HI-SPEED INDUSTRIAL SERVICE

MILLINGTON, TN

August 31, 2021

Tetra Technologies

Subject: August 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

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Reportable equipment

Pump 305
Pump data shows low amplitude shaft speed harmonics and an elevated noise floor. We suspect recirculation and or cavitation. Check pump for proper operation. Motor data also shows non-synchronous harmonics which could indicate early distress in the bearings. Motor was making an audible noise. Ensure the bearing are lubricated if applicable. No other actions are required. **Rated a Class I Defect.**

Pump 306
First data on this pump indicates possible early bearing defects are present. 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 acceleration spectrum. Motor was making an audible noise. Ensure the bearing are lubricated if applicable. No other actions are required. **Rated a Class I Defect.**

Pump 415
Data shows multiple shaft speed harmonics with dominant 2x RPM vibration peak in the motor inboard vertical measurement. Check fasteners and possibly alignment as time allows. Motor bearing fits could be slightly worn. **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. There is one small peak at 2x line frequency and another one at just over 1 KHz. Both could be drive related. No actions are required. **Rated a Class I Defect.**

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 702
This unit has a vibration at 115.46 Hz with apparent sidebands at 16.55 Hz in multiple points but is strongest in the motor. We believe it could be electrical in nature at this time. Ensure all electrical connections are tight. Inspect the coupling just in case it is mechanical. We will watch for changes. **Rated a Class I Defect.**

Previously reported but not running this survey

Pump 307
Data shows a dominant shaft speed vibration in the pump input bearing. Check the fasteners, coupling and alignment as time allows. **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
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Database: TETRA TECHNOLOGIES.rbm
Area: TETRA NEW
Route No. 1: NEW TETRA
Report Date: 31-Aug-21 10:58

MEASUREMENT POINT	OVERALL LEVEL	HFD / VHFD	EQUIPMENT SPEED
424 - PUMP 424		(31-Aug-21)	
	OVERALL LEVEL	1 - 20 KHz	
MOH	.035 In/Sec	.685 G-s	1785.0 RPM
MOV	.028 In/Sec	.148 G-s	
MIH	.024 In/Sec	.510 G-s	
MIV	.044 In/Sec	.540 G-s	
MIA	.018 In/Sec	.269 G-s	
EIA	.062 In/Sec	.311 G-s	
EIH	.047 In/Sec	.506 G-s	
EIV	.046 In/Sec	.351 G-s	
EOH	.043 In/Sec	.276 G-s	

	EOV	.040 In/Sec	.463 G-s	

421 - PUMP 421 (31-Aug-21)

	OVERALL LEVEL	1 - 20 KHz	
MOH	.036 In/Sec	.841 G-s	1785.0 RPM
MOV	.052 In/Sec	.252 G-s	
MIH	.032 In/Sec	.624 G-s	
MIV	.045 In/Sec	.208 G-s	
MIA	.022 In/Sec	.303 G-s	
EIA	.058 In/Sec	.179 G-s	
EIH	.057 In/Sec	.427 G-s	
EIV	.050 In/Sec	.133 G-s	
EOH	.038 In/Sec	.348 G-s	
EOV	.056 In/Sec	.217 G-s	

312 - PUMP 312 (31-Aug-21)

	OVERALL LEVEL	1 - 20 KHz	
MOH	.044 In/Sec	.853 G-s	1785.0 RPM
MOV	.097 In/Sec	.638 G-s	
MIH	.067 In/Sec	1.123 G-s	
MIV	.089 In/Sec	.971 G-s	
MIA	.053 In/Sec	.436 G-s	
EIA	.028 In/Sec	.022 G-s	
EIH	.031 In/Sec	.095 G-s	
EIV	.032 In/Sec	.055 G-s	
EOH	.024 In/Sec	.171 G-s	
EOV	.032 In/Sec	.032 G-s	

300 - PUMP 300 (31-Aug-21)

	OVERALL LEVEL	1 - 20 KHz	
MOH	.027 In/Sec	.459 G-s	1785.0 RPM
MOV	.033 In/Sec	.196 G-s	
MIH	.029 In/Sec	.278 G-s	
MIV	.032 In/Sec	.139 G-s	
MIA	.029 In/Sec	.304 G-s	
EIA	.036 In/Sec	.080 G-s	
EIH	.042 In/Sec	.216 G-s	
EIV	.047 In/Sec	.087 G-s	
EOH	.027 In/Sec	.237 G-s	
EOV	.026 In/Sec	.151 G-s	

702 - PUMP 702 (31-Aug-21)

	OVERALL LEVEL	1 - 20 KHz	
MOH	.147 In/Sec	.156 G-s	1785.0 RPM
MOV	.037 In/Sec	.035 G-s	
MIH	.069 In/Sec	.122 G-s	
MIV	.019 In/Sec	.010 G-s	
MIA	.063 In/Sec	.029 G-s	
EIA	.040 In/Sec	.0092 G-s	
EIH	.042 In/Sec	.052 G-s	
EIV	.024 In/Sec	.010 G-s	
EOH	.021 In/Sec	.050 G-s	
EOV	.016 In/Sec	.0097 G-s	

308 - PUMP 308 (31-Aug-21)

	OVERALL LEVEL	1 - 20 KHz	
MOH	.030 In/Sec	.245 G-s	1785.0 RPM

	MOV	.038 In/Sec	.084 G-s	
	MIH	.023 In/Sec	.209 G-s	
	MIV	.032 In/Sec	.166 G-s	
	MIA	.018 In/Sec	.078 G-s	
	EIA	.048 In/Sec	.109 G-s	
	EIH	.044 In/Sec	.148 G-s	
	EIV	.047 In/Sec	.107 G-s	
	EOH	.032 In/Sec	.203 G-s	
	EOV	.036 In/Sec	.057 G-s	

305 - PUMP 305 (31-Aug-21)

	OVERALL LEVEL	1 - 20 KHz	
MOH	.031 In/Sec	.930 G-s	1785.0 RPM
MOV	.053 In/Sec	.649 G-s	
MIH	.035 In/Sec	.973 G-s	
MIV	.052 In/Sec	.521 G-s	
MIA	.027 In/Sec	.801 G-s	
EIA	.065 In/Sec	.246 G-s	
EIH	.088 In/Sec	.139 G-s	
EIV	.054 In/Sec	.213 G-s	
EOH	.072 In/Sec	.166 G-s	
EOV	.047 In/Sec	.123 G-s	

306 - PUMP 306 (31-Aug-21)

	OVERALL LEVEL	1 - 20 KHz	
MOH	.055 In/Sec	.713 G-s	1785.0 RPM
MOV	.056 In/Sec	.217 G-s	
MIH	.070 In/Sec	.769 G-s	
MIV	.073 In/Sec	.195 G-s	
MIA	.080 In/Sec	.209 G-s	
EIA	.096 In/Sec	.793 G-s	
EIH	.156 In/Sec	.464 G-s	
EIV	.085 In/Sec	.674 G-s	
EOH	.090 In/Sec	.548 G-s	
EOV	.058 In/Sec	.371 G-s	

314 - PUMP 314 (31-Aug-21)

	OVERALL LEVEL	1 - 20 KHz	
MOH	.018 In/Sec	.168 G-s	1785.0 RPM
MOV	.011 In/Sec	.067 G-s	
MIH	.016 In/Sec	.189 G-s	
MIV	.011 In/Sec	.080 G-s	
MIA	.0093 In/Sec	.096 G-s	
EIA	.013 In/Sec	.020 G-s	
EIH	.014 In/Sec	.077 G-s	
EIV	.013 In/Sec	.032 G-s	
EOH	.012 In/Sec	.032 G-s	
EOV	.0094 In/Sec	.023 G-s	

315 - PUMP 315 (31-Aug-21)

	OVERALL LEVEL	1 - 20 KHz	
MOH	.026 In/Sec	.157 G-s	1785.0 RPM
MOV	.039 In/Sec	.122 G-s	
MIH	.028 In/Sec	.145 G-s	
MIV	.042 In/Sec	.080 G-s	
MIA	.049 In/Sec	.109 G-s	
EIA	.042 In/Sec	.123 G-s	

	EIH	.035 In/Sec	.294 G-s	
	EIV	.036 In/Sec	.291 G-s	
	EOH	.033 In/Sec	.253 G-s	
	EOV	.039 In/Sec	.198 G-s	

416 - PUMP 416 (31-Aug-21)

	OVERALL LEVEL	1 - 20 KHz	
MOH	.042 In/Sec	.572 G-s	1785.0 RPM
MOV	.068 In/Sec	.196 G-s	
MIH	.051 In/Sec	.318 G-s	
MIV	.094 In/Sec	.089 G-s	
MIA	.090 In/Sec	.318 G-s	
EIA	.054 In/Sec	.125 G-s	
EIH	.192 In/Sec	.320 G-s	
EIV	.046 In/Sec	.141 G-s	
EOH	.091 In/Sec	.338 G-s	
EOV	.063 In/Sec	.113 G-s	

501 - PUMP 501 (31-Aug-21)

	OVERALL LEVEL	1 - 20 KHz	
MOH	.050 In/Sec	1.290 G-s	1785.0 RPM
MOV	.040 In/Sec	1.120 G-s	
MIH	.047 In/Sec	.798 G-s	
MIV	.051 In/Sec	.106 G-s	
MIA	.028 In/Sec	.487 G-s	
EIA	.047 In/Sec	.033 G-s	
EIH	.049 In/Sec	.061 G-s	
EIV	.034 In/Sec	.029 G-s	
EOH	.033 In/Sec	.131 G-s	
EOV	.042 In/Sec	.167 G-s	

415 - PUMP 415 (31-Aug-21)

	OVERALL LEVEL	1 - 20 KHz	
MOH	.078 In/Sec	.269 G-s	1785.0 RPM
MOV	.087 In/Sec	.139 G-s	
MIH	.109 In/Sec	.360 G-s	
MIV	.145 In/Sec	.113 G-s	
MIA	.062 In/Sec	.137 G-s	
EIA	.047 In/Sec	.177 G-s	
EIH	.065 In/Sec	.467 G-s	
EIV	.043 In/Sec	.485 G-s	
EOH	.046 In/Sec	.826 G-s	
EOV	.037 In/Sec	.405 G-s	

402 - PUMP 402 (31-Aug-21)

	OVERALL LEVEL	1 - 20 KHz	
MOH	.040 In/Sec	.553 G-s	1785.0 RPM
MOV	.041 In/Sec	.158 G-s	
MIH	.042 In/Sec	.444 G-s	
MIV	.044 In/Sec	.190 G-s	
MIA	.018 In/Sec	.427 G-s	
EIA	.069 In/Sec	.056 G-s	
EIH	.064 In/Sec	.184 G-s	
EIV	.055 In/Sec	.122 G-s	
EOH	.049 In/Sec	.181 G-s	
EOV	.040 In/Sec	.153 G-s	

Clarification Of Vibration Units:

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