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December 23, 2019

Aria Energy Millington, TN

The following is a summary of findings from the December 2019 vibration survey at your facility. Please let us know if there are any questions or comments.

QualiTest® uses a four step rating system for defects.

<u>Class I:</u> Defect is present, but effect on reliability is not clear; no immediate action is required. Continue to normally monitor.

**<u>Class II:</u>** Defect (s) present that may cause problem in long term (2-6 months). Repair during normal maintenance scheduling. Continue to monitor.

<u>Class III:</u> 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.

**<u>Class IV</u>**; 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.

# Defects

## HX453C Vac Pump Oil Cool Fan

Vibration has decreased slightly since last month. Data shows a tremendously high 1 x rpm vibration at the motor axial with amplitude of 1.2 ips this month. Last month, the axial was 2.0 ips. Fan hub is likely cocked on the bushing or something may be bent. Ensure fan is properly mounted to the bushing and ensure bushing is not damaged or loose. This issue should be addressed ASAP. Rated as a **CLASS IV** defect.

## 451D Vacuum Pump

New motor on this unit continues to have an electrical vibration. We will monitor this closely. Rated as a **CLASS I** defect for now.

## HX453D Vac Pump Oil Cool Fan

Vibration data is showing signs of bearing defects. Motor bearings may need to be replaced as time allows. We will monitor this issue closely. Rated as a **CLASS II** defect.

## **101B Feed Compressor**

Compressor seemed to have some different type of vibration this survey. There is a pulsing and impacting in the compressor section. This could be due to the loaders having issues. Data of the compressor does normally vary some month to month due to load; with acceleration being highest in the compressor second stage axial. We will continue to monitor these issues closely. Rated as a **CLASS II** defect.

## HX507B Gas Cool Fan

Drive end motor bearing is now showing signs of bearing defects. We will monitor this issue closely. Rated as a **CLASS II** defect.

| Abbreviated Last Measurement Sum   | mary<br>************************* | ****       |  |  |  |  |
|--|-----------------------------------|------------|--|--|--|--|
| Database: Clean Energy.rbm<br>Area: millington plant<br>Report Date: 23-Dec-19 08:14 |                                   |            |  |  |  |  |
| MEASUREMENT POINT  | OVERALL LEVEL                     | HFD / VHFD |  |  |  |  |
| 303 FLARE - 303 FLARE BLO  | WER (11                           | -Dec-19)   |  |  |  |  |
|  | OVERALL LEVEL                     | 1K-20KHz   |  |  |  |  |
| MOH  | .066 In/Sec                       | .406 G-s   |  |  |  |  |
| MIH  | .086 In/Sec                       | .348 G-s   |  |  |  |  |
| MIA  | .064 In/Sec                       | .382 G-s   |  |  |  |  |
| EIH  | .084 In/Sec                       | .099 G-s   |  |  |  |  |
| EIA  | .045 In/Sec                       | .150 G-s   |  |  |  |  |
| EOH  | .099 In/Sec                       | .149 G-s   |  |  |  |  |
| 101A COMP - 101A FEED COM  | IPRESSOR (11                      | -Dec-19)   |  |  |  |  |
|  | OVERALL LEVEL                     | 1K-20KHz   |  |  |  |  |
| MOH  | .097 In/Sec                       | .368 G-s   |  |  |  |  |
| MIH  | .086 In/Sec                       | .233 G-s   |  |  |  |  |
| MIA  | .089 In/Sec                       | .278 G-s   |  |  |  |  |
| IIH  | .189 In/Sec                       | .662 G-s   |  |  |  |  |
| IIA  | .378 In/Sec                       | 1.311 G-s  |  |  |  |  |
| IOH  | .205 In/Sec                       | .848 G-s   |  |  |  |  |
| OIH  | .155 In/Sec                       | .426 G-s   |  |  |  |  |
| OIA  | .158 In/Sec                       | .425 G-s   |  |  |  |  |
| OOH  | .109 In/Sec                       | 1.052 G-s  |  |  |  |  |

| 101B COMP                              | - | 101B  | FEED   | COMPRESSOR                           |  | (11-Dec-19)   |
|--|---|-------|--------|--------------------------------------|--|---|
|  |   |       |        | OVERA                                | LL LEVEI                                       | 1K-20KHz  |
| MOH                                    |   |       |        | .066                                 | In/Sec   | .180 G-s  |
| MIH                                    |   |       |        | .062                                 | In/Sec   | .101 G-s  |
| MIA                                    |   |       |        | .056                                 | In/Sec   | .075 G-s  |
| IIH                                    |   |       |        | .090                                 | In/Sec   | .790 G-s  |
| IIA                                    |   |       |        | . 322                                | In/Sec   | 2.697 G-s   |
| IOH                                    |   |       |        | .140                                 | In/Sec   | .732 G-s  |
| OTH                                    |   |       |        | .126                                 | In/Sec   | .856 G-s  |
| 014                                    |   |       |        | 187                                  | In/Sec   | 945 G-s   |
| OOH                                    |   |       |        | .118                                 | In/Sec   | 1.087 G-s   |
|  |   |       |        |                                      | ,  |   |
| HX132B FAN                             | _ | HX132 | B GAS  | S OIL COOLER                         | FAN  | (11-Dec-19)   |
|  |   |       |        | OVERA                                | LL LEVEI                                       | 1K-20KHz  |
| MOH                                    |   |       |        | . 092                                | In/Sec   | .148 G-s  |
| мтн                                    |   |       |        | 115                                  | Tn/Sec   | 186 G-s   |
| <br>ЕТН                                |   |       |        | 055                                  | In/Sec   | 038 G-s   |
| EOH                                    |   |       |        | 059                                  | In/Sec   | 042 G-s   |
| 1011                                   |   |       |        | .035                                 | 111,000  | .042 0 5  |
| 451 A PIIMP                            | _ | 451a  | VACCI  |                                      |  | (11-Dec-19)   |
| 40111 I OMI                            |   | 40111 | *****  | OVERA                                | T.T. T.EVET                                    | 1K-20KH7  |
| MOH                                    |   |       |        | 048                                  |  | 214 C-C   |
| мтн                                    |   |       |        | .040                                 | In/Sec   | 2214 G S  |
| MIII                                   |   |       |        | .039                                 | In/Sec   | .222 G-S  |
| MIA                                    |   |       |        | .045                                 | In/Sec   | .314 G-S  |
| EIR                                    |   |       |        | .107                                 | In/Sec   | .175 G-S  |
| EIA                                    |   |       |        | .076                                 | In/Sec   | .229 G-S  |
| EOH                                    |   |       |        | .143                                 | In/Sec   | .138 G-S  |
| 11X/E22 1123                           |   |       |        |                                      |  | (11 Dec 10)   |
| HX453A FAN                             | - | HX45. | SA VAG | PUMP OIL CO                          | OL FAN   | (II-DeC-I9)   |
|  |   |       |        | OVERA.                               | LL LEVEL                                       | IK-20KHz  |
| MOH                                    |   |       |        | .161                                 | In/Sec   | .094 G-s  |
| MIH                                    |   |       |        | .125                                 | In/Sec   | .042 G-s  |
|  |   |       |        |                                      |  |   |
| 451B PUMP                              | - | 451B  | VACCU  | JM PUMP                              |  | (11-Dec-19)   |
|  |   |       |        | OVERA                                | LL LEVEI                                       | 1K-20KHz  |
| MOH                                    |   |       |        | .039                                 | In/Sec   | .137 G-s  |
| MIH                                    |   |       |        | .065                                 | In/Sec   | .218 G-s  |
| MIA                                    |   |       |        | .044                                 | In/Sec   | .317 G-s  |
| EIH                                    |   |       |        | .163                                 | In/Sec   | .227 G-s  |
| EIA                                    |   |       |        | .099                                 | In/Sec   | .219 G-s  |
| EOH                                    |   |       |        | .184                                 | In/Sec   | .152 G-s  |
|  |   |       | _      |                                      |  |   |
| HX453B FAN                             | - | HX453 | BB VAC | C PUMP OIL CO                        | OL FAN   | (11-Dec-19)   |
|  |   |       |        | OVERA                                | LL LEVEI                                       | 1K-20KHz  |
| MOH                                    |   |       |        | .173                                 | In/Sec   | .136 G-s  |
| MIH                                    |   |       |        | .089                                 | In/Sec   | .022 G-s  |
|  |   |       |        |                                      |  |   |
| 451C PUMP                              | - | 451C  | VACCU  | JM PUMP                              |  | (11-Dec-19)   |
|  |   |       |        | OVERA                                | LL LEVEI                                       | 1K-20KHz  |
| MOH                                    |   |       |        | .066                                 | In/Sec   | .317 G-s  |
| MIH                                    |   |       |        | .079                                 | In/Sec   | .599 G-s  |
| MIA                                    |   |       |        | .061                                 | In/Sec   | .432 G-s  |
| EIH                                    |   |       |        | .166                                 | In/Sec   | .215 G-s  |
| EIA                                    |   |       |        | .070                                 | In/Sec   | .239 G-s  |
| EOH                                    |   |       |        | .149                                 | In/Sec   | .281 G-s  |
|  |   |       |        |                                      |  |   |
| HX453C FAN                             | - | HX453 | BC VAC | C PUMP OIL CO                        | OL FAN   | (11-Dec-19)   |
|  |   |       |        | OVERA                                | LL LEVEI                                       | 1K-20KHz  |
| MOH                                    |   |       |        | 1.000                                | In/Sec   | .025 G-s  |
| MIH                                    |   |       |        | . 325                                | In/Sec   | .017 G-s  |
| MIA                                    |   |       |        | 1.234                                | In/Sec   | .053 G-s  |
|  |   |       |        |                                      |  |   |
| 451D PUMP                              | - | 451D  | VACCU  | JM PUMP                              |  | (11-Dec-19)   |
|  |   |       |        | OVERA                                | LL LEVEI                                       | 1K-20KHz  |
| Vor                                    |   |       |        | 008                                  | Tn/Sec   | 417 0 -   |
| MOH                                    |   |       |        | .090                                 | 111, 000                                       | .41/ G-S  |
| MOH<br>MIH                             |   |       |        | .126                                 | In/Sec   | .417 G-s<br>.837 G-s  |
| MOH<br>MIH<br>MIA                      |   |       |        | .126                                 | In/Sec<br>In/Sec                               | .417 G-s<br>.837 G-s<br>2.112 G-s                                     |
| MOH<br>MIH<br>MIA<br>EIH               |   |       |        | .126<br>.069<br>.187                 | In/Sec<br>In/Sec<br>In/Sec                     | .417 G-s<br>.837 G-s<br>2.112 G-s<br>.224 G-s                         |
| MOH<br>MIH<br>MIA<br>EIH<br>EIA        |   |       |        | .126<br>.069<br>.187<br>.118         | In/Sec<br>In/Sec<br>In/Sec<br>In/Sec           | .417 G-s<br>.837 G-s<br>2.112 G-s<br>.224 G-s<br>.304 G-s             |
| MOH<br>MIH<br>MIA<br>EIH<br>EIA<br>EOH |   |       |        | .126<br>.069<br>.187<br>.118<br>.145 | In/Sec<br>In/Sec<br>In/Sec<br>In/Sec<br>In/Sec | .417 G-s<br>.837 G-s<br>2.112 G-s<br>.224 G-s<br>.304 G-s<br>.099 G-s |

HX453D FAN - HX453D VAC PUMP OIL COOL FAN (11-Dec-19) OVERALL LEVEL 1K-20KHz .743 G-s .090 G-s .175 In/Sec .126 In/Sec MOH MIH 506A COMP - 506A PRODUCT COMPRESSOR (11-Dec-19) OVERALL LEVEL 1K-20KHz .481 G-s MOH .078 In/Sec .074 In/Sec .498 G-s MIH .068 In/Sec .546 G-s MIA .216 G-s .160 In/Sec TIH .332 In/Sec .327 G-s IIA IOH .170 In/Sec .825 G-s HX507A FAN - HX507A GAS COOL FAN (11-Dec-19) OVERALL LEVEL 1K-20KHz .161 In/Sec .058 G-s MOH .244 In/Sec .030 G-s MIH 506B COMP - 506B PRODUCT COMPRESSOR (11-Dec-19) OVERALL LEVEL 1K-20KHz MOH .130 In/Sec .190 G-s .096 In/Sec MIH .228 G-s .103 In/Sec .148 G-s MIA .535 G-s IIH .109 In/Sec .276 In/Sec .415 G-s .190 In/Sec 1.173 G-s .415 G-s IIA IOH (11-Dec-19) HX507B FAN - HX507B GAS COOL FAN OVERALL LEVEL 1K-20KHz .428 G-s MOH .132 In/Sec .221 In/Sec .954 G-s MIH \_\_\_\_\_ Clarification Of Vibration Units: Acc --> G-s RMS Vel --> In/Sec PK

As always, it has been a pleasure to serve Aria Energy. If there are any comments or questions, do not hesitate to contact us.

Sincerely,

Kevin W. Maxuell

ISO Certified Vibration Analyst, Category III



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