HI-SPEED INDUSTRIAL SERVICE QualiTest® Diagnostics

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January 3, 2024

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Arkema
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The following is a summary of findings from the December 2023 H2O2 WEEK 4, H2 MONTHLY, and semi-annual 70% Pumps vibration surveys that were performed on December 27, 2023.

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.

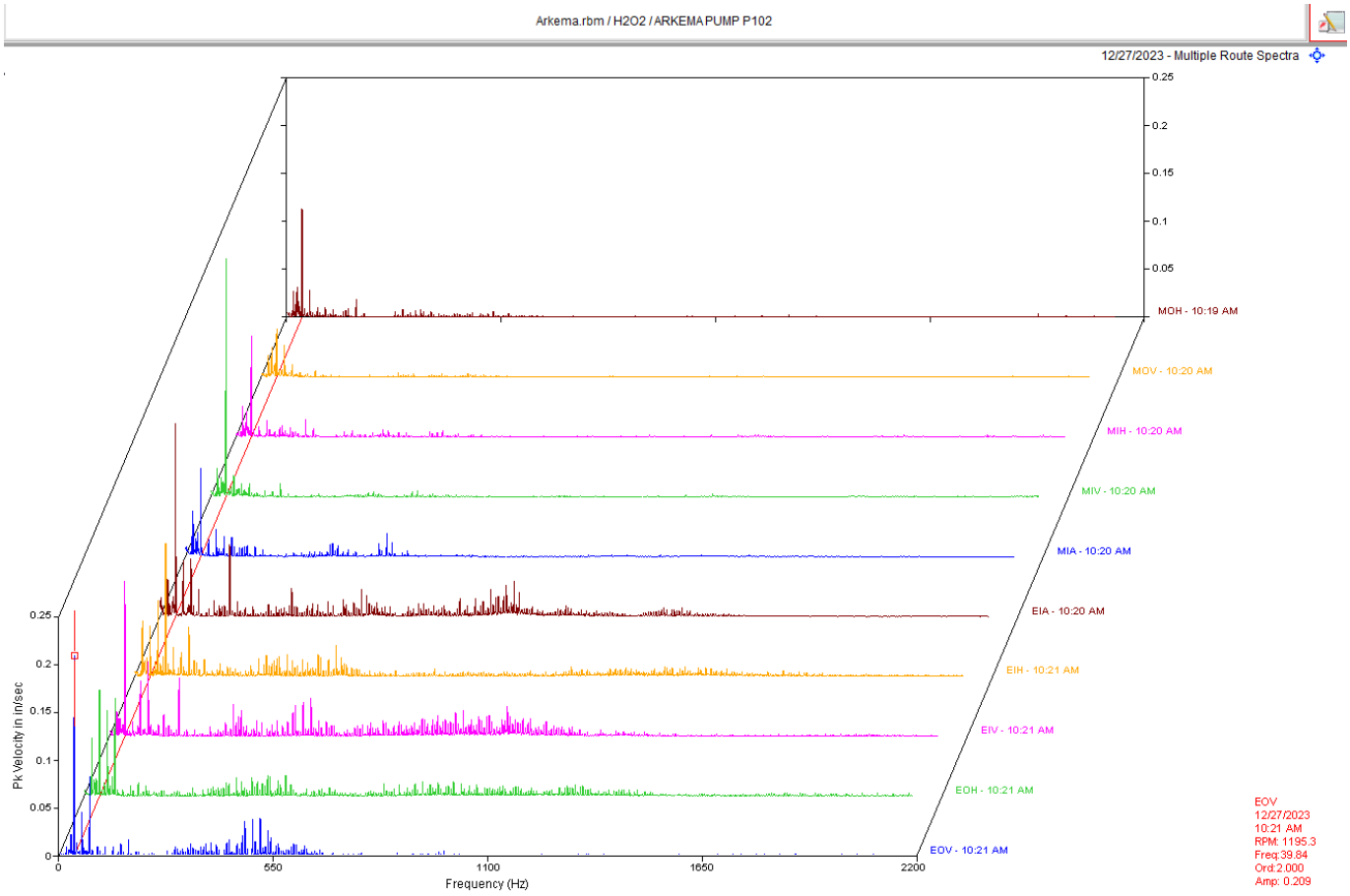
CLASS III: Defect (s) present that may cause failure in short term (less than 2 months). This should be addressed as soon as practical, with a high maintenance priority. Increase monitoring frequency.

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

WEEK 4 H2O2 Plant

Pump 102 P102 CLASS I



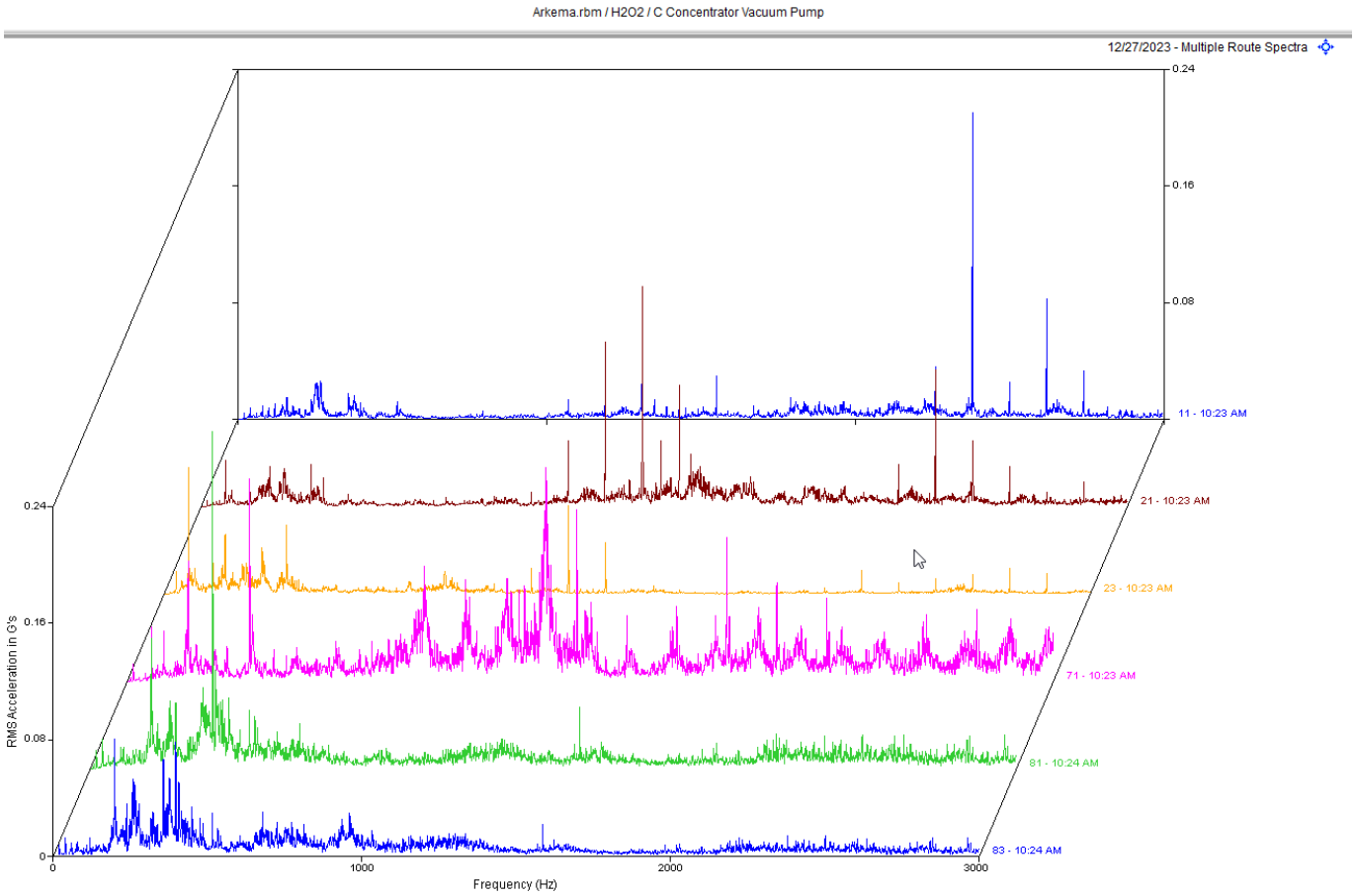
Observation:

Data above is a multipoint spectral waterfall. Pump data shows a 2 x rpm peak with multiple pump rpm harmonics throughout the pump spectra.

Recommendation:

The pump appears to have possible internal wear beginning to occur. The higher vibration in the axial direction may indicate excessive axial clearances. We are monitoring this very closely.

C Concentrator Vacuum Pump CLASS I



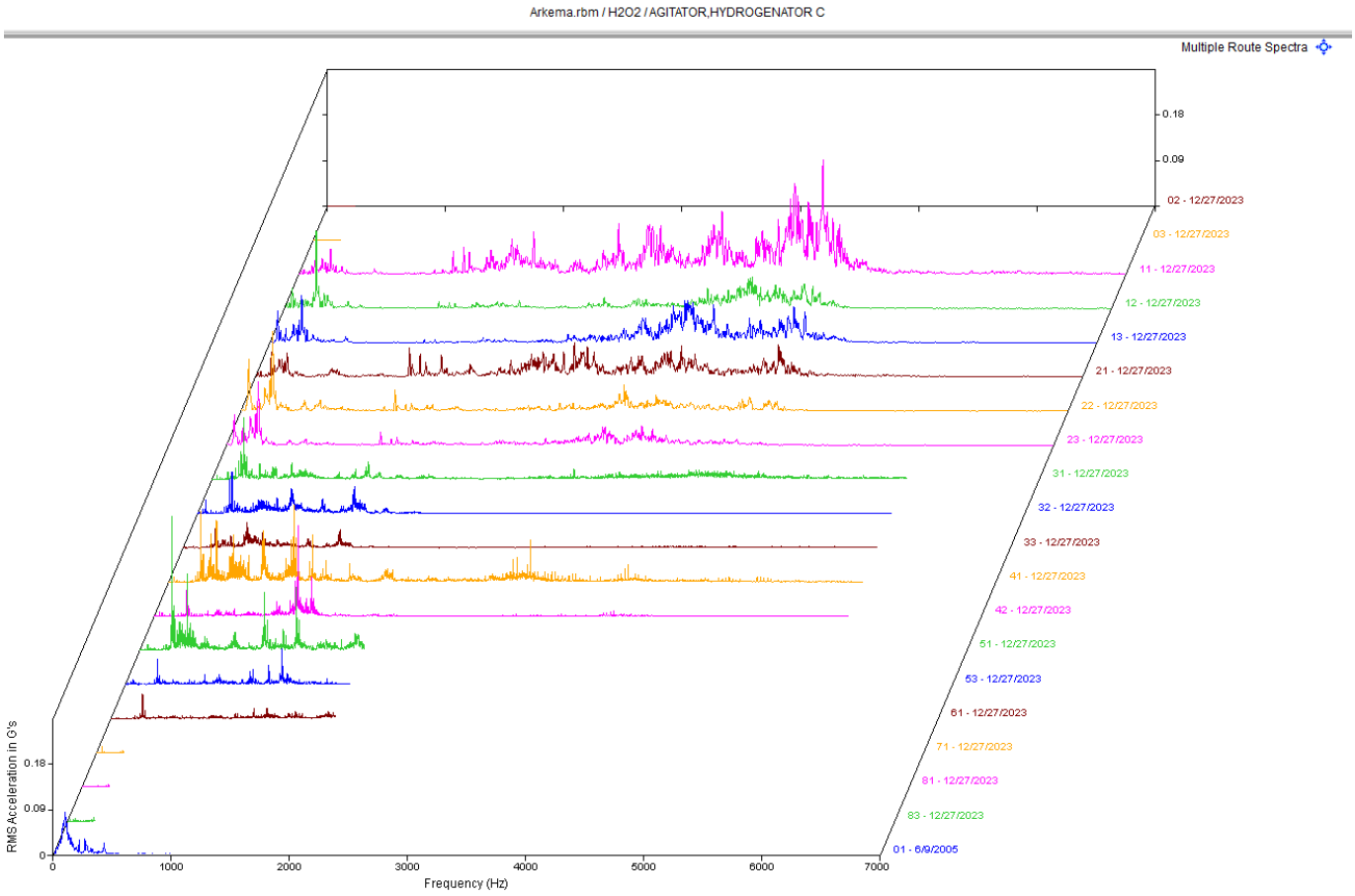
Observation:

Data above is the multi-point spectra of the motor and the pump. Pump drive end horizontal spectrum (71) shows 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



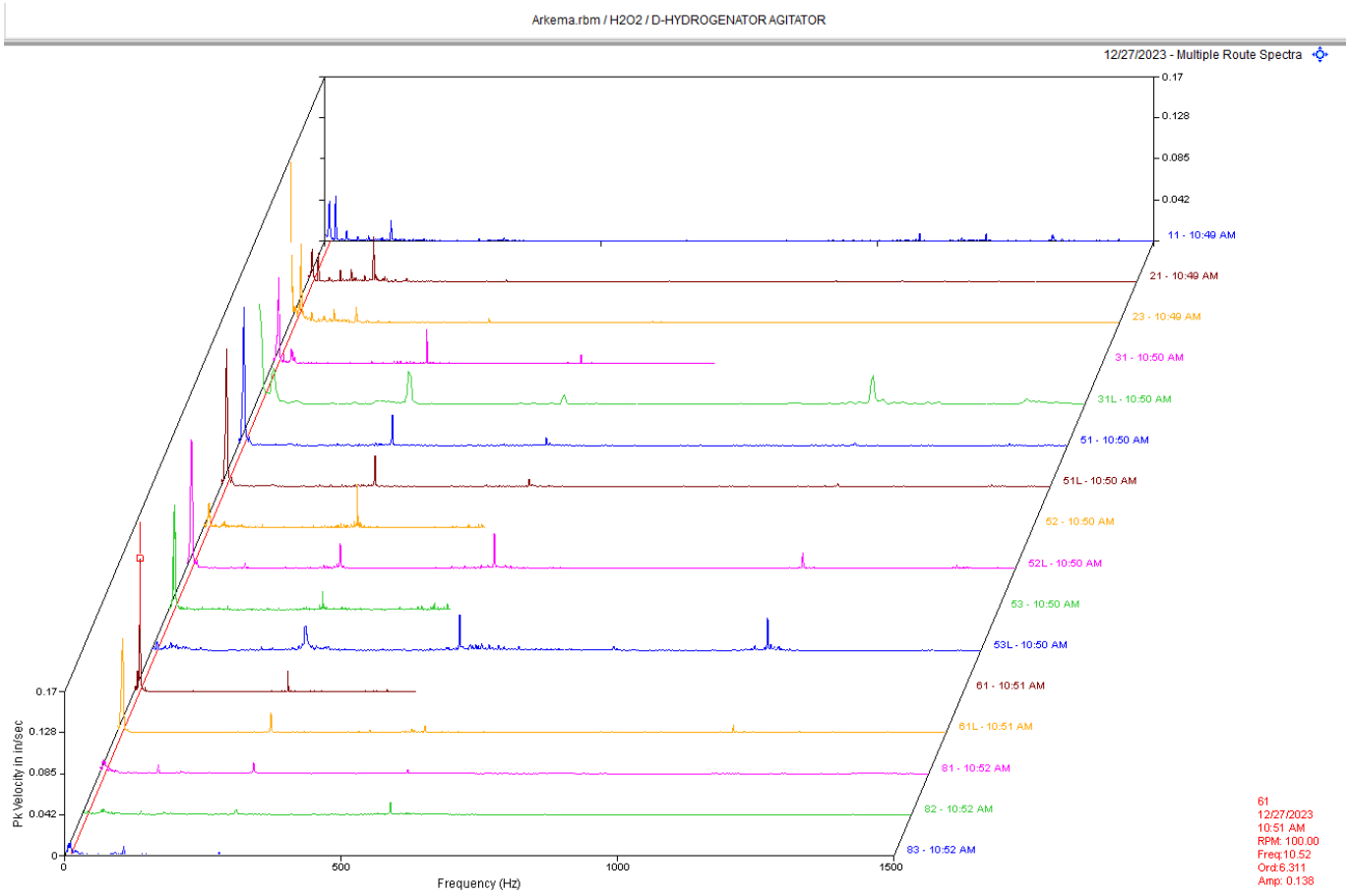
Observation:

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 I



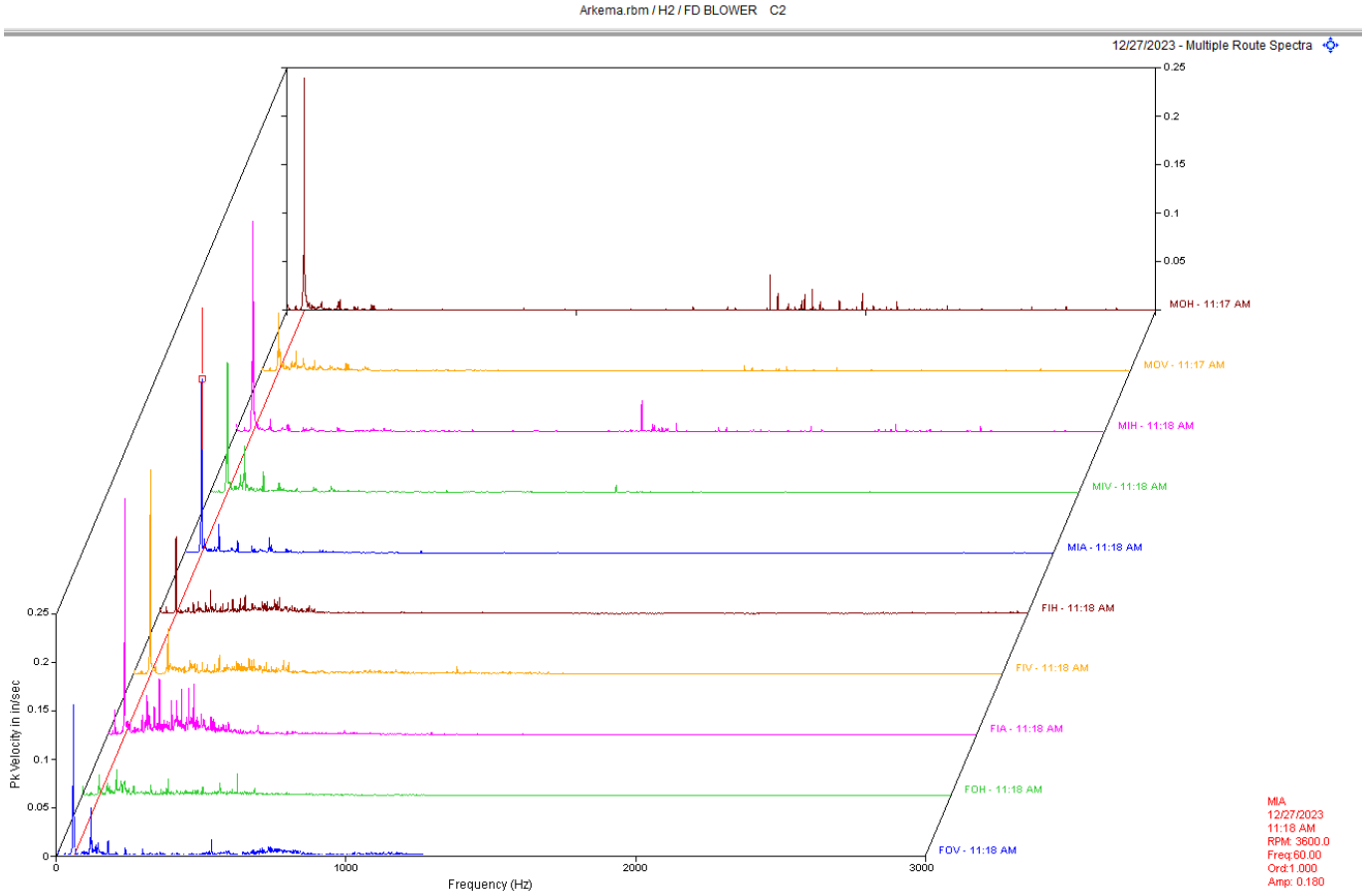
Observation:

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 that have increased in amplitude.

Recommendation:

Data shows a decrease in amplitude throughout gear drive. This will be downgraded to a CLASS I defect. We still recommend to 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.

FD Blower CLASS I



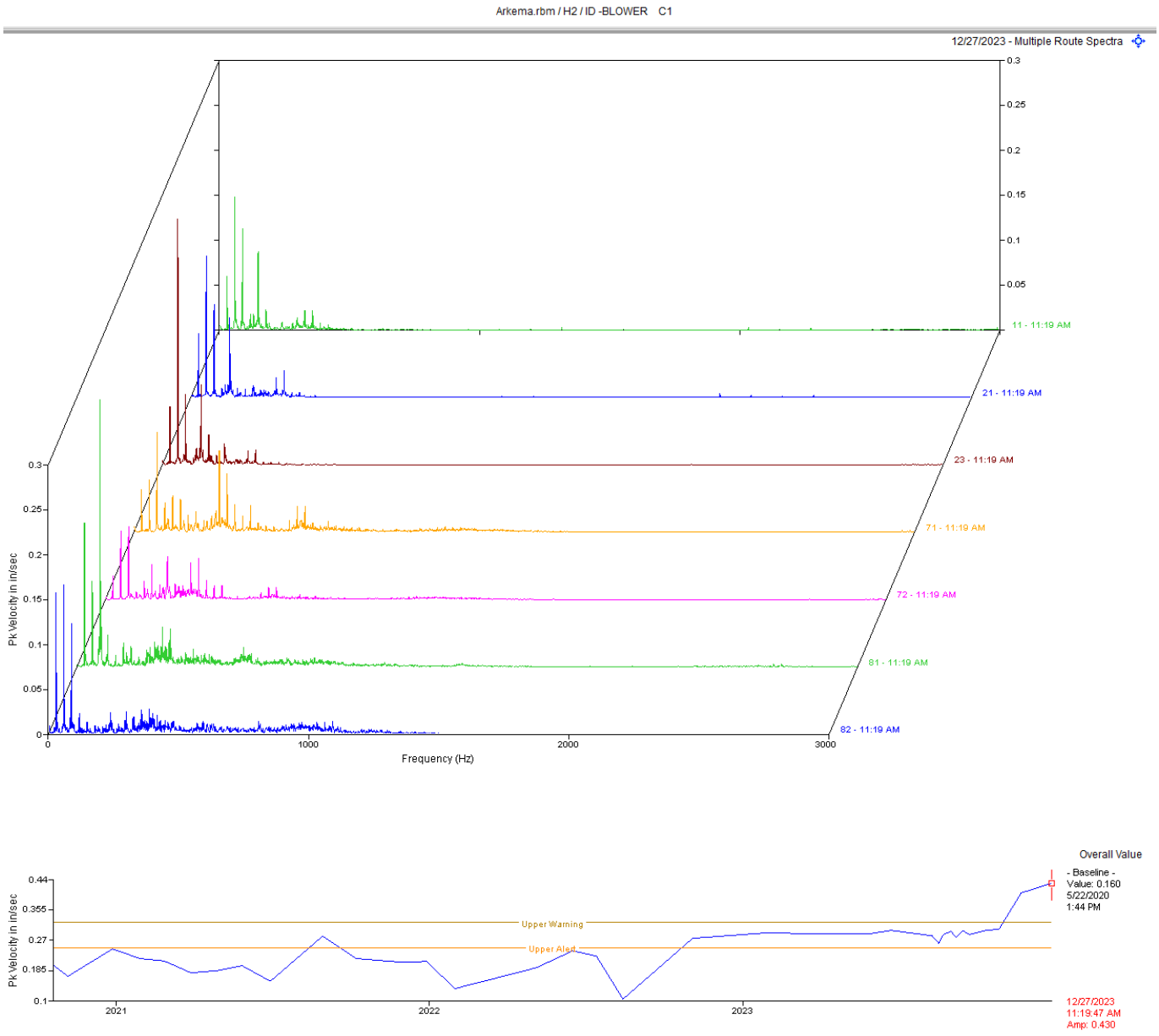
Observation:

Data above shows a high 1 x rpm vibration in the motor and fan. This may be due to the coupling type. TB Woods couplings are not a good coupling for high speed applications. We recommend looking into changing the coupling type to a Rexnord Omega Coupling. This coupling has a much higher rpm rating. TB Woods couplings for this size coupling have a max rpm of 3600 rpm. Omega couplings this size have a speed rating of 6600 rpm.

Recommendation:

We recommend looking into changing coupling type. Also the fan bearing clearances should be inspected during next available time.

ID Fan CLASS II



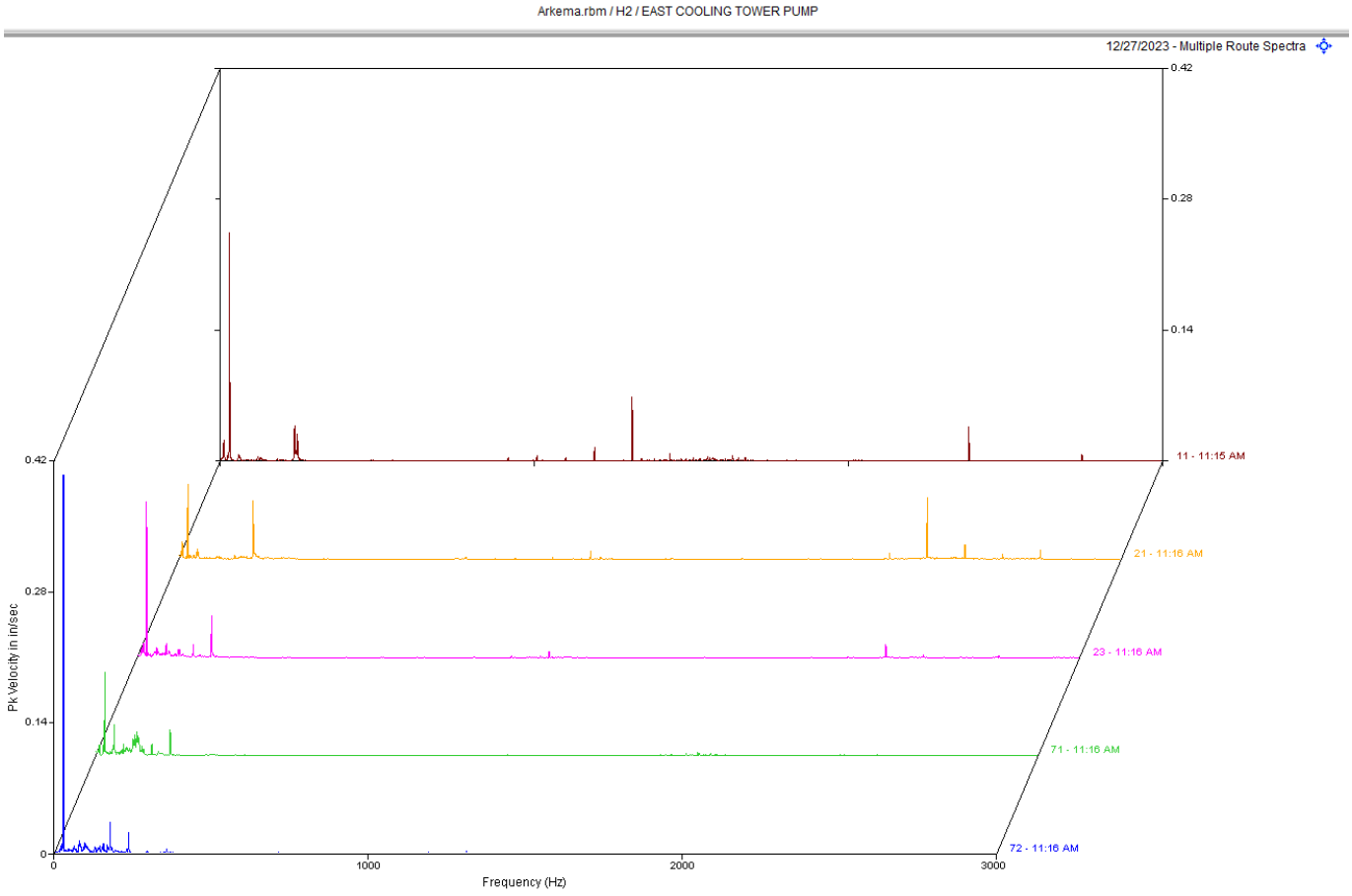
Observation:

Multi-point spectra of the motor and fan shows several rpm harmonics in the fan data. Motor also has some 1-6 x rpm peaks present. Trend data shows an increase in amplitude at ODE fan bearing.

Recommendation:

The fan bearing data indicates mechanical looseness in the fan bearings particularly the ODE fan bearing. This is also where the most fan shaft wear is at which is likely the cause of the high vibration. The fan shaft will likely need attention in the near future if vibration keeps increasing.

East and West Cooling Tower Pumps CLASS II



Observation:

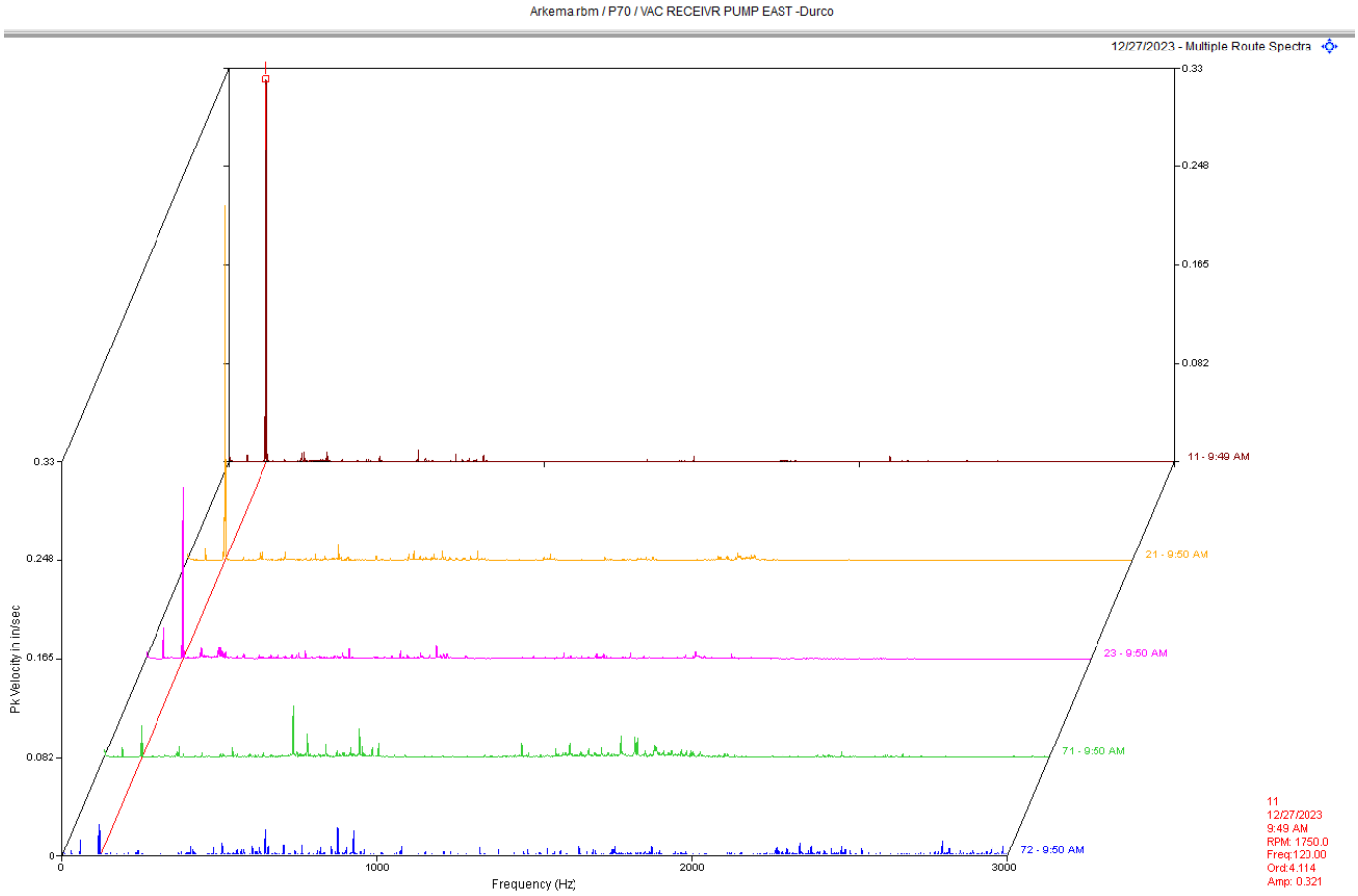
Data above is the East Pump. Data shows a high vibration at 1 x rpm in motor and pump.
All three pumps have similar vibration and similar issues.

Recommendation:

Cooling tower motors/pumps have base issues. They were not installed correctly. Bases need to be leveled and fastened properly to the concrete. There should not be gaps between the base frame and the concrete pad. The bases also need to epoxy grouted. Because the bases are not installed correctly, there is excessive vibration, especially in the motor/pump verticals. Ensure bases are leveled, fastened properly, and grouted in as soon as time allows.

70% Pumps SEMI-ANNUAL

Vac Receiver Pump East Durco CLASS I



Observation:

Muli-point spectra of the motor and pump Shows a peak vibration at 120 Hz. This is 2 x line frequency and is electrical in nature.

Recommendation:

120 Hz. vibration is usually an air gap issue in the motor. For now, check motor for soft foot and re-align the motor to the pump.

Abbreviated Last Measurement Summary

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Database: Arkema.rbm
Station: PEROXIDE
Route No. 4: ARK WK4

MEASUREMENT POINT		OVERALL LEVEL	HFD / VHFD
P102	- ARKEMA PUMP P102	(27-Dec-23)	
		OVERALL LEVEL	1K-20KHz
MOH		.138 In/Sec	.470 G-s
MOV		.086 In/Sec	.323 G-s
MIH		.130 In/Sec	.729 G-s
MIV		.261 In/Sec	.606 G-s
MIA		.142 In/Sec	.353 G-s
EIA		.299 In/Sec	1.102 G-s
EIH		.246 In/Sec	1.852 G-s
EIV		.290 In/Sec	1.790 G-s
EOH		.234 In/Sec	2.957 G-s
EOV		.266 In/Sec	1.225 G-s
2130-1old	- C Concentrator Vacuum Pump	(27-Dec-23)	
		OVERALL LEVEL	1-20 KHz
11		.057 In/Sec	.411 G-s
21		.072 In/Sec	.623 G-s
23		.135 In/Sec	.240 G-s
71		.134 In/Sec	2.323 G-s
81		.155 In/Sec	.561 G-s
83		.118 In/Sec	.335 G-s
7000-01	- AGITATOR,HYDROGENATOR C	(27-Dec-23)	
		OVERALL LEVEL	1-20 KHZ
02		.053 In/Sec	.042 G-s
03		.039 In/Sec	.012 G-s
11		.066 In/Sec	1.553 G-s
12		.107 In/Sec	.558 G-s
13		.119 In/Sec	.778 G-s
21		.075 In/Sec	.704 G-s
22		.192 In/Sec	.308 G-s
23		.132 In/Sec	.342 G-s
31		.086 In/Sec	.459 G-s
32		.099 In/Sec	.357 G-s
33		.086 In/Sec	.294 G-s
41		.103 In/Sec	.550 G-s
42		.061 In/Sec	.409 G-s
51		.140 In/Sec	.693 G-s
53		.046 In/Sec	.227 G-s
61		.033 In/Sec	.299 G-s
71		.041 In/Sec	.632 G-s
81		.023 In/Sec	.369 G-s
83		.037 In/Sec	.279 G-s
57	- A/B Concentr Vac Pmp-var RPM	(27-Dec-23)	
		OVERALL LEVEL	1-20 KHz
11		.042 In/Sec	.282 G-s
12		.038 In/Sec	.137 G-s
21		.041 In/Sec	.336 G-s
23		.039 In/Sec	.127 G-s
71		.076 In/Sec	.559 G-s
81		.074 In/Sec	.550 G-s
83		.054 In/Sec	.402 G-s

2130-1 - FLASH VAP VAC PUMP-var speed (27-Dec-23)

	OVERALL LEVEL	1-20 KHz
11	.039 In/Sec	.624 G-s
12	.040 In/Sec	.672 G-s
21	.044 In/Sec	1.559 G-s
22	.048 In/Sec	.580 G-s
23	.046 In/Sec	.683 G-s
71	.080 In/Sec	.899 G-s
72	.092 In/Sec	1.289 G-s
81	.079 In/Sec	1.208 G-s
82	.083 In/Sec	.701 G-s
83	.052 In/Sec	.335 G-s

C-203 - C-203 Comp (27-Dec-23)

	OVERALL LEVEL	1-20 KHz
11	.073 In/Sec	3.163 G-s
12	.034 In/Sec	1.162 G-s
21	.045 In/Sec	1.725 G-s
22	.025 In/Sec	.634 G-s
23	.025 In/Sec	.627 G-s
	OVERALL LEVEL	1-20 KHZ
71M	.090 In/Sec	4.414 G-s
72M	.054 In/Sec	1.611 G-s
73M	.062 In/Sec	1.233 G-s
81M	.048 In/Sec	7.357 G-s
82M	.045 In/Sec	1.139 G-s
71F	.048 In/Sec	8.420 G-s
72F	.062 In/Sec	1.193 G-s
73F	.036 In/Sec	1.728 G-s
81F	.045 In/Sec	5.326 G-s
82F	.044 In/Sec	1.465 G-s

C-202 - C-202 Comp (27-Dec-23)

	OVERALL LEVEL	1-20 KHz
11	.245 In/Sec	9.066 G-s
12	.164 In/Sec	2.593 G-s
21	.081 In/Sec	1.332 G-s
22	.052 In/Sec	.477 G-s
23	.053 In/Sec	.328 G-s
	OVERALL LEVEL	1-20 KHZ
71M	.070 In/Sec	3.274 G-s
72M	.059 In/Sec	.978 G-s
73M	.093 In/Sec	1.024 G-s
81M	.050 In/Sec	7.534 G-s
82M	.061 In/Sec	1.320 G-s
71F	.037 In/Sec	4.192 G-s
72F	.063 In/Sec	1.095 G-s
73F	.050 In/Sec	1.211 G-s
81F	.042 In/Sec	4.930 G-s
82F	.057 In/Sec	2.307 G-s

C-201 - C-201 Comp (27-Dec-23)

	OVERALL LEVEL	1-20 KHz
11	.134 In/Sec	4.055 G-s
12	.060 In/Sec	.964 G-s
21	.114 In/Sec	1.471 G-s
22	.038 In/Sec	.391 G-s
23	.061 In/Sec	.249 G-s
	OVERALL LEVEL	1-20 KHZ
71M	.086 In/Sec	5.448 G-s
72M	.053 In/Sec	1.235 G-s
73M	.087 In/Sec	1.732 G-s
81M	.050 In/Sec	9.530 G-s
82M	.040 In/Sec	1.299 G-s
71F	.036 In/Sec	7.666 G-s
72F	.077 In/Sec	2.578 G-s
73F	.043 In/Sec	1.403 G-s
81F	.048 In/Sec	8.004 G-s
82F	.077 In/Sec	1.342 G-s

new AC - INSTRUMENT AIR COMPRESSOR (27-Dec-23)

	OVERALL LEVEL	1-20 KHz
11	.103 In/Sec	1.218 G-s
12	.098 In/Sec	.510 G-s
13	.061 In/Sec	.351 G-s
21	.082 In/Sec	1.845 G-s
22	.074 In/Sec	.591 G-s
23	.033 In/Sec	.399 G-s
	OVERALL LEVEL	1-20 KHZ
71M	.118 In/Sec	9.668 G-s
72M	.121 In/Sec	3.222 G-s
73M	.094 In/Sec	2.931 G-s
81M	.121 In/Sec	4.371 G-s
82M	.186 In/Sec	1.587 G-s
83M	.274 In/Sec	1.995 G-s
71F	.162 In/Sec	8.731 G-s
72F	.077 In/Sec	2.207 G-s
73F	.137 In/Sec	1.754 G-s
81F	.136 In/Sec	9.560 G-s
82F	.332 In/Sec	2.357 G-s
83F	.220 In/Sec	2.342 G-s

201-08A - COMPRESSOR,NASH A 201-08A (27-Dec-23)

	OVERALL LEVEL	1-20 KHz
11	.054 In/Sec	.171 G-s
12	.055 In/Sec	.118 G-s
13	.107 In/Sec	.296 G-s
21	.054 In/Sec	.316 G-s
22	.039 In/Sec	.433 G-s
23	.041 In/Sec	.306 G-s
71	.139 In/Sec	.498 G-s
72	.102 In/Sec	.165 G-s
73	.196 In/Sec	.116 G-s
81	.114 In/Sec	.233 G-s
82	.179 In/Sec	.145 G-s
83	.161 In/Sec	.070 G-s

202-05 - NASH SEAL LIQUID PUMP-A (27-Dec-23)

	OVERALL LEVEL	1-20 KHz
11	.017 In/Sec	.258 G-s
21	.021 In/Sec	.397 G-s
23	.019 In/Sec	.103 G-s
71	.026 In/Sec	.064 G-s
72	.022 In/Sec	.044 G-s

9002-10 - D-HYDROGENATOR AGITATOR (27-Dec-23)

	OVERALL LEVEL	1-20 KHz
11	.076 In/Sec	.390 G-s
21	.078 In/Sec	.260 G-s
23	.185 In/Sec	.145 G-s
	OVERALL LEVEL	1-20 KHZ
31	.164 In/Sec	.663 G-s
31L	.130 In/Sec	.824 G-s
	OVERALL LEVEL	1-20 KHz
51	.206 In/Sec	.288 G-s
51L	.206 In/Sec	.288 G-s
52	.081 In/Sec	.178 G-s
52L	.213 In/Sec	.440 G-s
53	.214 In/Sec	.076 G-s
53L	.089 In/Sec	.607 G-s
61	.239 In/Sec	.287 G-s
61L	.147 In/Sec	.287 G-s
81	.037 In/Sec	.072 G-s
82	.027 In/Sec	.011 G-s
83	.033 In/Sec	.012 G-s

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

MEASUREMENT POINT		OVERALL LEVEL	HFD / VHFD
401-04	- 265C STABILITY TANK	(27-Dec-23)	
		OVERALL LEVEL	1-20 KHz
11		.029 In/Sec	.423 G-s
21		.034 In/Sec	.464 G-s
23		.033 In/Sec	.425 G-s
71		.029 In/Sec	.212 G-s
72		.021 In/Sec	.230 G-s
404-13	- 265J STABILITY TANK	(27-Dec-23)	
		OVERALL LEVEL	1-20 KHz
11		.081 In/Sec	.562 G-s
21		.130 In/Sec	.519 G-s
23		.110 In/Sec	.931 G-s
71		.148 In/Sec	1.019 G-s
72		.163 In/Sec	1.589 G-s
7073-02	- 245B STABILITY TANK	(27-Dec-23)	
		OVERALL LEVEL	1-20 KHz
11		.025 In/Sec	.0036 G-s
21		.022 In/Sec	.0048 G-s
23		.013 In/Sec	.0032 G-s
71		.036 In/Sec	.0078 G-s
72		.015 In/Sec	.012 G-s
357-12	- K STORAGE TANK PUMP	(27-Dec-23)	
		OVERALL LEVEL	1-20 KHz
11		.134 In/Sec	.488 G-s
21		.117 In/Sec	.489 G-s
23		.105 In/Sec	.740 G-s
71		.140 In/Sec	1.596 G-s
72		.086 In/Sec	1.574 G-s
56	- A PRODUCT PUMP	(27-Dec-23)	
		OVERALL LEVEL	1-20 KHz
11		.065 In/Sec	.115 G-s
21		.039 In/Sec	.149 G-s
23		.149 In/Sec	.241 G-s
71		.106 In/Sec	.120 G-s
72		.206 In/Sec	.168 G-s
247-11	- A OVERRUN PUMP	(27-Dec-23)	
		OVERALL LEVEL	1-20 KHz
11		.060 In/Sec	.353 G-s
21		.035 In/Sec	.341 G-s
23		.055 In/Sec	.087 G-s
71		.019 In/Sec	.798 G-s
72		.030 In/Sec	.694 G-s
249-24	- B CONC PRODUCT PUMP, NORTH	(27-Dec-23)	
		OVERALL LEVEL	1-20 KHz
11		.093 In/Sec	1.571 G-s
21		.102 In/Sec	1.822 G-s
23		.077 In/Sec	.192 G-s
71		.032 In/Sec	.483 G-s
72		.021 In/Sec	.389 G-s
7034-04	- C CONC OVERRUN PUMP	(27-Dec-23)	
		OVERALL LEVEL	1-20 KHz
11		.143 In/Sec	.109 G-s
21		.127 In/Sec	.142 G-s
23		.046 In/Sec	.128 G-s
71		.021 In/Sec	.109 G-s
72		.034 In/Sec	.130 G-s

27412	- A TANK CAR LOAD PUMP	(27-Dec-23)	
		OVERALL LEVEL	1-20 KHz
11		.161 In/Sec	.079 G-s
21		.138 In/Sec	.221 G-s
23		.065 In/Sec	.166 G-s
71		.148 In/Sec	.252 G-s
72		.065 In/Sec	.490 G-s
27428	- C TANK CAR LOAD PUMP	(27-Dec-23)	
		OVERALL LEVEL	1-20 KHz
11		.269 In/Sec	.386 G-s
21		.234 In/Sec	.595 G-s
23		.099 In/Sec	.261 G-s
71		.130 In/Sec	.728 G-s
72		.121 In/Sec	1.084 G-s
0041	- VAC RECEIVR PUMP EAST -Durco	(27-Dec-23)	
		OVERALL LEVEL	1-20 KHz
11		.325 In/Sec	.504 G-s
21		.304 In/Sec	.490 G-s
23		.157 In/Sec	.689 G-s
71		.104 In/Sec	1.633 G-s
72		.097 In/Sec	2.773 G-s
P105	- STP BUILDING P105	(27-Dec-23)	
		OVERALL LEVEL	1-20 KHz
11		.128 In/Sec	1.194 G-s
21		.133 In/Sec	.548 G-s
23		.150 In/Sec	.046 G-s
71		.050 In/Sec	1.343 G-s
72		.044 In/Sec	.468 G-s

Station: HYDROGEN
Route No. 1: H2 MONTHLY

MEASUREMENT POINT		OVERALL LEVEL	HFD / VHFD
P2B	- PUMP MEA CIRC EAST P2B	(27-Dec-23)	
		OVERALL LEVEL	1-20 KHz
11		.025 In/Sec	.421 G-s
21		.033 In/Sec	.532 G-s
23		.052 In/Sec	.126 G-s
71		.157 In/Sec	3.033 G-s
72		.148 In/Sec	2.487 G-s
P1B	- PUMP BFW EAST P1B	(27-Dec-23)	
		OVERALL LEVEL	1-20 KHz
11		.077 In/Sec	.757 G-s
21		.065 In/Sec	.975 G-s
23		.049 In/Sec	.338 G-s
71		.110 In/Sec	.690 G-s
72		.077 In/Sec	.455 G-s
81		.079 In/Sec	.870 G-s
82		.065 In/Sec	.571 G-s
83		.046 In/Sec	.506 G-s
C2	- FD BLOWER C2	(27-Dec-23)	
		OVERALL LEVEL	1-20 KHz
MOH		.294 In/Sec	1.682 G-s
MOV		.101 In/Sec	.411 G-s
MIH		.278 In/Sec	1.221 G-s
MIV		.185 In/Sec	.240 G-s
MIA		.220 In/Sec	.180 G-s
FIH		.134 In/Sec	2.158 G-s
FIV		.282 In/Sec	1.113 G-s
FIA		.352 In/Sec	.499 G-s

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            FOH                      .098 In/Sec      1.049 G-s
            FOV                      .236 In/Sec       .417 G-s

      C1          - ID -BLOWER    C1              (27-Dec-23)
                                  OVERALL LEVEL     1-20 KHz
            11                     .243 In/Sec       .736 G-s
            21                     .246 In/Sec      1.277 G-s
            23                     .331 In/Sec      1.070 G-s
            71                     .252 In/Sec      1.750 G-s
            72                     .194 In/Sec      1.060 G-s
            81                     .430 In/Sec      2.077 G-s
            82                     .340 In/Sec      1.290 G-s

      CTPE        - EAST COOLING TOWER PUMP       (27-Dec-23)
                                  OVERALL LEVEL     1-20 KHz
            11                     .276 In/Sec      2.381 G-s
            21                     .138 In/Sec      3.121 G-s
            23                     .189 In/Sec      1.052 G-s
            71                     .138 In/Sec      1.061 G-s
            72                     .426 In/Sec       .185 G-s

      CTPW        - WEST COOLING TOWER PUMP       (27-Dec-23)
                                  OVERALL LEVEL     1-20 KHz
            11                     .082 In/Sec      1.077 G-s
            21                     .163 In/Sec      5.292 G-s
            23                     .150 In/Sec      1.424 G-s
            71                     .222 In/Sec      1.916 G-s
            72                     .171 In/Sec       .241 G-s

-------------------------------------------------------------------------------
   Clarification Of Vibration Units:
      Acc       -->  G-s       PK
      Vel       -->  In/Sec    PK
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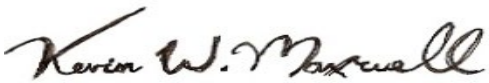
As always, it has been a pleasure to serve Arkema. If there are any comments or questions, do not hesitate to contact us.

Sincerely,



ISO Certified Vibration Analyst, Category III

HI-SPEED INDUSTRIAL SERVICE

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