HI-SPEED INDUSTRIAL SERVICE QualiTest® Diagnostics

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September 6th, 2023

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The following is a summary of findings from the September 2023 WEEK 1 vibration survey at the H2O2 Plant along with the 70% PUMPS and H2 WEEKLY FAN vibration survey.

QualiTest® uses a four step rating system for defects.

CLASS I: Defect is present, but effect on reliability is not clear; no immediate action is required. Continue to normally monitor.

CLASS II: Defect (s) present that may cause problem in long term (2-6 months). Repair during normal maintenance scheduling. Continue to monitor.

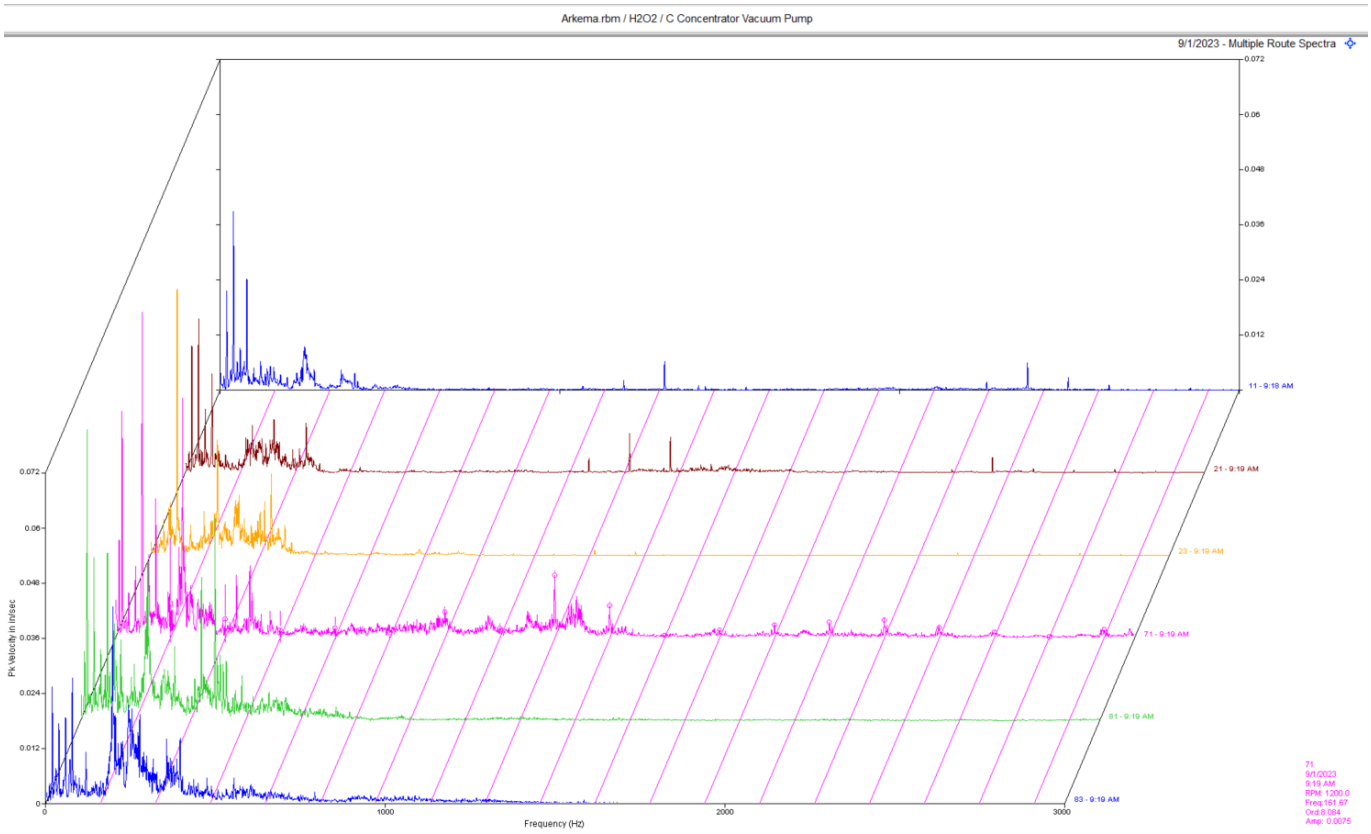
CLASS III; Defect (s) present that may cause failure in short term (less than 2 months). This should be addressed as soon as practical, with a high maintenance priority. Increase monitoring frequency.

CLASS IV; Defect (s) present that makes continued reliability unpredictable, and possibility of secondary damage is high. Repairs should be made ASAP. An unscheduled shutdown should be considered for repairs

Defect Summary

H2O2 Plant

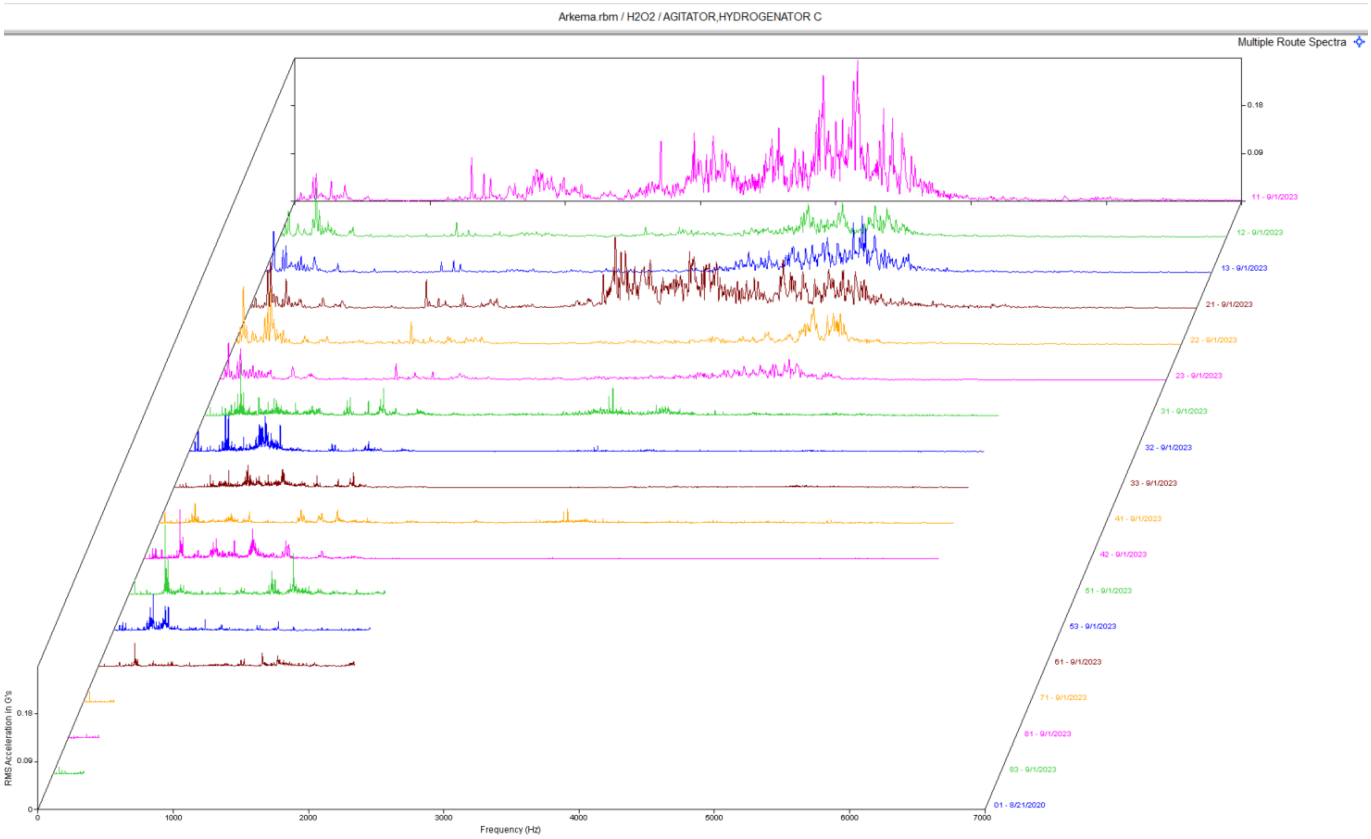
C Concentrator Vacuum Pump CLASS I



Observation:
Data above is a multipoint spectral waterfall. Data point labeled 71 is the pump drive end horizontal. The small peaks in mid to high range of the spectrum are non-synchronous peaks and are very likely bearing defect frequencies.

Recommendation:
The pump appears to have early to mid stage bearing defects/wear. We are monitoring this issue closely.

Agitator, Hydrogenator C CLASS I



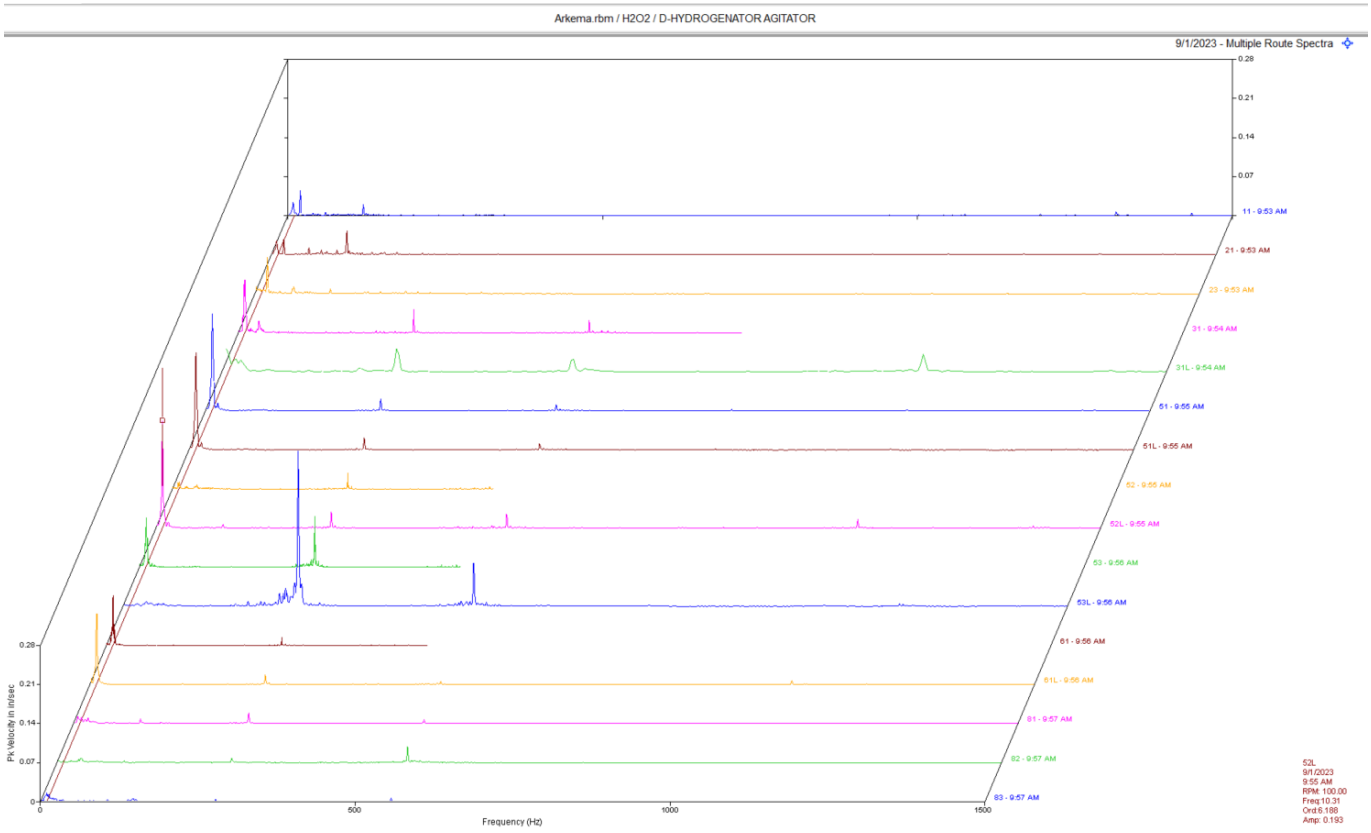
Observation:

Data above is a multipoint spectral waterfall. Data still shows some noise floor in the motor data. Data points labeled 11-23.

Recommendation:

Motor data still suggests a possible issue in the motor. May be rolling element defects in bearings. This issue appears to be minor at this time and we are monitoring this closely.

D Hydrogenator Agitator CLASS II



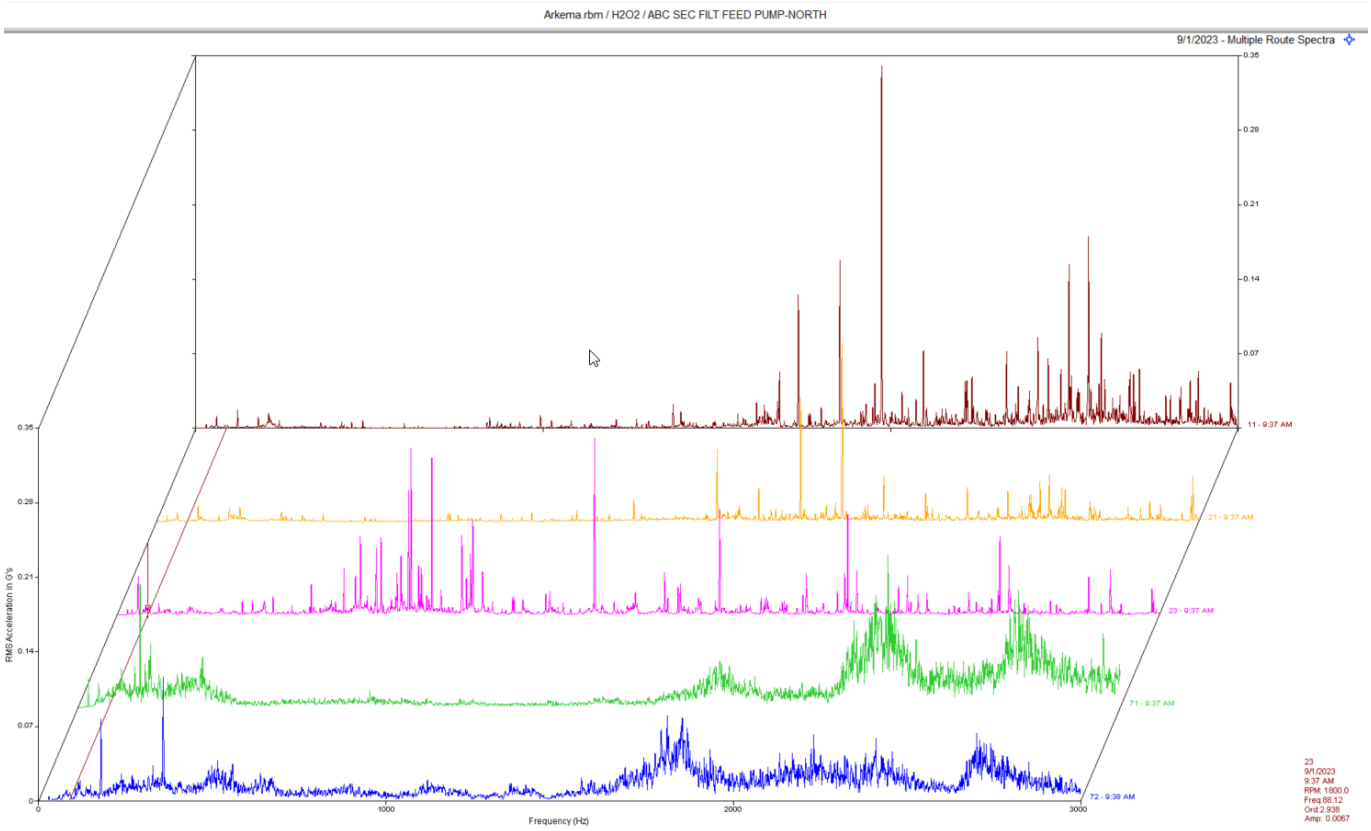
Observation:

Data above is a multi-point spectra of the motor and gear drive. There is quite a bit of low frequency vibration in the gear drive. Spectral and waveform data shows a dominant low frequency vibration that is likely a harmonic of output speed of the gearbox. Gearbox does appear to have visible torsional movement. There is also some gear mesh harmonics on the output axial.

Recommendation:

Ensure output shaft does not excessive shaft defection. Check coupling hubs and shaft for run out using a dial indicator. Will continue to monitor closely.

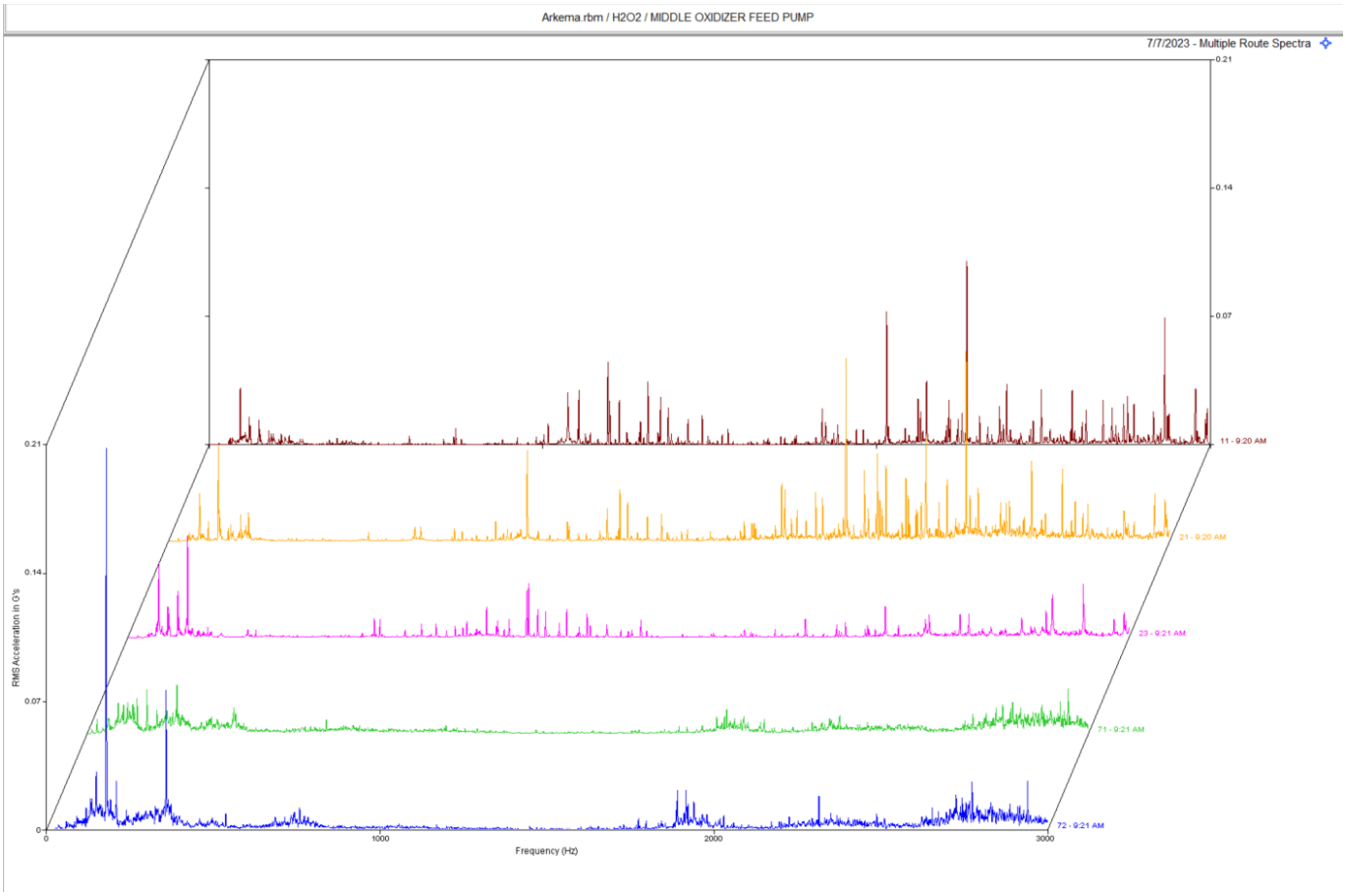
ABC Secondary Filter Feed Pump NORTH CLASS II



Observation:
Data above is a multi-point spectra. Non-synchronous peaks can be seen in the motor data (points 11-23).

Recommendation:
Motor data suggests defects are present in the motor bearings. Pump also has quite a bit of noise floor and signs of internal issues such as cavitation and possible bearing defects. Inspect motor and pump as scheduling allows.

Middle Oxidizer Feed Pump CLASS I



Observation:

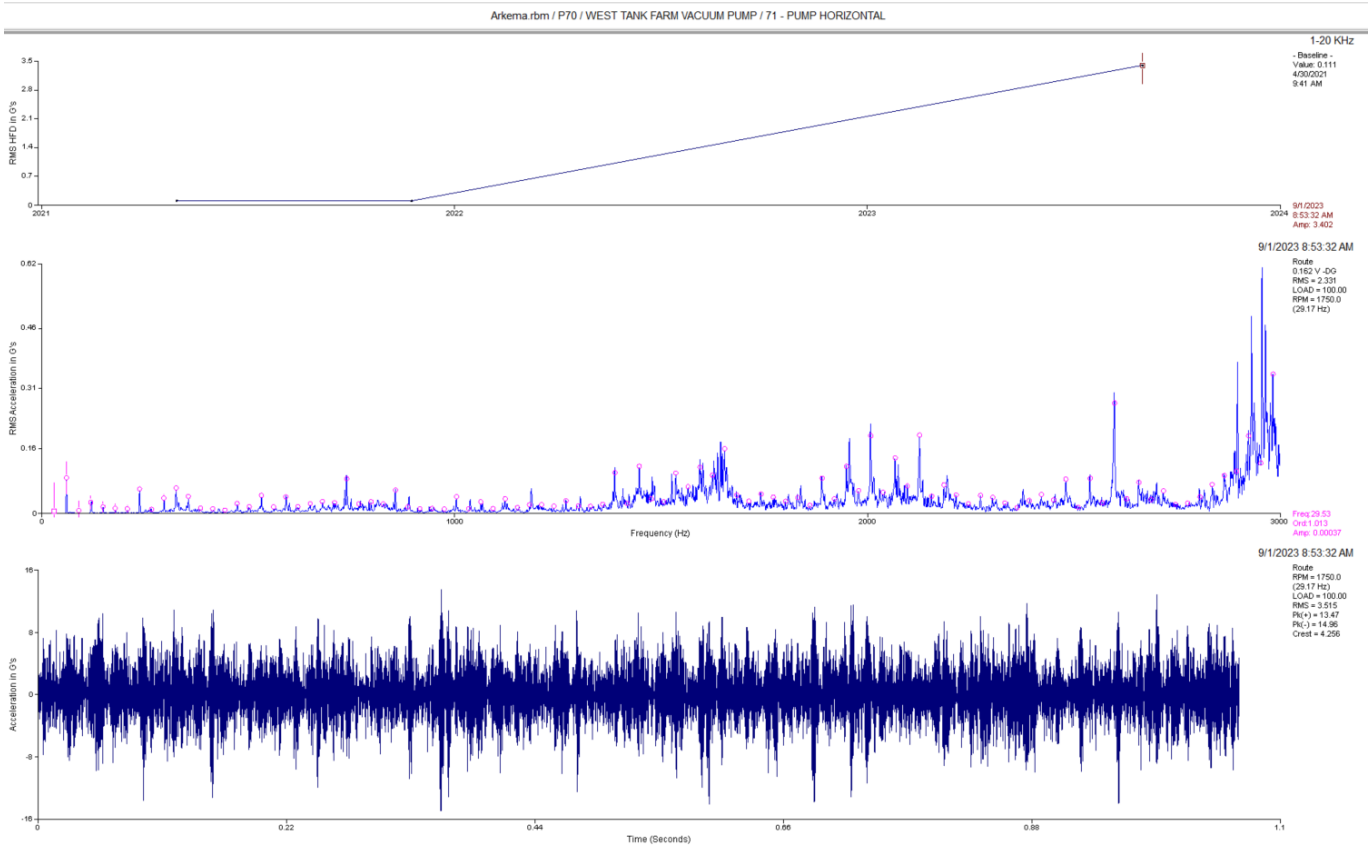
Data above is multi-point spectra of the motor and pump. Points 11-23 are motor points. Non-synchronous peaks present at these points indicate bearing defects of the motor bearings.

Recommendation:

Motor data suggests defects are present in the motor bearings. Motor may need attention in the next few months.

H2O2 70% PUMPS

West Tank Farm Vacuum Pump CLASS III



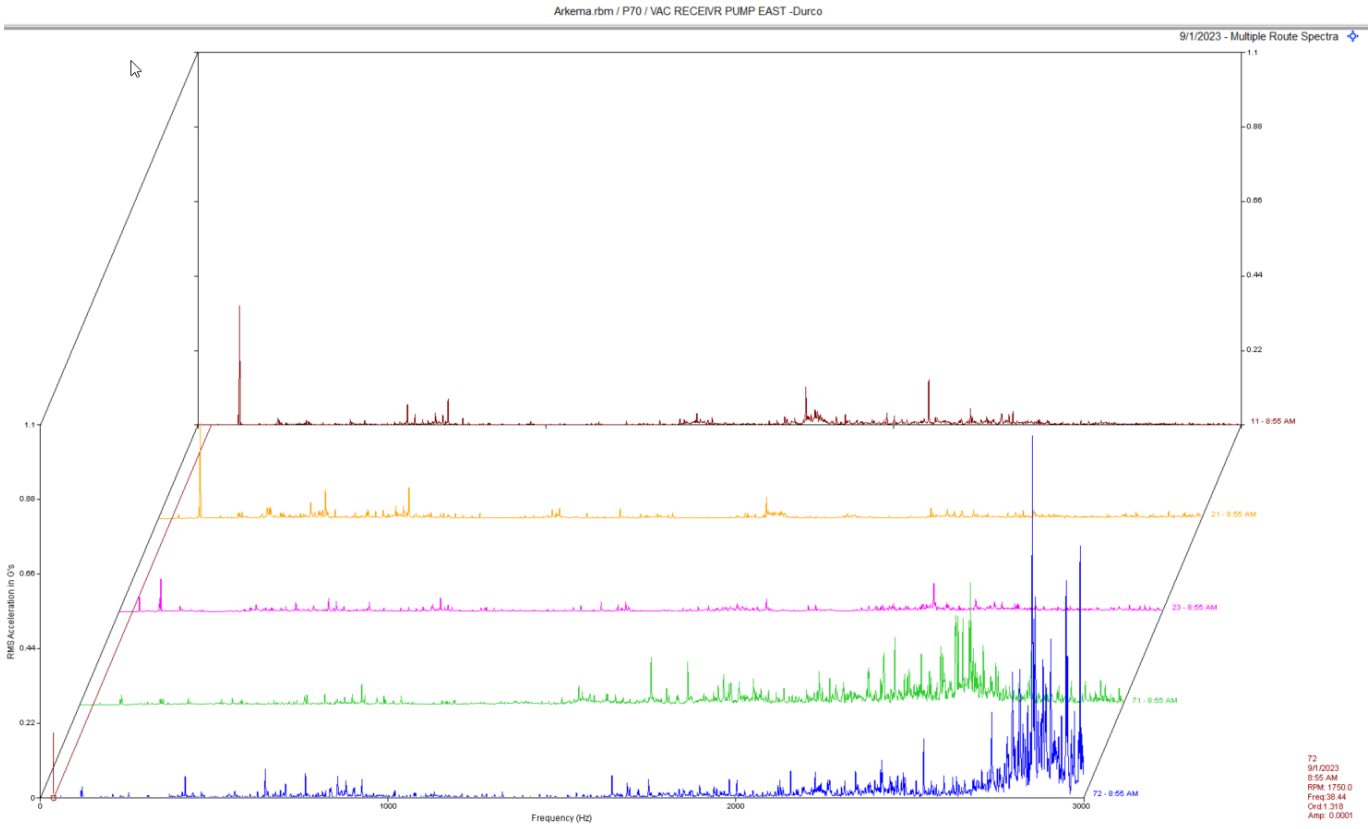
Observation:

Data above is the pump horizontal. Spectrum shows high frequency noise and waveform shows high amplitude of 17 g's peak to peak. Trend data shows an increase in 1-20 Khz amplitude from

Recommendation:

Pump data suggests defects/wear are present in the pump internals. Pump needs attention soon.

Vacuum Receiver Pump EAST CLASS II

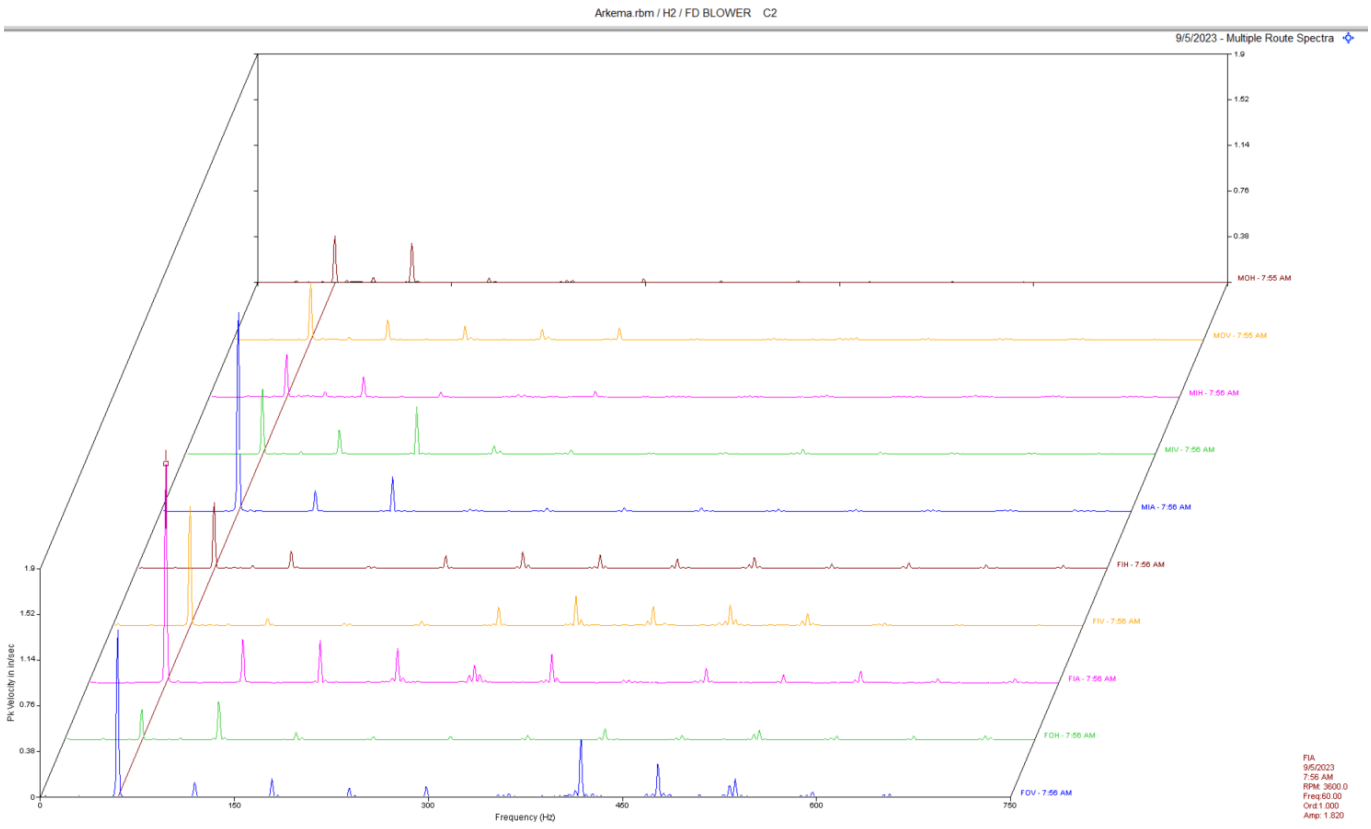


Observation:
Data above is multi-point spectra of the motor and pump. Points 71 and 72 are pump points. Non-synchronous peaks present at these points indicate internal pump defects/wear.

Recommendation:
Pump data suggests defects are present in the pump. The pump will likely need attention in the next few months.

H2O2 Plant WEEKLY

FD Blower **CLASS IV**



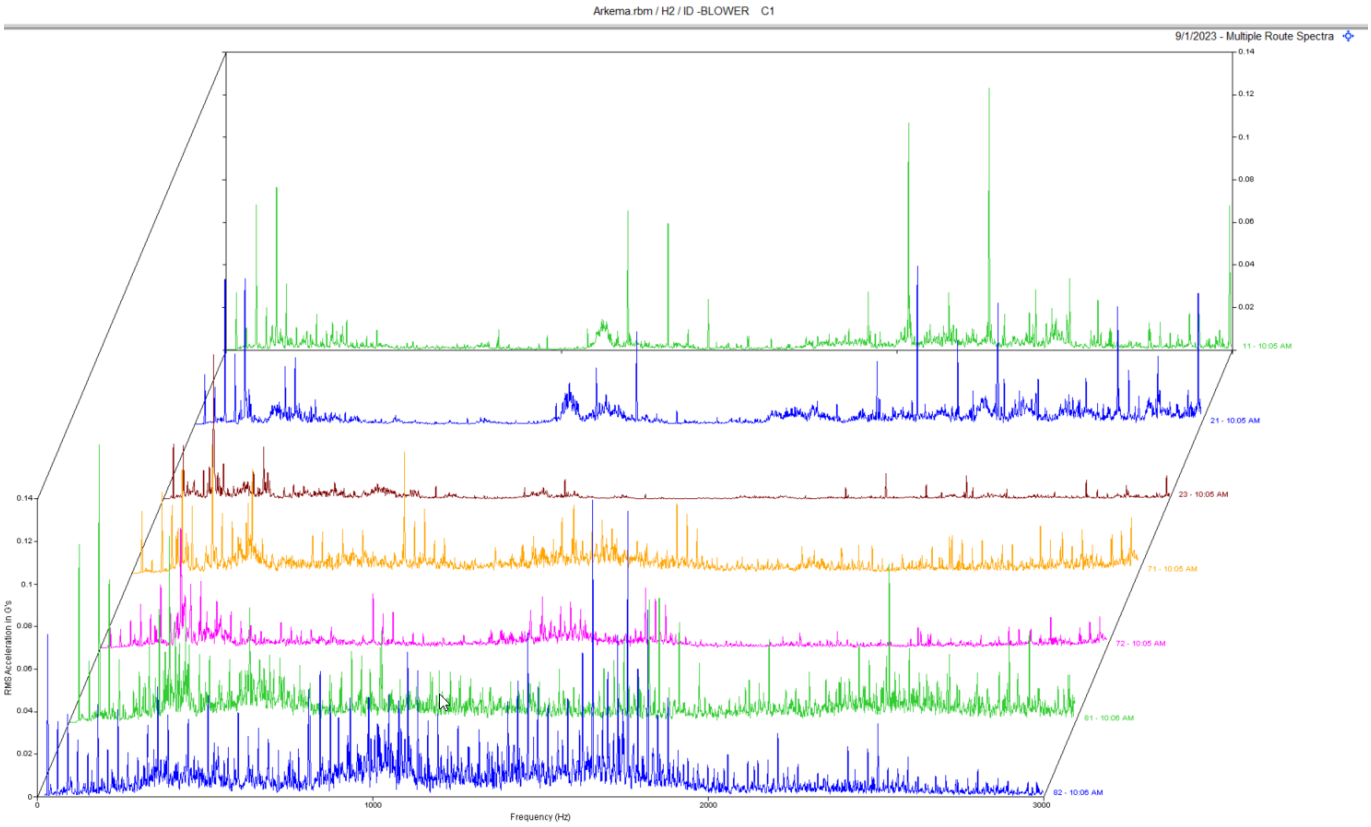
Observation:

Data above shows the highest vibration to be at the motor and fan inboard axial. Data shows a high 1 x rpm with a smaller 2, 3, and 4 x rpm vibration. Vibration has increased significantly since replacing fan shaft and fan bearings. The shaft that in place right now has excessive run-out (.003 to .005" in various spots on shaft).

Recommendation:

Fan shaft and or the fan wheel is likely the issue here. We recommend replacing the fan shaft with a TGP 4140 (steel type) shaft. Replace bearings also. Ensure fan wheel is not warped or cracked. Fan wheel needs to be dynamically balanced with new shaft and coupling. **Replace ASAP due to high vibration.**

ID Blower CLASS II



Observation:

Data above is a multi-point spectrum of the motor and the fan Spectral data indicates bearing defects are present in the fan bearings.

Recommendation:

Not a lot of change since last survey. Fan bearings may need to be replaced in the next few months. Monitoring this issue closely.

Abbreviated Last Measurement Summary

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Station: PEROXIDE
Route No. 1: ARK WK 1

MEASUREMENT POINT		OVERALL LEVEL	HFD / VHFD
P102	- ARKEMA PUMP P102	(01-Sep-23)	
		OVERALL LEVEL	1K-20KHz
MOH		.111 In/Sec	.465 G-s
MOV		.112 In/Sec	.406 G-s
MIH		.088 In/Sec	.663 G-s
MIV		.279 In/Sec	.753 G-s
MIA		.106 In/Sec	.522 G-s
EIA		.329 In/Sec	1.629 G-s
EIH		.218 In/Sec	2.028 G-s
EIV		.263 In/Sec	.902 G-s
EOH		.200 In/Sec	.445 G-s
EOV		.204 In/Sec	1.227 G-s
2130-1old	- C Concentrator Vacuum Pump	(01-Sep-23)	
		OVERALL LEVEL	1-20 KHz
11		.072 In/Sec	.439 G-s
21		.081 In/Sec	.512 G-s
23		.107 In/Sec	.148 G-s
71		.168 In/Sec	2.595 G-s
81		.170 In/Sec	.689 G-s
83		.147 In/Sec	.299 G-s
7000-01	- AGITATOR,HYDROGENATOR C	(01-Sep-23)	
		OVERALL LEVEL	1-20 KHZ
02		.039 In/Sec	.011 G-s
03		.043 In/Sec	.0086 G-s
11		.075 In/Sec	1.731 G-s
12		.110 In/Sec	.448 G-s
13		.142 In/Sec	.665 G-s
21		.099 In/Sec	1.119 G-s
22		.199 In/Sec	.297 G-s
23		.150 In/Sec	.263 G-s
31		.071 In/Sec	.376 G-s
32		.104 In/Sec	.121 G-s
33		.049 In/Sec	.126 G-s
41		.058 In/Sec	.178 G-s
42		.087 In/Sec	.115 G-s
51		.083 In/Sec	.268 G-s
53		.067 In/Sec	.061 G-s
61		.029 In/Sec	.238 G-s
71		.065 In/Sec	.174 G-s
81		.025 In/Sec	.201 G-s
83		.050 In/Sec	.053 G-s
57	- A/B Concentr Vac Pmp-var RPM	(01-Sep-23)	
		OVERALL LEVEL	1-20 KHz
11		.046 In/Sec	.605 G-s
12		.061 In/Sec	.151 G-s
21		.064 In/Sec	.307 G-s
23		.054 In/Sec	.122 G-s
71		.124 In/Sec	.706 G-s
81		.304 In/Sec	1.041 G-s
83		.100 In/Sec	1.138 G-s
2130-1	- FLASH VAP VAC PUMP-var speed	(01-Sep-23)	
		OVERALL LEVEL	1-20 KHz
11		.046 In/Sec	.356 G-s
12		.039 In/Sec	.091 G-s
21		.053 In/Sec	.420 G-s
22		.069 In/Sec	.096 G-s

	23	.070 In/Sec	.095 G-s
	71	.066 In/Sec	.444 G-s
	72	.068 In/Sec	.380 G-s
	81	.075 In/Sec	1.323 G-s
	82	.080 In/Sec	.799 G-s
	83	.053 In/Sec	.599 G-s

236-06 - HYDRO FD PUMP N 236-06 -2FLR (01-Sep-23)

	OVERALL LEVEL	1-20 KHz
11	.113 In/Sec	.101 G-s
21	.081 In/Sec	.352 G-s

2130-6 - ABC SEC FILT FEED PUMP-NORTH (01-Sep-23)

	OVERALL LEVEL	1-20 KHz
11	.043 In/Sec	1.114 G-s
21	.035 In/Sec	.758 G-s
23	.077 In/Sec	.747 G-s
71	.183 In/Sec	2.577 G-s
72	.108 In/Sec	1.366 G-s

9001-1 - EAST OXIDIZER FEED PUMP (01-Sep-23)

	OVERALL LEVEL	1-20 KHz
11	.024 In/Sec	.418 G-s
21	.039 In/Sec	.555 G-s
23	.054 In/Sec	.538 G-s
71	.092 In/Sec	.734 G-s
72	.123 In/Sec	.802 G-s

9001-2 - MIDDLE OXIDIZER FEED PUMP (01-Sep-23)

	OVERALL LEVEL	1-20 KHz
11	.049 In/Sec	.704 G-s
21	.047 In/Sec	.607 G-s
23	.050 In/Sec	.899 G-s
71	.047 In/Sec	.594 G-s
72	.093 In/Sec	.657 G-s

7016-11 - WEST OXIDIZER FEED PUMP (01-Sep-23)

	OVERALL LEVEL	1-20 KHz
11	.046 In/Sec	.479 G-s
21	.041 In/Sec	.760 G-s
23	.042 In/Sec	.918 G-s
71	.106 In/Sec	.990 G-s
72	.106 In/Sec	1.357 G-s

234-01 - CHILL WATER PUMP 234-01 (01-Sep-23)

	OVERALL LEVEL	1-20 KHz
11	.066 In/Sec	1.117 G-s
21	.079 In/Sec	.607 G-s
23	.042 In/Sec	
71	.115 In/Sec	.563 G-s
72	.031 In/Sec	.706 G-s

C-203 - C-203 Comp (01-Sep-23)

	OVERALL LEVEL	1-20 KHz
11	.061 In/Sec	2.479 G-s
12	.028 In/Sec	.802 G-s
21	.078 In/Sec	3.310 G-s
22	.022 In/Sec	.180 G-s
23	.024 In/Sec	.433 G-s
	OVERALL LEVEL	1-20 KHZ
71M	.085 In/Sec	4.234 G-s
72M	.043 In/Sec	1.011 G-s
73M	.067 In/Sec	.835 G-s
81M	.049 In/Sec	9.690 G-s
82M	.034 In/Sec	1.744 G-s
71F	.039 In/Sec	5.350 G-s
72F	.055 In/Sec	2.332 G-s
73F	.035 In/Sec	.566 G-s
81F	.042 In/Sec	2.677 G-s
82F	.029 In/Sec	.717 G-s

9000-02 - D HYDROGENATOR FD PUMP- EAST (01-Sep-23)

	OVERALL LEVEL	1-20 KHz
11	.050 In/Sec	.577 G-s
21	.061 In/Sec	.849 G-s
23	.053 In/Sec	.552 G-s
71	.099 In/Sec	.627 G-s
72	.074 In/Sec	1.016 G-s

236-04A - HYDROGNTOR PRECOOLER FD PUMP (01-Sep-23)

	OVERALL LEVEL	1-20 KHz
11	.036 In/Sec	.288 G-s
21	.060 In/Sec	.878 G-s
23	.070 In/Sec	1.343 G-s
71	.186 In/Sec	.314 G-s
72	.095 In/Sec	.336 G-s

C-202 - C-202 Comp (01-Sep-23)

	OVERALL LEVEL	1-20 KHz
11	.117 In/Sec	4.889 G-s
12	.149 In/Sec	1.285 G-s
21	.068 In/Sec	.751 G-s
22	.059 In/Sec	.454 G-s
23	.051 In/Sec	.774 G-s
	OVERALL LEVEL	1-20 KHZ
71M	.057 In/Sec	3.792 G-s
72M	.030 In/Sec	.826 G-s
73M	.077 In/Sec	.873 G-s
81M	.046 In/Sec	10.45 G-s
82M	.040 In/Sec	1.335 G-s
71F	.028 In/Sec	2.875 G-s
72F	.064 In/Sec	.742 G-s
73F	.040 In/Sec	1.296 G-s
81F	.036 In/Sec	6.906 G-s
82F	.046 In/Sec	1.068 G-s

C-201 - C-201 Comp (01-Sep-23)

	OVERALL LEVEL	1-20 KHz
11	.140 In/Sec	3.927 G-s
12	.077 In/Sec	2.103 G-s
21	.101 In/Sec	.946 G-s
22	.038 In/Sec	.253 G-s
23	.051 In/Sec	.308 G-s
	OVERALL LEVEL	1-20 KHZ
71M	.066 In/Sec	4.023 G-s
72M	.035 In/Sec	.554 G-s
73M	.063 In/Sec	.787 G-s
81M	.044 In/Sec	9.060 G-s
82M	.025 In/Sec	1.261 G-s
71F	.041 In/Sec	3.541 G-s
72F	.049 In/Sec	.911 G-s
73F	.040 In/Sec	.701 G-s
81F	.060 In/Sec	12.01 G-s
82F	.059 In/Sec	1.630 G-s

new AC - INSTRUMENT AIR COMPRESSOR (01-Sep-23)

	OVERALL LEVEL	1-20 KHz
11	.091 In/Sec	.978 G-s
12	.104 In/Sec	.488 G-s
13	.047 In/Sec	.123 G-s
21	.074 In/Sec	1.580 G-s
22	.076 In/Sec	.813 G-s
23	.037 In/Sec	.442 G-s
	OVERALL LEVEL	1-20 KHZ
71F	.095 In/Sec	11.70 G-s
72F	.106 In/Sec	1.997 G-s
73F	.065 In/Sec	2.507 G-s
81F	.098 In/Sec	3.681 G-s
82F	.179 In/Sec	1.426 G-s
83F	.136 In/Sec	1.357 G-s

	71M	.115 In/Sec	9.457 G-s
	72M	.085 In/Sec	1.883 G-s
	73M	.135 In/Sec	1.571 G-s
	81M	.120 In/Sec	9.017 G-s
	82M	.286 In/Sec	1.312 G-s
	83M	.207 In/Sec	1.705 G-s

201-08A - COMPRESSOR,NASH A 201-08A (01-Sep-23)

	OVERALL LEVEL	1-20 KHz
11	.046 In/Sec	.086 G-s
12	.056 In/Sec	.074 G-s
13	.110 In/Sec	.079 G-s
21	.048 In/Sec	.111 G-s
22	.066 In/Sec	.071 G-s
23	.168 In/Sec	.089 G-s
71	.147 In/Sec	.623 G-s
72	.184 In/Sec	.070 G-s
73	.126 In/Sec	.107 G-s
81	.152 In/Sec	.196 G-s
82	.183 In/Sec	.050 G-s
83	.137 In/Sec	.068 G-s

9002-10 - D-HYDROGENATOR AGITATOR (01-Sep-23)

	OVERALL LEVEL	1-20 KHz
11	.063 In/Sec	.212 G-s
21	.070 In/Sec	.236 G-s
23	.077 In/Sec	.064 G-s
	OVERALL LEVEL	1-20 KHZ
31	.182 In/Sec	.755 G-s
31L	.086 In/Sec	.650 G-s
	OVERALL LEVEL	1-20 KHz
51	.230 In/Sec	.250 G-s
51L	.230 In/Sec	.250 G-s
52	.052 In/Sec	.508 G-s
52L	.224 In/Sec	.422 G-s
53	.222 In/Sec	.108 G-s
53L	.363 In/Sec	.392 G-s
61	.163 In/Sec	.232 G-s
61L	.164 In/Sec	.232 G-s
81	.041 In/Sec	.034 G-s
82	.042 In/Sec	.016 G-s
83	.040 In/Sec	.0091 G-s

Station: PEROXIDE 70% H202 PUMPS
Route No. 1: 70% PUMPS

MEASUREMENT POINT	OVERALL LEVEL	HFD / VHFD

401-04 - 265C STABILITY TANK (01-Sep-23)

	OVERALL LEVEL	1-20 KHz
11	.066 In/Sec	.459 G-s
21	.030 In/Sec	.666 G-s
23	.029 In/Sec	.229 G-s
71	.028 In/Sec	.239 G-s
72	.022 In/Sec	.315 G-s

260-13 - 265E STABILITY TANK (01-Sep-23)

	OVERALL LEVEL	1-20 KHz
11	.155 In/Sec	1.189 G-s
21	.177 In/Sec	2.041 G-s
23	.129 In/Sec	1.709 G-s
71	.104 In/Sec	.767 G-s
72	.085 In/Sec	1.290 G-s

357-12 - K STORAGE TANK PUMP (01-Sep-23)

	OVERALL LEVEL	1-20 KHz
11	.130 In/Sec	.319 G-s

21		.116 In/Sec	.528 G-s
23		.116 In/Sec	.433 G-s
71		.162 In/Sec	1.014 G-s
72		.074 In/Sec	1.063 G-s

56 - A PRODUCT PUMP (01-Sep-23)

	OVERALL LEVEL	1-20 KHz
11	.039 In/Sec	.142 G-s
21	.026 In/Sec	.301 G-s
23	.046 In/Sec	.111 G-s
71	.039 In/Sec	.100 G-s
72	.103 In/Sec	.137 G-s

247-11 - A OVERRUN PUMP (01-Sep-23)

	OVERALL LEVEL	1-20 KHz
11	.036 In/Sec	.233 G-s
21	.044 In/Sec	.346 G-s
23	.067 In/Sec	.372 G-s
71	.025 In/Sec	.150 G-s
72	.039 In/Sec	.230 G-s

249-24 - B CONC PRODUCT PUMP, NORTH (01-Sep-23)

	OVERALL LEVEL	1-20 KHz
11	.081 In/Sec	1.469 G-s
21	.084 In/Sec	1.489 G-s
23	.043 In/Sec	.201 G-s
71	.034 In/Sec	.434 G-s
72	.020 In/Sec	.439 G-s

7035-05 - C CONC PRODUCT PUMP (01-Sep-23)

	OVERALL LEVEL	1-20 KHz
11	.024 In/Sec	.176 G-s
21	.021 In/Sec	.255 G-s
23	.028 In/Sec	.224 G-s
71	.043 In/Sec	.116 G-s
72	.038 In/Sec	.096 G-s

7034-04 - C CONC OVERRUN PUMP (01-Sep-23)

	OVERALL LEVEL	1-20 KHz
11	.121 In/Sec	.143 G-s
21	.119 In/Sec	.263 G-s
23	.055 In/Sec	.191 G-s
71	.034 In/Sec	.042 G-s
72	.016 In/Sec	.084 G-s

27428 - C TANK CAR LOAD PUMP (01-Sep-23)

	OVERALL LEVEL	1-20 KHz
11	.083 In/Sec	.533 G-s
21	.094 In/Sec	.626 G-s
23	.095 In/Sec	.357 G-s
71	.161 In/Sec	1.833 G-s
72	.085 In/Sec	1.685 G-s

27431 - D TANK CAR LOAD PUMP PERONE (01-Sep-23)

	OVERALL LEVEL	1-20 KHz
11	.048 In/Sec	.439 G-s
21	.038 In/Sec	.468 G-s
23	.041 In/Sec	.300 G-s
71	.039 In/Sec	.546 G-s
72	.068 In/Sec	.753 G-s

28133 - WEST TANK FARM VACUUM PUMP (01-Sep-23)

	OVERALL LEVEL	1-20 KHz
11	.178 In/Sec	1.484 G-s
21	.186 In/Sec	2.927 G-s
23	.188 In/Sec	1.052 G-s
71	.162 In/Sec	4.811 G-s
72	.203 In/Sec	10.12 G-s

0041 - VAC RECEIVR PUMP EAST -Durco (01-Sep-23)

		OVERALL LEVEL	1-20 KHz
	11	.259 In/Sec	.496 G-s
	21	.211 In/Sec	.487 G-s
	23	.109 In/Sec	.486 G-s
	71	.061 In/Sec	2.179 G-s
	72	.096 In/Sec	5.297 G-s

P105 - STP BUILDING P105 (01-Sep-23)

		OVERALL LEVEL	1-20 KHz
	11	.171 In/Sec	.812 G-s
	21	.167 In/Sec	.569 G-s
	23	.079 In/Sec	.448 G-s
	71	.044 In/Sec	1.130 G-s
	72	.035 In/Sec	.784 G-s

Station: HYDROGEN
Route No. 2: H2 WEEKLY

MEASUREMENT POINT		OVERALL LEVEL	HFD / VHFD
C2 - FD BLOWER C2		(05-Sep-23)	
		OVERALL LEVEL	1-20 KHz
	MOH	.560 In/Sec	1.004 G-s
	MOV	.572 In/Sec	.262 G-s
	MIH	.441 In/Sec	1.184 G-s
	MIV	.748 In/Sec	.229 G-s
	MIA	1.815 In/Sec	.206 G-s
	FIH	.687 In/Sec	3.728 G-s
	FIV	1.157 In/Sec	.612 G-s
	FIA	2.088 In/Sec	.782 G-s
	FOH	.504 In/Sec	2.739 G-s
	FOV	1.643 In/Sec	.485 G-s

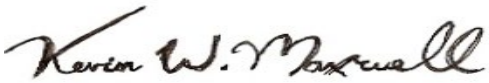
C1 - ID -BLOWER C1 (01-Sep-23)

		OVERALL LEVEL	1-20 KHz
	11	.123 In/Sec	.356 G-s
	21	.119 In/Sec	.451 G-s
	23	.104 In/Sec	.102 G-s
	71	.118 In/Sec	.666 G-s
	72	.065 In/Sec	.358 G-s
	81	.296 In/Sec	1.106 G-s
	82	.244 In/Sec	.560 G-s

Clarification Of Vibration Units:
Acc --> G-s PK
Vel --> In/Sec PK

As always, it has been a pleasure to serve Arkema. If there are any comments or questions, do not hesitate to contact us.

Sincerely,



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