HI-SPEED INDUSTRIAL SERVICE

MILLINGTON, TN

December 28, 2021

Tetra Technologies

Subject: December vibration service report

Most of the machines surveyed were found to be in good condition with the exception of the following: Supporting data included.

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

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

Reportable equipment

Pump 305
Motor data shows non-synchronous harmonics which could indicate early distress in the bearings. Ensure the bearing are lubricated if applicable. No other actions are required. **Rated a Class I Defect.**

Pump 306
Vibration data on the motor and pump indicates possible early bearing defects are present and there is possible cavitation in the pump. Ensure the pump bearings are lubricated and that the pump is operating optimally. **Rated a Class I Defect.**

Pump 312
Motor inboard bearing data shows non-synchronous harmonics which could indicate early distress in the bearings. There is also a noise hump in the pump acceleration spectrum. Ensure the bearing are lubricated if applicable. No other actions are required. **Rated a Class I Defect.**

Pump 402
Motor data shows low amplitude non-synchronous harmonic vibrations that could be early bearing defects. Ensure the bearing are lubricated if applicable. No other actions are required. **Rated a Class I Defect.**

Pump 415
Data shows a dominant 2x RPM vibration peak in the motor inboard vertical measurement. Check fasteners and possibly alignment as time allows. **Rated a Class I Defect.**

Pump 416
Data still shows a dominant 5x RPM vibration in the drive end of the pump. (Most likely 5 vanes on pump impeller). Check pump for proper operational parameters. **Rated a Class I Defect.**

Pump 421
Motor data still shows low amplitude non-synchronous harmonic vibrations that could be early bearing defects, and also what looks to be possible drive issues. No immediate actions are required. **Rated a Class I Defect.**

Previously reported but not running this survey

Pump 501
Motor data still shows non-synchronous harmonic vibrations that could be bearing defects. We will watch this unit for changes. Ensure the bearing are lubricated if applicable. No other actions are required. **Rated a Class I Defect.**

Pump 602
Motor data still shows low amplitude non-synchronous harmonic vibrations that could be bearing defects. There could be some electrical related issues also present. We will watch this unit for changes. Ensure the bearing are lubricated if applicable. No other actions are required. **Rated a Class I Defect.**

Pump 706
Data shows a dominant 5x RPM vibration. (Most likely 5 vanes on pump impeller). There is also two harmonics. Check pump for proper operational parameters. Pump could have some impeller wear or looseness. **Rated a Class I Defect.**

Abbreviated Last Measurement Summary
****

Database: TETRA TECHNOLOGIES.rbm
Area: TETRA NEW
Report Date: 28-Dec-21 13:19

MEASUREMENT POINT	OVERALL LEVEL	HFD / VHFD	EQUIPMENT SPEED
300 - PUMP 300		(22-Dec-21)	
	OVERALL LEVEL	1 - 20 KHz	
MOH	.026 In/Sec	1.342 G-s	1785.0 RPM
MOV	.029 In/Sec	.138 G-s	
MIH	.020 In/Sec	.741 G-s	
MIV	.024 In/Sec	.216 G-s	
MIA	.021 In/Sec	.353 G-s	
EIA	.019 In/Sec	.068 G-s	
EIH	.022 In/Sec	.205 G-s	
EIV	.018 In/Sec	.082 G-s	
EOH	.017 In/Sec	.178 G-s	
EOV	.016 In/Sec	.109 G-s	
301 - PUMP 301		(22-Dec-21)	
	OVERALL LEVEL	1 - 20 KHz	
MOH	.027 In/Sec	.164 G-s	1785.0 RPM
MOV	.038 In/Sec	.076 G-s	
MIH	.019 In/Sec	.209 G-s	
MIV	.039 In/Sec	.112 G-s	
MIA	.024 In/Sec	.078 G-s	

EIA	.034 In/Sec	.092 G-s	
EIH	.046 In/Sec	.240 G-s	
EIV	.036 In/Sec	.081 G-s	
EOH	.022 In/Sec	.119 G-s	
EOV	.043 In/Sec	.039 G-s	

305 - PUMP 305 (22-Dec-21)

	OVERALL LEVEL	1 - 20 KHz	
MOH	.055 In/Sec	1.234 G-s	1785.0 RPM
MOV	.108 In/Sec	1.600 G-s	
MIH	.033 In/Sec	1.069 G-s	
MIV	.057 In/Sec	.656 G-s	
MIA	.025 In/Sec	.989 G-s	
EIA	.059 In/Sec	.280 G-s	
EIH	.092 In/Sec	.191 G-s	
EIV	.047 In/Sec	.209 G-s	
EOH	.053 In/Sec	.243 G-s	
EOV	.037 In/Sec	.177 G-s	

306 - PUMP 306 (22-Dec-21)

	OVERALL LEVEL	1 - 20 KHz	
MOH	.065 In/Sec	.955 G-s	1785.0 RPM
MOV	.070 In/Sec	.316 G-s	
MIH	.115 In/Sec	.619 G-s	
MIV	.071 In/Sec	.279 G-s	
MIA	.141 In/Sec	.248 G-s	
EIA	.175 In/Sec	.265 G-s	
EIH	.269 In/Sec	.598 G-s	
EIV	.113 In/Sec	.507 G-s	
EOH	.192 In/Sec	.645 G-s	
EOV	.164 In/Sec	.308 G-s	

307 - PUMP 307 (22-Dec-21)

	OVERALL LEVEL	1 - 20 KHz	
MOH	.023 In/Sec	.228 G-s	1785.0 RPM
MOV	.028 In/Sec	.066 G-s	
MIH	.026 In/Sec	.185 G-s	
MIV	.024 In/Sec	.043 G-s	
MIA	.023 In/Sec	.037 G-s	
EIA	.043 In/Sec	.108 G-s	
EIH	.065 In/Sec	.153 G-s	
EIV	.048 In/Sec	.095 G-s	
EOH	.041 In/Sec	.154 G-s	
EOV	.042 In/Sec	.065 G-s	

308 - PUMP 308 (22-Dec-21)

	OVERALL LEVEL	1 - 20 KHz	
MOH	.031 In/Sec	.258 G-s	1785.0 RPM
MOV	.046 In/Sec	.057 G-s	
MIH	.025 In/Sec	.273 G-s	
MIV	.043 In/Sec	.116 G-s	
MIA	.027 In/Sec	.097 G-s	
EIA	.046 In/Sec	.058 G-s	
EIH	.057 In/Sec	.114 G-s	
EIV	.045 In/Sec	.083 G-s	
EOH	.034 In/Sec	.178 G-s	
EOV	.048 In/Sec	.080 G-s	

314 - PUMP 314 (22-Dec-21)

	OVERALL LEVEL	1 - 20 KHz	
MOH	.021 In/Sec	.290 G-s	1785.0 RPM
MOV	.013 In/Sec	.061 G-s	
MIH	.019 In/Sec	.304 G-s	
MIV	.016 In/Sec	.054 G-s	
MIA	.017 In/Sec	.096 G-s	
EIA	.013 In/Sec	.018 G-s	
EIH	.014 In/Sec	.090 G-s	
EIV	.014 In/Sec	.023 G-s	
EOH	.011 In/Sec	.030 G-s	
EOV	.010 In/Sec	.020 G-s	

315 - PUMP 315 (22-Dec-21)

	OVERALL LEVEL	1 - 20 KHz	
MOH	.028 In/Sec	.159 G-s	1785.0 RPM
MOV	.034 In/Sec	.083 G-s	
MIH	.036 In/Sec	.299 G-s	
MIV	.042 In/Sec	.074 G-s	
MIA	.031 In/Sec	.109 G-s	
EIA	.049 In/Sec	.610 G-s	
EIH	.034 In/Sec	.352 G-s	
EIV	.044 In/Sec	.401 G-s	
EOH	.030 In/Sec	.212 G-s	
EOV	.036 In/Sec	.125 G-s	

402 - PUMP 402 (22-Dec-21)

	OVERALL LEVEL	1 - 20 KHz	
MOH	.057 In/Sec	1.362 G-s	1785.0 RPM
MOV	.065 In/Sec	.170 G-s	
MIH	.062 In/Sec	.451 G-s	
MIV	.062 In/Sec	.141 G-s	
MIA	.044 In/Sec	.354 G-s	
EIA	.060 In/Sec	.212 G-s	
EIH	.057 In/Sec	.170 G-s	
EIV	.058 In/Sec	.165 G-s	
EOH	.040 In/Sec	.149 G-s	
EOV	.028 In/Sec	.127 G-s	

415 - PUMP 415 (22-Dec-21)

	OVERALL LEVEL	1 - 20 KHz	
MOH	.092 In/Sec	.330 G-s	1785.0 RPM
MOV	.158 In/Sec	.124 G-s	
MIH	.137 In/Sec	.432 G-s	
MIV	.284 In/Sec	.124 G-s	
MIA	.135 In/Sec	.201 G-s	
EIA	.070 In/Sec	.181 G-s	
EIH	.066 In/Sec	.374 G-s	
EIV	.053 In/Sec	.096 G-s	
EOH	.049 In/Sec	.745 G-s	
EOV	.042 In/Sec	.281 G-s	

416 - PUMP 416 (22-Dec-21)

	OVERALL LEVEL	1 - 20 KHz	
MOH	.030 In/Sec	1.011 G-s	1785.0 RPM
MOV	.062 In/Sec	.221 G-s	

MIH	.048 In/Sec	.297 G-s	
MIV	.078 In/Sec	.100 G-s	
MIA	.068 In/Sec	.219 G-s	
EIA	.093 In/Sec	.072 G-s	
EIH	.217 In/Sec	.247 G-s	
EIV	.075 In/Sec	.088 G-s	
EOH	.116 In/Sec	.358 G-s	
EOV	.062 In/Sec	.160 G-s	

421 - PUMP 421 (22-Dec-21)

	OVERALL LEVEL	1 - 20 KHz	
MOH	.034 In/Sec	.737 G-s	1785.0 RPM
MOV	.043 In/Sec	.202 G-s	
MIH	.032 In/Sec	.601 G-s	
MIV	.050 In/Sec	.188 G-s	
MIA	.040 In/Sec	.221 G-s	
EIA	.053 In/Sec	.115 G-s	
EIH	.066 In/Sec	.313 G-s	
EIV	.074 In/Sec	.134 G-s	
EOH	.025 In/Sec	.268 G-s	
EOV	.061 In/Sec	.279 G-s	

702 - PUMP 702 (22-Dec-21)

	OVERALL LEVEL	1 - 20 KHz	
MOH	.012 In/Sec	.103 G-s	1785.0 RPM
MOV	.020 In/Sec	.035 G-s	
MIH	.0089 In/Sec	.125 G-s	
MIV	.011 In/Sec	.029 G-s	
MIA	.010 In/Sec	.034 G-s	
EIA	.0086 In/Sec	.012 G-s	
EIH	.0063 In/Sec	.049 G-s	
EIV	.0066 In/Sec	.015 G-s	
EOH	.0055 In/Sec	.056 G-s	
EOV	.0066 In/Sec	.014 G-s	

Clarification Of Vibration Units:

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