HI-SPEED INDUSTRIAL SERVICE

MILLINGTON, TN

December 9, 2021

Pennakem

Subject: November vibration service report

Most of the machines surveyed were found to be in good condition, with the exception of the following:

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

Hi-Speed **Industrial Service** tests and inspects industrial machinery and equipment and makes recommendations concerning maintenance and repairs based on its experience in the field of industrial repair and maintenance. The information contained herein is provided as an opinion only, not as a guaranty or warranty of the matters discussed herein.

This completes our assessment of your equipment for this survey. Thank you for your business and don't hesitate to call if you have any comments or questions.

Sincerely,

David W. Shook
Senior Reliability Specialists
Hi-Speed **Industrial Service**
dshook@gohispeed.com

7030 Ryburn Drive
Millington, TN 38053
P. 901-873-5300
F. 901-873-5301

Observations

P 24 Big Blue Water Pump
The pump trend has increased again and is dominated by a shaft speed vibration in the horizontal with the overall above 0.6"/second velocity peak. The pump data still indicates possible looseness in the bearing fits as well as wear in the pump, such as imbalance, and vane pass, which we suspect is 5x RPM. The motor shows a dominant 5x RPM vibration also in the horizontal. **Rated a Class III Defect.**

P 48-7B Roto jet High Pressure Pump
The pump vibration has increased again. Clean the pump. **Rated a Class II Defect.**

R53-301 Reactor Agitator Motor and Gearbox
The Motor/Gearbox frame appears cracked at the base on the south side. The agitator adapter shaft appears to have run out which most likely helped in the progression of the fatigue and subsequent crack. Repair the base and correct the shaft run out as soon as possible. **Rated a Class III Defect.**

R55-106 Reactor Agitator Motor Gearbox
Motor/gearbox has a 1xRPM vibration at input speed. Inspect the fasteners, structure, coupling and alignment as time allows. **Rated a Class I Defect.**

C67-51 Twin Screw Axial Compressor End
The lobe pass vibrations at 2x and 4x input speed are dominant in the data but have not changed much. Loading could affect vibrations. **Rated a Class I Defect.**

P67-504 Hot Oil Circulation Pump 50 HP
Multiple low amplitude harmonics of shaft speed are still evident in the motor axial. We still suggest inspecting the coupling and alignment. Check for run out. **Rated a Class I Defect.**

R80-10 Agitator Motor and Gearbox
The motor overall vibrations are low due to the slow rotation speeds; however, the raw data suggest the bearings are in severe distress. The gearbox has some similar vibrations, but we believe they are from the motor**. We still recommend replacing the motor and inspecting the coupling and gearbox at the very next opportunity. Rated a Class IV Defect.**

B82-101A Southwest FD Fan 10 HP (Outside)
The motor axial vibration has dropped for now.

CHLR45-1 20 Ton Trane Chiller
The East compressor was running and vibrating at over 1.0"/sec velocity peak at 60 Hz shaft speed. Vibrations at this levels in either unit will likely cause a reduced lifespan. **Rated a Class I Defect.**

Abbreviated Last Measurement Summary

****

Database: penn.rbm
Station: PENNAKEM NEW CURRENT DATABASE
Report Date: 09-Dec-21 13:27

MEASUREMENT POINT	OVERALL LEVEL	HFD / VHFD	MACHINE SPEED
B4C101-877 - ZURN BOILER BLOWER	(02-Dec-21)		
	OVERALL LEVEL	1-20 KHZ	
11	.189 In/Sec	1.049 G-s	1180.0 RPM
12	.125 In/Sec	1.457 G-s	
13	.124 In/Sec	.115 G-s	
21	.185 In/Sec	.955 G-s	
22	.144 In/Sec	1.702 G-s	
23	.116 In/Sec	.562 G-s	
71	.184 In/Sec	.728 G-s	
72	.112 In/Sec	.916 G-s	
73	.150 In/Sec	.436 G-s	
81	.158 In/Sec	1.014 G-s	
82	.123 In/Sec	.526 G-s	
P4C-102A - BOILER FEEDWATER PUMP	(02-Dec-21)		
	OVERALL LEVEL	1-20 KHZ	
11	.046 In/Sec	.510 G-s	3570.0 RPM
12	.035 In/Sec	.984 G-s	
21	.058 In/Sec	.705 G-s	
22	.030 In/Sec	1.017 G-s	
23	.055 In/Sec	.591 G-s	
71	.077 In/Sec	.449 G-s	
72	.079 In/Sec	.642 G-s	
73	.065 In/Sec	.577 G-s	
81	.053 In/Sec	.881 G-s	
82	.036 In/Sec	.254 G-s	
83	.087 In/Sec	.448 G-s	
P24-63DEGS - 63 DEG S WATER PUMP	(02-Dec-21)		
	OVERALL LEVEL	1-20 KHZ	
11	.107 In/Sec	.214 G-s	1750.0 RPM
12	.057 In/Sec	.226 G-s	
21	.115 In/Sec	.421 G-s	
22	.054 In/Sec	.557 G-s	
23	.082 In/Sec	.310 G-s	
71	.077 In/Sec	.257 G-s	
72	.064 In/Sec	.357 G-s	
73	.081 In/Sec	1.026 G-s	
81	.065 In/Sec	.437 G-s	
82	.053 In/Sec	.775 G-s	
83	.183 In/Sec	1.885 G-s	
P24-85DEGN - 85 DEG N WATER CIRC PUMP 125	(02-Dec-21)		
	OVERALL LEVEL	1-20 KHZ	
11	.090 In/Sec	.826 G-s	1750.0 RPM
12	.070 In/Sec	.258 G-s	

21	.066 In/Sec	.688 G-s	
22	.084 In/Sec	.974 G-s	
23	.043 In/Sec	.291 G-s	
71	.136 In/Sec	1.837 G-s	
72	.190 In/Sec	1.497 G-s	
73	.281 In/Sec	1.028 G-s	
81	.119 In/Sec	1.141 G-s	
82	.204 In/Sec	1.265 G-s	
83	.240 In/Sec	2.022 G-s	

P24-85DEGS - 85 DEG S WATER CIRC PUMP 125 (02-Dec-21)

	OVERALL LEVEL	1-20 KHZ	
11	.142 In/Sec	1.050 G-s	1750.0 RPM
12	.110 In/Sec	.165 G-s	
21	.095 In/Sec	.721 G-s	
22	.066 In/Sec	.714 G-s	
23	.057 In/Sec	.655 G-s	
71	.139 In/Sec	.622 G-s	
72	.083 In/Sec	.632 G-s	
73	.162 In/Sec	.530 G-s	
81	.069 In/Sec	.775 G-s	
82	.058 In/Sec	.631 G-s	
83	.086 In/Sec	1.126 G-s	

P24BGBL876 - BIG BLUE WATER PUMP-63 DEG (02-Dec-21)

	OVERALL LEVEL	1-20 KHZ	
11	.457 In/Sec	1.223 G-s	1180.0 RPM
12	.106 In/Sec	1.099 G-s	
21	.642 In/Sec	.541 G-s	
22	.169 In/Sec	1.259 G-s	
23	.219 In/Sec	.430 G-s	
71	.661 In/Sec	.304 G-s	
72	.150 In/Sec	.418 G-s	
73	.301 In/Sec	.339 G-s	
81	.669 In/Sec	.428 G-s	
82	.120 In/Sec	.708 G-s	
83	.207 In/Sec	.497 G-s	

P36-905C - N COOL TWR-EAST PUMP (02-Dec-21)

	OVERALL LEVEL	1-20 KHZ	
11	.032 In/Sec	.127 G-s	1780.0 RPM
12	.025 In/Sec	.166 G-s	
21	.033 In/Sec	.871 G-s	
22	.042 In/Sec	.663 G-s	
23	.030 In/Sec	.041 G-s	
71	.091 In/Sec	1.627 G-s	
72	.093 In/Sec	1.883 G-s	
73	.132 In/Sec	.776 G-s	
81	.115 In/Sec	1.658 G-s	
82	.133 In/Sec	1.405 G-s	
83	.150 In/Sec	2.224 G-s	

C36-EAST - UTILITY AIRCOMP ROTARY 200HP (02-Dec-21)

	OVERALL LEVEL	1-20 KHZ	
11	.102 In/Sec	.506 G-s	1750.0 RPM
12	.085 In/Sec	.546 G-s	
21	.051 In/Sec	1.264 G-s	

22	.079 In/Sec	.996 G-s	
23	.050 In/Sec	.477 G-s	
71	.108 In/Sec	2.783 G-s	3570.0 RPM
72	.104 In/Sec	3.465 G-s	
73	.147 In/Sec	2.107 G-s	
81	.130 In/Sec	4.066 G-s	
82	.160 In/Sec	6.117 G-s	
71F	.105 In/Sec	5.852 G-s	
72F	.114 In/Sec	2.593 G-s	
81F	.137 In/Sec	4.673 G-s	
82F	.128 In/Sec	4.093 G-s	

P39-4-877 - WELL PUMP #4 (02-Dec-21)

	OVERALL LEVEL	1-20 KHZ	
11	.237 In/Sec	.360 G-s	1780.0 RPM
12	.239 In/Sec	.457 G-s	
21	.131 In/Sec	.469 G-s	
22	.117 In/Sec	.322 G-s	
23	.076 In/Sec	.380 G-s	

C42-4 - AXIAL TWIN SCREW COMPRESSOR (02-Dec-21)

	OVERALL LEVEL	1-20 KHZ	
11	.073 In/Sec	1.113 G-s	1185.0 RPM
12	.053 In/Sec	1.449 G-s	1750.0 RPM
13	.086 In/Sec	.763 G-s	
21	.076 In/Sec	1.965 G-s	
22	.088 In/Sec	2.733 G-s	
23	.076 In/Sec	.799 G-s	
71	.074 In/Sec	4.176 G-s	3570.0 RPM
72	.056 In/Sec	3.122 G-s	
73	.071 In/Sec	3.800 G-s	
81	.045 In/Sec	2.611 G-s	
82	.038 In/Sec	1.364 G-s	
83	.056 In/Sec	1.209 G-s	
71F	.114 In/Sec	1.996 G-s	
72F	.039 In/Sec	2.069 G-s	
73F	.063 In/Sec	2.851 G-s	
81F	.071 In/Sec	1.191 G-s	
82F	.046 In/Sec	1.558 G-s	
83F	.071 In/Sec	1.728 G-s	

P42-4A - CENTRIFUGAL HOT OIL PUMP 5HP (02-Dec-21)

	OVERALL LEVEL	1-20 KHZ	
11	.017 In/Sec	.099 G-s	1760.0 RPM
21	.013 In/Sec	.044 G-s	
23	.020 In/Sec	.115 G-s	
71	.012 In/Sec	.173 G-s	
73	.0097 In/Sec	.069 G-s	
81	.018 In/Sec	.137 G-s	

P42-4B - CENTRIFUGAL HOT OIL PUMP 5HP (02-Dec-21)

	OVERALL LEVEL	1-20 KHZ	
11	.032 In/Sec	.061 G-s	1760.0 RPM
21	.023 In/Sec	.124 G-s	
23	.044 In/Sec	.056 G-s	
71	.035 In/Sec	.173 G-s	
73	.022 In/Sec	.094 G-s	

	81	.018 In/Sec	.101 G-s	

P42-4D - CENTRIFUGAL HOT OIL PUMP 5HP (02-Dec-21)

	OVERALL LEVEL	1-20 KHZ	
11	.025 In/Sec	.088 G-s	1760.0 RPM
21	.021 In/Sec	.058 G-s	
23	.022 In/Sec	.163 G-s	
71	.020 In/Sec	.169 G-s	
81	.036 In/Sec	.075 G-s	

P45-VAC - NEW VACUUM PUMP PILOT PLANT (02-Dec-21)

	OVERALL LEVEL	1-20 KHZ	
11	.196 In/Sec	.515 G-s	1760.0 RPM
21	.149 In/Sec	.768 G-s	
23	.164 In/Sec	.493 G-s	
71M	.123 In/Sec	.307 G-s	
71F	.129 In/Sec	.393 G-s	
73M	.101 In/Sec	.414 G-s	
81M	.113 In/Sec	.601 G-s	
81F	.110 In/Sec	.499 G-s	

P48-7B - ROTOJET HIGH PRESS PUMP 15HP (02-Dec-21)

	OVERALL LEVEL	1-20 KHZ	
11	.208 In/Sec	.208 G-s	1750.0 RPM
12	.463 In/Sec	.324 G-s	
21	.097 In/Sec	.733 G-s	
22	.431 In/Sec	.665 G-s	
23	.080 In/Sec	.306 G-s	
71	.527 In/Sec	2.074 G-s	
72	.256 In/Sec	1.769 G-s	
73	.088 In/Sec	.475 G-s	
81	.512 In/Sec	.776 G-s	
82	.361 In/Sec	1.172 G-s	

C53-301B - C-301B RECIP COMPRESSOR (02-Dec-21)

	OVERALL LEVEL	1-20 KHZ	
11	.047 In/Sec	.939 G-s	1800.0 RPM
12	.046 In/Sec	.538 G-s	
13	.062 In/Sec	.243 G-s	
21	.057 In/Sec	.233 G-s	
22	.044 In/Sec	.516 G-s	
23	.066 In/Sec	.162 G-s	
71	.052 In/Sec	.140 G-s	237.0 RPM
72	.028 In/Sec	.078 G-s	
73	.074 In/Sec	.069 G-s	
81	.059 In/Sec	.047 G-s	
82	.038 In/Sec	.052 G-s	

P53-301 - ANSI CENTRIFUGAL PUMP 50 HP (02-Dec-21)

	OVERALL LEVEL	1-20 KHZ	
11	.102 In/Sec	.062 G-s	1750.0 RPM
12	.060 In/Sec	.116 G-s	
21	.091 In/Sec	.254 G-s	
22	.113 In/Sec	.290 G-s	
23	.083 In/Sec	.545 G-s	
71	.073 In/Sec	.360 G-s	
72	.079 In/Sec	.293 G-s	

73	.060 In/Sec	.517 G-s		
81	.052 In/Sec	.951 G-s		
82	.058 In/Sec	.522 G-s		

R53-301 - AGITATOR GBX CHEMINEER 15HP (02-Dec-21)

	OVERALL LEVEL		
11	.393 In/Sec		1760.0 RPM
12	.237 In/Sec		
21	.389 In/Sec		
22	.238 In/Sec		
23	.464 In/Sec		
31	.344 In/Sec		
32	.100 In/Sec		
33	.279 In/Sec		
41	.283 In/Sec		
42	.081 In/Sec		
51	.312 In/Sec		
61	.183 In/Sec		
63	.077 In/Sec		
71	.042 In/Sec		

P53-310A - GRUNDFOSS VERT PUMP 10HP (02-Dec-21)

	OVERALL LEVEL	1-20 KHZ	
11	.087 In/Sec	.038 G-s	1750.0 RPM
12	.051 In/Sec	.309 G-s	
21	.068 In/Sec	.275 G-s	
22	.063 In/Sec	.152 G-s	
23	.031 In/Sec	.240 G-s	
71	.073 In/Sec	.186 G-s	
72	.069 In/Sec	.251 G-s	
73	.019 In/Sec	.261 G-s	
81	.045 In/Sec	.133 G-s	
82	.044 In/Sec	.203 G-s	

C54--115 - COMP 2CYL 2 STAGE 75 HP (02-Dec-21)

	OVERALL LEVEL	1-20 KHZ	
11	.086 In/Sec	.777 G-s	1800.0 RPM
12	.149 In/Sec	.473 G-s	
21	.090 In/Sec	.773 G-s	
22	.062 In/Sec	.401 G-s	
23	.151 In/Sec	.330 G-s	
71	.039 In/Sec	.074 G-s	
72	.154 In/Sec	.088 G-s	
73	.081 In/Sec	.052 G-s	
81	.029 In/Sec	.046 G-s	
82	.066 In/Sec	.040 G-s	

P54-112 - CANNED MOTOR CENTRIFUG PUMP (02-Dec-21)

	OVERALL LEVEL	1-20 KHZ	
11	.027 In/Sec	.041 G-s	1800.0 RPM
12	.016 In/Sec	.041 G-s	
13	.025 In/Sec	.059 G-s	
21	.032 In/Sec	.078 G-s	
22	.022 In/Sec	.126 G-s	
71	.029 In/Sec	.070 G-s	
72	.026 In/Sec	.081 G-s	

R55-101 - AGITATOR GBX AND MOTOR (02-Dec-21)

	OVERALL LEVEL		
11	.156 In/Sec		1760.0 RPM
12	.054 In/Sec		
21	.147 In/Sec		
22	.057 In/Sec		
23	.070 In/Sec		
31	.139 In/Sec		
32	.014 In/Sec		
33	.100 In/Sec		
41	.129 In/Sec		
42	.015 In/Sec		
51	.152 In/Sec		
61	.112 In/Sec		
63	.027 In/Sec		
71	.026 In/Sec		

R55-106 - REACTOR AGIT R-106 (02-Dec-21)

	OVERALL LEVEL	1-20 KHZ	
11	.184 In/Sec	.075 G-s	1760.0 RPM
12	.248 In/Sec		
21	.164 In/Sec	.164 G-s	
22	.118 In/Sec	.049 G-s	
23	.161 In/Sec	.190 G-s	
31	.208 In/Sec		
32	.148 In/Sec		
33	.157 In/Sec		
41	.377 In/Sec		
42	.082 In/Sec		
51	.352 In/Sec		
61	.298 In/Sec		
62	.094 In/Sec		
63	.068 In/Sec		
71	.042 In/Sec		

C67-51 - AXIAL TWIN SCREW COMPRESSOR (02-Dec-21)

	OVERALL LEVEL	1-20 KHZ	
11	.094 In/Sec	4.263 G-s	1750.0 RPM
12	.049 In/Sec	2.568 G-s	
13	.094 In/Sec	.661 G-s	
21	.065 In/Sec	1.947 G-s	
22	.075 In/Sec	2.206 G-s	
23	.080 In/Sec	1.762 G-s	
61	.251 In/Sec	.420 G-s	1500.0 RPM
71	.220 In/Sec	.527 G-s	3570.0 RPM
72	.180 In/Sec	.103 G-s	
73	.199 In/Sec	1.071 G-s	
81	.173 In/Sec	.290 G-s	
82	.162 In/Sec	.123 G-s	
83	.253 In/Sec	.510 G-s	
71F	.310 In/Sec	.608 G-s	
72F	.311 In/Sec	.082 G-s	
73F	.272 In/Sec	.553 G-s	
81F	.206 In/Sec	.068 G-s	
82F	.214 In/Sec	.015 G-s	
83F	.256 In/Sec	.654 G-s	

P67-54 - HOT OIL CIRC PMP CENT 15HP (02-Dec-21)

	OVERALL LEVEL	1-20 KHZ	
11	.149 In/Sec	1.081 G-s	1750.0 RPM
12	.051 In/Sec	.474 G-s	
21	.153 In/Sec	.320 G-s	
22	.022 In/Sec	.133 G-s	
23	.034 In/Sec	.176 G-s	
71	.106 In/Sec	.166 G-s	
72	.055 In/Sec	.167 G-s	
73	.059 In/Sec	.299 G-s	
81	.042 In/Sec	.157 G-s	
82	.036 In/Sec	.141 G-s	

P67-504 - HOT OIL CIRC PMP CENT 50HP (02-Dec-21)

	OVERALL LEVEL	1-20 KHZ	
11	.218 In/Sec	.150 G-s	1750.0 RPM
12	.123 In/Sec	.160 G-s	
21	.231 In/Sec	.285 G-s	
22	.254 In/Sec	.375 G-s	
23	.214 In/Sec	.268 G-s	
71	.221 In/Sec	.350 G-s	
72	.242 In/Sec	.419 G-s	
73	.167 In/Sec	.165 G-s	
81	.197 In/Sec	.272 G-s	
82	.187 In/Sec	.429 G-s	

R80-10 - AGITATOR GBX (02-Dec-21)

	OVERALL LEVEL	
11	.087 In/Sec	1760.0 RPM
12	.127 In/Sec	
21	.061 In/Sec	
22	.065 In/Sec	
23	.052 In/Sec	
31	.054 In/Sec	
32	.048 In/Sec	
33	.042 In/Sec	
41	.051 In/Sec	
42	.052 In/Sec	
51	.066 In/Sec	
52	.048 In/Sec	
61	.049 In/Sec	
62	.041 In/Sec	
63	.041 In/Sec	
71	.024 In/Sec	

B82-101A - FAN FORCED DRAFT 10HP SOUTH (02-Dec-21)

	OVERALL LEVEL	1-20 KHZ	
11	.155 In/Sec	.181 G-s	1800.0 RPM
12	.299 In/Sec	.197 G-s	
* 13	.264 In/Sec	.091 G-s	
21	.253 In/Sec	.180 G-s	
22	.282 In/Sec	.221 G-s	
23	.222 In/Sec	.110 G-s	

B82-102 - INDUCED DRAFT 150 HP (02-Dec-21)

	OVERALL LEVEL	1-20 KHZ	
11	.048 In/Sec	.063 G-s	1800.0 RPM

12	.037 In/Sec	.037 G-s	
21	.044 In/Sec	.309 G-s	
22	.055 In/Sec	.427 G-s	
23	.044 In/Sec	.294 G-s	
31	.032 In/Sec	.512 G-s	
32	.036 In/Sec	.631 G-s	
41	.052 In/Sec	.100 G-s	
42	.036 In/Sec	.300 G-s	

CHLR45-1 - 20T TRANE CHILLER (02-Dec-21)

	OVERALL LEVEL	
11W	.204 In/Sec	3570.0 RPM
12W	.234 In/Sec	
13W	.176 In/Sec	
11E	1.258 In/Sec	
12E	.633 In/Sec	
13E	.185 In/Sec	

Clarification Of Vibration Units:

Acc	-->	G-s	PK
Vel	-->	In/Sec	PK

* - Indicates Data Has Date/Time Different From Machine Date/Time