setup

All data presented in this report was acquired from plant equipment installed on the Recirculation and RHR lines. This instrumentation included 13 high temperature accelerometers with the associated charge amplifiers and cables, accelerometer power supply and digital data acquisition system. The accelerometers, charge amplifiers, cables, and power supply were manufactured by Endevco while the digital data acquisition system was manufactured by National Instruments with software by Structural Integrality.

All measurements contained in this report were acquired using a DLI Engineering DCX 4 channel data acquisition system running ExpertALERT and Signal AQ software. The DCX was connected directly to the Endevco power supply outputs in order to sense the acceleration signals directly; thus bypassing the station installed data acquisition hardware. Both the ExpertALERT and Signal AQ software packages provide advanced signal analysis capability. For the troubleshooting of the data acquisition system the ExpertALERT analysis software was utilized for its ability to integrate signals and ease of data comparison. While the Signal AQ software package was used to assist in the identification of the RHR audible noise.

3.0 Summary of Results

A. Evaluation of plant collected vibration data indicated that low level signal noise (not actual vibration) was being amplified as a result of the integration process. This activity had a negative impact on the vibration levels being reported to the plant. This was evident from review of integrated spectrum data which showed a Ski Slope effect at low frequencies. The low frequency Ski Slope components were caused by the double integration of low level signal noise and not representative of actual piping vibration. The effects of double integrating acceleration signals and the potential for amplitude error are well recognized and documented.

B. Trouble shooting of the installed transducer and data acquisition system showed the signal noise to be electrically induced due to a system ground loop. This resulted in the presence of a 60 Hz. component and low level signal noise being induced onto the acceleration signal. Evaluation showed that the most effective method of reducing the signal noise was to isolate the electrical input of the power supply from plant ground. Figure 1 shows before and after spectrums of the A RHR Vertical transducer location. Evaluation showed that noise was reduced on all monitored channels.

C. Accelerometer Bias Voltage was checked on all installed transducers. The Bias voltage was measured to be between 13.1 and 13.5 Vdc on all transducers with the exception of channel 10 which was measured to be 9.1 Vdc.

D. Channel 10 was not functional during our evaluation. (Figure 2)

E. Channel 6 showed some initial failure indications. Review of the time signal at this location showed that the transducer output was being affected intermittently. (Figure 3)

F. Following reduction in signal noise the acceleration signals were double integrated to displacement using an analog integrator and then passed thru a 5 Hz high pass filter before overall amplitudes were recorded. This was a similar process to what was being performed by Structural Integrity. Review of the collected data showed that amplitudes had been significantly reduced with the highest levels being measured on the Jet Pump at 6.7 Mils Pk-Pk. See Table 1.

G. Review of the acquired spectrum still showed that the overall level was still dominated by low frequency components not believed associated with actual piping motion. This response characteristic is typical for acceleration signals which have been double integrated to displacement. See Figure 4.

H. Data acquired and subsequently analyzed by Structural Integrity following reduction of the signal noise 13 May, 2004 confirmed the decrease in measured overall level. However data acquired 14 May indicated that the overall level on channels 1-3 (A RHR) had increased, displaying both an increase in spectrum noise floor and discreet component level. As the result of a conference call between PSEG, Structural Integrity and VibrAlign the following actions were agreed in order to verify validity of the increase. These were to shutdown and restart both the computer and data acquisition system and acquire data. Secondly following restart of the system, increase the input voltage level specified in the setup file. Information provided to VibrAlign indicated that the total system reboot had no effect on the measured level however changing the input voltage level resulted in a decrease in overall displacement levels.

I. Review of data collected on the A RHR line indicates that the audible noise noted in the North Pipe Chase is most likely the result of a problem with either the Check or Bypass Valve located in the Drywell. Collected data shows evidence of high frequency impacts due to component movement. Impact response was measured on the piping both within and external to the Drywell. This indicates that the source of the impacts is between the measurement points making the valves the most likely source. Inspection of the valves during a unit outage is warranted. See figure 5.

4.0 Measurement Results and Discussion

Reduction of the 60 cycle component and noise floor by floating the ground on the accelerometer power supply. The apparent ground loop was believed to be caused by the potential difference in ground between the installed accelerometer system in the Drywell and the plant ground available at the power outlet that the power supply was connected to. Isolation of the ground at the power supply reduced both the 60 Hz. component and the low level induced noise caused by the potential difference.

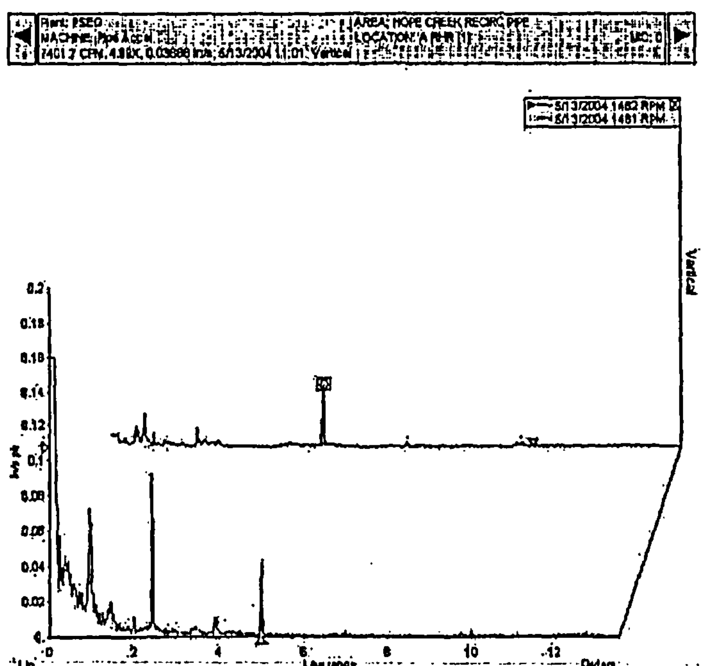

Figure 1- Before and After Noise Reduction

Review of the installed transducers showed that Channel #10, B RHR Perpendicular, was not functional during our evaluation of the system. This was indicated by a low measured Bias Voltage and through review of the acquired signal. Figure 2 shows a spectrum of channel 10 following reduction of the electrical signal noise.

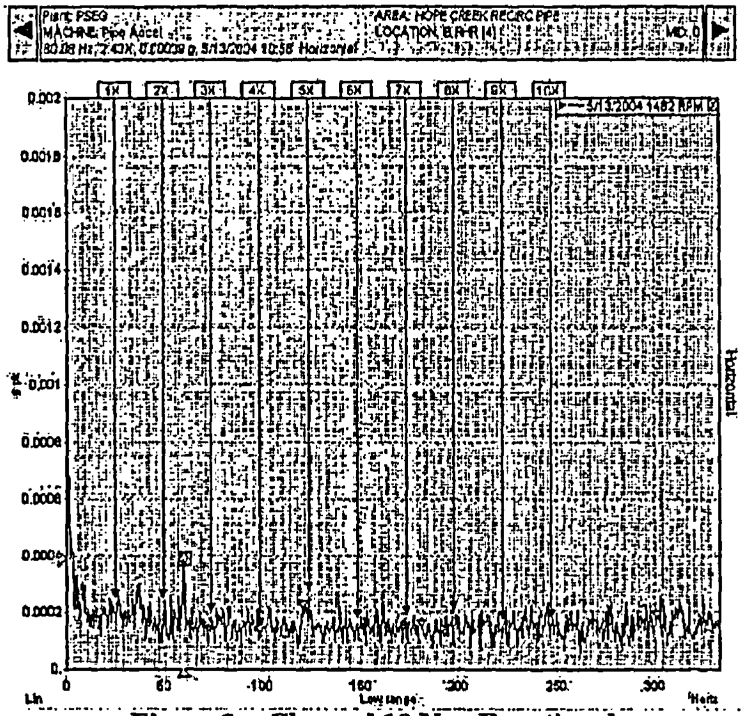

Figure 2 – Channel 10 Non Functional

During evaluation of the accelerometer outputs it was noted that channel 6, A Recirc Vertical, showed indications of intermittent failure. This condition was not always present. This was most easily seen on in the time waveform of the acceleration signal.

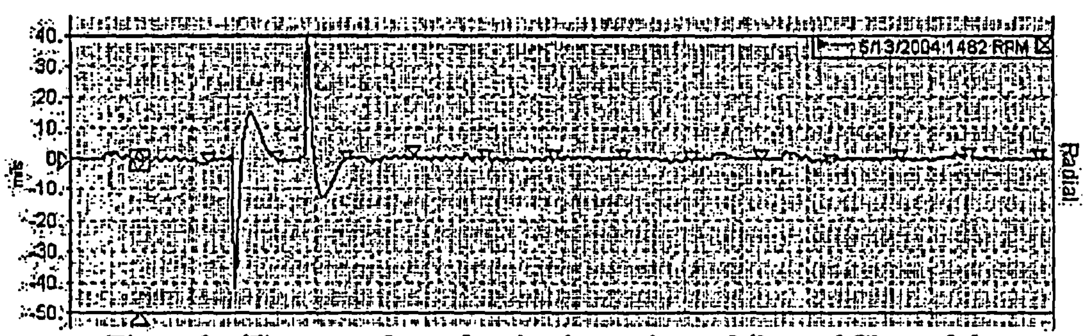

Figure 3 – Time waveform showing intermittent failure of Channel 6

Overall displacement amplitudes were acquired following reduction of the signal noise. This was accomplished by double integrating the acceleration signals and then passing the output through a 5 Hz. high pass filter before acquiring the time waveforms and spectrums. The 5 Hz. high pass filter was used to suppress low frequency integration noise present. The presence of low frequency components in an acceleration signal which has been double integrated is not unusual. However, as can be seen in Figure 4 the low frequency components resulting from this manipulation of the data can dominate the reported vibration levels.

Channel	Location	Displacement Mil Pk-Pk
1	A RHR Vertical	2.6
2	A RHR Inline	2.6
3	A RHR Perpendicular	1.9
4	A Recirc Inline	3.0
5	A Recirc Perpendicular	2.1
6	A Recirc Vertical	3.4
7	Recirc Jet Pump Vertical	6.7
8	B RHR Vertical	1.2
9	B RHR Inline	2.3
10	B RHR Perpendicular	0.8
11	B Recirc Vertical	2.6
12	B Recirc Inline	2.6
13	B Recirc Perpendicular	2.2

Table 1 – Overall Vibration Level

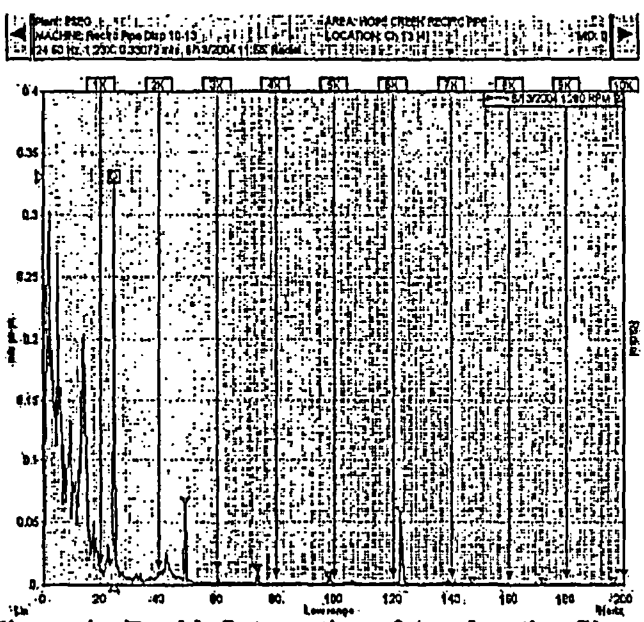

Figure 4 – Double Integration of Acceleration Signal

Review of data collected on the A RHR line indicates that the audible noise noted in the North Pipe Chase is most likely the result of a problem with either the Check or Bypass Valve located in the Drywell. Collected data shows evidence of high frequency impacts due to component movement. Impact response was measured on the piping both within and external to the Drywell. This indicates that the source of the impacts is between the measurement points making the valves the most likely source. Figure 5 is representative of the impact response measured on the A RHR line.

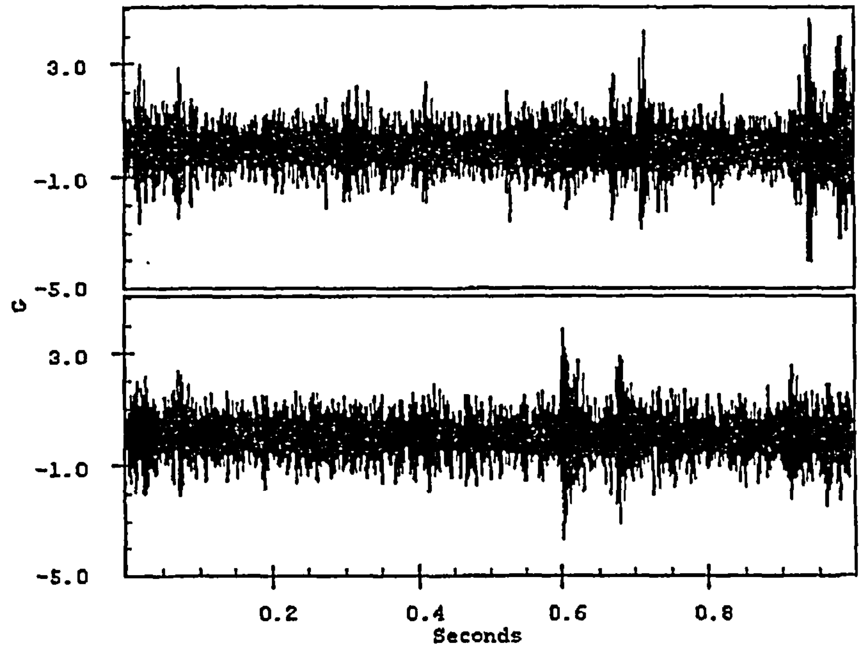

Figure 5 – Impacting on A RHR Line