HI-SPEED INDUSTRIAL SERVICE

MILLINGTON, TN

February 12, 2021

Penn A Kem

Subject: February vibration service

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

Detailed Defects

Big Blue Water Pump
The pump data still indicates possible slight 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 data for the inboard bearing shows what we believe to be bearing fundamental outer race defect frequency and harmonics. **Rated a Class II Defect.**

New Vacuum Pump Pilot Plant
The unit was making odd sounds. The waterfall spectrum for the inboard bearing for the second shaft shows a large increase in harmonics and sub-synchronous noise. The unit could be in distress. Inspect the unit soon. Be prepared for service on the unit. **Rated a Class II Defect.**

Observations

P24-63 Degree Pump North
The pump axial vibrations still have a slight mound of noise in the spectrum that could be either bearing natural frequencies or some cavitation. We will watch closely going forward. No action required. **Rated a Class I Defect.**

P24-85 Degree Pump North
The pump axial is still elevated. Check the alignment and coupling as time allows. Could be a cocked bearing also. **Rated a Class I Defect.**

R48-2 Reactor Agitator Motor and Gearbox
The apparent bent agitator shaft is still causing distress in the drive components. Motor top bearing vibration is at 0.35”/sec velocity peak. **Rated a Class I Defect.**

R53-301 Reactor Agitator Motor and Gearbox
The motor outboard horizontal is at 1.0”/sec velocity peak. Inspect the motor and coupling, and check the shaft alignment, fasteners and frame as time allows. The agitator shaft could be bent. **Rated a Class II Defect.**

R55 106 Reactor Agitator
The unit vibrations at the motor outboard vertical are above ½”/second velocity peak overall. The dominant vibration is at 26.36 Hz and looks to be near or at shaft speed. Still recommend inspecting the unit including the unit fasteners, structure, motor cooling fan, coupling, and alignment in the near future. **Rated a Class II Defect.**

East H2 Plant FD Fan
The motor is still vibrating at the fundamental speed of the fan but at a lower amplitude this survey. We still suspect worn drivetrain components and or some imbalance in the fan. Inspect fasteners sheaves and belts for wear, eccentricity, and alignment. Clean and inspect the fan wheel. The inboard fan bearing axial shows a few harmonics of fan speed. The fan bearing could also have a little looseness in the shaft or housing fits. Inspect the unit, replace worn or defective components. **Rated a Class II Defect.**

East H2 Plant ID Fan
All measurement points have the same vibration which is 26.6 Hz or about what could be 1585 RPM. The motor and fan amplitudes are at almost 1"/second velocity peak overall. Inspect all aspects of this unit. Look for imbalance in the fan wheel or fan sheave, loose fasteners, or defective structures, loose or missing fasteners, and wear or misaligned sheaves. **Rated a Class III Defect.**

B82-101A South FD Fan 10 HP Outside
The unit axial is slightly elevated. Inspect and clean the fan wheel as time allows. **Rated a Class I Defect.**

CHLR45-1 20 Ton Trane Chiller
The East compressor was running and vibrating near 1.0"/sec velocity peak at 60 Hz shaft speed. Vibrations at these levels in either unit will likely cause a reduced lifespan. Have the unit checked for compliance with the manufacture's specification. **Rated a Class II Defect for now.**

Abbreviated Last Measurement Summary
****

Database: penn.rbm
Station: PENNAKEM NEW CURRENT DATABASE
Report Date: 12-Feb-21 10:59

MEASUREMENT POINT	OVERALL LEVEL	HFD / VHFD	MACHINE SPEED
B4C101-877 - ZURN BOILER BLOWER	(10-Feb-21)		
	OVERALL LEVEL	1-20 KHZ	
11	.170 In/Sec	.609 G-s	1180.0 RPM
12	.093 In/Sec	.382 G-s	
13	.128 In/Sec	.252 G-s	
21	.169 In/Sec	.687 G-s	
22	.120 In/Sec	1.781 G-s	
23	.107 In/Sec	.532 G-s	
71	.152 In/Sec	1.123 G-s	
72	.101 In/Sec	1.102 G-s	
73	.143 In/Sec	.468 G-s	
81	.143 In/Sec	.797 G-s	

P4C-102B - BOILER FEEDWATER PUMP (10-Feb-21)

	OVERALL LEVEL	1-20 KHZ	
11	.090 In/Sec	.895 G-s	3570.0 RPM
12	.049 In/Sec	1.002 G-s	
21	.070 In/Sec	.613 G-s	
22	.066 In/Sec	.551 G-s	
23	.072 In/Sec	.606 G-s	
71	.040 In/Sec	.982 G-s	
72	.032 In/Sec	.849 G-s	
73	.054 In/Sec	.653 G-s	
81	.076 In/Sec	.378 G-s	
82	.042 In/Sec	.514 G-s	
83	.061 In/Sec	2.177 G-s	

P24-102B - JOCKEY FIRE FLANGE PUMP HZ (10-Feb-21)

	OVERALL LEVEL	1-20 KHZ	
11	.106 In/Sec	.258 G-s	1785.0 RPM
12	.085 In/Sec	.795 G-s	
21	.056 In/Sec	.190 G-s	
22	.058 In/Sec	.319 G-s	
23	.074 In/Sec	.371 G-s	

P24-63DEGN - 63 DEG N WATER PUMP (10-Feb-21)

	OVERALL LEVEL	1-20 KHZ	
11	.074 In/Sec	.941 G-s	1750.0 RPM
12	.065 In/Sec	.417 G-s	
21	.084 In/Sec	.489 G-s	
22	.087 In/Sec	.444 G-s	
23	.050 In/Sec	.852 G-s	
71	.082 In/Sec	.762 G-s	
72	.065 In/Sec	1.396 G-s	
73	.170 In/Sec	1.722 G-s	
81	.093 In/Sec	1.270 G-s	
82	.042 In/Sec	1.126 G-s	
83	.108 In/Sec	3.521 G-s	

P24-63DEGS - 63 DEG S WATER PUMP (10-Feb-21)

	OVERALL LEVEL	1-20 KHZ	
11	.074 In/Sec	.189 G-s	1750.0 RPM
12	.100 In/Sec	.393 G-s	
21	.101 In/Sec	.922 G-s	
22	.068 In/Sec	.347 G-s	
23	.143 In/Sec	.769 G-s	
71	.109 In/Sec	.294 G-s	
72	.064 In/Sec	.572 G-s	
73	.101 In/Sec	1.375 G-s	
81	.063 In/Sec	.531 G-s	
82	.055 In/Sec	.547 G-s	
83	.166 In/Sec	1.184 G-s	

P24-85DEGN - 85 DEG N WATER CIRC PUMP 125 (10-Feb-21)

	OVERALL LEVEL	1-20 KHZ	
11	.086 In/Sec	1.244 G-s	1750.0 RPM
12	.073 In/Sec	1.880 G-s	
21	.077 In/Sec	1.499 G-s	
22	.059 In/Sec	1.102 G-s	
23	.030 In/Sec	.397 G-s	

71	.073 In/Sec	.510 G-s	
72	.295 In/Sec	.679 G-s	
73	.341 In/Sec	.730 G-s	
81	.171 In/Sec	.805 G-s	
82	.193 In/Sec	.896 G-s	
83	.399 In/Sec	1.263 G-s	

P24BGBL876 - BIG BLUE WATER PUMP-63 DEG (10-Feb-21)

	OVERALL LEVEL	1-20 KHZ	
11	.200 In/Sec	1.972 G-s	1180.0 RPM
12	.065 In/Sec	1.698 G-s	
21	.241 In/Sec	2.048 G-s	
22	.063 In/Sec	2.090 G-s	
23	.067 In/Sec	.807 G-s	
71	.392 In/Sec	.460 G-s	
72	.127 In/Sec	.568 G-s	
73	.267 In/Sec	.543 G-s	
81	.323 In/Sec	.693 G-s	
82	.184 In/Sec	.596 G-s	
83	.120 In/Sec	.823 G-s	

P36-905A - N COOL TWR-NORTH PUMP (10-Feb-21)

	OVERALL LEVEL	1-20 KHZ	
11	.052 In/Sec	.038 G-s	1780.0 RPM
12	.050 In/Sec	.559 G-s	
21	.049 In/Sec	.523 G-s	
22	.059 In/Sec	.376 G-s	
23	.045 In/Sec	.037 G-s	
71	.075 In/Sec	1.400 G-s	
72	.066 In/Sec	1.463 G-s	
73	.143 In/Sec	.500 G-s	
81	.097 In/Sec	1.227 G-s	
82	.075 In/Sec	1.932 G-s	
83	.123 In/Sec	1.996 G-s	

C36-SOUTH - UTILITY AIRCOMP ROTARY 150HP (10-Feb-21)

	OVERALL LEVEL	1-20 KHZ	
11	.043 In/Sec	.764 G-s	1750.0 RPM
12	.050 In/Sec	1.474 G-s	
21	.032 In/Sec	1.977 G-s	
22	.120 In/Sec	.765 G-s	
23	.056 In/Sec	1.965 G-s	
71	.147 In/Sec	1.842 G-s	3570.0 RPM
72	.114 In/Sec	2.156 G-s	
73	.127 In/Sec	2.072 G-s	
81	.075 In/Sec	1.243 G-s	
82	.100 In/Sec	1.955 G-s	
71F	.091 In/Sec	1.158 G-s	
72F	.166 In/Sec	3.633 G-s	
81F	.101 In/Sec	1.256 G-s	
82F	.125 In/Sec	1.959 G-s	

C36-WEST - UTILITY AIRCOMP ROTARY 150HP (10-Feb-21)

	OVERALL LEVEL	1-20 KHZ	
11	.073 In/Sec	.812 G-s	1750.0 RPM
12	.066 In/Sec	1.014 G-s	
21	.099 In/Sec	.620 G-s	

22	.076 In/Sec	1.249 G-s		
23	.137 In/Sec	1.132 G-s		
71	.089 In/Sec	1.363 G-s	3570.0 RPM	
72	.078 In/Sec	1.481 G-s		
73	.173 In/Sec	1.302 G-s		
81	.096 In/Sec	.802 G-s		
82	.094 In/Sec	1.779 G-s		
71F	.083 In/Sec	1.834 G-s		
72F	.099 In/Sec	2.051 G-s		
81F	.067 In/Sec	1.216 G-s		
82F	.114 In/Sec	1.513 G-s		

P42-4A - CENTRIFUGAL HOT OIL PUMP 5HP (10-Feb-21)

	OVERALL LEVEL	1-20 KHZ	
11	.015 In/Sec	.041 G-s	1760.0 RPM
21	.013 In/Sec	.075 G-s	
23	.014 In/Sec	.076 G-s	
71	.026 In/Sec	.478 G-s	
73	.010 In/Sec	.282 G-s	
81	.012 In/Sec	.409 G-s	

P42-4B - CENTRIFUGAL HOT OIL PUMP 5HP (10-Feb-21)

	OVERALL LEVEL	1-20 KHZ	
11	.038 In/Sec	.052 G-s	1760.0 RPM
21	.023 In/Sec	.176 G-s	
23	.040 In/Sec	.023 G-s	
71	.019 In/Sec	.054 G-s	
73	.030 In/Sec	.042 G-s	
81	.015 In/Sec	.051 G-s	

P42-4D - CENTRIFUGAL HOT OIL PUMP 5HP (10-Feb-21)

	OVERALL LEVEL	1-20 KHZ	
11	.028 In/Sec	.092 G-s	1760.0 RPM
21	.017 In/Sec	.091 G-s	
23	.024 In/Sec	.080 G-s	
71	.016 In/Sec	.011 G-s	
81	.033 In/Sec	.076 G-s	

P45-VAC - NEW VACUUM PUMP PILOT PLANT (10-Feb-21)

	OVERALL LEVEL	1-20 KHZ	
11	.243 In/Sec	.227 G-s	1760.0 RPM
21	.125 In/Sec	1.668 G-s	
23	.157 In/Sec	1.209 G-s	
71M	.134 In/Sec	.589 G-s	
71F	.243 In/Sec	.775 G-s	
73M	.130 In/Sec	1.362 G-s	
81M	.193 In/Sec	1.185 G-s	
81F	.212 In/Sec	.870 G-s	

P48-7B - ROTOJET HIGH PRESS PUMP 15HP (10-Feb-21)

	OVERALL LEVEL	1-20 KHZ	
11	.061 In/Sec	.631 G-s	1750.0 RPM
12	.119 In/Sec	.226 G-s	
21	.070 In/Sec	.734 G-s	
22	.086 In/Sec	.602 G-s	
23	.126 In/Sec	.250 G-s	
71	.191 In/Sec	1.163 G-s	

	72	.122 In/Sec	1.387 G-s	
	73	.070 In/Sec	1.020 G-s	
	81	.270 In/Sec	.935 G-s	
	82	.129 In/Sec	.568 G-s	
R48-2	- AGITATOR GEARBOX FAULK 15HP	(10-Feb-21)		
		OVERALL LEVEL		
	11	.318 In/Sec		1760.0 RPM
	12	.345 In/Sec		
	21	.202 In/Sec		
	22	.303 In/Sec		
	23	.061 In/Sec		
	31	.188 In/Sec		1775.0 RPM
	32	.233 In/Sec		1760.0 RPM
	41	.164 In/Sec		100.0 RPM
	42	.252 In/Sec		
	51	.074 In/Sec		
C53-301A	- C-301A RECIP COMPRESSOR	(10-Feb-21)		
		OVERALL LEVEL	1-20 KHZ	
	11	.087 In/Sec	1.026 G-s	1800.0 RPM
	12	.088 In/Sec	.515 G-s	
	13	.163 In/Sec	.113 G-s	
	21	.088 In/Sec	.298 G-s	
	22	.114 In/Sec	.765 G-s	
	23	.106 In/Sec	.459 G-s	
	71	.094 In/Sec	.086 G-s	325.0 RPM
	72	.071 In/Sec	.101 G-s	
	73	.158 In/Sec	.118 G-s	
	81	.094 In/Sec	.131 G-s	
	82	.072 In/Sec	.080 G-s	
P53-301	- ANSI CENTRIFUGAL PUMP 50 HP	(10-Feb-21)		
		OVERALL LEVEL	1-20 KHZ	
	11	.068 In/Sec	.169 G-s	1750.0 RPM
	12	.048 In/Sec	.139 G-s	
	21	.082 In/Sec	.507 G-s	
	22	.071 In/Sec	.472 G-s	
	23	.105 In/Sec	.421 G-s	
	71	.116 In/Sec	.593 G-s	
	72	.133 In/Sec	.581 G-s	
	73	.122 In/Sec	1.336 G-s	
	81	.099 In/Sec	.525 G-s	
	82	.092 In/Sec	.429 G-s	
R53-301	- AGITATOR GBX CHEMINEER 15HP	(10-Feb-21)		
		OVERALL LEVEL		
	11	1.037 In/Sec		1760.0 RPM
	12	.249 In/Sec		
	21	.850 In/Sec		
	22	.147 In/Sec		
	23	.226 In/Sec		
	31	.462 In/Sec		
	32	.034 In/Sec		
	33	.161 In/Sec		
	41	.220 In/Sec		
	42	.058 In/Sec		

51	.393 In/Sec			
61	.236 In/Sec			
63	.209 In/Sec			
71	.043 In/Sec			

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

	OVERALL LEVEL	1-20 KHZ	
11	.085 In/Sec	.081 G-s	1750.0 RPM
12	.064 In/Sec	.199 G-s	
21	.027 In/Sec	.206 G-s	
22	.061 In/Sec	.416 G-s	
23	.028 In/Sec	.243 G-s	
71	.061 In/Sec	.169 G-s	
72	.091 In/Sec	.223 G-s	
73	.029 In/Sec	.235 G-s	
81	.015 In/Sec	.212 G-s	
82	.036 In/Sec	.156 G-s	

C54--115 - COMP 2CYL 2 STAGE 75 HP (10-Feb-21)

	OVERALL LEVEL	1-20 KHZ	
11	.042 In/Sec	.604 G-s	1800.0 RPM
12	.120 In/Sec	.264 G-s	
21	.048 In/Sec	1.128 G-s	
22	.044 In/Sec	.500 G-s	
23	.135 In/Sec	.280 G-s	
71	.022 In/Sec	.117 G-s	
72	.022 In/Sec	.050 G-s	
73	.033 In/Sec	.036 G-s	
81	.025 In/Sec	.082 G-s	
82	.022 In/Sec	.036 G-s	

P54-112 - CANNED MOTOR CENTRIFUG PUMP (10-Feb-21)

	OVERALL LEVEL	1-20 KHZ	
11	.055 In/Sec	.059 G-s	1800.0 RPM
12	.032 In/Sec	.082 G-s	
21	.052 In/Sec	.131 G-s	
22	.022 In/Sec	.280 G-s	
23	.035 In/Sec	.093 G-s	
71	.048 In/Sec	.188 G-s	
72	.020 In/Sec	.131 G-s	
81	.039 In/Sec	.080 G-s	
82	.019 In/Sec	.096 G-s	

R55-102 - REACTOR AGIT R-102 (10-Feb-21)

	OVERALL LEVEL	1-20 KHZ	
11	.187 In/Sec	.100 G-s	1760.0 RPM
12	.139 In/Sec	.165 G-s	
21	.082 In/Sec	.289 G-s	
22	.067 In/Sec	.263 G-s	
23	.135 In/Sec	.146 G-s	
31	.048 In/Sec		
32	.021 In/Sec		
33	.065 In/Sec		
41	.164 In/Sec		
42	.021 In/Sec		
51	.098 In/Sec		
51L	.103 In/Sec		56.00 RPM

52	.032 In/Sec		1760.0 RPM
53	.017 In/Sec		
61	.080 In/Sec		
63	.020 In/Sec		
71	.040 In/Sec		

R55-104 - REACTOR AGIT R-104 (B55) (10-Feb-21)

	OVERALL LEVEL	1-20 KHZ	
11	.059 In/Sec	.491 G-s	1760.0 RPM
12	.031 In/Sec	.138 G-s	
21	.053 In/Sec	.479 G-s	
22	.027 In/Sec	.467 G-s	
23	.026 In/Sec	.242 G-s	
31	.040 In/Sec		
32	.012 In/Sec		
33	.029 In/Sec		
41	.031 In/Sec		
42	.019 In/Sec		
51	.038 In/Sec		
51L	.034 In/Sec		56.00 RPM
53	.011 In/Sec		1760.0 RPM
61	.032 In/Sec		
63	.013 In/Sec		
71	.013 In/Sec		

R55-106 - REACTOR AGIT R-106 (10-Feb-21)

	OVERALL LEVEL	1-20 KHZ	
11	.338 In/Sec	.205 G-s	1760.0 RPM
12	.529 In/Sec	.176 G-s	
21	.266 In/Sec	.163 G-s	
22	.266 In/Sec	.381 G-s	
23	.390 In/Sec	.021 G-s	
31	.105 In/Sec		
32	.037 In/Sec		
33	.235 In/Sec		
41	.139 In/Sec		
42	.048 In/Sec		
51	.150 In/Sec		
51L	.193 In/Sec		56.00 RPM
53	.033 In/Sec		1760.0 RPM
61	.111 In/Sec		
63	.042 In/Sec		
71	.048 In/Sec		

P67-504 - HOT OIL CIRC PMP CENT 50HP (10-Feb-21)

	OVERALL LEVEL	1-20 KHZ	
11	.034 In/Sec	.452 G-s	1750.0 RPM
12	.039 In/Sec	.238 G-s	
21	.029 In/Sec	.485 G-s	
22	.052 In/Sec	.506 G-s	
23	.042 In/Sec	.470 G-s	
71	.107 In/Sec	.196 G-s	
72	.101 In/Sec	.164 G-s	
73	.077 In/Sec	.288 G-s	
81	.071 In/Sec	.292 G-s	
82	.067 In/Sec	.153 G-s	

B76-101806 - FD FAN- EAST H2 PLANT (10-Feb-21)

	OVERALL LEVEL	1-20 KHZ	
11	.168 In/Sec	.127 G-s	1800.0 RPM
12	.243 In/Sec	.143 G-s	
21	.159 In/Sec	.278 G-s	
22	.480 In/Sec	.280 G-s	
23	.294 In/Sec	.162 G-s	
71	.363 In/Sec	.096 G-s	
72	.387 In/Sec	.168 G-s	
73	.450 In/Sec	.377 G-s	
81	.162 In/Sec	.458 G-s	

B76-103806 - ID FAN- EAST H2 PLANT (10-Feb-21)

	OVERALL LEVEL	1-20 KHZ	
11	.742 In/Sec	.179 G-s	1800.0 RPM
12	.414 In/Sec	.171 G-s	
21	.407 In/Sec	.138 G-s	
22	.590 In/Sec	.184 G-s	
23	.889 In/Sec	.134 G-s	
71	.780 In/Sec	.353 G-s	
73	.747 In/Sec	.068 G-s	
81	.979 In/Sec	.237 G-s	

P76-101806 - P101 BFW PUMP-EAST H2 PLANT (10-Feb-21)

	OVERALL LEVEL	1-20 KHZ	
11	.066 In/Sec	.785 G-s	3570.0 RPM
12	.092 In/Sec	2.177 G-s	
21	.026 In/Sec	.118 G-s	
22	.036 In/Sec	.131 G-s	
23	.029 In/Sec	.153 G-s	
71	.054 In/Sec	.171 G-s	10500. RPM
72	.044 In/Sec	.145 G-s	
73	.036 In/Sec	.360 G-s	
81	.034 In/Sec	.222 G-s	11400. RPM
82	.022 In/Sec	.098 G-s	

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

	OVERALL LEVEL	1-20 KHZ	
11	.147 In/Sec	.126 G-s	1800.0 RPM
12	.202 In/Sec	.108 G-s	
* 13	.264 In/Sec	.091 G-s	
21	.183 In/Sec	.211 G-s	
22	.284 In/Sec	.209 G-s	
23	.318 In/Sec	.108 G-s	

B82-102 - INDUCED DRAFT 150 HP (10-Feb-21)

	OVERALL LEVEL	1-20 KHZ	
11	.038 In/Sec	.083 G-s	1800.0 RPM
12	.029 In/Sec	.109 G-s	
21	.054 In/Sec	.248 G-s	
22	.049 In/Sec	.358 G-s	
23	.038 In/Sec	.276 G-s	
31	.027 In/Sec	.495 G-s	
32	.022 In/Sec	.552 G-s	
33	.032 In/Sec	.098 G-s	
41	.018 In/Sec	.246 G-s	
42	.030 In/Sec	.222 G-s	

CHLR45-1 - 20T TRANE CHILLER (10-Feb-21)

	OVERALL LEVEL	
11E	1.011 In/Sec	3570.0 RPM
12E	.649 In/Sec	

Clarification Of Vibration Units:

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

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