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VIBRATION ASSESSMENT OF UNIT 55 PIPEWORK

LOCATION: SOKU GAS PLANT

REPORT NO: STATIC VIB/2022/EA/SGP-001

SURVEY PERIOD: 29th October – 3rd November 2022

WORK ORDER NO:

CSI - 2140

CSI – MAGNETIC PROBES (Accelerometer)

Contact: Esaduvie Ayonoadu **(VA CAT I – VIA17113251AA)** | Bashiru Bello **(VA CAT II – 1712-8188A)**

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Ref Indicator: UPC/G/USMI | UPC/G/USMI

this report contains the findings of the vibration assessment of pipework around condensate spiking pumps in Soku Gas Plant on the

29th October – 3rd November 2022

TABLE OF CONTENTS:

Work Scope	Vibration Assessment of Pipework Around Condensate Spiking Pumps
Location	SOKU GAS PLANT
Survey Date	29th Oct. – 3rd Nov. 2022
Vibration Test Equipment	CSI 2140, Accelerometer Probe
Data Collection Team	Obiobu Richman **(VA CAT II – M-148301-01, ICML-MLA – 1-003403)** Nwagor Emmanuel **(ASNT II UT – GRNL/UT/4945)**,
Data Analyst	Obiobu Richman **(CAT II – M-148301-01, ICML-MLA – 1-003403)**
Report Review Team	Bashiru Bello (VI CAT II - 1712-8188A) Ikenna Osonwanne (API 571-94741) Amandi Onuba **(VA CAT II – M-125951-02, FMEA – ZSSFM121143442)**,– Fredricks Okoro (VA CAT 1- M-125995-01, VA CAT II Trained),
Report No.	STATIC VIB/2022/EA/SGP-001

About this Report:

This report and the information in it are based on our findings as at the time of the survey. We recommend that you read this report carefully and use the information in it as part of your on-going monitoring of your equipment and as a significant input in your decision making

…………………………………………………….
Esaduvie Ayonoadu
(Condition Monitoring Lead)

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List of Abbreviations

EIG Energy Institute's article, "Guideline for avoidance of vibration induced fatigue failure in process pipework.

SBC Small Bore Connection

IMS Integrity Management System.

GS.09.54406 Shell Global Solution Assessment Procedures for Vibration Induced Fatigue in Process Pipework.

LOF Calculations of likelihood of failure.

NDE Non-Destructive Examination

S-RBI Shell Risk Based Inspection

SGP Soku Gas Plant

Executive Summary

The vibration assessment of Unit 55 (condensate spiking pumps) pipework in Soku Gas Plant was based on Energy Institute's article, "Guideline for avoidance of vibration induced fatigue failure in process pipework" (Henceforth referred to as EIG) and "Shell Global Solution Assessment Procedures for Vibration Induced Fatigue in Process Pipework "(Henceforth referred to as GS.09.54406 T25). EIG Technical Module, T5-Visual Inspection-Piping was applied for the visual inspection while EIG T7-basic piping vibration measurement technique was applied for vibration data acquisition and EIG T7-2 Assessment Criteria was finally applied for data analysis.

The visual inspection revealed a total failure of the entire pipe support system around Unit 55. The total collapse of the support system/structure reduces the broadband natural frequencies of the pipework and exposes the entire pipework to vibration initiated by excitation frequency, coincidence of excitation frequencies and natural frequencies by the least excitation force, energy inputs at the system's natural frequencies and flow induced turbulence. Vibration data analysis indicates that there exists a high risk of fatigue damage already occurring in some areas while other areas possess a potential for fatigue damage to occur around the pipework.

Therefore, it is imperative that any malfunctioning supports should be rectified taking into cognizance EIG Technical Module, T2.2.3.3 / GS.09.54406-T25 determining support arrangement, stiffen the support system, tighten up support clearance, Install two (2) plane brace and clamp on the small-bore connections (SBCs), Install wear resistant compliant layer/ resilient pad between the pipework and the support surfaces to avoid the risk from fretting and carry out NDE to evaluate relevant welds. Thereafter, a vibration re-assessment using other more advanced specialist techniques can be done to ensure that the vibration levels are within acceptable limits and recorded in the integrity management system data base.

Introduction

The natural frequencies of the pipework in Unit 55(condensate spiking pumps) in Soku Gas Plant (SGP) are controlled by the system’s mass and stiffness (pre-charged pulsation dampeners and supports systems) and highly susceptible to vibration by the least excitation force.
The high vibration problem currently encountered on the piping system and their peripheral equipment around the spiking pumps at SGP has led to propagation of fatigue crack and consequent failure of the small-bore connection on spiking pump A. This threat further exposes the entire piping system to more fatigue failures on the main pipe work (discharge header line), other small-bore connections (SBCs) on the spiking pump B, C & D two inches (2´´) discharge and suction pipes, four inches (4´´) relief valve pipes, instrument connections and braces, damage to support connections, fretting of pipe work and associated structures, leaking of instrument tubing and loosing of bolts. Therefore, the critical nature and magnitude of the excessive vibration necessitated assessment and troubleshooting for the underlying root causes in greater details. Static equipment vibration is a multidisciplinary field that requires in-depth understanding of the entire SGP process, rotating equipment vibration, fluid dynamics, fluid to structure-interactions, pressure relief system design, structural vibration and acoustic vibration.
The vibration assessment was carried out based on Energy Institute’s article, “Guideline for avoidance of vibration induced fatigue failure in process pipework”. (Henceforth referred to as EIG) and consists of five (5) main steps,

1. Visual inspection of the entire pipework around the spiking pumps based on the EIG Technical Module, T5-Visual Inspection-Piping.

2. Acquisition and measuring a broadband vibration data (level, frequencies and natural frequencies) at different locations in adherence to EIG Technical Module, T7-Basic Piping Vibration Measurement Technique.

3. Comparative analysis of vibration level and frequencies against associated standards (EIG Technical Module, T7.2.2-vibration assessment criteria) to identify regions and areas of concern.

4. Investigation of different excitation mechanisms (tonal excitation-resonant, tonal excitation-forced & broadband excitation) as well as identifying the sources of vibration ((Flow induced turbulence, Mechanical excitation, pulsations etc...)

5. Implementing recommendations and system modifications if necessary to eliminate excessive vibration.

ASSESSMENT METHODOLOGY

1. Visual Inspection.

A visual inspection of the entire pipework around the condensate spiking pumps in SGP was carried out based on EIG Technical Module, T5-Visual Inspection-Piping. The aim of the inspection is to observe and decipher the cause of the reported failure and to help identify any potential piping issues or subjectively high vibration under certain operating conditions. Based on the outline provided by EIG, a worst-case operating condition (all four spiking pumps in operation) should have been ideal to carry out the assessment. However, a near worst case with three spiking pumps in operation was rather used due to the reported failure on spiking pump A. During the inspection, key sections of EIG Technical Module, T5-Visual Inspection-Piping, T5-1a-f, T5-2a-b T5-3a-c, T5-4 & T5-5 was applied, and the following observations was made.

a) Low, medium and high frequency vibration was observed to be present in the pipework around the condensate spiking pumps.

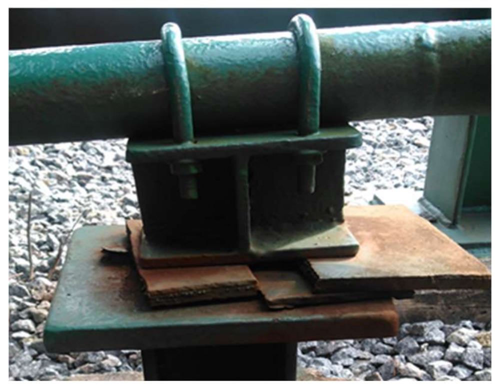
b) Fretting damage was observed. Typically, this occurs where there is relative movement between two moving surfaces. The movement could be small but can result in substantial localized loss of pipe wall. Areas considered for fretting damage includes U-bolt, resting support, deck penetration, loose insulation cladding, contacts between two pipes and temporary support etc.

c) Pipe support. The visual examination of the entire pipe support around the condensate spiking pumps revealed the following.

- Failed/no resilient pad between support and pipe.
- Concrete pipe support plinth detached from the ground.
- Pipe work is flexible and insufficiently stiff. A catalyst for excitation
- Pipework guide support slid off hanger allowing the pipework to vibrate.
- Poor practice of missing or damaged support.
- Defective support foundation.
- Pipework clear of resting support (air gap).
- Temporary fix of mass loading to detune of a structural resonance still in place.
- No support/bracing/clamping for SBCs on discharge and suction lines.

See attached pictures below.

Table 1- Pictures depicts the current defective state of the pipe support system of the pipework around the spiking pumps.

The inspection thus revealed a total failure of the entire pipe support system around the condensate spiking pumps. This total collapse of the support system/structure exposes the entire pipework to vibration initiated by excitation of natural frequencies by the least excitation force.

2 Vibration Frequency Measurement

Vibration velocity measurement was acquired based on the recommendation provided by EIG, T7-basic piping vibration measurement technique.

a) T7.2.1- Appropriate off route configured AMS 2140 Machinery Health Analyzer and accessories were used for the vibration data collection.

b) Vibration data measurement was acquired from several locations namely.

- SBCs on suction and discharge drain line on each of the condensate spiking pumps.
- Relief valve line on each condensate spiking pump,
- Mid span of unsupported pipe on the discharge header line on each condensate spiking pump,
- Large, lumped mass of check valve flange on each condensate spiking pump.
- Vibration measurement was acquired from three axes with a uniaxial accelerometer.

d) For SBCs, measurement was taken from the furthest flange from the connection to the main pipe.

e) EIG T7.2.1.1 was applied in selection of an appropriate transducer.

f) EIG T7.2.2. Was applied in attaching the transducer to the pipework.

g) EIG T7.2.2.3 was applied on FFT analyzer/data logger setup. A brief summary of the analyzer setup includes the following.

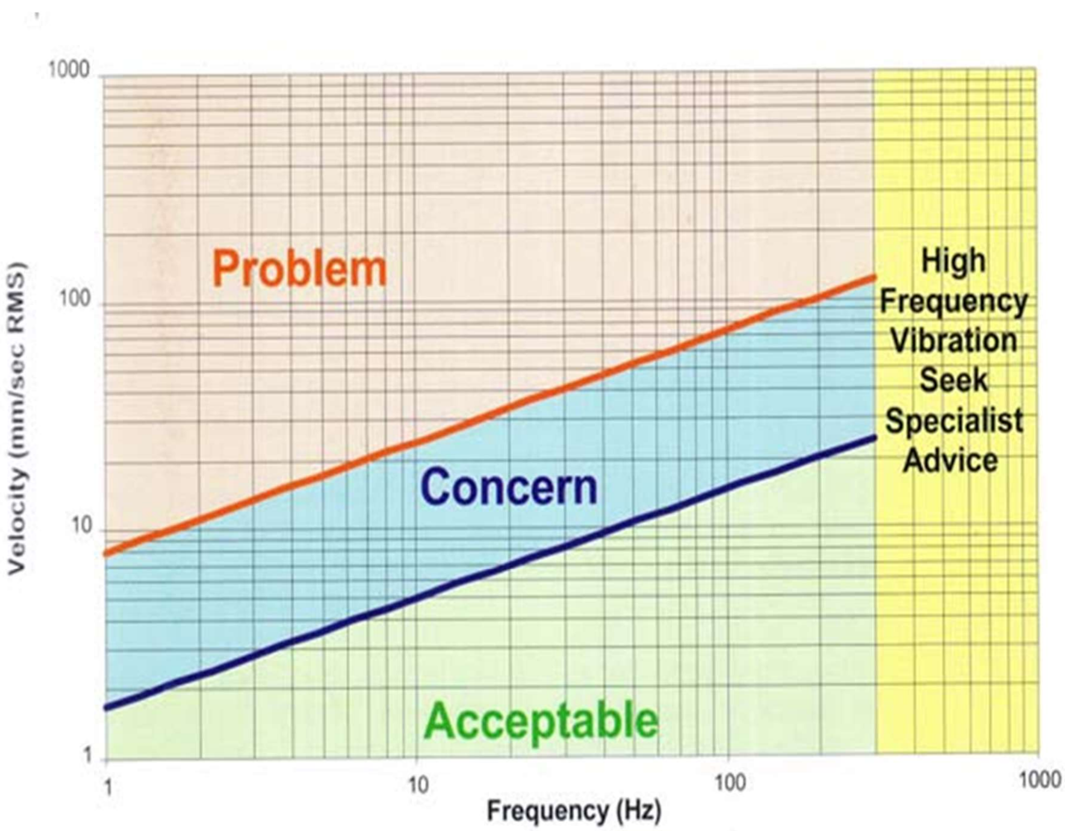
- AMS 2140 machinery Health analyzer was setup to measure velocity mm/sec rms.
- Frequency range of 1000 Hz
- Resolution; 800 lines with resolution of 1.25 Hz
- Number of averages; Ten (10) averages

- Accelerometer was employed and the signal was integrated to velocity RMS in the analyzer

h) Bump test to determine the natural frequency of each of the locations described above was also done.

3. **EIG T7-2 Assessment Criteria**

The vibration assessment criteria for both the main pipe and small-bore connection are given below, using the measured RMS levels and the peak frequency of the measured response.



Summary of Measurement Points, Dominant Frequencies in Hz & their Amplitude in RMS mm/sec

SPIKING PUMP B										
Measurement Points	**Dominant Frequency in the Spectrum (HZ)**			**Peak Amplitude in RMS mm/sec**			**Assessment Criteria**			**Implication**
	H	**V**	**A**	**H**	**V**	**A**	**H**	**V**	**A**	
Suction drain line	46.73	23.20	47.86	2.31	1.12	4.14	Accept	Accept	Accept	Record in IMS
Discharge drain line	23.92	23.43	23.92	39.73	4.55	39.57	Concern	Accept	Concept	Potential for fatigue damage to occur
discharge line check valve	64.69	24.11	22.13	2.84	3.82	4.76	Accept	Accept	Accept	Record in IMS
RV Line	13.77	13.44	13.26	15.62	13.17	8.13	Concern	Concern	Concern	Potential for fatigue damage to occur
Unsupported Mid Span	23.99	23.15	23.44	15.18	16.06	12.03	Concern	Concern	Concern	Potential for fatigue damage to occur

SPIKING PUMP C										
Measurement Points	**Dominant Frequency in the Spectrum (HZ)**			**Peak Amplitude in RMS mm/sec**			**Assessment Criteria**			**Implication (Risk of fatigue damage Occurring/ To occur**
	H	**V**	**A**	**H**	**V**	**A**	**H**	**V**	**A**	
Suction drain line	46.73	23.20	47.86	2.31	1.12	4.12	Accept	Accept	Accept	Record in IMS
Discharge drain line	23.92	35.36	23.92	39.73	8.29	39.57	Concern	concern	Problem	There is high risk of fatigue damage occurring
discharge line check valve	25.75	24.11	12.64	3.67	3.82	5.09	Accept	Accept	Concern	Potential for fatigue damage to occur
RV Line	13.77	13.44	13.26	15.63	13.17	8.13	Concern	Concern	Concern	Potential for fatigue damage to occur
Unsupported Mid Span	23.99	23.15	23.44	15.18	16.06	12.03	Concern	Concern	Concern	Potential for fatigue damage to occur

SPIKING PUMP D										
Measurement Points	**Dominant Frequency in the Spectrum (HZ)**			**Peak Amplitude in RMS mm/sec**			**Assessment Criteria**			**Implication (Risk of fatigue damage Occurring/ To occur)**
	H	**V**	**A**	**H**	**V**	**A**	**H**	**V**	**A**	
Suction drain line	47.42	48.16	19.03	9.45	6.60	2.51	Concern	Accept	Accept	Potential for fatigue damage to occur
Discharge drain line	47.76	24.01	24.16	24.67	21.68	13.58	concern	Concern	Concern	Potential for fatigue damage to occur
discharge line check valve	24.06	23.91	23.86	13.71	17.36	7.51	Concern	Concern	Accept	Potential for fatigue damage to occur
RV Line	39.00	22.95	66.39	2.30	21.17	4.74	Accept	Concern	Accept	Potential for fatigue damage to occur
Unsupported Mid Span	24.08	24.07	24.05	25.53	5.82	6.13	Accept	Accept	Accept	Record in IMS

Recommendation

1.

EI Guideline Assessment Category	Susceptibility to Failure	Recommended Action
Acceptable	Low	Record in IMS
Concern	Medium	✓ Implement applicable corrective actions listed below. ✓ Consider NDE of relevant welds to ensure fatigue cracks have not initiated. ✓ S-RBI vibration screening module SR.16.10669. the assessment should be done using the software tool pipework LOF
Problem (Immediate action required)	High	✓ Implement applicable corrective actions listed below ✓ Consider NDE of relevant welds to ensure fatigue cracks have not initiated. ✓ S-RBI vibration screening module SR.16.10669. the assessment should be done using the software tool pipework LOF.

2. Tighten up clearance on support; the existing clearances on the pipework allow the pipework to move freely resulting in excessive vibration. By tightening the clearance on the support, the fundamental natural frequency of the pipe is increased thus reducing energy level in the system.

3. Avoid metal to metal contact; Install wear resistant compliant layer/ resilient pad between the pipework and the support surfaces to avoid the risk from fretting.

4. Reduce fluid velocity: Increasing the diameter of the main pipe and the operating conditions will reduce the excitation energy from fluid induced turbulence and the response of the pipework. Reduction in excitation energy and the response of the pipework will reduce the vibration level currently experienced in the system.

5. Install anti-vibration mounts to isolate the source of excitation from the rest of the system.

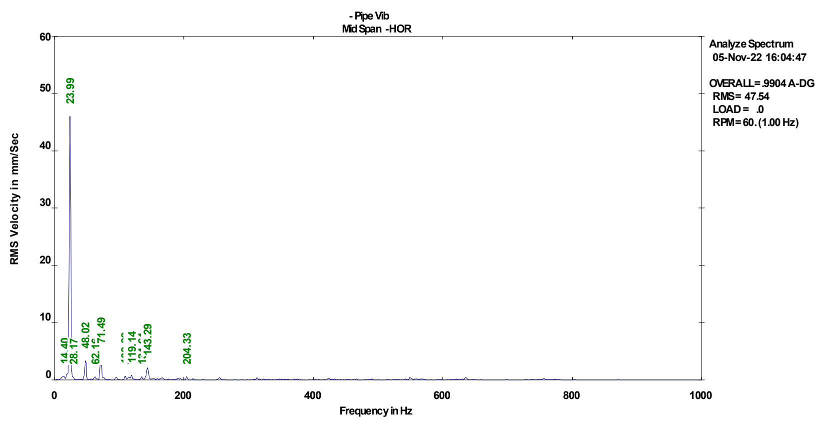
6. The speed of the condensate spiking pump should not be within ± 20% of the nearest acoustic natural frequency.

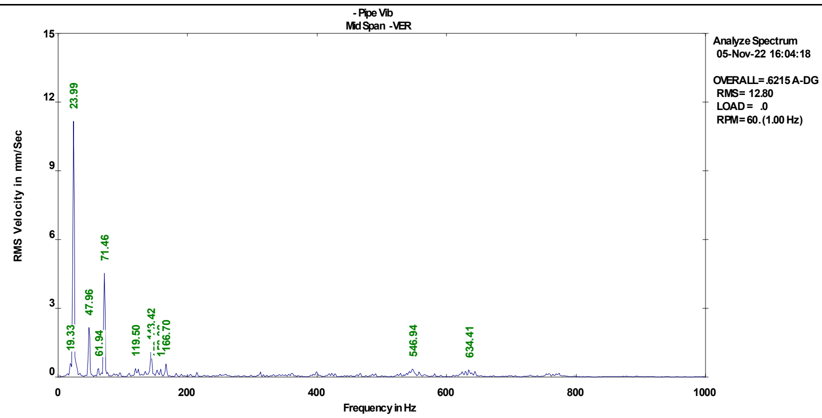
7. Install two (2) plane brace and clamp on the SBCs located on the discharge drain line and the suction drain line on each of the spiking pumps A, B, C &D. Ensure that the SBCs are firmly supported.

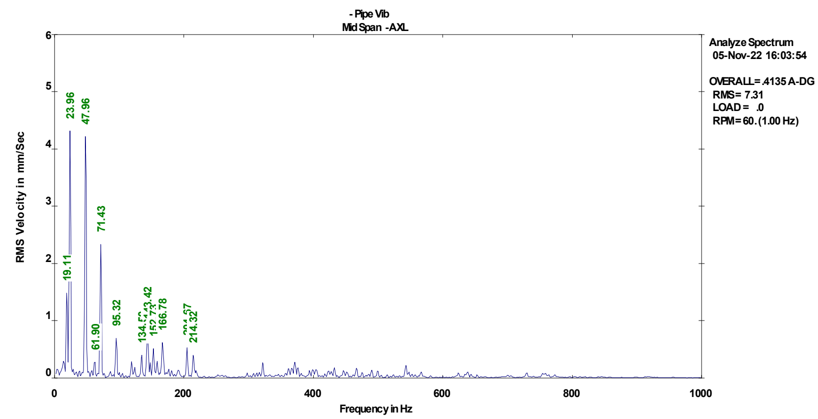
References

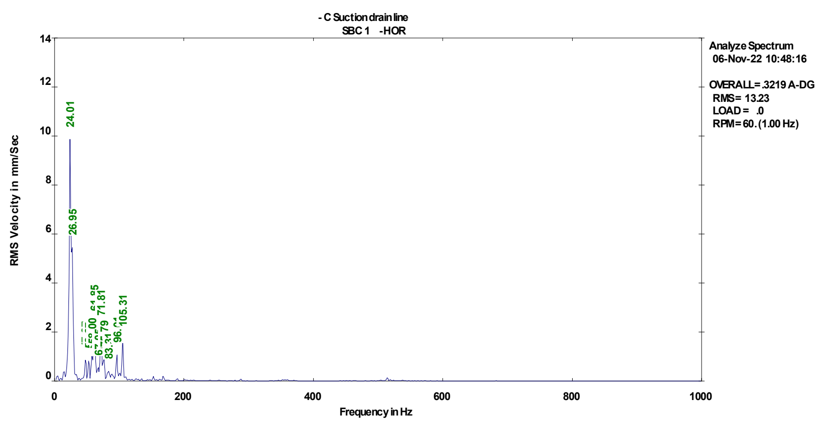
1. Energy Institute's article, "Guideline for avoidance of vibration induced fatigue failure in process pipework".
2. Draft AMS 5.04.05-Pipework Vibration Recommended Practice
3. API 571 Damage Mechanisms
4. Shell Global Solution Assessment Procedures for Vibration
5. API Standard 618: Reciprocating Compressors for Petroleum, Chemical and Gas Industry Services

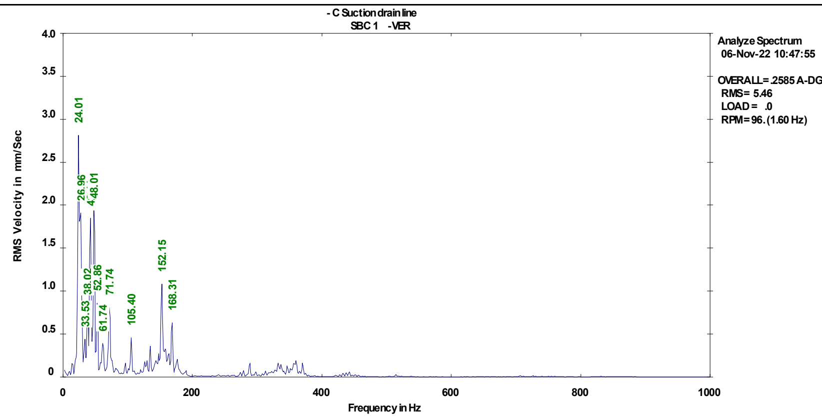
5 Appendix 1 Vibration Spectrum from some of the measured points

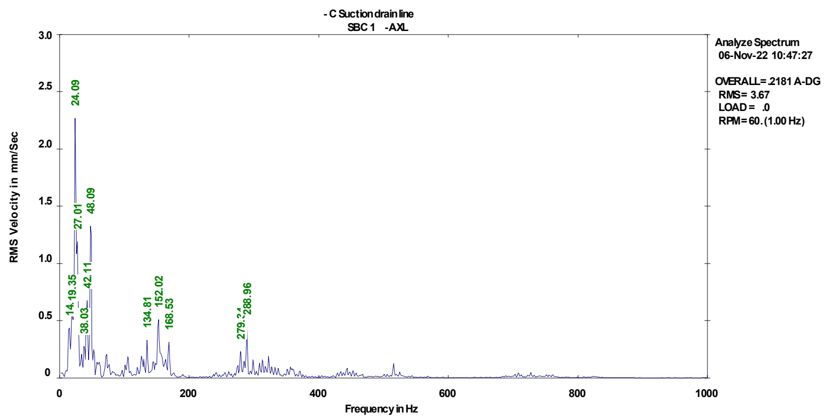


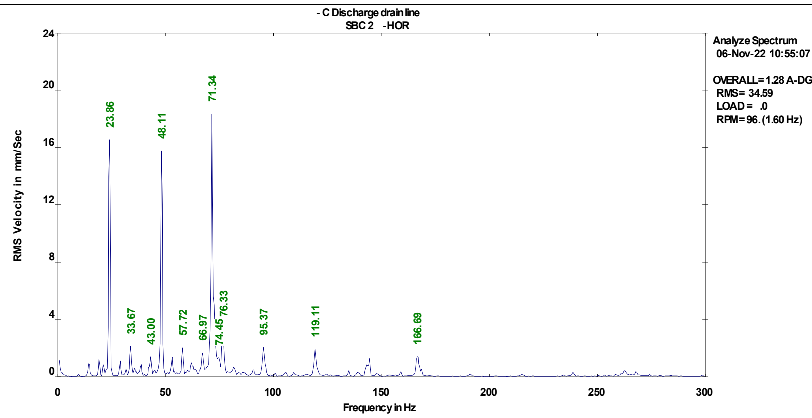

- Pipe Vib
Mid Span -VER
Analyze Spectrum
05-Nov-22 16:04:18
OVERALL= .6215 A-DG
RMS= 12.80
LOAD= .0
RPM= 60. (1.00 Hz)
RMS Velocity in mm/Sec
Frequency in Hz
23.99
71.46
47.96
19.33
61.94
119.50
166.70
546.94
634.41

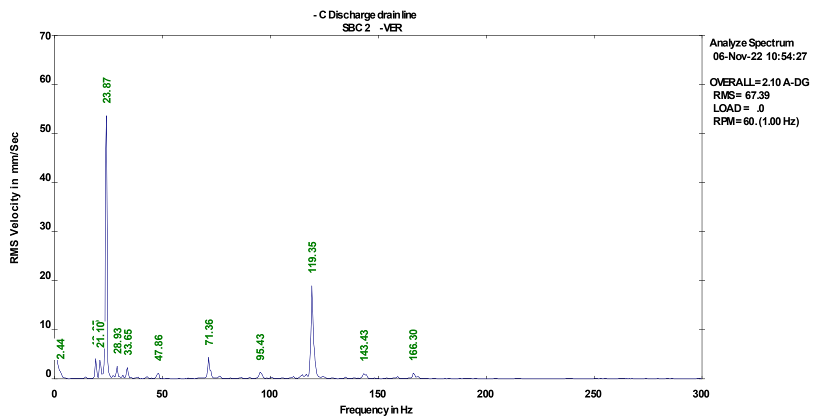

- Pipe Vib
Mid Span -AXL
Analyze Spectrum
05-Nov-22 16:03:54
OVERALL= .4135 A-DG
RMS= 7.31
LOAD= .0
RPM= 60. (1.00 Hz)
RMS Velocity in mm/Sec
Frequency in Hz
23.96
47.96
71.43
19.11
95.32
61.90
166.78
214.32

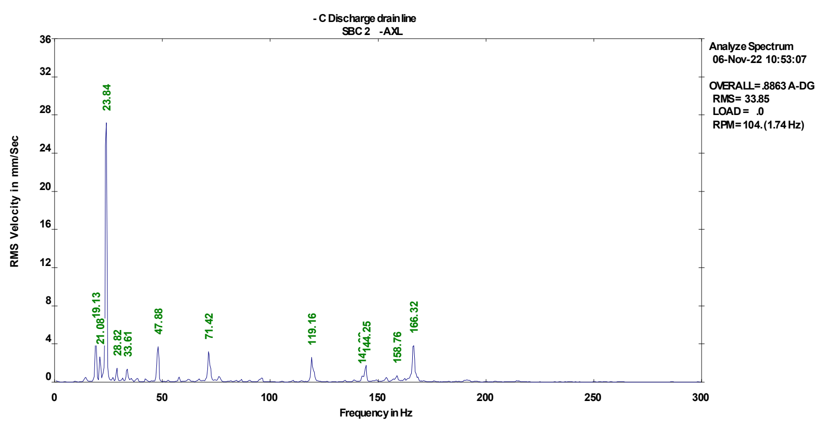

- C Suction drain line
SBC 1 -HOR
Analyze Spectrum
06-Nov-22 10:48:16
OVERALL= .3219 A-DG
RMS= 13.23
LOAD= .0
RPM= 60. (1.00 Hz)
RMS Velocity in mm/Sec
Frequency in Hz
24.01
26.95
71.81
105.31

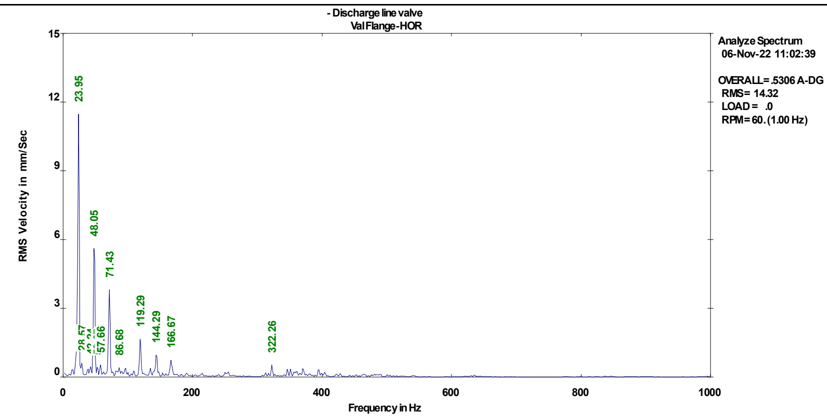

- C Suction drain line
SBC 1 -VER
Analyze Spectrum
06-Nov-22 10:47:55
OVERALL= .2585 A-DG
RMS= 5.46
LOAD= .0
RPM= 96. (1.60 Hz)
RMS Velocity in mm/Sec
Frequency in Hz
24.01
26.96
48.01
152.15
168.31
105.40
71.74
52.86
38.02
33.53
61.74

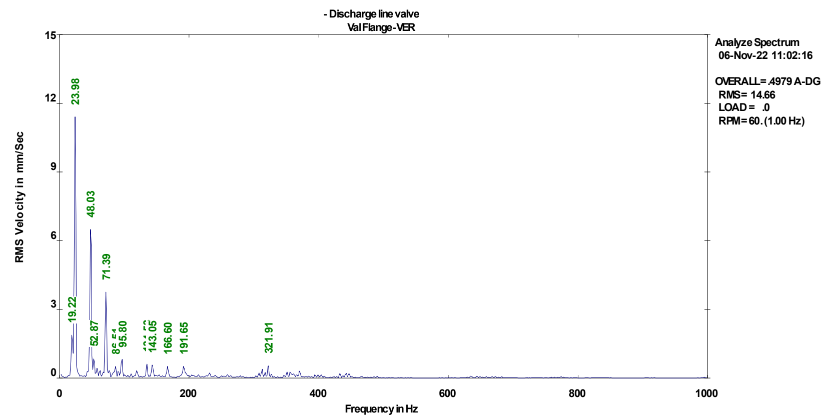

- C Suction drain line
SBC 1 -AXL
Analyze Spectrum
06-Nov-22 10:47:27
OVERALL= .2181 A-DG
RMS= 3.67
LOAD= .0
RPM= 60. (1.00 Hz)
RMS Velocity in mm/Sec
Frequency in Hz
24.09
27.01
48.09
42.11
19.35
38.03
134.81
152.02
168.53
288.96

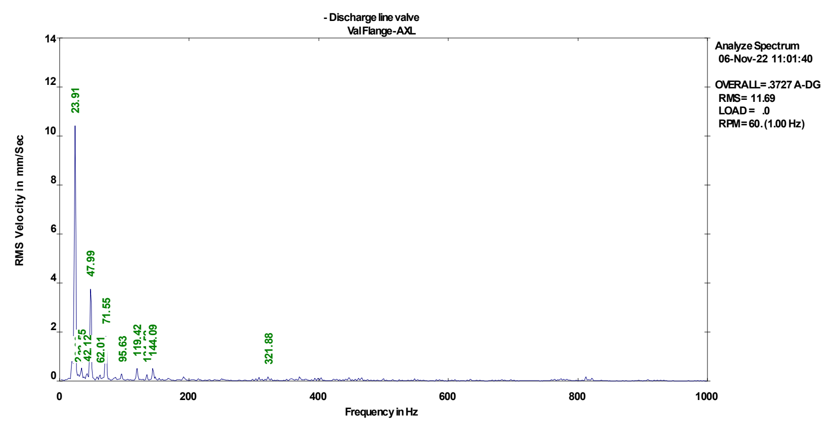

- C Discharge drain line
SBC 2 -HOR
Analyze Spectrum
06-Nov-22 10:55:07
OVERALL= 1.28 A-DG
RMS= 34.59
LOAD= .0
RPM= 96. (1.60 Hz)
RMS Velocity in mm/Sec
Frequency in Hz
23.86
48.11
71.34
33.67
43.00
57.72
66.97
74.45
76.33
95.37
119.11
166.69


- C Discharge drain line
SBC 2 -VER
Analyze Spectrum
06-Nov-22 10:54:27
OVERALL= 2.10 A-DG
RMS= 67.39
LOAD= .0
RPM= 60. (1.00 Hz)
RMS Velocity in mm/Sec
Frequency in Hz
23.87
119.35
2.44
21.10
28.93
33.65
47.86
71.36
95.43
143.43
166.30


- C Discharge drain line
SBC 2 -AXL
Analyze Spectrum
06-Nov-22 10:53:07
OVERALL= .8863 A-DG
RMS= 33.85
LOAD= .0
RPM= 104. (1.74 Hz)
RMS Velocity in mm/Sec
Frequency in Hz
23.84
19.13
21.08
28.82
33.61
47.88
71.42
119.16
144.25
158.76
166.32







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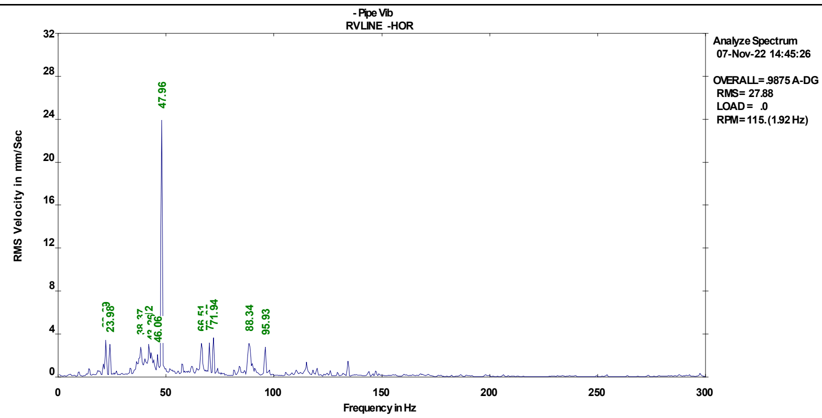

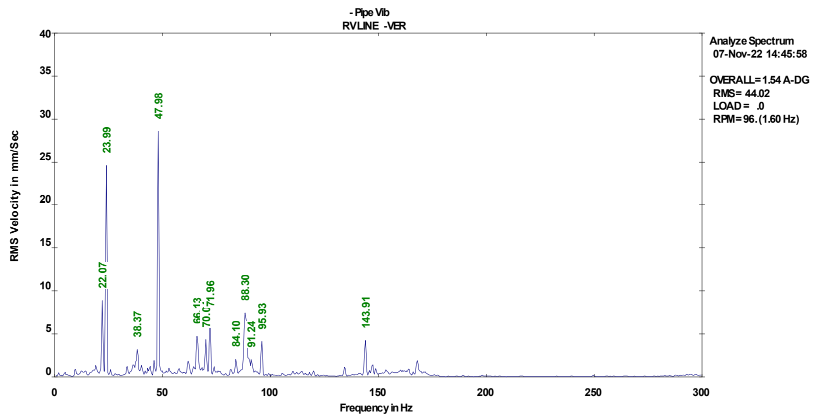

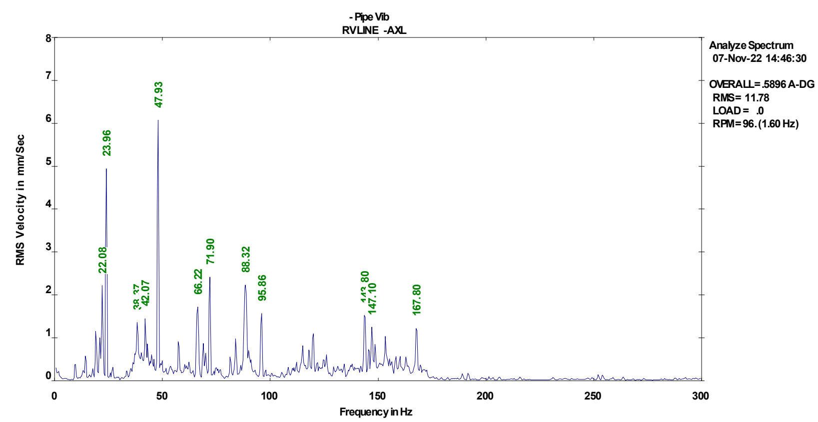

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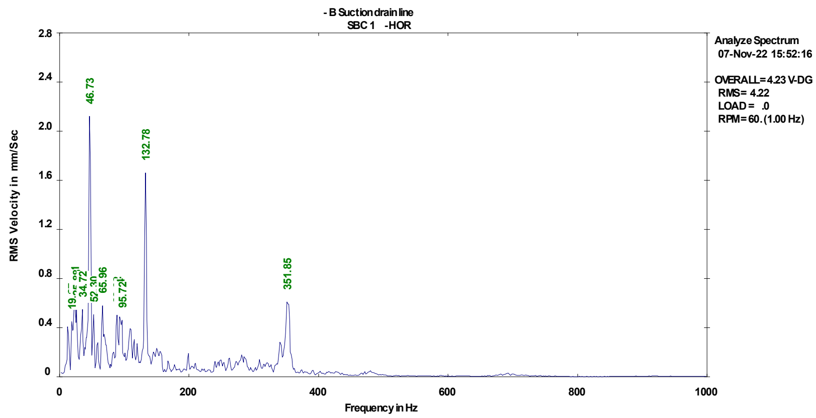

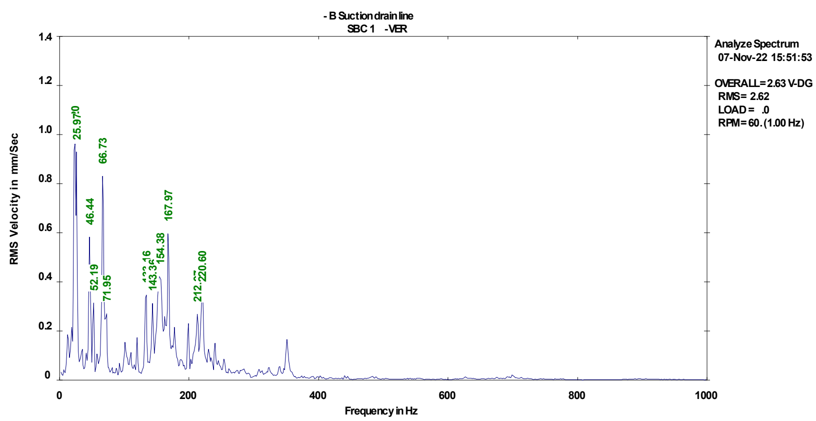

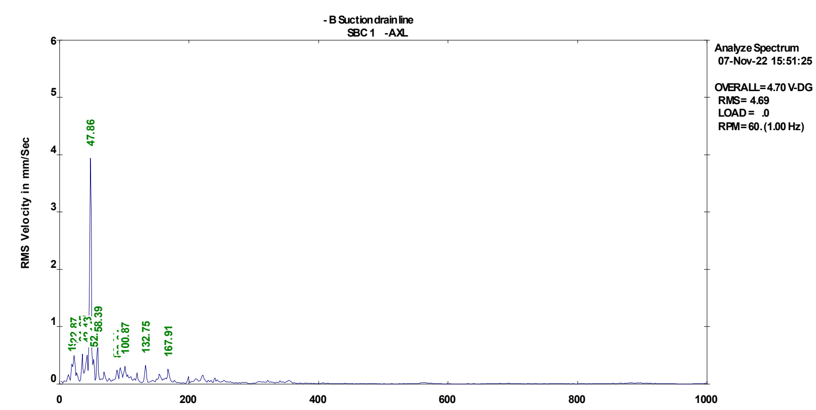

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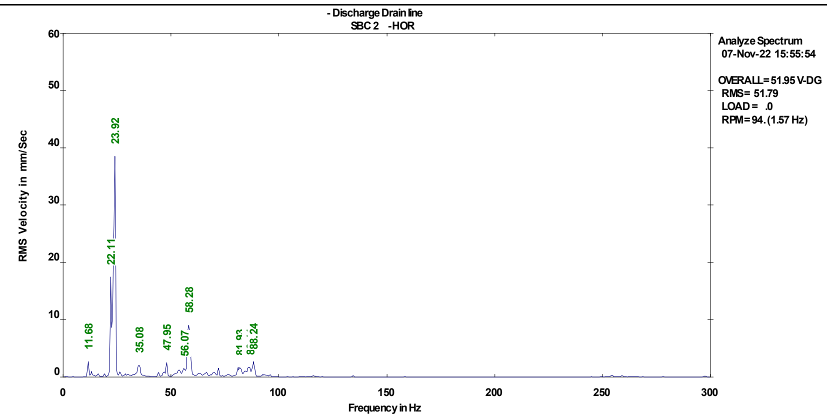

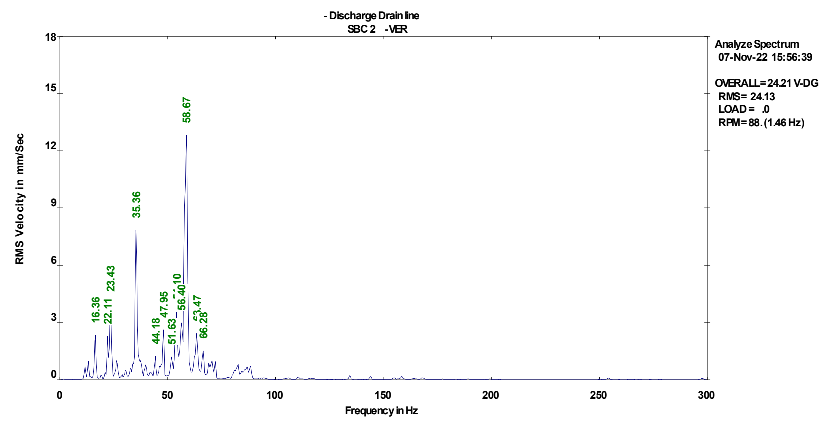

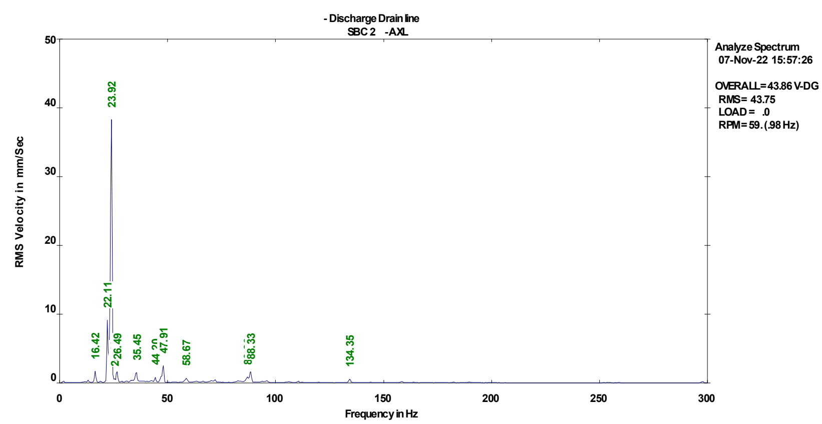

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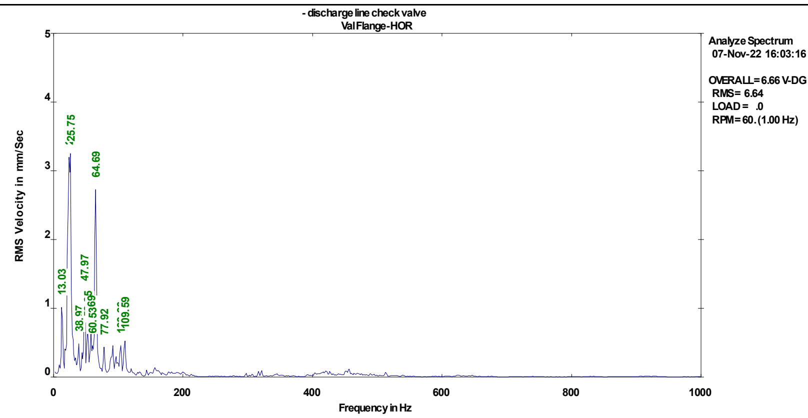
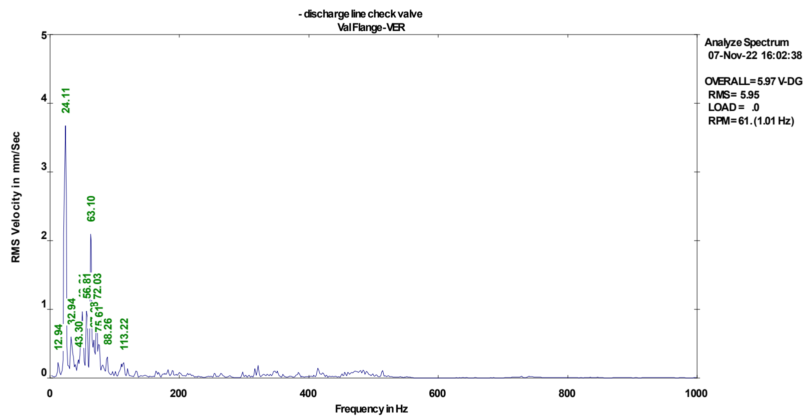
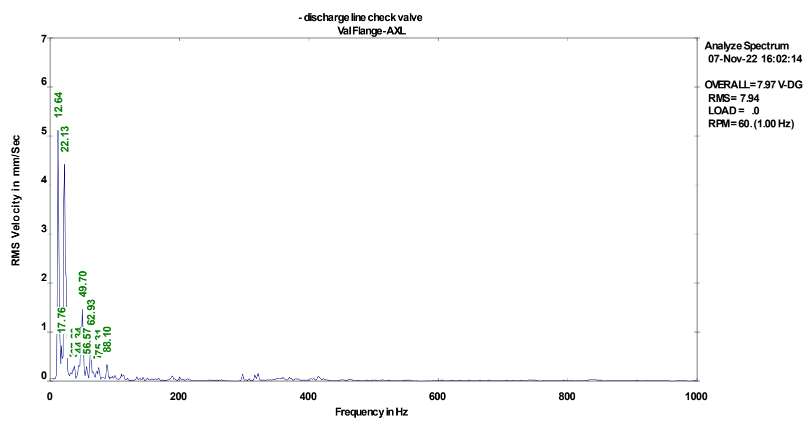
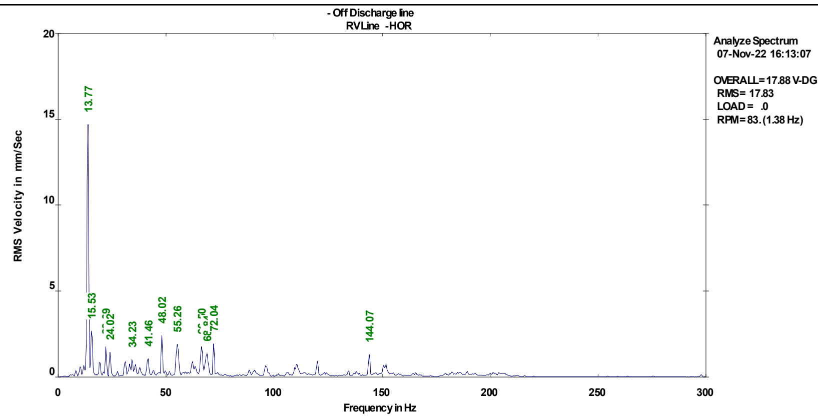
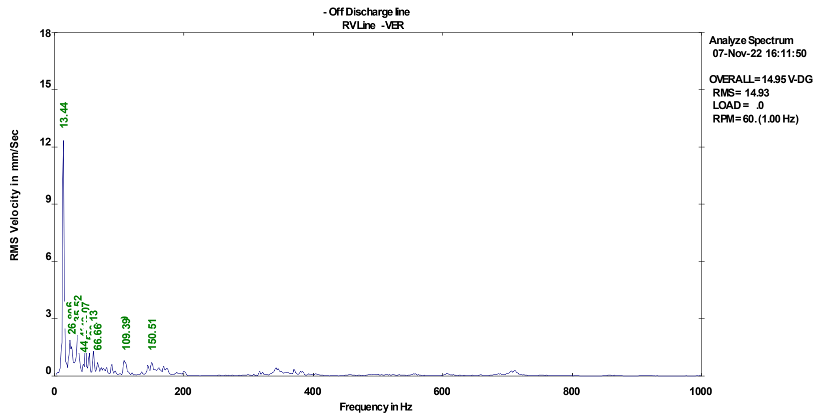
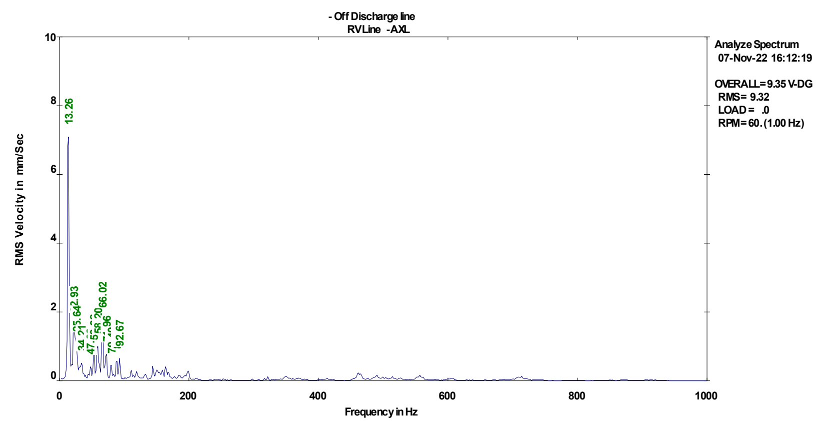

- discharge line check valve
Val Flange-HOR
Analyze Spectrum
07-Nov-22 16:03:16
OVERALL=6.66 V-DG
RMS= 6.64
LOAD= .0
RPM=60. (1.00 Hz)
RMS Velocity in mm/Sec
Frequency in Hz
25.75
64.69
47.97
13.03
38.97
77.92
109.59


- discharge line check valve
Val Flange-VER
Analyze Spectrum
07-Nov-22 16:02:38
OVERALL=5.97 V-DG
RMS= 5.95
LOAD= .0
RPM=61. (1.01 Hz)
RMS Velocity in mm/Sec
Frequency in Hz
24.11
63.10
56.81
72.03
32.94
12.94
43.30
88.26
113.22


- discharge line check valve
Val Flange-AXL
Analyze Spectrum
07-Nov-22 16:02:14
OVERALL=7.97 V-DG
RMS= 7.94
LOAD= .0
RPM=60. (1.00 Hz)
RMS Velocity in mm/Sec
Frequency in Hz
12.64
22.13
49.70
17.76
62.93
56.57
88.10







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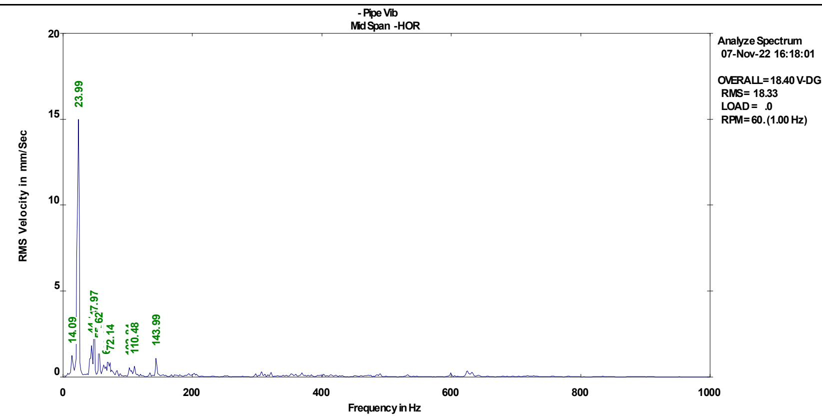
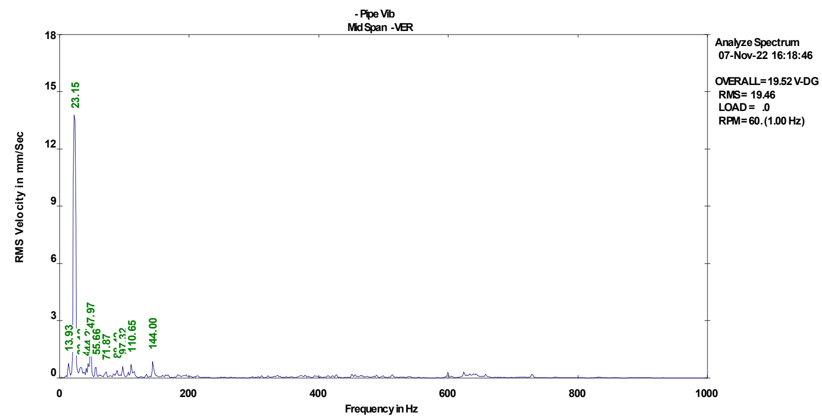
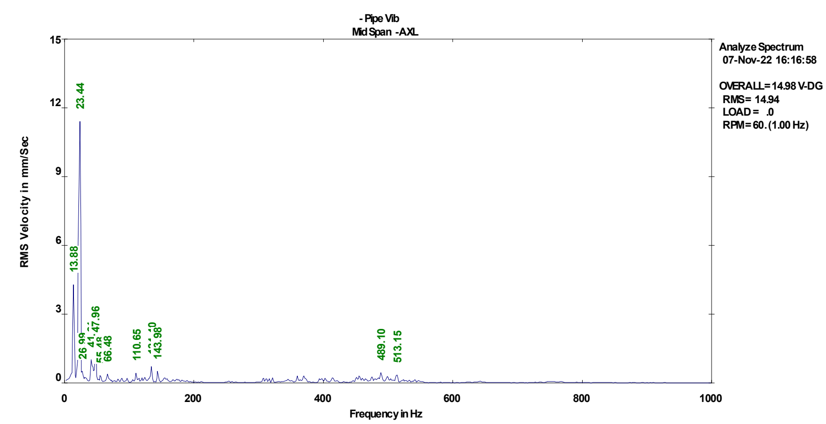
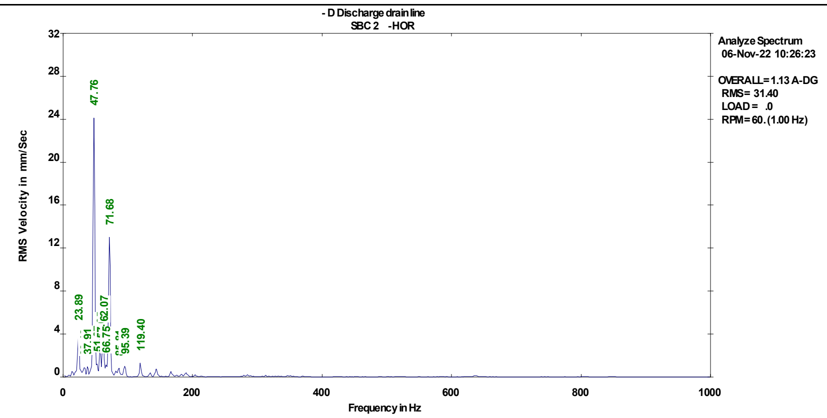
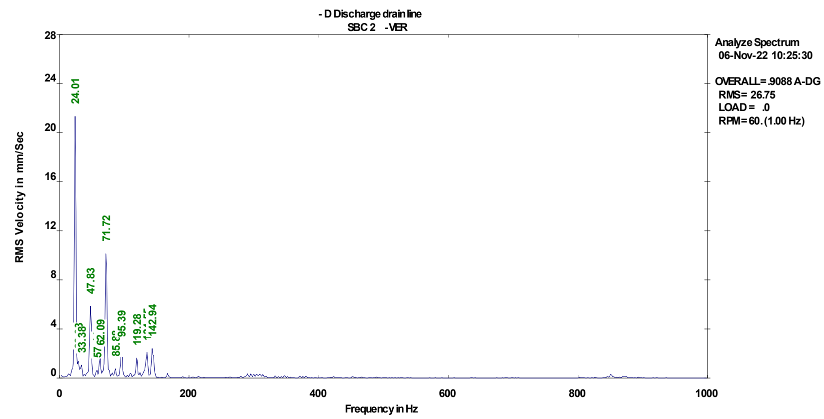
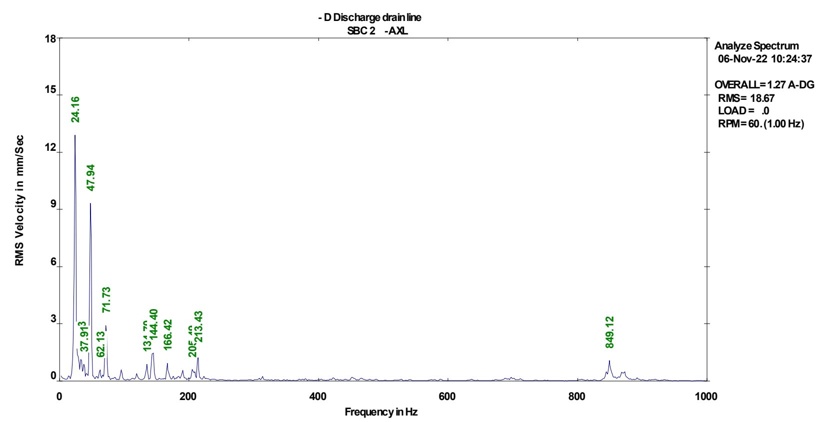

- Pipe Vib
Mid Span -HOR
Analyze Spectrum
07-Nov-22 16:18:01
OVERALL= 18.40 V-DG
RMS= 18.33
LOAD = .0
RPM= 60. (1.00 Hz)
RMS Velocity in mm/Sec
Frequency in Hz
23.99
14.09
72.14
110.48
143.99

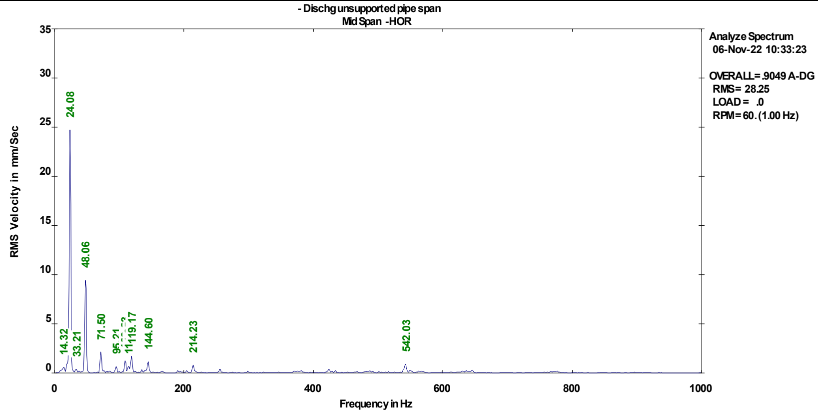

- Pipe Vib
Mid Span -VER
Analyze Spectrum
07-Nov-22 16:18:46
OVERALL= 19.52 V-DG
RMS= 19.46
LOAD = .0
RPM= 60. (1.00 Hz)
RMS Velocity in mm/Sec
Frequency in Hz
23.15
13.93
47.97
71.87
110.65
144.00

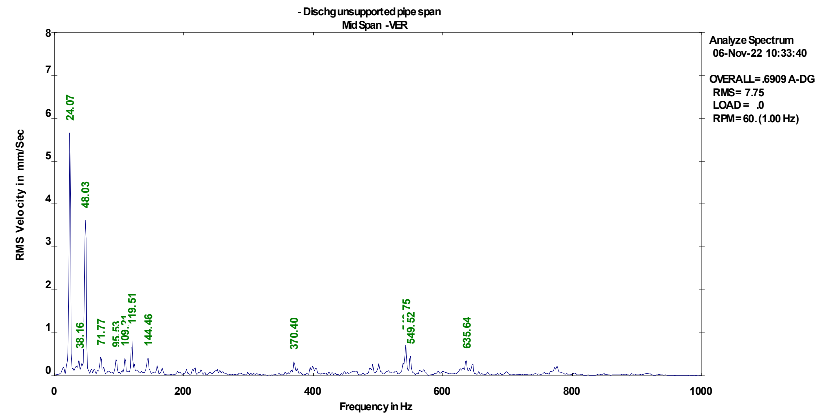

- Pipe Vib
Mid Span -AXL
Analyze Spectrum
07-Nov-22 16:16:58
OVERALL= 14.98 V-DG
RMS= 14.94
LOAD = .0
RPM= 60. (1.00 Hz)
RMS Velocity in mm/Sec
Frequency in Hz
23.44
13.88
47.96
66.48
110.65
143.98
489.10
513.15

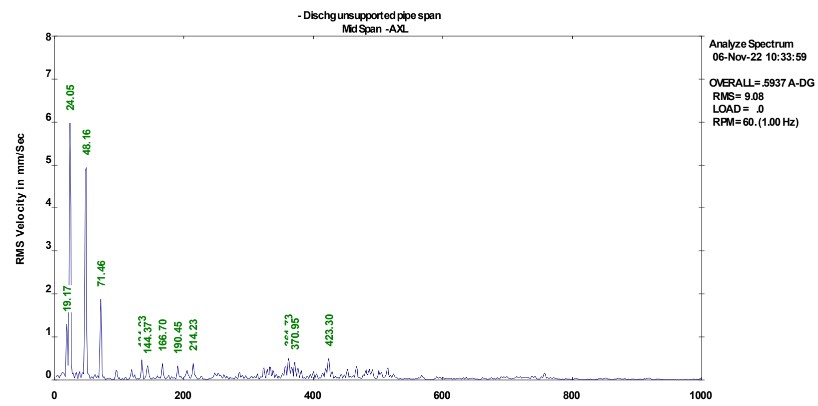

- D Discharge drain line
SBC 2 -HOR
Analyze Spectrum
06-Nov-22 10:26:23
OVERALL= 1.13 A-DG
RMS= 31.40
LOAD = .0
RPM= 60. (1.00 Hz)
RMS Velocity in mm/Sec
Frequency in Hz
47.76
71.68
23.89
37.91
62.07
66.75
95.39
119.40

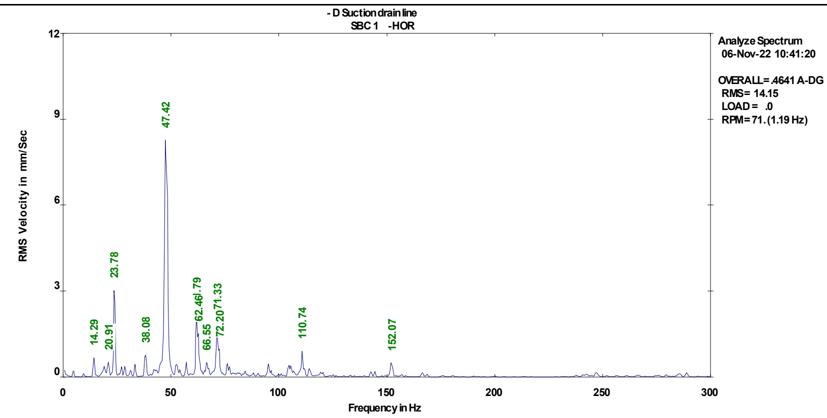

- D Discharge drain line
SBC 2 -VER
Analyze Spectrum
06-Nov-22 10:25:30
OVERALL= .9088 A-DG
RMS= 26.75
LOAD = .0
RPM= 60. (1.00 Hz)
RMS Velocity in mm/Sec
Frequency in Hz
24.01
71.72
47.83
33.39
62.09
95.39
119.28
142.94

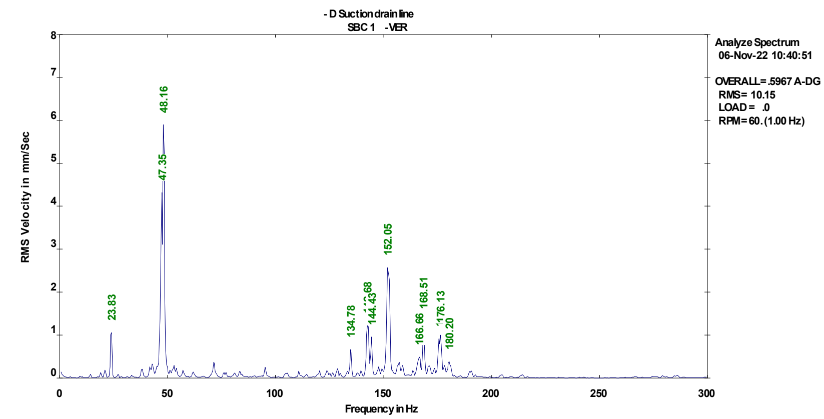

- D Discharge drain line
SBC 2 -AXL
Analyze Spectrum
06-Nov-22 10:24:37
OVERALL= 1.27 A-DG
RMS= 18.67
LOAD = .0
RPM= 60. (1.00 Hz)
RMS Velocity in mm/Sec
Frequency in Hz
24.16
47.94
71.73
37.91
62.13
144.40
166.42
213.43
849.12

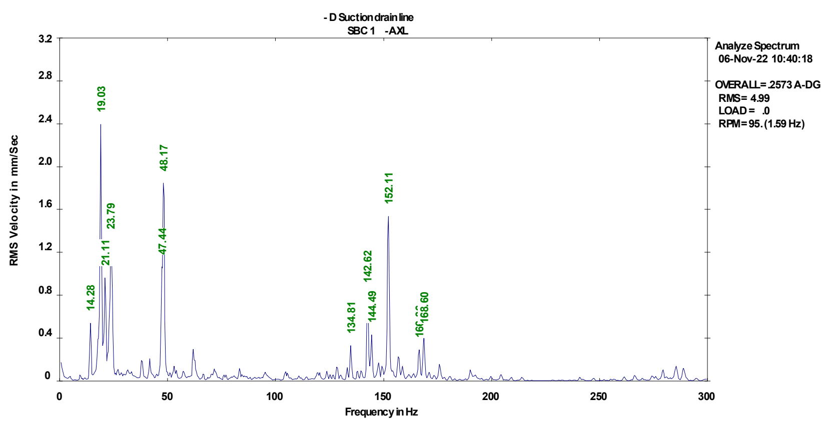

- Dischg unsupported pipe span
Mid Span -HOR
Analyze Spectrum
06-Nov-22 10:33:23
OVERALL= .9049 A-DG
RMS= 28.25
LOAD= .0
RPM= 60. (1.00 Hz)
RMS Velocity in mm/Sec
Frequency in Hz
24.08
48.06
14.32
33.21
71.50
95.21
119.17
144.60
214.23
542.03

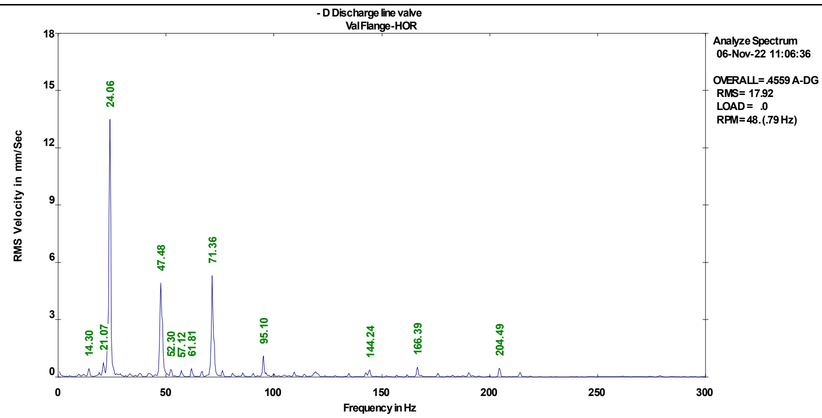

- Dischg unsupported pipe span
Mid Span -VER
Analyze Spectrum
06-Nov-22 10:33:40
OVERALL= .6909 A-DG
RMS= 7.75
LOAD= .0
RPM= 60. (1.00 Hz)
RMS Velocity in mm/Sec
Frequency in Hz
24.07
48.03
38.16
71.77
95.53
119.51
144.46
370.40
549.52
635.64

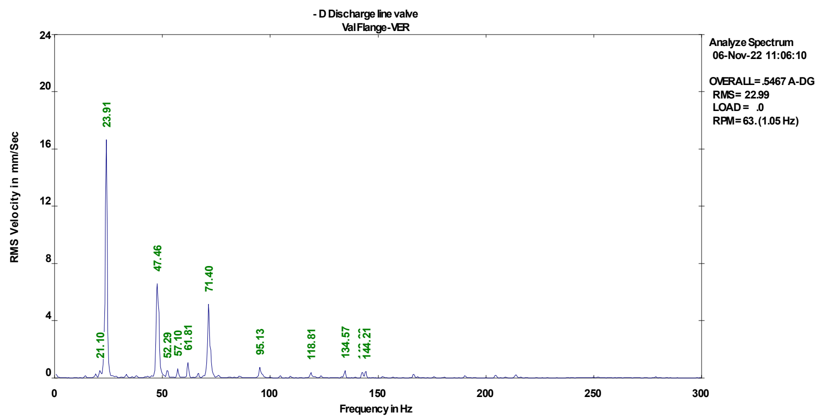

- Dischg unsupported pipe span
Mid Span -AXL
Analyze Spectrum
06-Nov-22 10:33:59
OVERALL= .5937 A-DG
RMS= 9.08
LOAD= .0
RPM= 60. (1.00 Hz)
RMS Velocity in mm/Sec
Frequency in Hz
24.05
48.16
71.46
19.17
144.37
166.70
190.45
214.23
370.95
423.30

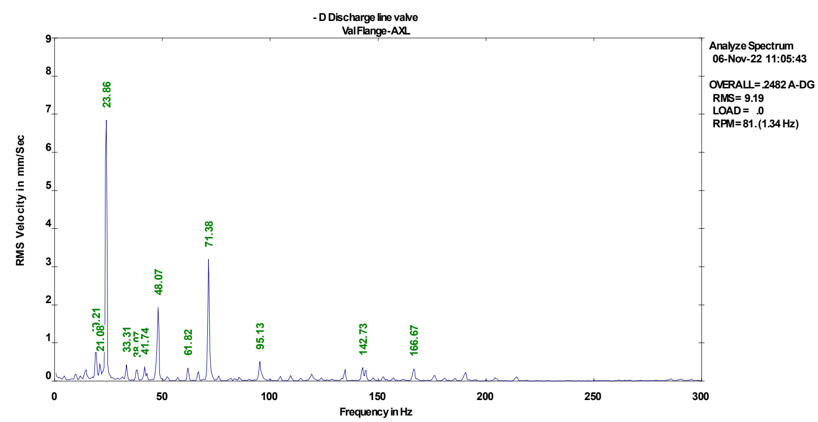

- D Suction drain line
SBC 1 -HOR
Analyze Spectrum
06-Nov-22 10:41:20
OVERALL= .4641 A-DG
RMS= 14.15
LOAD = .0
RPM= 71. (1.19 Hz)
RMS Velocity in mm/Sec
Frequency in Hz
47.42
23.78
14.29
20.91
38.08
66.55
71.33
110.74
152.07


- D Suction drain line
SBC 1 -VER
Analyze Spectrum
06-Nov-22 10:40:51
OVERALL= .5967 A-DG
RMS= 10.15
LOAD = .0
RPM= 60. (1.00 Hz)
RMS Velocity in mm/Sec
Frequency in Hz
48.16
47.35
23.83
134.78
144.43
152.05
166.66
168.51
176.13
180.20


- D Suction drain line
SBC 1 -AXL
Analyze Spectrum
06-Nov-22 10:40:18
OVERALL= .2573 A-DG
RMS= 4.99
LOAD = .0
RPM= 95. (1.59 Hz)
RMS Velocity in mm/Sec
Frequency in Hz
19.03
48.17
23.79
21.11
14.28
47.44
152.11
142.62
144.49
134.81
168.60







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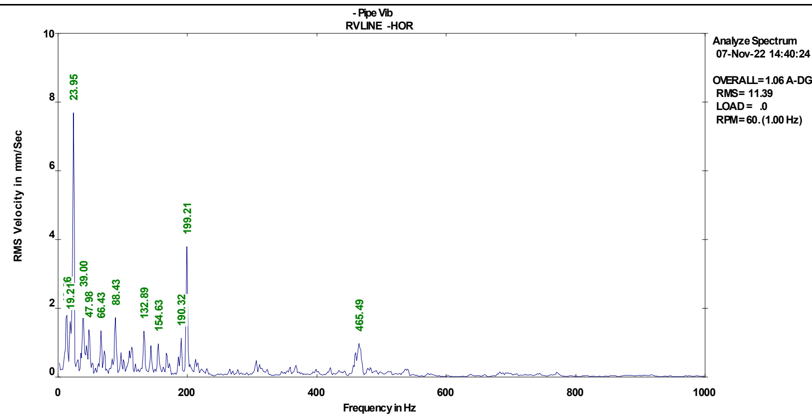

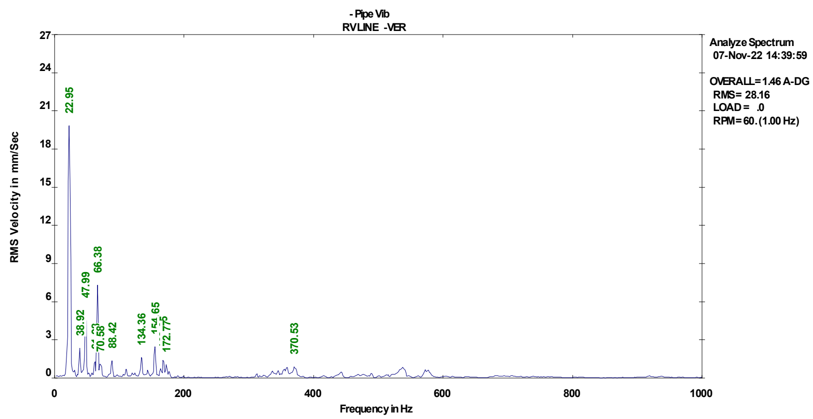

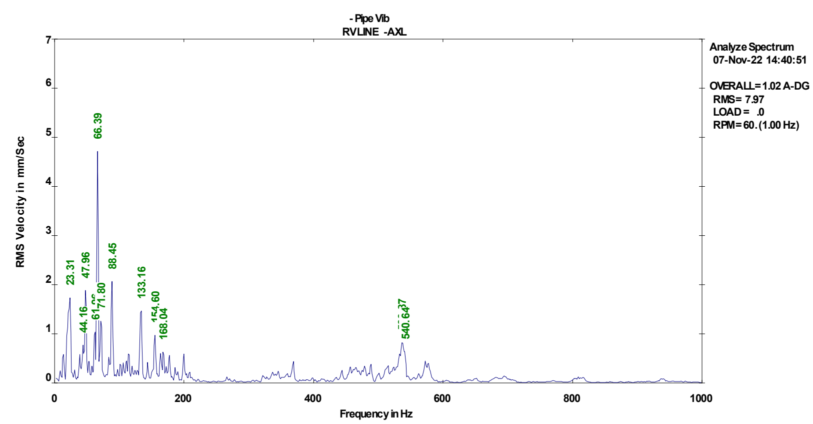

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