HI-SPEED INDUSTRIAL SERVICE

MILLINGTON, TN

August 17, 2021

Pennakem

Subject: August 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,

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Observations

P 24 Big Blue Water Pump
The pump trend has increased again and is dominated by a shaft speed vibration. 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 data for the inboard bearing shows what we believe to be bearing fundamental outer race defect frequency and harmonics. **Rated a Class II Defect due to the slight drop in pump vibrations this survey.**

P24-85 Degree Pump North
The pump has a slight shaft speed vibration which is dominant in the axial of both bearings. No immediate action indicated. **Rated a Class I Defect.**

P24-85 Degree Pump South
The pump axial vibrations are still elevated. Shaft speed harmonics are in the data. The acceleration trend is over 4 g's RMS but looks to be some cavitation noise. Ensure the pump is running at BOP. We suspect slight looseness in the shaft or bearing fits. **Rated a Class I Defect.**

P36-905C-72 North Cooling Tower East Pump
The pump inboard bearing is still showing shaft speed harmonics. This could be an indication of mechanical looseness in the bearing shaft or housing fits. Inspect the pump bearings and housings as well as the drive train components. **Rated a Class II Defect.**

CHLR45-1 20 Ton Trane Chiller
The East and West compressors were running and vibrating at over 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 I Defect.**

P 48-7B Rotojet High Pressure Pump
The pump and motor vibrations are at 79 Hz which we suspect is either pump shaft speed or vane pass. Inspect the drivetrain and pump impeller and check the operational parameters. **Rated a Class II Defect.**

R53-301 Reactor Agitator Motor and Gearbox
The motor vibrations are still almost all near 0.5"/sec velocity peak. The vibrations are dominated by shaft speed and the first two harmonics. This usually indicates a coupling and/or an alignment issue. We recommend inspecting the motor and coupling, and check the shaft alignment, fasteners and frame as time allows. **Rated a Class II Defect.**

C67-51 Twin Screw Axial Compressor Motor
Vibration data for the outboard motor bearing still shows synchronous and non-synchronous peaks. We suspect outer race bearing defect frequencies are present. Overall acceleration is near 4 g's RMS. No immediate action is required; however, we are keeping this a **Class II Defect for now.**

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. Loading could affect vibrations. **Rated a Class I Defect.**

P67-504 Hot Oil Circulation Pump 50 HP
The unit vibrations have significantly jumped up at shaft speed to more than 0.6"/second velocity peak. We suspect a coupling issue. Inspect ASAP to avoid loss of operation or secondary damage. **Rated a Class III 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.**

R80-30 Agitator Motor and Gearbox
The motor has a dominant shaft speed vibration. Inspect the coupling fasteners and alignment as time allows. **Rated a Class I Defect.**

B82-101A Southwest FD Fan 10 HP (Outside)
The motor axial still has a sub-synchronous vibration at near half speed of the shaft. This could be a rub or possible looseness or an issue with the fan wheel. We recommend cleaning and inspecting the fan wheel/hub and check all fasteners. **Rated a Class I Defect.**

Abbreviated Last Measurement Summary

Database: penn.rbm
Station: PENNAKEM NEW CURRENT DATABASE
Report Date: 17-Aug-21 07:07

MEASUREMENT POINT	OVERALL LEVEL	HFD / VHFD	MACHINE SPEED
P4C-102A - BOILER FEEDWATER PUMP	(11-Aug-21)		
	OVERALL LEVEL	1-20 KHZ	
11	.043 In/Sec	.607 G-s	3570.0 RPM
12	.028 In/Sec	.909 G-s	
21	.066 In/Sec	.756 G-s	
22	.035 In/Sec	1.053 G-s	
23	.043 In/Sec	.951 G-s	
71	.059 In/Sec	.706 G-s	
72	.029 In/Sec	.966 G-s	
73	.066 In/Sec	1.198 G-s	
81	.084 In/Sec	.889 G-s	
82	.037 In/Sec	.677 G-s	
83	.107 In/Sec	1.541 G-s	
P24-102B - JOCKEY FIRE FLANGE PUMP HZ	(11-Aug-21)		
	OVERALL LEVEL	1-20 KHZ	
11	.087 In/Sec	.243 G-s	1785.0 RPM
12	.087 In/Sec	.266 G-s	
21	.053 In/Sec	.081 G-s	
22	.060 In/Sec	.336 G-s	
23	.058 In/Sec	.334 G-s	
P24-63DEGN - 63 DEG N WATER PUMP	(11-Aug-21)		
	OVERALL LEVEL	1-20 KHZ	
11	.052 In/Sec	.477 G-s	1750.0 RPM
12	.031 In/Sec	.648 G-s	
21	.058 In/Sec	.406 G-s	
22	.089 In/Sec	.381 G-s	
23	.041 In/Sec	.783 G-s	
71	.068 In/Sec	.653 G-s	
72	.029 In/Sec	.711 G-s	
73	.111 In/Sec	2.290 G-s	
81	.061 In/Sec	.694 G-s	
82	.029 In/Sec	.903 G-s	
83	.088 In/Sec	2.175 G-s	
P24-63DEGS - 63 DEG S WATER PUMP	(11-Aug-21)		
	OVERALL LEVEL	1-20 KHZ	
11	.079 In/Sec	.352 G-s	1750.0 RPM
12	.093 In/Sec	.382 G-s	
21	.142 In/Sec	.407 G-s	
22	.083 In/Sec	.772 G-s	
23	.156 In/Sec	.431 G-s	
71	.063 In/Sec	.286 G-s	
72	.065 In/Sec	.373 G-s	
73	.072 In/Sec	1.051 G-s	

81	.065 In/Sec	.673 G-s	
82	.046 In/Sec	.469 G-s	
83	.084 In/Sec	1.233 G-s	

P24-85DEGN - 85 DEG N WATER CIRC PUMP 125 (11-Aug-21)

	OVERALL LEVEL	1-20 KHZ	
11	.073 In/Sec	.478 G-s	1750.0 RPM
12	.057 In/Sec	1.368 G-s	
21	.065 In/Sec	1.251 G-s	
22	.049 In/Sec	.584 G-s	
23	.035 In/Sec	.239 G-s	
71	.085 In/Sec	.762 G-s	
72	.145 In/Sec	.917 G-s	
73	.320 In/Sec	.714 G-s	
81	.089 In/Sec	.751 G-s	
82	.141 In/Sec	.754 G-s	
83	.232 In/Sec	.743 G-s	

P24-85DEGS - 85 DEG S WATER CIRC PUMP 125 (11-Aug-21)

	OVERALL LEVEL	1-20 KHZ	
11	.089 In/Sec	.920 G-s	1750.0 RPM
12	.081 In/Sec	.739 G-s	
21	.079 In/Sec	.974 G-s	
22	.057 In/Sec	.508 G-s	
23	.070 In/Sec	.471 G-s	
71	.237 In/Sec	2.198 G-s	
72	.199 In/Sec	1.736 G-s	
73	.332 In/Sec	4.559 G-s	
81	.182 In/Sec	2.229 G-s	
82	.212 In/Sec	2.269 G-s	
83	.227 In/Sec	2.831 G-s	

P24BGBL876 - BIG BLUE WATER PUMP-63 DEG (11-Aug-21)

	OVERALL LEVEL	1-20 KHZ	
11	.255 In/Sec	1.357 G-s	1180.0 RPM
12	.058 In/Sec	1.852 G-s	
21	.295 In/Sec	2.034 G-s	
22	.089 In/Sec	2.291 G-s	
23	.125 In/Sec	1.290 G-s	
71	.521 In/Sec	.383 G-s	
72	.205 In/Sec	.544 G-s	
73	.349 In/Sec	.429 G-s	
81	.491 In/Sec	1.025 G-s	
82	.223 In/Sec	.947 G-s	
83	.244 In/Sec	1.052 G-s	

P36-905A - N COOL TWR-NORTH PUMP (11-Aug-21)

	OVERALL LEVEL	1-20 KHZ	
11	.078 In/Sec	.414 G-s	1780.0 RPM
12	.046 In/Sec	.244 G-s	
21	.081 In/Sec	.864 G-s	
22	.080 In/Sec	.133 G-s	
23	.055 In/Sec	.156 G-s	
71	.096 In/Sec	1.259 G-s	
72	.158 In/Sec	.394 G-s	
73	.124 In/Sec	1.043 G-s	
81	.121 In/Sec	1.268 G-s	

	82	.102 In/Sec	1.198 G-s	
	83	.193 In/Sec	2.542 G-s	

P36-905C - N COOL TWR-EAST PUMP (11-Aug-21)

	OVERALL LEVEL	1-20 KHZ	
11	.068 In/Sec	.344 G-s	1780.0 RPM
12	.039 In/Sec	.151 G-s	
21	.091 In/Sec	.530 G-s	
22	.041 In/Sec	.354 G-s	
23	.053 In/Sec	.101 G-s	
71	.219 In/Sec	1.599 G-s	
72	.237 In/Sec	1.921 G-s	
73	.277 In/Sec	.343 G-s	
81	.240 In/Sec	.544 G-s	
82	.166 In/Sec	.611 G-s	
83	.260 In/Sec	.697 G-s	

C36-WEST - UTILITY AIRCOMP ROTARY 150HP (11-Aug-21)

	OVERALL LEVEL	1-20 KHZ	
11	.082 In/Sec	.899 G-s	1750.0 RPM
12	.056 In/Sec	.963 G-s	
21	.062 In/Sec	.722 G-s	
22	.065 In/Sec	.902 G-s	
23	.088 In/Sec	1.677 G-s	
71	.090 In/Sec	1.514 G-s	3570.0 RPM
72	.090 In/Sec	.980 G-s	
73	.165 In/Sec	2.031 G-s	
81	.066 In/Sec	1.228 G-s	
82	.076 In/Sec	1.367 G-s	
71F	.076 In/Sec	2.193 G-s	
72F	.109 In/Sec	2.301 G-s	
81F	.068 In/Sec	1.120 G-s	
82F	.099 In/Sec	1.537 G-s	

C42-4 - AXIAL TWIN SCREW COMPRESSOR (11-Aug-21)

	OVERALL LEVEL	1-20 KHZ	
11	.099 In/Sec	1.642 G-s	1750.0 RPM
12	.067 In/Sec	2.136 G-s	
13	.090 In/Sec	.555 G-s	
21	.092 In/Sec	.417 G-s	
22	.066 In/Sec	2.647 G-s	
23	.101 In/Sec	1.090 G-s	
71	.111 In/Sec	2.049 G-s	3570.0 RPM
72	.056 In/Sec	.289 G-s	
73	.085 In/Sec	3.876 G-s	
81	.105 In/Sec	2.040 G-s	
82	.056 In/Sec	.781 G-s	
83	.090 In/Sec	1.019 G-s	
71F	.153 In/Sec	2.583 G-s	
72F	.072 In/Sec	.919 G-s	
73F	.106 In/Sec	2.537 G-s	
81F	.179 In/Sec	1.180 G-s	
82F	.071 In/Sec	2.011 G-s	
83F	.104 In/Sec	2.993 G-s	

P42-4A - CENTRIFUGAL HOT OIL PUMP 5HP (11-Aug-21)

	OVERALL LEVEL	1-20 KHZ

11	.046 In/Sec	.081 G-s	1760.0 RPM
21	.017 In/Sec	.060 G-s	
23	.022 In/Sec	.051 G-s	
71	.016 In/Sec	.181 G-s	
73	.012 In/Sec	.063 G-s	
81	.013 In/Sec	.114 G-s	

P42-4B - CENTRIFUGAL HOT OIL PUMP 5HP (11-Aug-21)

	OVERALL LEVEL	1-20 KHZ	
11	.060 In/Sec	.060 G-s	1760.0 RPM
21	.027 In/Sec	.077 G-s	
23	.062 In/Sec	.063 G-s	
71	.021 In/Sec	.115 G-s	
73	.021 In/Sec	.057 G-s	
81	.019 In/Sec	.076 G-s	

P42-4D - CENTRIFUGAL HOT OIL PUMP 5HP (11-Aug-21)

	OVERALL LEVEL	1-20 KHZ	
11	.023 In/Sec	.104 G-s	1760.0 RPM
21	.015 In/Sec	.073 G-s	
23	.021 In/Sec	.061 G-s	
71	.022 In/Sec	.162 G-s	
81	.032 In/Sec	.084 G-s	

P48-7B - ROTOJET HIGH PRESS PUMP 15HP (11-Aug-21)

	OVERALL LEVEL	1-20 KHZ	
11	.100 In/Sec	.381 G-s	1750.0 RPM
12	.552 In/Sec	.477 G-s	
21	.056 In/Sec	.996 G-s	
22	.330 In/Sec	.786 G-s	
23	.236 In/Sec	.616 G-s	
71	.466 In/Sec	3.116 G-s	
72	.213 In/Sec	1.318 G-s	
73	.113 In/Sec	1.520 G-s	
81	.618 In/Sec	.692 G-s	
82	.331 In/Sec	1.363 G-s	

C53-301A - C-301A RECIP COMPRESSOR (11-Aug-21)

	OVERALL LEVEL	1-20 KHZ	
11	.081 In/Sec	1.552 G-s	1800.0 RPM
12	.079 In/Sec	.929 G-s	
13	.193 In/Sec	.122 G-s	
21	.091 In/Sec	.418 G-s	
22	.095 In/Sec	.580 G-s	
23	.161 In/Sec	.363 G-s	
71	.100 In/Sec	.154 G-s	325.0 RPM
72	.077 In/Sec	.166 G-s	
73	.227 In/Sec	.153 G-s	
81	.098 In/Sec	.250 G-s	
82	.076 In/Sec	.154 G-s	

P53-301 - ANSI CENTRIFUGAL PUMP 50 HP (11-Aug-21)

	OVERALL LEVEL	1-20 KHZ	
11	.071 In/Sec	.134 G-s	1750.0 RPM
12	.096 In/Sec	.109 G-s	
21	.083 In/Sec	.564 G-s	
22	.086 In/Sec	.327 G-s	

23	.080 In/Sec	.124 G-s		
71	.103 In/Sec	.514 G-s		
72	.157 In/Sec	.320 G-s		
73	.122 In/Sec	1.026 G-s		
81	.064 In/Sec	.687 G-s		
82	.101 In/Sec	.433 G-s		

R53-301 - AGITATOR GBX CHEMINEER 15HP (11-Aug-21)

	OVERALL LEVEL		
11	.453 In/Sec		1760.0 RPM
12	.210 In/Sec		
21	.462 In/Sec		
22	.355 In/Sec		
23	.407 In/Sec		
31	.296 In/Sec		
32	.082 In/Sec		
33	.252 In/Sec		
41	.196 In/Sec		
42	.060 In/Sec		
51	.241 In/Sec		
61	.167 In/Sec		
63	.062 In/Sec		
71	.064 In/Sec		

P53-310A - GRUNDFOSS VERT PUMP 10HP (11-Aug-21)

	OVERALL LEVEL	1-20 KHZ	
11	.090 In/Sec	.133 G-s	1750.0 RPM
12	.114 In/Sec	.176 G-s	
21	.110 In/Sec	.026 G-s	
22	.063 In/Sec	.252 G-s	
23	.034 In/Sec	.153 G-s	
71	.090 In/Sec	.175 G-s	
72	.089 In/Sec	.184 G-s	
73	.018 In/Sec	.209 G-s	
81	.016 In/Sec	.142 G-s	
82	.027 In/Sec	.057 G-s	

C54--115 - COMP 2CYL 2 STAGE 75 HP (11-Aug-21)

	OVERALL LEVEL	1-20 KHZ	
11	.049 In/Sec	.482 G-s	1800.0 RPM
12	.111 In/Sec	.488 G-s	
21	.051 In/Sec	.888 G-s	
22	.053 In/Sec	.351 G-s	
23	.129 In/Sec	.212 G-s	
71	.032 In/Sec	.056 G-s	
72	.035 In/Sec	.039 G-s	
73	.079 In/Sec	.043 G-s	
81	.109 In/Sec	.059 G-s	
82	.067 In/Sec	.044 G-s	

P54-112 - CANNED MOTOR CENTRIFUG PUMP (11-Aug-21)

	OVERALL LEVEL	1-20 KHZ	
11	.029 In/Sec	.048 G-s	1800.0 RPM
12	.019 In/Sec	.057 G-s	
13	.029 In/Sec	.037 G-s	
21	.027 In/Sec	.128 G-s	
22	.032 In/Sec	.145 G-s	

	71	.029 In/Sec	.098 G-s	
	72	.014 In/Sec	.073 G-s	
	81	.027 In/Sec	.057 G-s	
	82	.021 In/Sec	.032 G-s	

R55-102 - REACTOR AGIT R-102 (11-Aug-21)

	OVERALL LEVEL	1-20 KHZ	
11	.062 In/Sec	.276 G-s	1760.0 RPM
12	.184 In/Sec	.403 G-s	
22	.053 In/Sec	.371 G-s	

C67-51 - AXIAL TWIN SCREW COMPRESSOR (11-Aug-21)

	OVERALL LEVEL	1-20 KHZ	
11	.079 In/Sec	3.979 G-s	1750.0 RPM
12	.076 In/Sec	3.622 G-s	
13	.175 In/Sec	.951 G-s	
21	.079 In/Sec	2.240 G-s	
22	.092 In/Sec	3.017 G-s	
23	.127 In/Sec	3.529 G-s	
71	.206 In/Sec	.157 G-s	3570.0 RPM
72	.224 In/Sec	.314 G-s	
73	.183 In/Sec	2.293 G-s	
81	.171 In/Sec	.132 G-s	
82	.248 In/Sec	.046 G-s	
83	.196 In/Sec	.681 G-s	
71F	.304 In/Sec	.072 G-s	
72F	.305 In/Sec	.101 G-s	
73F	.262 In/Sec	.818 G-s	
81F	.157 In/Sec	.124 G-s	
82F	.200 In/Sec	.125 G-s	
83F	.253 In/Sec	.985 G-s	

P67-54 - HOT OIL CIRC PMP CENT 15HP (11-Aug-21)

	OVERALL LEVEL	1-20 KHZ	
71	.029 In/Sec	.529 G-s	1750.0 RPM
72	.049 In/Sec	.199 G-s	

P67-504 - HOT OIL CIRC PMP CENT 50HP (11-Aug-21)

	OVERALL LEVEL	1-20 KHZ	
11	.614 In/Sec	.429 G-s	1750.0 RPM
12	.193 In/Sec	.505 G-s	
13	.343 In/Sec	.332 G-s	
21	.656 In/Sec	.635 G-s	
22	.467 In/Sec	1.500 G-s	
23	.195 In/Sec	.409 G-s	
71	.493 In/Sec	.131 G-s	
72	.383 In/Sec	.154 G-s	
73	.313 In/Sec	.098 G-s	
81	.339 In/Sec	.251 G-s	
82	.279 In/Sec	.090 G-s	

R80-10 - AGITATOR GBX (11-Aug-21)

	OVERALL LEVEL	
11	.106 In/Sec	1760.0 RPM
12	.127 In/Sec	
13	.093 In/Sec	
21	.070 In/Sec	

	22	.069 In/Sec		
	23	.070 In/Sec		
	31	.072 In/Sec		
	32	.074 In/Sec		
	33	.046 In/Sec		
	41	.065 In/Sec		
	42	.048 In/Sec		
	43	.044 In/Sec		
	51	.057 In/Sec		
	52	.079 In/Sec		
	61	.046 In/Sec		
	62	.061 In/Sec		
	63	.059 In/Sec		
	71	.030 In/Sec		

R80-30 - AGITATOR GBX 15HP CHEMINEER (11-Aug-21)

		OVERALL LEVEL		
	11	.088 In/Sec		1760.0 RPM
	12	.344 In/Sec		
	21	.089 In/Sec		
	22	.194 In/Sec		
	23	.146 In/Sec		
	31	.077 In/Sec		
	32	.023 In/Sec		
	33	.074 In/Sec		
	41	.064 In/Sec		
	42	.026 In/Sec		
	51	.067 In/Sec		
	61	.045 In/Sec		
	63	.028 In/Sec		
	71	.023 In/Sec		

B82-101A - FAN FORCED DRAFT 10HP SOUTH (11-Aug-21)

		OVERALL LEVEL	1-20 KHZ	
	11	.189 In/Sec	.204 G-s	1800.0 RPM
	12	.180 In/Sec	.190 G-s	
*	13	.264 In/Sec	.091 G-s	
	21	.233 In/Sec	.139 G-s	
	22	.326 In/Sec	.125 G-s	
	23	.256 In/Sec	.063 G-s	

B82-102 - INDUCED DRAFT 150 HP (11-Aug-21)

		OVERALL LEVEL	1-20 KHZ	
	11	.037 In/Sec	.065 G-s	1800.0 RPM
	12	.035 In/Sec	.086 G-s	
	21	.054 In/Sec	.203 G-s	
	22	.054 In/Sec	.397 G-s	
	23	.041 In/Sec	.077 G-s	
	31	.036 In/Sec	.558 G-s	
	32	.035 In/Sec	.619 G-s	
	41	.028 In/Sec	.161 G-s	
	42	.038 In/Sec	.446 G-s	

CHLR67-1N - 240T TRANE CHILLER NORTH (11-Aug-21)

		OVERALL LEVEL		
	11	.092 In/Sec		3570.0 RPM
	12	.122 In/Sec		

13	.064 In/Sec	
21	.075 In/Sec	
22	.104 In/Sec	
71	.054 In/Sec	
72	.085 In/Sec	
81	.091 In/Sec	
82	.112 In/Sec	

CHLR67-1W - 240T TRANE CHILLER WEST (11-Aug-21)

	OVERALL LEVEL	
11	.196 In/Sec	3570.0 RPM
12	.177 In/Sec	
13	.247 In/Sec	
21	.144 In/Sec	
22	.200 In/Sec	
71	.108 In/Sec	
72	.170 In/Sec	
81	.160 In/Sec	
82	.207 In/Sec	

CHLR45-1 - 20T TRANE CHILLER (11-Aug-21)

	OVERALL LEVEL	
11W	1.304 In/Sec	3570.0 RPM
12W	.257 In/Sec	
13W	.616 In/Sec	
11E	1.231 In/Sec	
12E	.745 In/Sec	
13E	.043 In/Sec	

Clarification Of Vibration Units:

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

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