HI-SPEED INDUSTRIAL SERVICE QualiTest® Diagnostics

7030 Ryburn Dr. Millington, TN Phone: (901) 873-5300 Fax: (901) 873-5301 www.gohispeed.com

July 13, 2020

NUCOR Melt Shop

Subject: July vibration survey

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

Defects

West Caster Mold Water Pump
High 1 x rpm vibration is present in the motor axial. This indicates angular misalignment. Pump may also have some internal wear. Perform a precision alignment with less than .003" offset and angularity. Ensure there is no soft foot present in the motor. Rated as a **CLASS II** defect.

East Caster Mold Water Pump
Pump is still showing some signs of internal wear. Coupling may also be wearing due to misalignment. Perform a precision alignment with less than .003" offset and angularity. Ensure there is no soft foot present. Rated as a **CLASS II** defect.

West Booster Pump
Pump data shows another increase in non-synchronous vibration at the outboard end of the pump. This is good indication of bearing defects taking place in the pump bearings. Pump will need attention SOON. Rated as a **CLASS III** defect.

Cooling Tower #6 Supply Pump
The pump vibration data is still indicating that there is bearing wear, and possibly cavitation in the pump. Inspect ODE pump bearing SOON. Ensure the pump has no inlet restrictions and is operating in the correct part of the curve. Rated as a **CLASS II** defect.

Cooling Tower #3 Supply Pump
The pump appears to have cavitation which is causing a high noise floor in the spectrum. This is also making the ODE pump bearing have high acceleration. This could also be a bearing issues but the noise floor is masking the data somewhat. Pump impeller or other pump internals could also be worn which could be causing this vibration. Pump needs to be inspected as time allows. Rated as a **CLASS II** defect.

Cooling Tower #2 Supply Pump
Pump was not in service during this survey; however, the following most likely still applies: The pump appears to have cavitation which is causing a high noise floor in the spectrum. This is also making the ODE pump bearing have high acceleration. This could also be a bearing issues but the noise floor is masking the data somewhat. Pump impeller or other pump internals may also be worn which could be causing this vibration. Pump needs to be inspected as time allows. Rated as a **CLASS II** defect.

Furnace Reverse Air Fan
Drive end fan bearing axial data still shows some impacting occurring within the bearing. This could be signs of axial thrusting or some other type of aerodynamic forces being generated by the fan. For now, it is recommended to inspect the fan bearings as time allows. Ensure drive end bearing is fixed and outboard end bearing is set to float. Rated as a **CLASS II** defect.

Caster Baghouse ID Fan
High frequency acceleration is starting to increase in the outboard fan bearing. This is likely an early indication of bearing defects/wear of the outboard bearing. This will be monitored closely. Rated as a **CLASS I** defect.

East Furnace Baghouse Fan
A rattling noise can be heard in the back end of the fan. Some random impacting can also be seen in the outboard fan bearing data. An internal inspection of the fan and fan housing should be done soon. Rated as a **CLASS II** defect.

Spray Chamber Exhaust Fan

The DE fan bearing data still shows a high 1 x fan rpm vibration which typically indicates imbalance of the fan wheel. Outboard fan bearing data also shows a once per revolution impact in the time waveform data and an increase in high frequency acceleration amplitude. This indicates that the bearing is under stress and may have lack of lubrication or mechanical issue. **Motor has an increased high 1 x fan rpm vibration with amplitudes near 2 ips-pk. Inspect fan wheel ASAP for build-up/damage/wear and inspect fan bearings especially the ODE fan bearing.** This unit may be operating near a critical speed or resonance which could influence some of the high vibration. We will continue to monitor this closely. Rated as a **CLASS IV** defect.

```
Abbreviated Last Measurement Summary
                    ************************************

              Database:  nucorja9.rbm
              Station:   Melt Shop
              Report Date:  13-Jul-20   07:37

      MEASUREMENT POINT             OVERALL LEVEL       HFD / VHFD
      -----------------             -------------       ----------

      WCMWP      - WEST CASTER MOLD WATER PUMP   (09-Jul-20)
                                    OVERALL LEVEL     1K-20KHz
             MOH                     .108 In/Sec       .771 G-s
             MIH                     .098 In/Sec      1.409 G-s
             MIA                     .233 In/Sec      1.440 G-s
             PIA                     .272 In/Sec       .941 G-s
             PIH                     .177 In/Sec       .858 G-s
             POH                     .079 In/Sec       .844 G-s

      ECMWP      - EAST CASTER MOLD WATER PUMP   (09-Jul-20)
                                    OVERALL LEVEL     1K-20KHz
             MOH                     .070 In/Sec       .247 G-s
             MIH                     .057 In/Sec       .206 G-s
             MIA                     .303 In/Sec       .162 G-s
             PIA                     .394 In/Sec       .828 G-s
             PIH                     .142 In/Sec       .863 G-s
             POH                     .140 In/Sec       .889 G-s

      WBOSTRP    - WEST Booster PUMP             (09-Jul-20)
                                    OVERALL LEVEL     1K-20KHz
             MOH                     .075 In/Sec       .671 G-s
             MIH                     .033 In/Sec       .668 G-s
             MIA                     .026 In/Sec       .223 G-s
             PIA                     .115 In/Sec      1.549 G-s
             PIH                     .114 In/Sec       .760 G-s
             POH                     .146 In/Sec      1.545 G-s

      EBOSTRP    - EAST Booster PUMP             (09-Jul-20)
                                    OVERALL LEVEL     1K-20KHz
             MOH                     .065 In/Sec       .102 G-s
             MIH                     .078 In/Sec       .214 G-s
             MIA                     .080 In/Sec       .094 G-s
             PIA                     .133 In/Sec       .365 G-s
             PIH                     .119 In/Sec       .219 G-s
             POH                     .088 In/Sec       .209 G-s

      ECSWP 1LFT - EAST CASTER SPRAY WP 1 LEFT   (09-Jul-20)
                                    OVERALL LEVEL     1K-20KHz
             MOH                     .221 In/Sec       .353 G-s
             MIH                     .145 In/Sec       .769 G-s
             MIA                     .243 In/Sec       .345 G-s

      MCSWP 2LFT - MID CASTER SPRAY WP 2 LEFT    (09-Jul-20)
                                    OVERALL LEVEL     1K-20KHz
             MOH                     .807 In/Sec       .613 G-s
```

MIH	.233 In/Sec	1.425 G-s
MIA	.304 In/Sec	1.075 G-s

MCSWP 3RT - MID CASTER SPRAY WP 3 RIGHT (09-Jul-20)

	OVERALL LEVEL	1K-20KHz
MOH	.290 In/Sec	.512 G-s
MIH	.142 In/Sec	.960 G-s
MIA	.203 In/Sec	.327 G-s

ESERVOHYDP - EAST SERVO Hyd PUMP (09-Jul-20)

	OVERALL LEVEL	1K-20KHz
MOH	.025 In/Sec	.200 G-s
MIH	.052 In/Sec	.489 G-s
PIV	.138 In/Sec	1.124 G-s

WSERVOHYDP - WEST SERVO Hyd PUMP (09-Jul-20)

	OVERALL LEVEL	1K-20KHz
MOH	.110 In/Sec	.251 G-s
MIH	.080 In/Sec	.586 G-s
PIV	.105 In/Sec	1.395 G-s

SERVOHRECP - SERVO Hyd RECIRC PUMP (09-Jul-20)

	OVERALL LEVEL	1K-20KHz
MOH	.062 In/Sec	.127 G-s
MIH	.043 In/Sec	.356 G-s
PIV	.076 In/Sec	.897 G-s

N2DECKHYDP - North 2ND DECK Hyd PUMP (09-Jul-20)

	OVERALL LEVEL	1K-20KHz
MOH	.154 In/Sec	.330 G-s
MIH	.082 In/Sec	.375 G-s
PIV	.357 In/Sec	1.099 G-s

2DEKRECIP - 2ND DECK L&S Hyd RECIRC PUM (09-Jul-20)

	OVERALL LEVEL	1K-20KHz
MOH	.101 In/Sec	.276 G-s
MIH	.082 In/Sec	.290 G-s
PIV	.216 In/Sec	1.098 G-s

S2DECKHYDP - SOUTH 2ND DECK Hyd PUMP (09-Jul-20)

	OVERALL LEVEL	1K-20KHz
MOH	.499 In/Sec	.344 G-s
MIH	.387 In/Sec	.437 G-s
PIV	.297 In/Sec	.627 G-s

1SUPLYP - #1 Supply Pump (09-Jul-20)

	OVERALL LEVEL	1K-20KHz
MOH	.053 In/Sec	.172 G-s
MIH	.053 In/Sec	.260 G-s
MIA	.067 In/Sec	.127 G-s
PIA	.189 In/Sec	.909 G-s
PIH	.144 In/Sec	.509 G-s
POH	.155 In/Sec	.445 G-s

3SUPLYP - #3 Supply Pump (09-Jul-20)

	OVERALL LEVEL	1K-20KHz
MOH	.048 In/Sec	.799 G-s
MIH	.061 In/Sec	.904 G-s
MIA	.063 In/Sec	.615 G-s
PIA	.180 In/Sec	.721 G-s
PIH	.155 In/Sec	.759 G-s
POH	.241 In/Sec	1.761 G-s

5SUPLYP - #5 Supply Pump (09-Jul-20)

	OVERALL LEVEL	1K-20KHz
MOH	.045 In/Sec	.617 G-s
MIH	.036 In/Sec	.437 G-s
MIA	.075 In/Sec	.445 G-s
PIA	.167 In/Sec	1.495 G-s
PIH	.170 In/Sec	.906 G-s

	POH	.191 In/Sec	.989 G-s

6SUPLYP - #6 Supply Pump (09-Jul-20)

	OVERALL LEVEL	1K-20KHz
MOH	.043 In/Sec	.261 G-s
MIH	.061 In/Sec	.247 G-s
MIA	.077 In/Sec	.209 G-s
PIA	.191 In/Sec	1.202 G-s
PIH	.192 In/Sec	.875 G-s
POH	.205 In/Sec	1.182 G-s
POV	.132 In/Sec	1.295 G-s

CBRA - CASTER BAGHOUSE REVERSE AIR (09-Jul-20)

	OVERALL LEVEL	1K-20KHz
MOH	.047 In/Sec	.311 G-s
MIH	.041 In/Sec	.203 G-s
MIA	.020 In/Sec	.286 G-s
FIH	.042 In/Sec	.270 G-s
FOH	.063 In/Sec	.128 G-s

CBID - CASTER BAGHOUSE ID FAN (09-Jul-20)

	OVERALL LEVEL	1K-20KHz
MOH	.059 In/Sec	.091 G-s
MOV	.044 In/Sec	.079 G-s
MIH	.054 In/Sec	.308 G-s
MIV	.038 In/Sec	.143 G-s
MIA	.028 In/Sec	.234 G-s
FIA	.118 In/Sec	.766 G-s
FIH	.073 In/Sec	1.756 G-s
FIV	.050 In/Sec	1.618 G-s
FOH	.061 In/Sec	1.692 G-s
FOV	.018 In/Sec	1.251 G-s
FOA	.036 In/Sec	1.763 G-s

FRAF - Furnace REVERSE AIR Fan (09-Jul-20)

	OVERALL LEVEL	1K-20KHz
MOH	.053 In/Sec	.196 G-s
MIH	.060 In/Sec	.111 G-s
MIA	.041 In/Sec	.106 G-s
FIA	.053 In/Sec	.216 G-s
FIH	.122 In/Sec	.517 G-s
FOH	.087 In/Sec	.478 G-s

EFBHF - East Furnace Bag House Fan (09-Jul-20)

	OVERALL LEVEL	1K-20KHz
MOH	.060 In/Sec	.602 G-s
MIH	.051 In/Sec	.342 G-s
MIA	.049 In/Sec	.341 G-s
FIA	.055 In/Sec	.615 G-s
FIH	.078 In/Sec	.377 G-s
FOH	.115 In/Sec	1.577 G-s

WFBHF - WEST Furnace Bag House Fan (09-Jul-20)

	OVERALL LEVEL	1K-20KHz
MOH	.035 In/Sec	.153 G-s
MIH	.069 In/Sec	.159 G-s
MIA	.122 In/Sec	.329 G-s
FIA	.079 In/Sec	.329 G-s
FIH	.063 In/Sec	.689 G-s
FOH	.066 In/Sec	1.399 G-s

MIDCHYDP - MIDDLE CASTER Hyd PUMP (09-Jul-20)

	OVERALL LEVEL	1K-20KHz
MOH	.093 In/Sec	.294 G-s
MIH	.068 In/Sec	.419 G-s
PIH	.144 In/Sec	.513 G-s

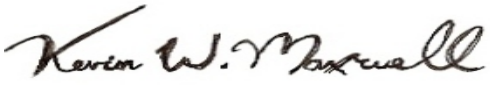
SCHYDP - SOUTH CASTER Hyd PUMP (09-Jul-20)

	OVERALL LEVEL	1K-20KHz
MOH	.057 In/Sec	.386 G-s

```
            MIH                      .021 In/Sec      1.045 G-s
            PIH                      .110 In/Sec      1.315 G-s

      SCEXFAN    - SPRAY CHAMBER EXHAUST Fan     (09-Jul-20)
                                   OVERALL LEVEL     1K-20KHz
            MOH                    1.891 In/Sec       .214 G-s
            MIH                    2.082 In/Sec       .248 G-s
            MIA                    1.323 In/Sec       .140 G-s
            FIH                    1.209 In/Sec       .829 G-s
            FOH                    1.199 In/Sec      1.142 G-s

      WNARCOHYDP - WEST NARCO Hyd PUMP           (09-Jul-20)
                                   OVERALL LEVEL     1K-20KHz
            MOH                     .322 In/Sec      .0020 G-s
            MIH                     .259 In/Sec      .0083 G-s
            PIV                     .482 In/Sec      .0067 G-s

      NC OCILLA  - North Caster Oscillator       (09-Jul-20)
                                   OVERALL LEVEL     1K-20KHz
            MOH                     .680 In/Sec       .213 G-s
            MIH                     .531 In/Sec       .164 G-s
            MIA                     .387 In/Sec       .405 G-s
            GIA                     .263 In/Sec       .140 G-s
            GIH                     .413 In/Sec       .608 G-s
            GOH                     .409 In/Sec       .390 G-s

      MC OCILLA  - Middle Caster Oscillator      (09-Jul-20)
                                   OVERALL LEVEL     1K-20KHz
            MOH                     .707 In/Sec       .094 G-s
            MIH                     .531 In/Sec       .144 G-s
            MIA                     .377 In/Sec       .556 G-s
            GIA                     .207 In/Sec       .119 G-s
            GIH                     .372 In/Sec       .045 G-s
            GOH                     .340 In/Sec       .115 G-s

      SC OCILLA  - South Caster Oscillator       (09-Jul-20)
                                   OVERALL LEVEL     1K-20KHz
            MOH                     .333 In/Sec       .105 G-s
            MIH                     .245 In/Sec       .080 G-s
            MIA                     .168 In/Sec       .104 G-s
            GIA                     .113 In/Sec       .172 G-s
            GIH                     .169 In/Sec       .445 G-s
            GOH                     .144 In/Sec       .240 G-s

-------------------------------------------------------------------------------
   Clarification Of Vibration Units:
      Acc      -->  G-s      RMS
      Vel      -->  In/Sec   PK
```

As always, it has been a pleasure to serve NUCOR Steel Flowood-Jackson, MS. If there are any comments or questions, do not hesitate to contact us.

Sincerely,



ISO Certified Vibration Analyst, Category III

HI-SPEED INDUSTRIAL SERVICE

QualiTest® Diagnostics

Cell: 901-486-4565
Email: kwilliam@gohispeed.com