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December 22, 2021

Nucor Roll Mill Jackson-Flowood, MS

Subject: December vibration survey

Below is a summary report for the monthly Roll Mill vibration survey that was performed on December 20, 2021. Most of the machines surveyed were found to be in good condition except for the following.

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.

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

Sincerely,

evin W. Maruell

ISO Certified Vibration Analyst, Category III



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Defects

Roll Stand 1A Planetary Gearbox

After further analysis on the gearbox, it appears that the highest vibration is coming from the first section of planetary gears. The vibration did appear to decrease after repairs were made late yesterday afternoon. There are several non-synchronous peaks in this data. Motor showed to be operating around 680 rpm; however, most of the peaks in the spectral data are synchronous to 8.3 Hz or 497 rpm. Gear issues generate synchronous peaks while bearing issues generate non-synchronous peaks. This may indicate some bearing issues. We will monitor this closely and recommend to monitor temps closely and prepare to take actions as scheduling and parts become available. Rated as a **CLASS II** defect.

Roll Stand 2

The drive end of the intermediate gearbox also shows gear mesh frequencies with 2 and 4 x input GMF being dominant. Input rpm sidebands were also present around the GMF harmonics. These peaks vary in amplitude according to speed and gear load. This may indicate some internal gear issues such as misaligned gears. We will continue to monitor closely. Rated as a **CLASS I** defect.

Roll Stand 3

Outboard motor bearing is starting to show some signs of bearing issue. This will be monitored very closely in the coming surveys. Rated as a **CLASS II** defect for now.

Roll Stand 5

Gear mesh vibration decreased some this month. Inspection of the gearbox does show some tooth wear in this gearbox. The up and down amplitude of this peak from month to month is likely due to change in tooth load and machine speed. We will continue to monitor this very closely. This is rated as a **CLASS II** defect.

Roll Stand 6

Gear mesh vibration decreased this month. Overall amplitude at the outboard side horizontal was .24 ips-pk. A dominant gear mesh vibration is present towards the output of the gearbox. The up and down amplitude of this peak is likely due to change in tooth load and speed. We will continue to monitor this very closely. Because of the high amplitude this month, this issue is rated as a **CLASS II** defect.

Roll Stand 7

Motor data is starting to show signs of bearing issue. This may be due to fluting of the bearings. We will monitor this closely. Gearbox vibration was away up this month from .16 to .72 ips-pk. We still suspect this to be possibly due to a resonant gear mesh frequency vibration. The up and down amplitude of this peak from month to month is likely due to change in tooth load and machine speed. We will continue to monitor this very closely. Because of the high amplitudes in the gearbox and bearing defect related vibrations in the motor, this is rated as a **CLASS II** defect.

Furnace Cooling Tower Drives North and South

Motor was lower this survey. The normally high vibration in the motor appears to be occurring at 1 x motor rpm and may indicate a structural issue such as loose fasteners, weak flexible motor base. This could also be caused by a resonance or air flow turbulence in this unit since the blade pitch has been altered. We will continue to monitor this issue closely. Rated as a **CLASS II** defect.

East Booster Pump (Small)

Motor has high 1 x rpm vibration. This may be due to excessive pump shaft movement. Pump may need attention in the near future. Rated as a **CLASS II** defect.

Database:	nucorja9.rbm
Station:	Roll Mill Rolls
Route No.	1: RM ROLL DRIVES

MEASUREN	MENT POINT	OVERALL LEVEL	HFD / VHFD				
STD1A	- Stand 1A	(21-Dec-21)					
		OVERALL LEVEL	1K-20KHz				
* 1	10H	.083 In/Sec	.032 G-s				
* N	4IH	.063 In/Sec	.320 G-s				
* N	AIA	.124 In/Sec	.149 G-s				
* (СОН	.401 In/Sec	.269 G-s				
* (GIA	.089 In/Sec	.411 G-s				
G	GIH	.153 In/Sec	1.236 G-s				
G	312	.118 In/Sec	.871 G-s				
c c	 	.127 In/Sec	2.344 G-s				
c c	5I4	.109 In/Sec	1.394 G-s				
* (.102 In/Sec	.201 G-s				
* (ST 6	.068 In/Sec	.277 G-s				
* (GOH	.062 In/Sec	.060 G-s				
STD2A	- Stand 2A	(2)	0-Dec-21)				
		OVERALL LEVEL	1K-20KHz				
N	10H	.057 In/Sec	.011 G-s				
N	4IH	.062 In/Sec	.081 G-s				
N	IIA	.082 In/Sec	.047 G-s				
C	СОН	.086 In/Sec	.059 G-s				
STD1	- Stand 1	(2)	0-Dec-21)				
		OVERALL LEVEL	1K-20KHz				
N	ЮН	.046 In/Sec	.021 G-s				
N	4IH	.118 In/Sec	.070 G-s				
N	IIA	.070 In/Sec	.051 G-s				
G	SIA	.047 In/Sec	.061 G-s				
Ċ	SIH	.061 In/Sec	.048 G-s				
Ċ	СОН	.128 In/Sec	.058 G-s				
STD2	- Stand 2	(2)	0-Dec-21)				
		OVERALL LEVEL	1K-20KHz				
N	10H	.115 In/Sec	.062 G-s				
N	4IH	.158 In/Sec	.139 G-s				
N	4IA	.201 In/Sec	.133 G-s				
G	GIA	.050 In/Sec	.0062 G-s				
G	GIH	.220 In/Sec	.743 G-s				
C	СОН	.450 In/Sec	.072 G-s				
STD3	- Stand 3	(2)	0-Dec-21)				
		OVERALL LEVEL	1K-20KHz				
N	ЮН	.060 In/Sec	.649 G-s				
N	4IH	.132 In/Sec	.059 G-s				
N	11A	.192 In/Sec	.899 G-s				
G	SIA	.051 In/Sec	.207 G-s				
G	SIH	.068 In/Sec	.085 G-s				
Ċ	СОН	.242 In/Sec	.070 G-s				
STD4	- Stand 4	(2)	0-Dec-21)				
		OVERALL LEVEL	1K-20KHz				
N	10H	.060 In/Sec	.018 G-s				
-	4IH	.081 In/Sec	.013 G-s				
-	4IA	.125 In/Sec	.041 G-s				
-	SIA	.088 In/Sec	.071 G-s				
6	SIH	.065 In/Sec	.061 G-s				
Ċ	СОН	.332 In/Sec	.050 G-s				
STD5	- Stand 5	(2)	0-Dec-21)				
		OVERALL LEVEL	1K-20KHz				

	MOH	.046 In/S	Gec .012 G-s
	MIH	.064 In/S	ec .053 G-s
	MIA	.166 In/S	ec .041 G-s
	GIA	.119 In/S	ec .013 G-s
	GIH	.088 In/S	ec .047 G-s
	GOH	189 Tn/S	ec 172 G-s
	CON	390 TD/S	
	COII	.590 11/3	
ടന്ന6	- Stand	6	(20-Dec-21)
0120	beana	OVERALL LE	$VFI. 1K-20KH_{7}$
	MOH	097 Tp/S	
	MOII	.007 11/2	
	MIH	.061 In/s	
	MIA	.102 In/S	ec .102 G-s
	GIA	.121 In/S	Gec .190 G-s
	GIH	.058 In/S	Gec .141 G-s
	GOH	.239 In/S	ec .328 G-s
	СОН	.263 In/S	ec .044 G-s
STD7	- Stand	7	(20-Dec-21)
		OVERALL LE	VEL 1K-20KHz
	MOH	.113 In/S	ec .092 G-s
	MIH	.141 In/S	ec .253 G-s
	MIA	.414 In/S	ec .128 G-s
	GIA	.089 In/S	ec .059 G-s
	GTH	074 Tn/S	ec 243 G-s
	COH	727 Tn/S	478 G-S
	COH	558 Tn/S	231 G-s
	con	.550 11/2	.231 6 3
STD9	- Stand	9	(20-Dec-21)
		OVERALL LE	VEL 1K-20KHz
	MOH	058 Tn/S	ec 062 G-s
	мтн	071 Tn/S	
	MTA	194 Tp/S	
	MIA	.194 11/5	.090 G-S
	GIA	.194 ln/s	ec .036 G-s
	GIH	.072 In/S	ec .275 G-s
	СОН	.220 In/S	ec .088 G-s
000011	Oband	11	(20 Dec 21)
STDII	- Stand		(20-Dec-21)
		OVERALL LE	IVEL IK-20KHZ
	MOH	.029 IN/S	ec .046 G-s
	MIH	.040 In/S	ec .031 G-s
	MIA	.036 In/S	ec .074 G-s
	GIA	.089 In/S	Gec .034 G-s
	GIH	.061 In/S	Gec .040 G-s
	GOH	.045 In/S	ec .097 G-s
	СОН	.144 In/S	ec .013 G-s
STD12	- Stand	12	(20-Dec-21)
		OVERALL LE	VEL 1K-20KHz
	MOH	.037 In/S	ec .076 G-s
	MIH	.045 In/S	ec .059 G-s
	MIA	.043 In/S	ec .119 G-s
	COH	.157 In/S	ec .033 G-s
STD13	- Stand	13	(20-Dec-21)
		OVERALL LE	VEL 1K-20KHz
	MOH	.073 In/S	ec .297 G-s
	MIH	.082 In/S	ec .156 G-s
	MIA	.093 In/S	ec .174 G-s
	GIA	.033 In/S	ec .046 G-s
	GIH	.037 In/s	ec .179 G-s
	GOH	.034 In/s	ec .121 G-s
	СОН	.245 In/s	ec .600 G-s
			-
STD14	- Stand	14	(20-Dec-21)
STD14	- Stand	14 OVERALL LE	(20-Dec-21) WEL 1K-20KHz
STD14	- Stand MOH	14 OVERALL LE .112 In/S	(20-Dec-21) VEL 1K-20KHz Sec .358 G-s
STD14	- Stand MOH MIH	14 OVERALL LE .112 In/S .105 In/S	(20-Dec-21) VEL 1K-20KHz Sec .358 G-s Sec .117 G-s
STD14	- Stand MOH MIH MIA	14 OVERALL LE .112 In/s .105 In/s .137 In/s	(20-Dec-21) VEL 1K-20KHz Sec .358 G-s Sec .117 G-s Sec .206 G-s

	GIA				•	114	In/Sec	.109	G-s
	GIH					081	In/Sec	.161	G-s
	GOH				. (075	In/Sec	.111	G-s
STD15		-	Stand	15				(20-Dec-21)
					ovi	ERA	LL LEVEL	1K-20	KHz
	MOH				. (087	In/Sec	.085	G-s
	MIH				. (079	In/Sec	.019	G-s
	MIA				. (065	In/Sec	.051	G-s
	GIA				. (038	In/Sec	.181	G-s
	GIH				. (064	In/Sec	.085	G-s
	СОН				.:	250	In/Sec	.088	G-s
STD16		-	Stand	16				(20-Dec-21)
					ovi	ERA	LL LEVEL	1K-20	KHz
	MOH				. (061	In/Sec	. 600	G-s
	MIH				. (071	In/Sec	. 473	G-s
	MIA				. (094	In/Sec	. 683	G-s
	GIA				. (076	In/Sec	.085	G-s
	GIH				. (026	In/Sec	.118	G-s
	GOH				. (031	In/Sec	.131	G-s
	СОН				•	159	In/Sec	.168	G-s
NORTH	AC	-	NORTH	AIR	COMPRESSO	RQI	UINCY	(20-Dec-21)
					OVI	ERA	LL LEVEL	1 - 2	0 KHz
	MOH				•	174	In/Sec	.872	G-s
	MIH				•	140	In/Sec	.844	G-s
	MIA				•	182	In/Sec	. 600	G-s
					ovi	ERA	LL LEVEL	1K-20	KHz
	CIA				• •	417	In/Sec	. 456	G-s
	CIH				•	189	In/Sec	. 521	G-s
	СОН				.:	207	In/Sec	.293	G-s
SOUTH	AC	-	SOUTH	AIR	COMPRESSO	RQI	UINCY	(20-Dec-21)
					ovi	ERA	LL LEVEL	1 - 2	0 KHz
	MOH				. (074	In/Sec	1.203	G-s
	MIH				•	150	In/Sec	1.242	G-s
	MIA				.:	119	In/Sec	1.121	G-s
					ovi	ERA	LL LEVEL	1K-20	KHz
	CIA				•	352	In/Sec	.418	G-s
	CIH				.:	145	In/Sec	. 433	G-s
	СОН				•	303	In/Sec	.170	G-s

Database: nucorja9.rbm Station: Roll Mill Utilities

MEASUREMENT	POINT	OVERALL LEVEL	HFD / VHFD
HYDPMP1 -	· Hydraulic Pump	East	(20-Dec-21)
		OVERALL LEVEL	1K-20KHz
MOH		.115 In/Sec	.205 G-s
MIH		.186 In/Sec	.276 G-s
PIV		.315 In/Sec	3.100 G-s
HYDPMP2 -	Hydraulic Pump	Center	(20-Dec-21)
		OVERALL LEVEL	1K-20KHz
MOH		.126 In/Sec	.282 G-s
MIH		.205 In/Sec	.301 G-s
PIV		.302 In/Sec	1.354 G-s
DESFAN -	· Desolution Fan		(20-Dec-21)
		OVERALL LEVEL	1K-20KHz
MOH		.058 In/Sec	.084 G-s
MIH		.051 In/Sec	.062 G-s
MIA		.027 In/Sec	.055 G-s

		Combustion A	iii ran	(2	O DEC LI)
			OVERALL	LEVEL	1K-20KHz
MO	н		.101 In	/Sec	.324 G-s
MI	н		.082 In	/Sec	.195 G-s
MI	A		.086 In	/Sec	.153 G-s
FI	H		.069 In	/Sec	.145 G-s
FO	н		.102 In	/Sec	.661 G-s
EJCFAN	_	Ejector Air	Fan	(2	0-Dec-21)
		2	OVERALL	LEVEL	1K-20KHz
MO	н		.093 In	/Sec	.320 G-s
MI	н		.106 In	/Sec	.302 G-s
MI	A		.076 In	/Sec	.190 G-s
FI	A		.049 In	/Sec	.593 G-s
FI	н		.056 In	/Sec	.853 G-s
FO	H		.128 In	/Sec	1.056 G-s
COLPMP2	-	Furnace Cool	ling Pump cent	er (2	0-Dec-21)
			OVERALL	LEVEL	1K-20KHz
MO	H		.204 In	/Sec	.167 G-s
MI	H		.114 In	/Sec	.214 G-s
MI	A		.119 In	/Sec	.140 G-s
FCTSOUTH	-	Furnace CT I	orive South	(2	0-Dec-21)
			OVERALL	LEVEL	1K-20KHz
MO	H		.154 In	/Sec	.162 G-s
MI	н		.153 In	/Sec	.077 G-s
MI	A		.315 In	/Sec	.029 G-s
FCTNORTH	-	Furnace CT I	orive North	(2	0-Dec-21)
			OVERALL	LEVEL	1K-20KHz
MO	н		.295 In	/Sec	.065 G-s
MI	H		.247 In	/Sec	.153 G-s
MI	A		.149 In	/Sec	.170 G-s
SCLPMP1	-	Scale Pit Pu	mp South	(2	0-Dec-21)
			OVERALL	LEVEL	1K-20KHz
MO	H		.161 In	/Sec	.279 G-s
MO	v		.161 In	/Sec	.690 G-s
MI	V		.124 In	/Sec	.112 G-s
MI	H		.200 In	/Sec	.219 G-s
MI	A		.124 In	/Sec	.051 G-s
CTWTR2	-	CT Pump West	:	(2	0-Dec-21)
			OVERALL	LEVEL	1K-20KHz
MO	H		.163 In	/Sec	.326 G-s
MI	H		.162 In	/Sec	.175 G-s
MI	A		.071 In	/Sec	.118 G-s
MILWTR3	-	Mill Water H	Pump West	(2	0-Dec-21)
			OVERALL	LEVEL	1K-20KHz
MO	н		.059 In	/Sec	.422 G-s
MI	н		.063 In	/Sec	.619 G-s
MI	A		.039 In	/Sec	.277 G-s
MILWTR1	_	Mill Water H	Pump East	(2	0-Dec-21)
			OVERALL	LEVEL	1K-20KHz
MO	H		.061 In	/Sec	.178 G-s
MI	н		.044 In	/Sec	.513 G-s
MI	A		.032 In	/Sec	.181 G-s
	n O:	f Vibration (Jnits:		
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CC	>	G-s RM	1S		