Final Report

Client name:	Verso paper - Duluth
Title:	Valve inspection
Job Number:	517700
Date:	5-14-15

Final Report

CONTENTS

1. JOB DETAILS
2. MACHINE DETAILS
3. MECHANICAL NARRATIVE
    a. CONTROL VALVES / NON RETURN VALVES
    b. GEARBOX
    c. LOW SPEED COUPLING
4. CONCLUSIONS & RECOMMENDATIONS
5. APPENDIX
    a. INSPECTION SHEETS
    b. DAILY LOG

Final Report

SECTION 1 – JOB DETAILS

CUSTOMER REPRESENTATIVES:	***William Scott*** ***Engineer*** ***William.Scott@versoco.com***
ETHOSENERGY REPRESENTATIVE:	***Robert Bradley*** ***TFA***
JOB #:	***517700***
EQUIPMENT TYPE:	**Turbodyne/*Dresser Rand***
JOB TYPE:	***Valve inspection***
JOB START DATE:	***May 14, 2015***
JOB COMPLETION DATE:	***May 31, 2015***
COMPILED BY:	***Robert Bradley***
APPROVED BY:	**Iain MacLean**

SECTION 2 – MACHINE DETAILS

TURBINE INFORMATION

UNIT TYPE	Condensing Turbine
MODEL & RATING	Turbodyne/Dresser Rand
INSPECTION TYPE	Valve
TURBINE SERIAL NUMBER	37769
CONTROL SYSTEM	Woodward 505
LOAD TYPE	Generator
GEARBOX MODEL	Lufkin N2400C
GEARBOX SERIAL NUMBER	4595
STEAM CONDITIONS INLET PSI	820
INLET TEMPERATURE	720 F
TYPE OF OUTAGE	Planned
DATE UNIT OUT OF SERVICE	5-14-15
DATE UNIT RETURNED TO SERVICE	5-29-15

SECTION 3 – MECHANICAL NARRATIVE

GENERAL SCOPE

On 5/14/15, Ethos Energy mobilized tooling and craft labor to Duluth, MN for a planned Steam Turbine Inspection. On 5/14/15 the unit was shut down and LOTO was applied and turned over for the outage to begin.

The original scope consisted of a control valve, borescope, gearbox visual, and low speed coupling inspections.

The unit is located on Verso paper property, owned and operated by Verso paper.

Final Report

CONTROL VALVES

Disposition:			
Replaced with New Component: _X__	Replaced with Refurbished Component: ___	Repaired: ___	No Repair or Replacement: ___

Comments:

During the removal of the valve stem from the cross heads one valve broke and one bent due to the stem being drilled too deep for the stem lock. Two new stems were made and installed. Two lower bushings were changed during the outage. All components were dye penetrant checked, blue contact checked, run outs documented, and clearances documented.

Final Report

CAM SHAFT

Disposition:			
Replaced with New Component: _X__	Replaced with Refurbished Component: ___	Repaired: ___	No Repair or Replacement: ___

Comments:

The sealed bearings on the cam shaft were replaced during the outage. The cam lobe for the # 6 valve had some wear and was replaced. The gear teeth were in good shape and no repair necessary.

Final Report

ROCKER ARM ROLLERS

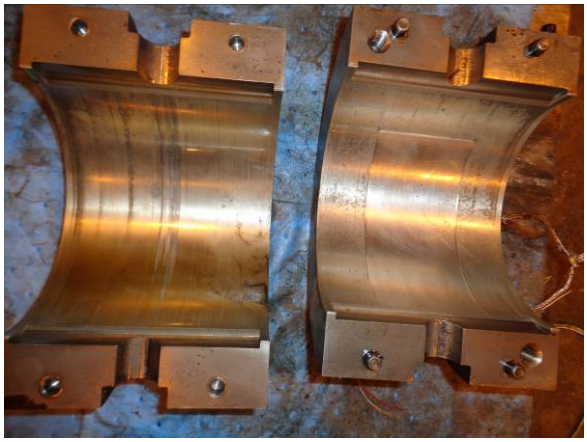
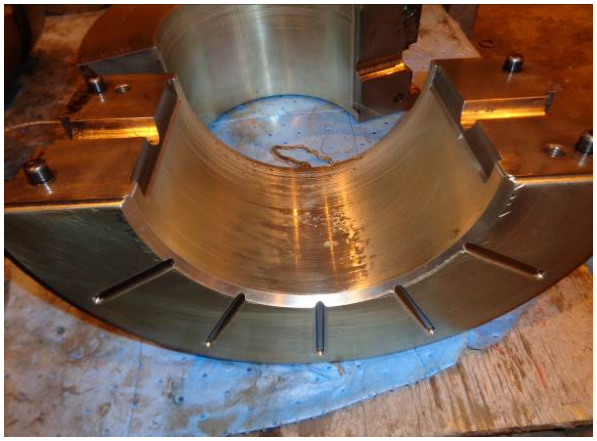
Disposition:			
Replaced with New Component: _X__	Replaced with Refurbished Component: ___	Repaired: ___	No Repair or Replacement: ___

Comments:

The rocker arm rollers were worn. The rollers were replaced with new ones.

Final Report

GEARBOX

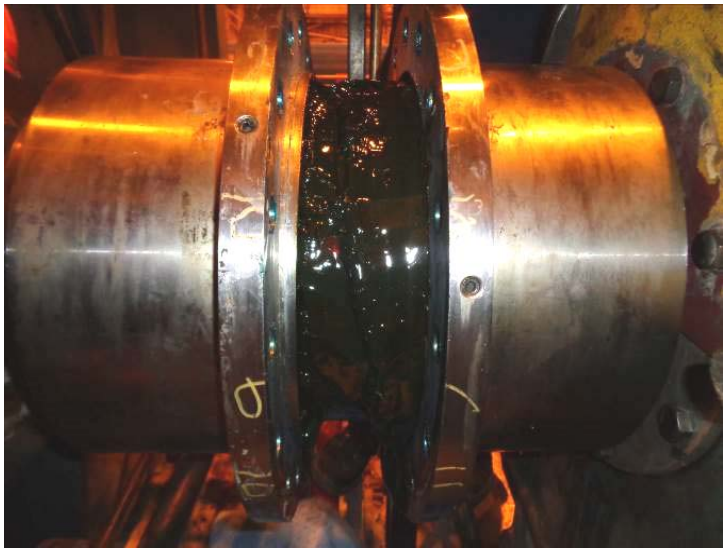

Disposition:			
Replaced with New Component: _X__	Replaced with Refurbished Component: ___	Repaired: ___	No Repair or Replacement: __

Comments:

The original scope was for a visual inspection of the gear box. During start up the unit tripped on high vibration in the low speed bearing. The gear box was opened up and a full inspection performed. All four bearings were replaced during the inspection. There was no apparent cause for the vibration. Later it was discovered that the coupling had too much grease causing the vibration.

Final Report

LOW SPEED COUPLING



Disposition:			
Replaced with New Component: __	Replaced with Refurbished Component: ___	Repaired: ___	No Repair or Replacement: _X_

Comments:

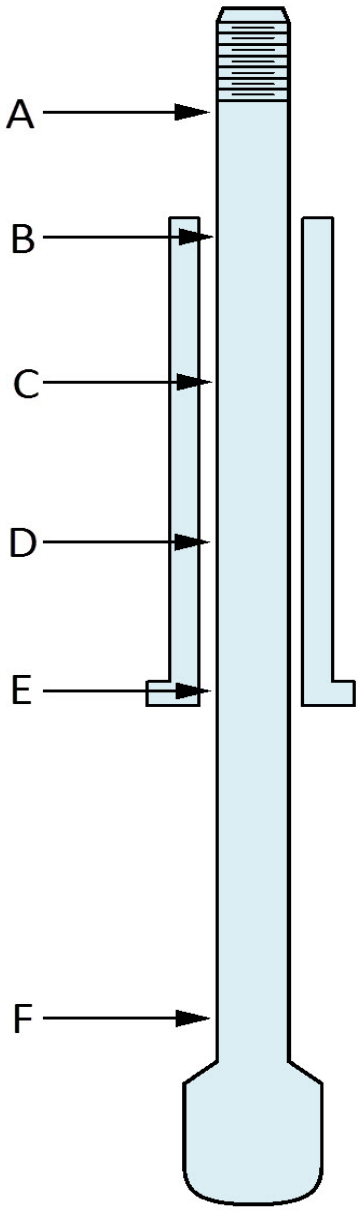
The low speed coupling was separated and re-greased. The hubs were not able to separate enough to visually inspect gear teeth. During start up the unit tripped on high vibration due to too much grease. The coupling was separated and the correct amount of grease installed.

SECTION 4 - CONCLUSIONS & RECOMMENDATIONS

RECOMMENDATIONS

- Have new valve stems available on site prior to the start of the next outage.

Turbine S/N:	37769	Prepared by:	R.Bradley
Customer:	VERSO DULUTH	Date:	May 16, 2015
EE Job No.:	517700	Data Type:	Disassembly
		Control Valve #:	



STEM RUNOUT (Mils)

	A	C	D	F	Max	Bowed?
Valve #1	4 Mils	1 Mils	0 Mils	0 Mils	4.0	
Valve #2	2 Mils	2 Mils	0 Mils	0 Mils	2.0	
Valve #3	3 Mils	3 Mils	0 Mils	0 Mils	3.0	
Valve #4	5 Mils	5 Mils	0 Mils	0 Mils	5.0	
Valve #5	1 Mils	1 Mils	1 Mils	1 Mils	0.0	
Valve #6	N/A	N/A	N/A	N/A	0.0	
STEM LENGTH:		21.750"	Inches			
MAX TIR per foot:			Mils/Ft			
Max Allowable TIR:			Mils			

INSTRUCTIONS: 1. Record stem and bushing diameters both BEFORE and AFTER cleaning.
2. Try bar diameter must be recorded.

TRY BAR DIAMETER:	

VALVE CLEARANCES

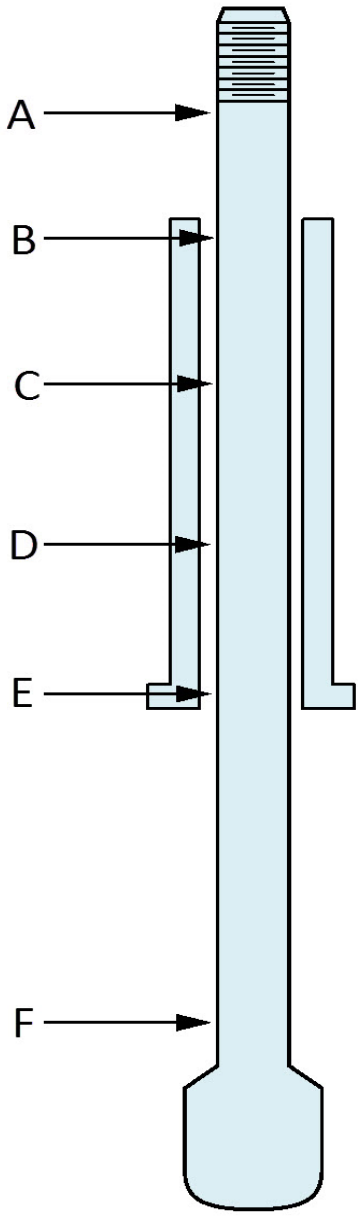
		BEFORE CLEAN	AFTER CLEAN	BEFORE CLEAN	AFTER CLEAN
		B	B	E	E
VALVE #1	Bush. ID	.687	.687	2.126	2.126
	Stem OD	.681	.681	2.118	2.118
	Clearance	.006	.006	.008	.008
VALVE #2	Bush. ID	.690	.690	1.663	1.663
	Stem OD	.681	.681	1.651	1.651
	Clearance	.009	.009	.012	.012
VALVE #3	Bush. ID	.686	.686	1.662	1.662
	Stem OD	.681	.681	1.652	1.652
	Clearance	.005	.005	.010	.010
VALVE #4	Bush. ID	.690	.690	1.662	1.662
	Stem OD	.681	.681	1.652	1.652
	Clearance	.009	.009	.010	.010
VALVE #5	Bush. ID	.688	.688	.692	.692
	Stem OD	.681	.681	.681	.681
	Clearance	.007	.007	.011	.011
VALVE #6	Bush. ID	.691	.691	1.662	1.662
	Stem OD	.681	.681	1.652	1.652
	Clearance	.010	.010	.010	.010

COMMENTS

6 stem broke during removal. # 3 stem bent during removal. Both will need to be replaced

EthosEnergy	ETHOS ENERGY - PPS	EE5280
	INSPECTION SHEET	
	CONTROL VALVES - STEMS & BUSHINGS	

Turbine S/N:	37769	Prepared by:	R.Bradley
Customer:	VERSO DULUTH	Date:	May 29, 2015
EE Job No.:	517700	Data Type:	Reassembly
		Control Valve #:	



STEM RUNOUT (Mils)

	A	C	D	F	Max	Bowed?
Valve #1	4 Mils	1 Mils	0 Mils	0 Mils	4.0	
Valve #2	2 Mils	2 Mils	0 Mils	0 Mils	2.0	
Valve #3	0 Mils	0 Mils	0 Mils	0 Mils	0.0	
Valve #4	5 Mils	5 Mils	0 Mils	0 Mils	5.0	
Valve #5	1 Mils	1 Mils	1 Mils	1 Mils	0.0	
Valve #6	0 Mils	0 Mils	0 Mils	0 Mils	0.0	

STEM LENGTH:	21.750"	Inches
MAX TIR per foot:		Mils/Ft
Max Allowable TIR:		Mils

INSTRUCTIONS: 1. Record stem and bushing diameters both BEFORE and AFTER cleaning.
2. Try bar diameter must be recorded.

TRY BAR DIAMETER:	

VALVE CLEARANCES

		BEFORE CLEAN	AFTER CLEAN	BEFORE CLEAN	AFTER CLEAN
		B	B	E	E
VALVE #1	Bush. ID	.687	.687	2.126	2.126
	Stem OD	.681	.681	2.118	2.118
	Clearance	.006	.006	.008	.008
VALVE #2	Bush. ID	.690	.690	1.660	1.660
	Stem OD	.681	.681	1.651	1.651
	Clearance	.009	.009	.009	.009
VALVE #3	Bush. ID	.686	.686	1.662	1.662
	Stem OD	.680	.680	1.653	1.653
	Clearance	.006	.006	.009	.009
VALVE #4	Bush. ID	.690	.690	1.662	1.662
	Stem OD	.681	.681	1.652	1.652
	Clearance	.009	.009	.010	.010
VALVE #5	Bush. ID	.688	.688	.692	.692
	Stem OD	.681	.681	.681	.681
	Clearance	.007	.007	.012	.011
VALVE #6	Bush. ID	.691	.691	1.660	1.660
	Stem OD	.681	.681	1.652	1.652
	Clearance	.010	.010	.008	.008

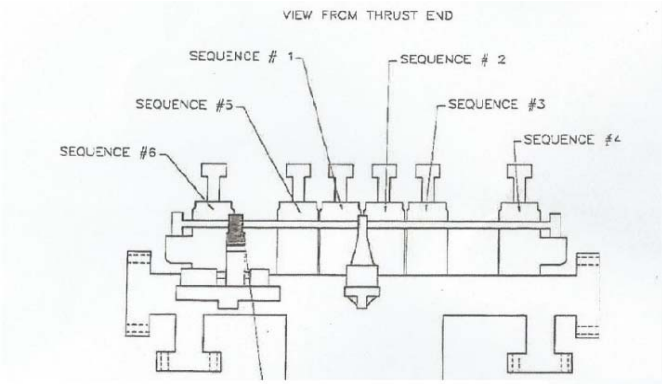
COMMENTS

3 & # 6 stems are new. New lower bushings were installed on # 2 & # 6 valves

EthosEnergy	ETHOS ENERGY - PPS	EE5281
	INSPECTION SHEET	
	CONTROL VALVES - STEMS & BUSHINGS	

EthosEnergy
A WOOD GROUP - TURBOCARE VENTURE

REASSEMBLY	
DATE	5/28/2015



START WITH CAM GEARS AT 0 POSITION

MEASURE THE GAPS BETWEEN THE CAM AND VALVE LIFTER WHILE AT 0 POSITION AND RECORD.

PLACE INDICATOR ON SEQUENCE #1 AND SEQUENCE #2, ROTATE CAM UNTIL #2 MOVES AND RECORD TIMING ON #1.

MOVE INDICATORS TO SEQUENCE #2 & #3 AND REPEAT ABOVE. RECORD #2 TIMING WHEN #3 SHOWS MOVEMENT

CONTINUE WITH ABOVE PROCEDURE UNTIL ALL VALVE TIMING HAS BEEN RECORDED

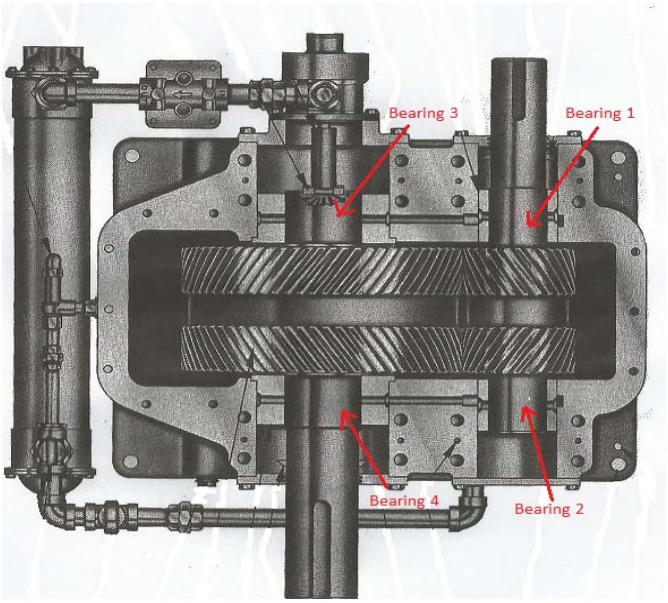
THE PURPOSE OF THIS SHEET IS TO RECORD WHEN EACH VALVE BEGINS TO OPEN RELATIVE TO THE PREVIOUS ONE IN THE SEQUENCE

TIMING OF VALVES					
	Sequence 1	Sequence 2	Sequence 3	Sequence 4	Sequence 5
ACTUAL	0.397	0.323	0.313	0.309	0.373
DESIGN					

GAPS @ 0 POSITION					
Valve 1	Valve 2	Valve 3	Valve 4	Valve 5	Valve 6
0.083	0.08	0.088	0.09	0.074	0.082

EthosEnergy
A WOOD GROUP - TURBOCARE VENTURE

DISASSEMBLY	
DATE	5/30/2015



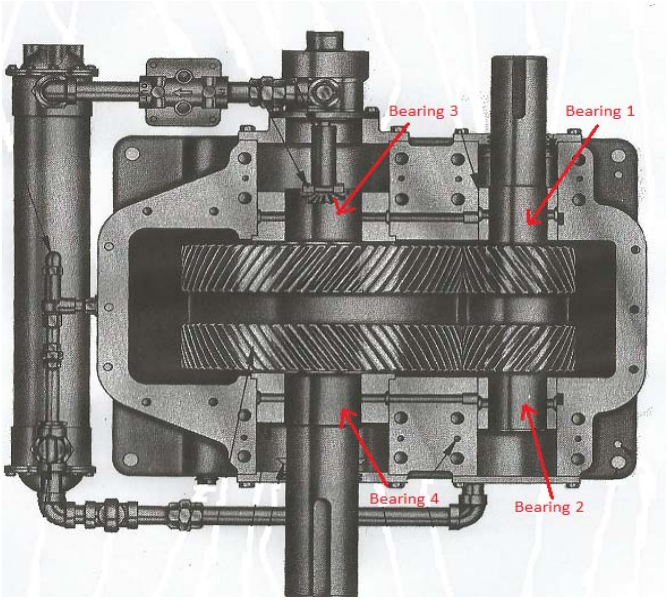
BEARING	LIFT
1	0.009
2	0.014
3	0.014
4	0.0125

THRUST	0.03
END FLOAT	0.086
BACK LASH	0.025

	SEAL CLEARANCE	
	INPUT SHAFT	**OUTPUT SHAFT**
TOP	0.012	0.012
BOTTOM	0.002	0.012
LEFT	0.006	0.006
RIGHT	0.007	0.009

EthosEnergy
A WOOD GROUP - TURBOCARE VENTURE

Reassembly	
DATE	5/30/2015



BEARING	LIFT
1	0.011
2	0.011
3	0.009
4	0.01

THRUST	0.015
END FLOAT	0.071
BACK LASH	0.018

	SEAL CLEARANCE	
	INPUT SHAFT	**OUTPUT SHAFT**
TOP	0.012	0.012
BOTTOM	0.002	0.002
LEFT	0.006	0.007
RIGHT	0.007	0.008

DAILY STATUS REPORT

EthosEnergy	PROJECT:	Verso Corporation Duluth	PROJECT NUMBER:	517700
	Call in # for Conf Calls:	Call in # Pass code	DATE:	May 15, 2015

Field work accomplished in the last 24 hours

- 1. Walked down LOTO
- 2. Staged tooling
- 3. Removed control valve hinge arms
- 4. Removed steam leak off lines
- 5. Removed cam shaft
- 6. Removed spring cans
- 7. Began removing control valves
- 8. Visual inspection on gear box
- 9. Began cleaning parts
-
-
-

Field work to be accomplished in the next 24 hours

- 1. Finish removing control valves
- 2 .Clean and inspect parts
- 3. Bore scope turbine
- 4. Replace parts as necessary
-
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-
-
-

DAILY STATUS REPORT

EthosEnergy	PROJECT:	Verso Corporation Duluth	PROJECT NUMBER:	517700
	Call in # for Conf Calls:	Call in # Pass code	DATE:	May 16, 2015

Field work accomplished in the last 24 hours

- 1. Removed remaining control valve
- 2. Replaced 1 cam shaft lobe
- 3. Seperated low speed coupling
- 4. Disassembled control valves- # 6 stem broke during removal due to the shaft being weakened by the stem lock grub screw
- hole. # 3 valve stem bent during removal for the same reason.
- 5. Measured valve components-will be replacing 5 bushings
- 6. Dye checked valve components for cracks,none found
- 7. Cleaned bolts
- 8. Tapped holes
- 9. Began to bore scope unit, lens was fogging up due to bypass steam
- 10. Drilled broken stem from # 6 cross head
-

Field work to be accomplished in the next 24 hours

- 1. Change valve bushings
- 2. Begin assembly of control valves
- 3. Assemble low speed coupling and grease
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-
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-
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-
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-

DAILY STATUS REPORT

EthosEnergy	PROJECT:	Verso Corporation Duluth	PROJECT NUMBER:	517700
	Call in # for Conf Calls:	Call in # Pass code	DATE:	May 17, 2015

Field work accomplished in the last 24 hours

- 1. attempted to remove valve bushings-will need dry ice tomorrow
- 2. Assembled and installed # 1 & # 4 control valves
- 3. Made up low speed coupling-stlll needs grease
-
-
-

Field work to be accomplished in the next 24 hours

- 1. Change valve bushings
- 2. Continue assembly of control valves
-

DAILY STATUS REPORT

EthosEnergy	PROJECT:	Verso Corporation Duluth	PROJECT NUMBER:	517700
	Call in # for Conf Calls:	Call in # Pass code	DATE:	May 18, 2015

Field work accomplished in the last 24 hours

- 1. Replaced lower bushings on # 2 & # 6 control valves- Tried to remove upper bushings but was not successful without cuttin
- them out. Site decided not to change them on this outage.
- 2. Assembled and installed # 2 & # 5 control valves
- 3. Tightened gear box inspection cover
- 4. Installed bore scope inspection flange
-

Field work to be accomplished in the next 24 hours

- 1. Will demobilize until replacement valve stems arrive
-
-

DAILY STATUS REPORT

EthosEnergy	PROJECT:	Verso Corporation Duluth	PROJECT NUMBER:	517700
	Call in # for Conf Calls:	Call in # Pass code	DATE:	May 28, 2015

Field work accomplished in the last 24 hours

- 1. Measured new valve stems
- 2. Blue contact checked new valves
- 3 .Assembled and installed new valves
- 4. Installed new roller bearings on cam shaft
- 5. Installed cam shaft
- 6. Adjusted valve timing and roller clearances

Field work to be accomplished in the next 24 hours

- 1. Start up support
-
-

DAILY STATUS REPORT

EthosEnergy	PROJECT:	Verso Corporation Duluth	PROJECT NUMBER:	517700
	Call in # for Conf Calls:	Call in # Pass code	DATE:	May 29, 2015

Field work accomplished in the last 24 hours

- 1. Turned on lube oil and had to wait for lube oil temp to reach 95 before start up
- 2. Brought unit up to full speed no load
- 3. Tied into grid and shortly after unit tripped
- 4. Attempted to bring unit back up and unit tripped progressivly faster each attempt on gear box vibration
- 5. Shut down and let cool overnight
-

Field work to be accomplished in the next 24 hours

- 1. Start up support
-
-

DAILY STATUS REPORT

EthosEnergy	PROJECT:	Verso Corporation Duluth	PROJECT NUMBER:	517700
	Call in # for Conf Calls:	Call in # Pass code	DATE:	May 30, 2015

Key Contacts on Project

Field work accomplished in the last 24 hours

- 1. Started up turbine -unit tripped on high vibration at the low speed output shaft bearing
- 2. LOTO unit
- 3. Removed gear box inspection covers and checked lift, float, and baclash
- 4. Removed gear box cover
- 5. Measured new gear box bearings
- 6.Replaced gear box bearings

7. Installed gear box cover
8. Measured lift, float, and backlash
9. Installed inspection covers
10. Set oil seals
11. Started up turbine-after several hours online unit tripped on high vibration on the low speed gear

Field work to be accomplished in the next 24 hours

DAILY STATUS REPORT

EthosEnergy	PROJECT:	Verso Corporation Duluth	PROJECT NUMBER:	517700
	Call in # for Conf Calls:	Call in # Pass code	DATE:	May 31, 2015

Field work accomplished in the last 24 hours

- 1. Seperated low speed coupling and cleaned out grease
- 2. Greased low speed coupling and assembled
- 3. Started up turbine- unit runs good, vibration was due to coupling having too much grease
-
-
-