EthosEnergy

Client name:	VERSO, DULUTH MN
Title:	Unit 1, Minor Inspection
Job Number:	40-J12994
Date:	August 2018

Final Report

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Final Report

SECTION 1 – JOB DETAILS

CUSTOMER REPRESENTATIVES:	***Bill Scott*** ***Mechanical Reliability Engineer*** ***William.scott@versoco.com***
ETHOSENERGY REPRESENTATIVE:	***Dominic Volpe*** **Dominic.*volpe@ethosenergygroup.com*** ***TFA***
JOB #:	***40-J12994***
EQUIPMENT TYPE:	***Turbodyne/Dresser Rand*** **Condensing Turbine** **Single Flow**
JOB TYPE:	***Planned Outage***
JOB START DATE:	***July 23, 2018***
JOB COMPLETION DATE:	***August 2, 2018***
COMPILED BY:	***Dominic Volpe***
APPROVED BY:	**Iain MacLean**

SECTION 2 – MACHINE DETAILS

TURBINE INFORMATION

UNIT TYPE	Condensing Turbine
MODEL & RATING	Turbodyne/Dresser Rand
CUSTOMER DESIGNATION	Unit 1
INSPECTION TYPE	Minor Inspection
TURBINE SERIAL NUMBER	37769
SERVICE YEAR	Originally 1987
CONTROL SYSTEM	Woodward 505
LOAD TYPE	Generator
GEARBOX MODEL	Lufkin N2400C
GEARBOX SERIAL NUMBER	4295
STEAM CONDITIONS INLET PSI	820
INLET TEMPERATURE	720 F
TYPE OF OUTAGE	Planned
DATE UNIT OUT OF SERVICE	7/23/2018
DATE UNIT RETURNED TO SERVICE	8/2/2018

GENERATOR INFORMATION

STATOR	
SERIAL NUMBER	186361011
RATING (in KVA)	10659
VOLTS / AMPS	13800/448
COOLING SYSTEM (Conventional, Single pass, Double Pass, Conductor)	Conventional
COOLING TYPE (Air, Hydrogen)	Air
FIELD	
RPM	1800
POLES	4

SECTION 3 – MECHANICAL NARRATIVE

GENERAL SCOPE

On 7/23/18, EthosEnergy mobilized tooling and craft labor to Verso's Duluth Plant for a Planned Steam Turbine Outage on Unit 1. The unit was shut down, cooled and LOTO was applied and turned over for the outage to begin. EthosEnergy Field Services began work on Monday July 23, 2018 working one (1) ten (10) for the entire outage, the unit was mechanically complete on August 2, 2018. The site was demobilized and tooling was shipped out on Wednesday July 11,2018.

The original scope of work was a steam turbine minor inspection which included bearing inspections on the turbine, generator &gearbox, including disassembly, cleaning, inspection and reassembly of the control valves, removal and replacement of the control valve hydraulic actuator, alignment checks of the turbine to gearbox and gearbox to generator, installation and removal of fine mesh screens in the oil feed lines on the generator, gearbox, front standard, trip throttle valve, turbine bearings and hydraulic operator for flushing oil prior to start up. The turbine was also borescoped and a generator GAP inspection was performed. NDE inspections and borescope were performed by Three Angles Inspection Services, report found in Appendix section. Gap Inspection was performed by Ethos Generator Services, report also found in Appendix section.

The work permits were returned to the station operations department at 12:00 PM on August 1, 2018. Station Operations began clearing tags and preparing the unit to go back into service. On Thursday August 2, 2018, the TTV would not stroke (work was performed by others), the feed and drain lines were removed and an FME plug was found in the supply line, it was missed by the pipefitters. The feed and drain lines were reassembled. Station I & C stroked and verified valve functionally.

The initial unit roll was at 9:36 AM, overspeed testing was performed, unit tripped normally. Second roll was at 9:53 AM, tripped on vibration, Bentley Vibration Probes were adjusted to ensure proper setting and voltage. Third roll was at 10:48 AM, unit reached full speed no load, while attempting to sync unit, it tripped on Generator Reverse Power Relay. Fourth roll was at 11:07 AM, unit reached full speed no load 11:09, Generator breaker closed 11:11 AM successfully.

The unit is located in the Duluth Mill at 100 N. Central Ave, Duluth Mn., it is owned and operated by Verso Corporation.

Final Report

CONTROL VALVES / NON RETURN VALVES

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

Comments:

The control valves were removed from the valve chest, and partially disassembled, it was decided by the customer not to remove the valve stems from the crossheads, because at a previous outage when removal had been attempted, two of the stems snapped off during disassembly. Limited visual inspection indicated that the bolt that pins the stems were inserted too deep, the threaded end that is inserted into the crosshead is only a 5/8" thread and inspection of a damaged stem from the previous outage showed that it had been drilled between 50 and 60 percent thru. The valve seats and discs were NDE inspected. All parts and bolting were cleaned. The control valves discs were contact blue checked. All six valves were at 100 percent contact at reassembly. Three of the leak off line trumpets were broken off. Replacements were fabricated on site by plant pipefitters and installed. The camshaft roller bearings were cleaned and greased prior to start up.

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THRUST BEARING / THRUST RUNNER

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

Comments:

The thrust bearing was disassembled, cleaned, inspected, and an NDE was performed on the active and inactive thrust pads, no defects were indicated, please refer to attached NDE Report. The cage, active and inactive plates, and shims were found slightly coated with an oil like varnish. All parts were cleaned with an industrial cleaning fluid. At reassembly all parts were coated with new turbine oil. A thrust bearing float or bump thrust check was performed prior to disassembly, the resulting bump was .013" within spec for this unit and repeatable 3 times. Spec for this unit is .010" to .015". A thrust bearing float or bump was performed at reassembly, the resulting bump was .013" which was within spec and repeated 3 times. Assistance was given to Bentley-Nevada pushing the rotor to the active and inactive sides for setting of the thrust probes for alarms and trips.

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T1 BEARING

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

Comments:

The T-1 Bearing and its respective journal was disassembled, cleaned, inspected, dimensionally checked and reassembled. T-1 bearing is a double tilt pad type bearing. The customer fabricated a mandrel on site to perform bearing clearance and contact checks. The clearance check showed .005" clearance and the contact check on all four pads was eighty percent or greater. NDE was performed on the bearing pads. All checks were acceptable. The T-1 Bearing and T-1 Journal were in good condition. All parts were cleaned with an industrial cleaning fluid. At reassembly all parts were coated with new turbine oil. Please see attached data sheets and NDE report.

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T2 BEARING

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

Comments:

The T-2 Bearing and its respective journal was disassembled, cleaned, inspected, dimensionally checked and reassembled. T-2 bearing is a double tilt pad type bearing. The customer fabricated a mandrel on site to perform bearing clearance and contact checks. The clearance check showed .006” clearance and the contact check on all four pads was eighty percent or greater. NDE was performed on the bearing pads. All checks were acceptable. The T-2 Bearing and T-2 Journal were in good condition. All parts were cleaned with an industrial cleaning fluid. At reassembly all parts were coated with new turbine oil. Please see attached data sheets and NDE report.

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T3 BEARING

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

Comments:

Generator: Turbine End Bearing

The Turbine End Bearing and its respective journal was disassembled, cleaned, inspected, dimensionally checked and reassembled. At reassembly a twist, tilt and pinch check were performed. An NDE check was performed on the bearing. All checks were acceptable. The Turbine End Bearing and Turbine End Journal were found in good condition. All parts were cleaned with an industrial cleaning fluid. At reassembly all parts were coated with new turbine oil. Please see attached data sheets and NDE Report.

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T4 BEARING

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

Comments:

Generator: Collector End Bearing

The Collector End Bearing and its respective journal was disassembled, cleaned, inspected, dimensionally checked and reassembled. At reassembly a twist, tilt and pinch check were performed. An NDE check was performed on the bearing. All checks were acceptable. The Collector End Bearing and Collector End Journal were found in good condition. All parts were cleaned with an industrial cleaning fluid. At reassembly all parts were coated with new turbine oil. Please see attached data sheets and NDE Report.

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OIL DEFLECTORS AND AIR SEALS

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

Comments:

The oil deflectors were removed from their respective bearings and standards, they were disassembled, cleaned, inspected, dimensionally checked and reassembled. All of the deflectors were found heavily coated with a heavy oily residue. The oil baffles at both ends of the thrust are slightly worn and should be replaced next outage. The front standard and T-2 turbine deflectors were all oversized, egg shaped and sprung, they are aluminium. The T-2 GE deflector was found installed upside down, the oil drain holes were in the top of the pedestal. The front standard and both T-2 oil deflectors should be replaced next outage. A replacement front standard oil deflector was in stock, when it was dimensionally checked the size was incorrect. The generator TE and CE Oil Deflectors Inboard and Outboard were acceptable when dimensionally checked, some of the teeth were worn and were sharpened. The Generator oil deflectors are bronze or brass, a spare set was found but they were only rough machined as full circles no horizontal joints were cut, bolt holes were cut but no dowel holes. All parts were cleaned with an industrial cleaning fluid. Please see attached data sheets.

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EHC / OIL LUBE PUMPS AND LUBRICATION SYSTEM

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

Comments:

Prior to start up fine mesh screens were installed in the oil feed lines on the generator, gearbox, front standard, trip throttle valve, turbine bearings and hydraulic operator for flushing oil. The oil system was placed in service at 7:00 AM on July 31,2018 no leaks were found, oil flushed for 4 hours. The oil pumps were shutdown at 11:00 AM, and all screens were inspected. Small particles of dirt were found, the screens were cleaned and reinstalled, the oil system back in service 12:00 PM 7/31/2018. The oil was allowed to circulate until 10 AM on 8/1/2018. The lube oil system was shutdown and the screens inspected. The screens were found clean, the lube oil system was restored to normal operating condition.

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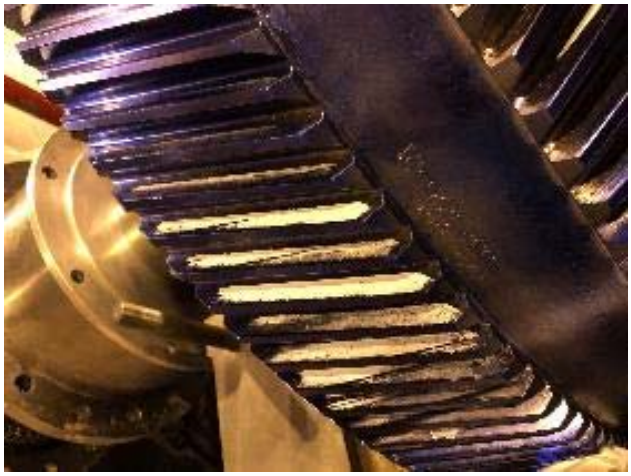
BULL AND TURNING GEAR ASSEMBLY



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

Comments:

This unit has a Lufkin Reduction Gear, the upper half cover was unbolted and removed for bearing inspections. The upper half high and low speed bearing were removed. The pinion and bullgear were removed and the lower half bearings were removed. All of the Bearings and their respective journals were disassembled, cleaned, inspected, dimensionally checked and reassembled. At reassembly twist and tilt checks were performed. An NDE check was performed on the bearings. All checks were acceptable. The bullgear and pinion gear journals were found in good condition. All parts were cleaned with an industrial cleaning fluid. The following additional data was also recorded Gear Thrust .041", Gear End Float .061", Gear Backlash .020". At reassembly all parts were coated with new turbine oil. Please see attached data sheets and NDE Report.

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FRONT STANDARD

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

Comments:

The T-1 journal bearing and thrust bearing were inspected. Please refer to Bearings and Oil Deflector Sections of Report for detailed information.

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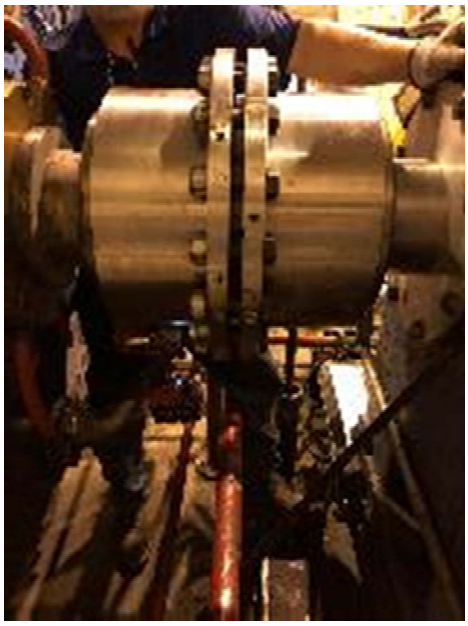
COUPLING & ALIGNMENT



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

Comments:

As left coupling alignment checks were recorded from the turbine to reduction gear and from the reduction gear to generator. No data as left could be located from any previous outages. The face alignment was well within spec per alignment drawings, the rims were just out of spec, a rim correction move would have had impact the face alignment, no corrections were made. The gearbox to generator coupling was greased 13 pounds of grease. The bolting on the turbine to gearbox coupling and the gearbox to generator coupling, were torqued to spec. turbine to gearbox small bolts 46 ft lbs, large bolts 56 ft lbs, gearbox to generator 250 ft lbs. Please see attached data sheets.

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GENERATOR

Disposition:			
Replaced with New Component: ___	Replaced with Refurbished Component: ___	Repaired: ___	No Repair or Replacement: ___
Comments:			
A GAP 1 Inspection was performed. Report can be found in Appendix section.			

SECTION 4 - RECOMMENDATIONS

RECOMMENDATIONS

- The bearing mandrels that the station machine shop fabricated for T-1 and T-2 Bearings should be stored and protected for use in future outages.
- The crane should be loaded tested and certified for continued service.
- Lube Oil EBOP Testing should be performed annually.
- The bull and pinion (low speed and high speed) gears should be NDE inspected next outage.
- The gearbox horizontal joint studs should be replaced next outage as they were hour glassed from over torqueing and stretching.
- A set of bull and pinion gear bearings should be in stock for future outages.
- The thrust oil baffles on the governor end and the generator end should be replaced next outage.
- The T-1 Front Standard Oil Deflector is worn and should be replaced next outage. One was located in the station, when a dimensional check was performed, it was too small, it was the same size as the T-1 journal, it would have to be finish machined.
- The T-2 Bearing Oil Deflectors governor end and generator end should be replaced next outage.
- A spare set of thrust shims active and inactive should be in stock for next outage.
- A spare set of thrust pads active and inactive should be in stock for next outage.
- Spare generator oil deflectors were located in the station however they were unusable as they were whole rings and did not have any horizontal joint splits. They are not doweled and should be. These deflectors could be finish machined after a dimensional check of the deflector journals.
- A sufficient supply of O-rings should be on hand for use on the control valve hydraulic operator.
- A full parts inventory should be performed to see what is in stock and what would be required for the next outage. This should be performed when starting to plan for the next scheduled outage.
- Prior to a major turbine inspection an inventory of all specialty tools and devices should be accomplished.

- There should be a separate field office and a break trailer for the crew, we utilized the control room but it interferes with regular operations and maintenance personnel.

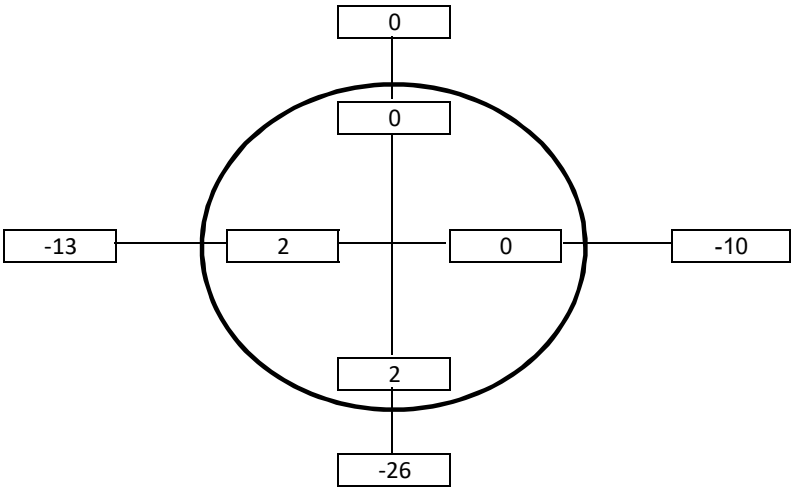
- All the coupling bolts on the High Speed Coupling (Ameridrive Flex Coupling), should be replaced as a full set, they are worn and stretched from torqueing and retorquing.
- The Ameridrive Flex Coupling should be inspected and refurbished by a qualified vendor.
- Preventative Maintenance should continue on the lube oil system, perform sampling and analysis to ensure continued good oil quality.
- A complete set of control valve stems and discs should be ordered prior to the next outage.
- A set of camshaft roller bearings should be ordered prior to next outage.
- A set of consumable hardware should be ordered prior to next outage i.e. Bolts that pin stem to cross head, pins to install discs to stem and any other associated hardware. Please reference valve assembly drawings.

SECTION 5 – APPENDIX

APPENDIX A - DATA SHEETS

EthosEnergy	ETHOS ENERGY - PPS	EE3690
	INSPECTION SHEET	
	ALIGNMENT COUPLINGS	

Turbine S/N:	37769	Prepared by:	J.Townes
Customer:	VERSO Duluth	Date:	July 31, 2018
EE Job No.:	40-J12994	Data Type:	Reassembly
		Coupling Designation:	B



Record RIM readings in mils.
Record FACE readings in inches.

Position	Top	Left	Bottom	Right
Rim (mils)	0	-13	-26	-10
Face 0º	0.812	0.814	0.813	0.811
Face 90º	0.807	0.810	0.811	0.807
Face 180º	0.806	0.808	0.810	0.808
Face 270º	0.797	0.797	0.798	0.797
Average	0.806	0.807	0.808	0.806
Relative	0	2	2	0

Check	Face	Rim
Top + Bottom =	2	-26
Right + Left =	2	-23
Difference =	0	-3

Sweep Diameter (Inches)
.

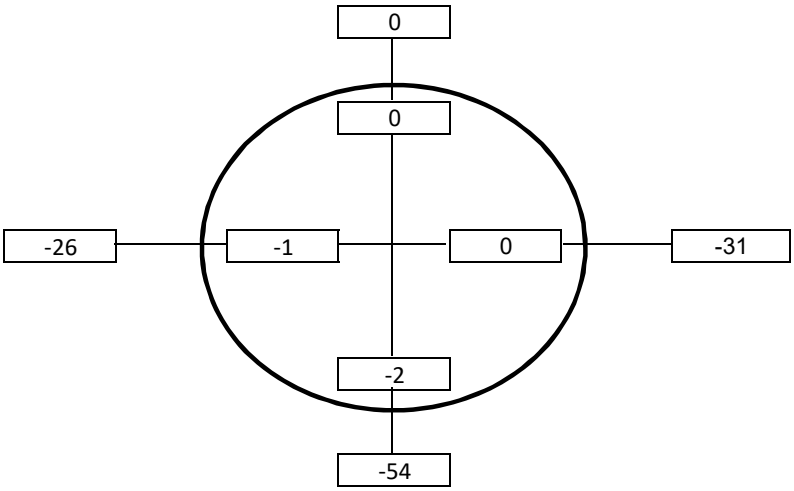
Indicator Mounting Location
Gearbox Riding Generator

COMMENTS
Reassembly Gearbox to Generator Alignement check taken twice very repeatable results.

EthosEnergy	ETHOS ENERGY - PPS	EE3691
	INSPECTION SHEET	
	ALIGNMENT COUPLINGS	

Turbine S/N:	37769	Prepared by:	J. Townes
Customer:	VERSO Duluth	Date:	July 31, 2018
EE Job No.:	40-J12994	Data Type:	Reassembly

Coupling Designation: A



Record RIM readings in mils.
Record FACE readings in inches.

Position	Top	Left	Bottom	Right
Rim (mils)	0	-26	-54	-31
Face 0º	0.543	0.542	0.541	0.543
Face 90º	0.544	0.543	0.543	0.544
Face 180º	0.544	0.543	0.542	0.544
Face 270º	0.546	0.545	0.544	0.545
Average	0.544	0.543	0.543	0.544
Relative	0	-1	-2	0

Check	Face	Rim
Top + Bottom =	-2	-54
Right + Left =	-1	-57
Difference =	0	3

Sweep Diameter (Inches)

Indicator Mounting Location
Gearbox Riding on Turbine

COMMENTS
Reassembly Turbine to Gear Box Alignement check taken twice very repeatable results. THE ALIGNMENT CHECKS WERE RECORDED WITH OIL ON TEMPERATURE 118 DEGREES F VIA BEARING RTD'S.

EthosEnergy	ETHOS ENERGY - PPS	EE4820
	INSPECTION SHEET	
	JOURNAL BEARINGS	

Turbine S/N:	37769	Prepared by:	J. Townes
Customer:	VERSO Duluth	Date:	July 26, 2018
EE Job No.:	40-J12994	Data Type:	Disassembly

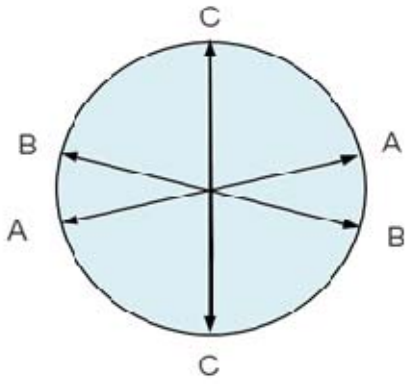
Ball Seat Pinch Fits

Bearing Number	Pinch* Mils	Bearing Number	Pinch* Mils

*Pinch equals wire thickness minus shim

Shim _____

Leadwire _____



Bearing Number	Bearing Type	Forward or Turbine End			AFT or Generator End			Journal Diam.	Vertical Clearance	
		A-Diam	B-Diam	C-Diam	A-Diam	B-Diam	C-Diam		Mils	Mils/In
T-1	DT							4.001		
T-2	DT							5.001		
GearBox										
TE HS	CYL	6.249	6.250	6.250	6.249	6.249	6.249	6.239	10	1.7
TE LS	CYL	8.249	8.249	8.249	8.249	8.249	8.249	8.239	10	1.2
GE HS	CYL	6.249	6.249	6.249	6.249	6.249	6.249	6.239	10	1.6
GE LS	CYL	8.249	8.249	8.250	8.249	8.249	8.249	8.240	10	1.2
Gen TE	Elipt	10.021	10.018	10.012	10.020	10.019	10.013	9.999	13	1.4
Gen CE	Elipt	10.022	10.021	10.014	10.023	10.020	10.013	9.999	15	1.5

COMMENTS:

The turbine bearings T-1 and T-2 were checked to bearing mandrels, revealing .005" bearing clearance on T-1, and .006" clearance on T-2. Contact checks were also performed 80% contact was observed on all pads.

EthosEnergy	ETHOS ENERGY - PPS	EE4820
	INSPECTION SHEET	
	JOURNAL BEARINGS	

Turbine S/N:	37769	Prepared by:	J. Townes
Customer:	VERSO Duluth	Date:	July 27, 2018
EE Job No.:	40-J12994	Data Type:	Reassembly

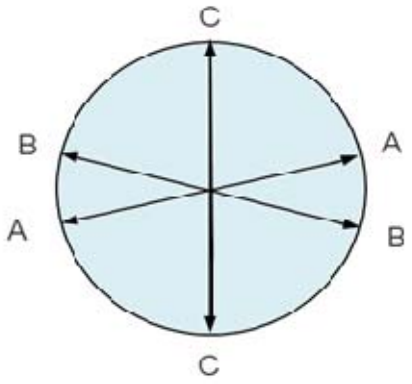
Ball Seat Pinch Fits

Bearing Number	Pinch* Mils	Bearing Number	Pinch* Mils
T-1	N/A		
T-2	1		
Gen TE	1		
Gen CE	2		

*Pinch equals wire thickness minus shim

Shim 10

Leadwire



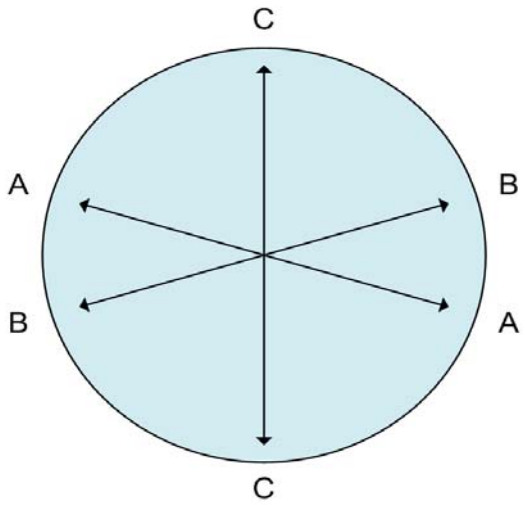
Bearing Number	Bearing Type	Forward or Turbine End			AFT or Generator End			Journal Diam.	Vertical Clearance	
		A-Diam	B-Diam	C-Diam	A-Diam	B-Diam	C-Diam		Mils	Mils/In
T-1	DT							4.001		
T-2	DT							5.001		
GearBox										
TE HS	CYL	6.249	6.250	6.250	6.249	6.249	6.249	6.239	10	1.7
TE LS	CYL	8.249	8.249	8.249	8.249	8.249	8.249	8.239	10	1.2
GE HS	CYL	6.249	6.249	6.249	6.249	6.249	6.249	6.239	10	1.6
GE LS	CYL	8.249	8.249	8.250	8.249	8.249	8.249	8.240	10	1.2
Gen TE	Elipt	10.021	10.018	10.012	10.020	10.019	10.013	9.999	13	1.4
Gen CE	Elipt	10.022	10.021	10.014	10.023	10.020	10.013	9.999	15	1.5

COMMENTS:

The turbine bearings T-1 and T-2 were checked to bearing mandrels, revealing .005" bearing clearance on T-1, and .006" clearance on T-2. Contact checks were also performed 80% contact was observed on all pads

EthosEnergy	ETHOS ENERGY - PPS	EE5140
	INSPECTION SHEET	
	OIL DEFLECTORS & SEALS ID DIMENSIONS	
Applicable to: GT 3002, 5001, 5002, 7001, 7001F, 9001, 9001F, D11, Small Steam		

Turbine S/N:	37769	Prepared by:	J. Townes
Customer:	VERSO Duluth	Date:	July 25, 2018
EE Job No.:	40-J12994	Data Type:	Disasssembly

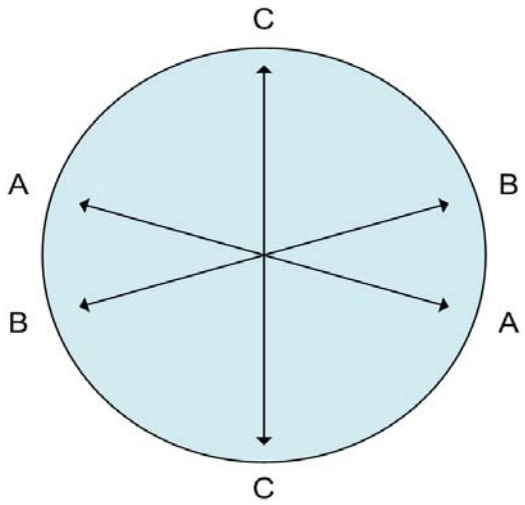


Location	Oil Deflector			Journal	Average	Clearance		Condition
Number	A-Dia	B-Dia	C-Dia	Diameter		Min.	Max.	
Front Std	5.304"	5.307"	5.316"	5.249"	.060"	.055"	.067"	Excessive Clearance
T-2 TE	5.047"	5.077"	5.083"	4.999"	.070"	.048"	.084"	Excessive Clearance
T-2 GE	5.067"	5.068"	5.070"	4.999"	.069"	.068"	.071"	Excessive Clearance
TE OUTBD	11.011"	11.012"	11.015"	10.999"	.014"	.012"	.016"	Okay
TE INBD	11.027"	10.993"	11.034"	10.999"	.019"	-.006"	.035"	Okay
CE INBD	11.024"	10.995"	11.025"	10.999"	.016"	-.004"	.026"	Okay
CE OUTBD	10.992"	11.019"	11.006"	10.999"	.007"	-.007"	.020"	Okay

COMMENTS

EthosEnergy	ETHOS ENERGY - PPS	EE5140
	INSPECTION SHEET	
	OIL DEFLECTORS & SEALS ID DIMENSIONS	
Applicable to: GT 3002, 5001, 5002, 7001, 7001F, 9001, 9001F, D11, Small Steam		

Turbine S/N:	37769	Prepared by:	J. Townes
Customer:	VERSO Duluth	Date:	July 27, 2018
EE Job No.:	40-J12994	Data Type:	Reassembly



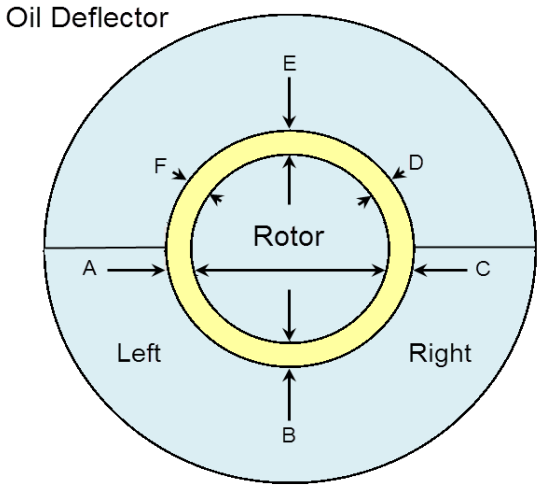
Location	Oil Deflector			Journal	Average	Clearance		Condition
Number	A-Dia	B-Dia	C-Dia	Diameter		Min.	Max.	
Front Std	5.304"	5.307"	5.316"	5.249"	.060"	.055"	.067"	Reused As Is, Replace
T-2 TE	5.047"	5.077"	5.083"	4.999"	.070"	.048"	.084"	Reused As Is, Replace
T-2 GE	5.067"	5.068"	5.070"	4.999"	.069"	.068"	.071"	Reused As Is, Replace
TE OUTBD	11.011"	11.012"	11.015"	10.999"	.014"	.012"	.016"	Reused As is
TE INBD	11.027"	10.993"	11.034"	10.999"	.019"	-.006"	.035"	Reused As is
CE INBD	11.024"	10.995"	11.025"	10.999"	.016"	-.004"	.026"	Reused As is
CE OUTBD	10.992"	11.019"	11.006"	10.999"	.007"	-.007"	.020"	Reused As is

COMMENTS

EthosEnergy	ETHOS ENERGY - PPS	EE5150
	INSPECTION SHEET	
	OIL DEFLECTOR - ALIGNMENT	

Turbine S/N:	37769	Prepared by:	J. Townes
Customer:	VERSO Duluth	Date:	7/29/2018
EE Job No.:	40-J12994	Data Type:	Reassembly

Deflector Location	Position (Mils)						Clearance			Ideal Position		
	A	B	C	D	E	F	Min	Median	Max	Bottom	Sides	Top
Thrust Baffle TE	11	5	10	18	24	22	5 mils	15 mils	24 mils	10 mils	15 mils	19 mils
Thrust Baffle GE	10	12	8	5	12	9	5 mils	10 mils	12 mils	8 mils	8 mils	16 mils
Front Standard	14	12	14	5	2	5	2 mils	9 mils	14 mils	5 mils	10 mils	9 mils
T-2 TE	15	10	5	10	12	15	5 mils	11 mils	15 mils	7 mils	11 mils	15 mils
T-2 GE	34	35	40	3	10	22	3 mils	28 mils	40 mils	15 mils	25 mils	30 mils
Gearbox												
High Speed TE	7	3	5	5	11	7	3 mils	6 mils	11 mils	5 mils	6 mils	9 mils
Low Speed GE	7	3	7	5	6	6	3 mils	6 mils	7 mils	3 mils	6 mils	6 mils
Generator												
TE Outboard	5	8	5	6	6	8	5 mils	6 mils	8 mils	5 mils	6 mils	9 mils
TE Inboard	4	10	3	10	16	5	3 mils	8 mils	16 mils	9 mils	6 mils	17 mils
GE Inboard	4	8	5	2	8	3	2 mils	5 mils	8 mils	5 mils	4 mils	11 mils
GE Outboard	5	7	2	3	6	4	2 mils	5 mils	7 mils	4 mils	4 mils	9 mils



COMMENTS
Oil Deflector Clearances AT RESSEMBLY, Turbine Deflectors all have excessive clearance, all were reused at reassembly.

EthosEnergy	ETHOS ENERGY - PPS	EE4830
	INSPECTION SHEET	
	BEARING TO JOURNAL ALIGNMENT - FOR BEARING WITH BALL SEATS	

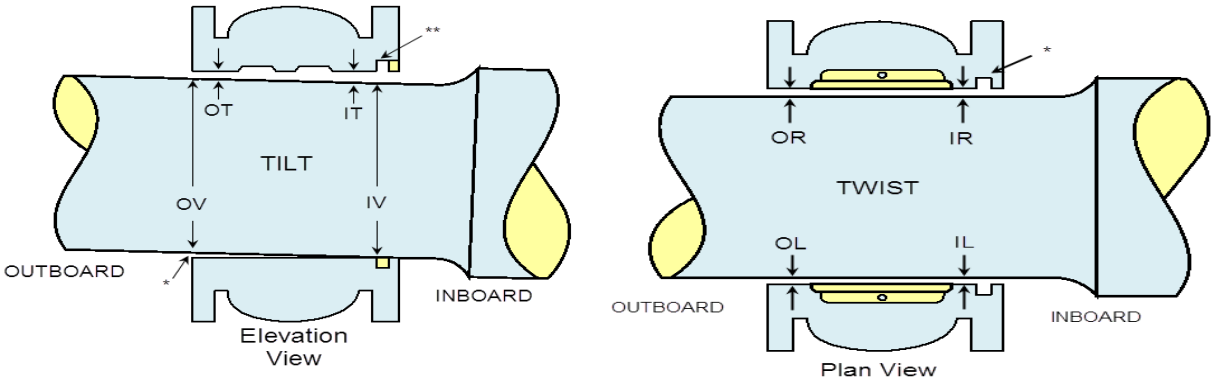
Turbine S/N:	37769	Prepared by:	J. Townes
Customer:	VERSO Duluth	Date:	7/29/2018
EE Job No.:	40-J12994	Data Type:	Reassembly

TILT

BRG #	Section	Reading in Mils		Reading in Inches		Limits 0.0 To	Actual (Mils)	Tolerance Check
		IT	OT	IV	OV			
TE	Generator	16.0 Mils	15.0 Mils	10.013	10.012	1.0 Mils	0.0 Mils	0.000
CE	Generator	17.0 Mils	16.0 Mils	10.014	10.013	1.0 Mils	0.0 Mils	0.000

TWIST

BRG #	Section	Readings in Mils				Limits	Actual	Tolerance Check
		IR	OR	IL	OL			
TE	Generator	12.0 Mils	12.0 Mils	13.0 Mils	13.0 Mils	± 3.0	0.0 Mils	PASS
CE	Generator	15.0 Mils	15.0 Mils	15.0 Mils	15.0 Mils		0.0 Mils	



* On most generator bearings, the end leakage groove is on the outboard end

* On hood bearings, the outboard end is set low to compensate for vacuum deflection

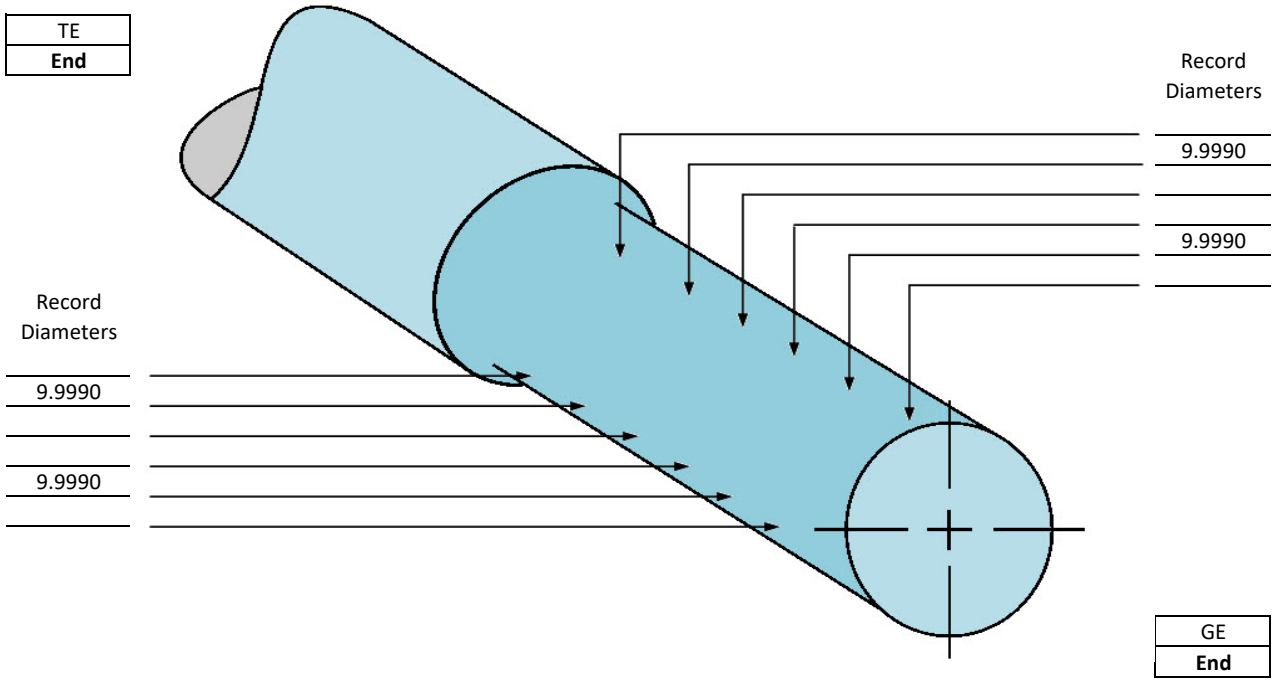
COMMENTS
As Reassembly

EthosEnergy	ETHOSENERGY PPS	EE3530
	INSPECTION SHEET	
	ROTOR JOURNAL CONDITION	

Turbine S/N:	37769	Prepared by:	John Townes
Customer:	Verso Duluth	Date:	July 27, 2018
EE Job No.:	40-J12994	Data Type:	Reassembly

Journal Number GEN CE

1. Record diameters as indicated next to diagram.
2. Mark on sketch to show grooving, discoloration, carbon inclusions, or irregularities in the journal surface.



JOURNAL SIZES

	0º	90º	All
Maximum		9.9990	
Minimum	9.9990	9.9990	9.9990
Difference	-9.9990	0.0000	-9.9990
Average	9.9990	9.9990	9.9990

OUT OF ROUNDNESS

Diameters		Out of
0º	90º	Round
9.999	9.999	0.000
9.999	9.999	0.000

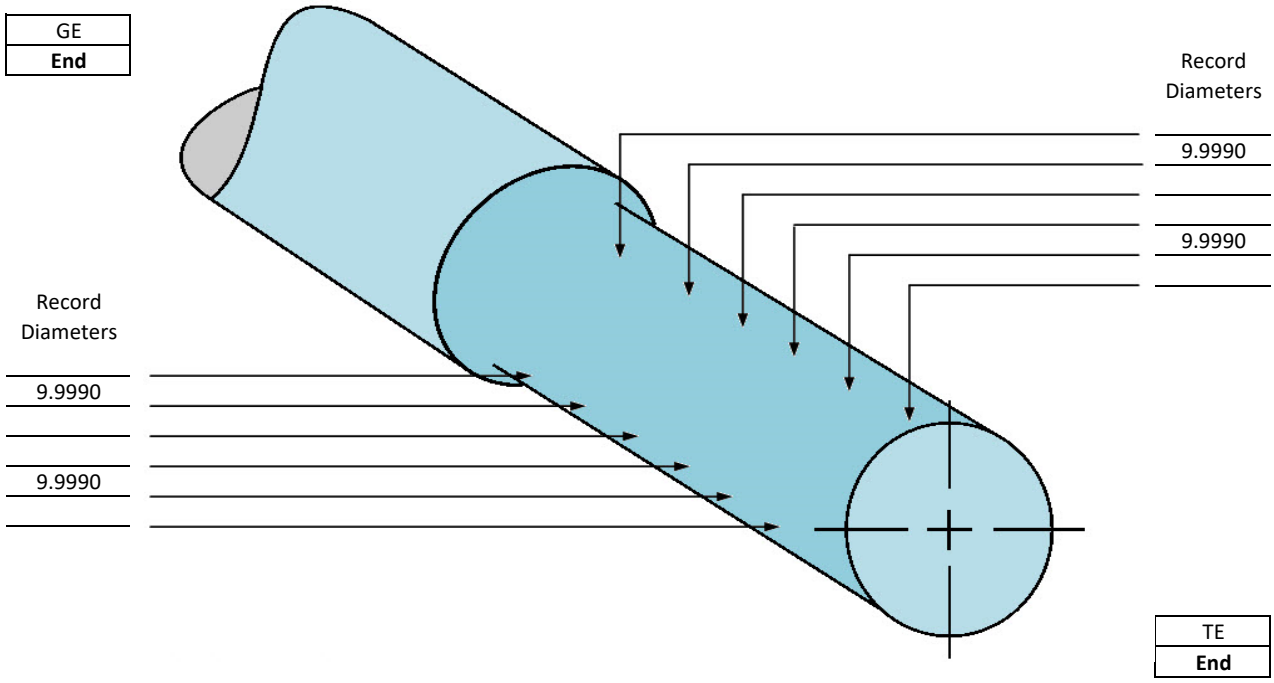
COMMENTS
The Generator Collector End Rotor Journal is in good condition, the journal was cleaned and strap lapped at reassembly.

EthosEnergy	ETHOSENERGY PPS	EE3530
	INSPECTION SHEET	
	ROTOR JOURNAL CONDITION	

Turbine S/N:	37769	Prepared by:	John Townes
Customer:	Verso Duluth	Date:	July 27, 2018
EE Job No.:	40-J12994	Data Type:	Reassembly

Journal Number GEN TE

1. Record diameters as indicated next to diagram.
2. Mark on sketch to show grooving, discoloration, carbon inclusions, or irregularities in the journal surface.



JOURNAL SIZES

	0º	90º	All
Maximum		9.9990	
Minimum	9.9990	9.9990	9.9990
Difference	-9.9990	0.0000	-9.9990
Average	9.9990	9.9990	9.9990

OUT OF ROUNDNESS

Diameters		Out of
0º	90º	Round
9.999	9.999	0.000
9.999	9.999	0.000

COMMENTS
The Generator Turbine End Rotor Journal is in good condition, the journal was cleaned and strap lapped at reassembly.

EthosEnergy	ETHOSENERGY PPS	EE3530
	INSPECTION SHEET	
	ROTOR JOURNAL CONDITION	

Turbine S/N:	37769	Prepared by:	John Townes
Customer:	Verso Duluth	Date:	July 27, 2018
EE Job No.:	40-J12994	Data Type:	Reassembly

Journal Number HP 1

1. Record diameters as indicated next to diagram.
2. Mark on sketch to show grooving, discoloration, carbon inclusions, or irregularities in the journal surface.

GE

Record Diameters

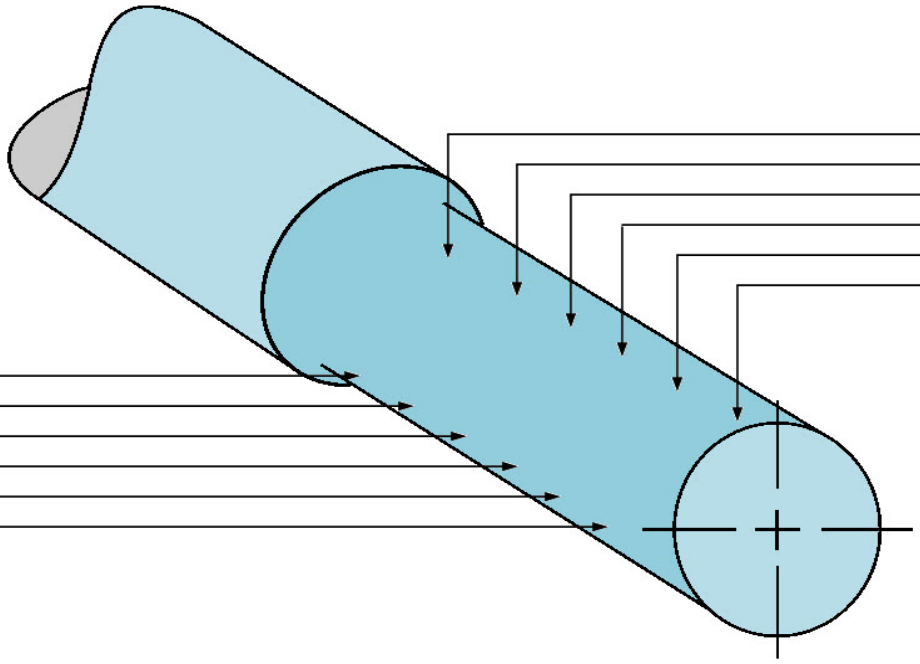
4.0010

4.0010

Record Diameters

4.0010

4.0010



TE

JOURNAL SIZES

	0º	90º	All
Maximum		4.0010	
Minimum	4.0010	4.0010	4.0010
Difference	-4.0010	0.0000	-4.0010
Average	4.0010	4.0010	4.0010

OUT OF ROUNDNESS

Diameters		Out of
0º	90º	Round
4.001	4.001	0.000
4.001	4.001	0.000

COMMENTS

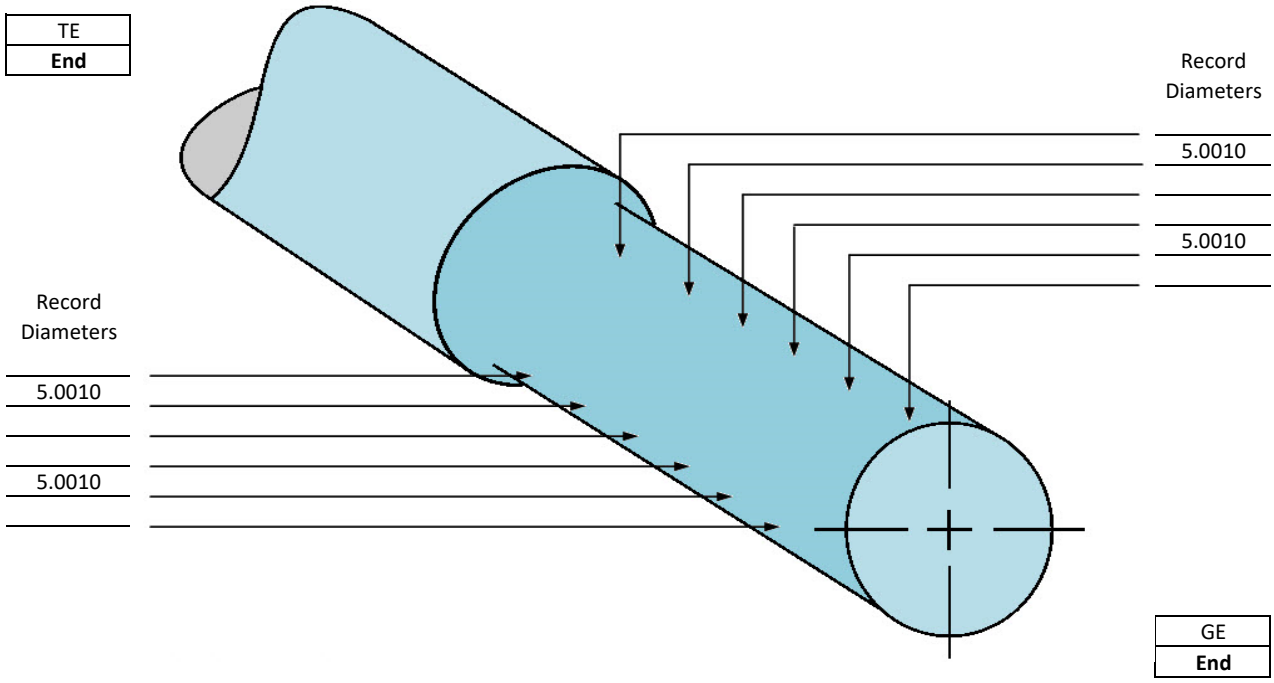
HP-1 Rotor Journal is in good condition, the journal was cleaned and strap lapped at reassembly.

EthosEnergy	ETHOSENERGY PPS	EE3530
	INSPECTION SHEET	
	ROTOR JOURNAL CONDITION	

Turbine S/N:	37769	Prepared by:	John Townes
Customer:	Verso Duluth	Date:	July 27, 2018
EE Job No.:	40-J12994	Data Type:	Reassembly

Journal Number LP 2

1. Record diameters as indicated next to diagram.
2. Mark on sketch to show grooving, discoloration, carbon inclusions, or irregularities in the journal surface.



JOURNAL SIZES

	0º	90º	All
Maximum		5.0010	
Minimum	5.0010	5.0010	5.0010
Difference	-5.0010	0.0000	-5.0010
Average	5.0010	5.0010	5.0010

OUT OF ROUNDNESS

Diameters		Out of
0º	90º	Round
5.001	5.001	0.000
5.001	5.001	0.000

COMMENTS

LP-2 Rotor Journal is in good condition, the journal was cleaned and strap lapped at reassembly.

APPENDIX B – NDT REPORTS

3angles Inc.
2 Access Road
Albany, NY 12205
P: (518) 640-3000
F: (518) 218-0490

EthosEnergy Field Services, LLC

3444 E. Pasadena Frwy
Pasadena, TX 77503

VERSO Duluth

100 N. Central Ave

Duluth, MN 55807
Attention: Dominic Volpe

3ANGLES Job Number: CF-5321
Purchase Order Number: 40-PO15231
Nondestructive Testing Report
8MW Dresser-Rand Steam Turbine

Mr. Dominic Volpe

At the request of EthosEnergy Field Services, LLC, 3angles, Inc. has conducted nondestructive examinations and inspections in accordance with qualified procedures and industry standards. This document presents the findings of the tests and inspections and it provides supporting information regarding how testing was conducted for each respective part or component item defined within the scope of work. NDT was performed between 07/25/18 and 07/26/18.

Findings reported in the enclosed document are provided for informational purposes only. Any determinations, actions, recommendations or dispositions should be made by engineering representation or consultants deemed qualified to use the data and test results provided for such purposes.

We at 3angles extend our appreciation for being given the opportunity to support the outage requirements and to perform the work as defined and reported within the enclosed submittal. If you have any questions in regards to this document or if you wish to discuss any aspect of this job or future jobs, please do not hesitate to contact our offices.

Sincerely,

Stewart Wardlaw

Level II NDT Examiner
3angles, Inc.
(518) 640-3000

3angles Inc.
2 Access Road
Albany, NY 12205
P: (518) 640-3000
F: (518) 218-0490

VERSO

VERSO Duluth

Duluth, MN 55807

3ANGLES JOB NUMBER CF-5321

NDT REPORT OF ***8MW Dresser-Rand Steam Turbine***
DATES OF EXAMINATIONS: ***07/25/18 - 07/26/18***

Job Number-File Reference: CF-5321 *Date:* 7/26/2018

3angles Inc.
2 Access Road
Albany, NY 12205
P: (518) 640-3000
F: (518) 218-0490

REPORT TABLE OF CONTENTS

3angles Inc.
2 Access Road
Albany, NY 12205
P: (518) 640-3000
F: (518) 218-0490

Project: CF-5321
Site: Verso Duluth, 100 N. Central Ave, Duluth, MN
Date: 7/25/2018 Page 4 of 16

LIQUID PENETRANT INSPECTION

CUSTOMER:	EthosEnergy Field Services, LLC		
PO #:	40-PO15231	SURFACE CONDITION:	In Service / Cleaned
PROCEDURE/SPEC:	KT-NDE-3000, Rev. 8.1	ACCEPTANCE STD:	Report all indications
MATERIAL DESCRIPTION:	Dresser-Rand Steam Turbine Control Valves		

MATERIALS / EQUIPMENT

CLEANER/REMOVER MFG / BATCH:	Magnaflux SKC-S / 18C20K		
PENETRANT MFG / BATCH:	Magnaflux SKL-SP2 / 18C02K		
DEVELOPER MFG / BATCH:	Magnaflux SKD-S2 / 18B06K		
OTHER MATERIALS:	n/a		
BLACKLIGHT METER:	n/a		
BLACKLIGHT:	n/a	READING:	n/a µW/cm2
BLACKLIGHT:	n/a	READING:	n/a µW/cm2
WHITELIGHT METER:	Spectroline AccuMAX XRP-3000 S/N: 1915223/4	Cal Due: 01/05/19	
WHITELIGHT:	Flashlight: Energizer	READING:	258 fc.
WHITELIGHT:	n/a	READING:	fc.

PROCESS: [X] Color Contrast [ ] Fluorescent [X] Solvent Removable [ ] Water Washable

INSPECTION RESULTS

Liquid Penetrant Inspection of Control Valve yielded the following results:

Valve Discs (6) : No reportable indications.

Valve Seats (6) : No reportable indications.

Valve Seat Seal Welds (6) : No reportable indications.

NDT Technician: Stewart Wardlaw - MT/PT/VT II UT I n/a

n/a n/a

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Project: CF-5321
Site: Verso Duluth, 100 N. Central Ave, Duluth, MN
Date: 7/25/2018 Page 5 of 16

LIQUID PENETRANT INSPECTION

CUSTOMER:	EthosEnergy Field Services, LLC		
PO #:	40-PO15231	SURFACE CONDITION:	In Service / Cleaned
PROCEDURE/SPEC:	KT-NDE-3002, Rev. 3	ACCEPTANCE STD:	Report all indications
MATERIAL DESCRIPTION:	Dresser-Rand Steam Turbine Bearings		

MATERIALS / EQUIPMENT

CLEANER/REMOVER MFG / BATCH:	Magnaflux SKC-S / 18C20K		
PENETRANT MFG / BATCH:	Magnaflux SKL-SP2 / 18C02K		
DEVELOPER MFG / BATCH:	Magnaflux SKD-S2 / 18B06K		
OTHER MATERIALS:	n/a		
BLACKLIGHT METER:	n/a		
BLACKLIGHT:	n/a	READING:	n/a µW/cm2
BLACKLIGHT:	n/a	READING:	n/a µW/cm2
WHITELIGHT METER:	Spectroline AccuMAX XRP-3000 S/N: 1915223/4	Cal Due: 01/05/19	
WHITELIGHT:	Flashlight: Energizer	READING:	258 fc.
WHITELIGHT:	n/a	READING:	fc.

PROCESS: [X] Color Contrast [ ] Fluorescent [X] Solvent Removable [ ] Water Washable

INSPECTION RESULTS

Liquid Penetrant Inspection of Steam Turbine Bearings yielded the following results:

T1 - Upper - No reportable indications.

T1 - Lower - No reportable indications.

T2 - Upper - No reportable indications.

T2 - Lower - No reportable indications.

NDT Technician: Stewart Wardlaw - MT/PT/VT II UT I | n/a

n/a | n/a

3angles Inc.
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F: (518) 218-0490

ULTRASONIC INSPECTION

CUSTOMER:	EthosEnergy Field Services, LLC		
PO #:	40-PO15231	SURFACE CONDITION:	In Service / Cleaned
PROCEDURE/SPEC:	QCI-1004, Rev. 1.1	ACCEPTANCE STD:	Report all indications
MATERIAL DESCRIPTION:	Dresser-Rand Steam Turbine Bearings		

MATERIALS / EQUIPMENT

UT SCOPE:	COUPLANT
MFG: USM GO S/N: 9080158 CAL DUE: 09/08/18	SAE 30
TRANSDUCER: LONGITUDNAL	
MFG: GEIT Benchmark .750"x.750" Bearing Frequency: 2.25MHz. S/N: 00XKBB	DELAY: 25.42
TRANSDUCER: SHEAR WEDGE:	
MFG: n/a	DELAY:
CAL BLOCK: Bearing: E-UT-261	LINEARITY PERFORMED: OK

INSPECTION RESULTS

Ultrasonic Inspection of Steam Turbine Bearings yielded the following results:

T1 - Upper - No reportable indications.

T1 - Lower - No reportable indications.

T2 - Upper - No reportable indications.

T2 - Lower - No reportable indications.

NDT Technician: Stewart Wardlaw - MT/PT/VT II UT I n/a

n/a n/a

3angles Inc.
2 Access Road
Albany, NY 12205
P: (518) 640-3000
F: (518) 218-0490

LIQUID PENETRANT INSPECTION

CUSTOMER:	EthosEnergy Field Services, LLC		
PO #:	40-PO15231	SURFACE CONDITION:	In Service / Cleaned
PROCEDURE/SPEC:	KT-NDE-3002, Rev. 3	ACCEPTANCE STD:	Report all indications
MATERIAL DESCRIPTION:	Dresser-Rand Generator Rotor Bearings		

MATERIALS / EQUIPMENT

CLEANER/REMOVER MFG / BATCH:	Magnaflux SKC-S / 18C20K		
PENETRANT MFG / BATCH:	Magnaflux SKL-SP2 / 18C02K		
DEVELOPER MFG / BATCH:	Magnaflux SKD-S2 / 18B06K		
OTHER MATERIALS:	n/a		
BLACKLIGHT METER:	n/a		
BLACKLIGHT:	n/a	READING:	n/a µW/cm2
BLACKLIGHT:	n/a	READING:	n/a µW/cm2
WHITELIGHT METER:	Spectroline AccuMAX XRP-3000 S/N: 1915223/4	Cal Due: 01/05/19	
WHITELIGHT:	Flashlight: Energizer	READING:	258 fc.
WHITELIGHT:	n/a	READING:	fc.

PROCESS: [X] Color Contrast [ ] Fluorescent [X] Solvent Removable [ ] Water Washable

INSPECTION RESULTS

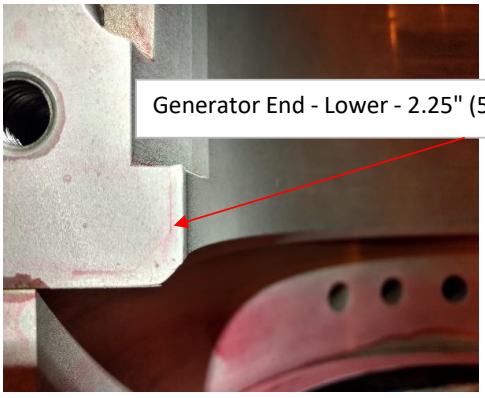
Liquid Penetrant Inspection of Generator Rotor Bearings yielded the following results:

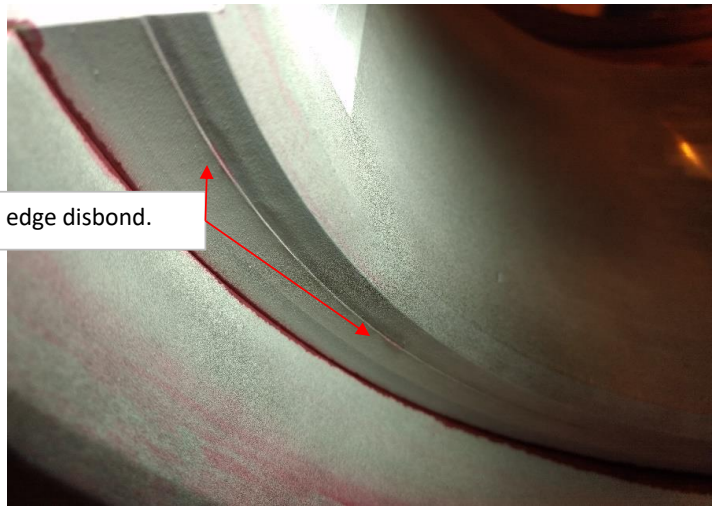
Turbine End - Upper - No reportable indications.

Turbine End - Lower - No reportable indications.

Generator End - Upper - No reportable indications.

Generator End - Lower - 2.25" (5%) babbit edge disbond.





NDT Technician: Stewart Wardlaw - MT/PT/VT II UT I n/a

n/a n/a

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F: (518) 218-0490

ULTRASONIC INSPECTION

CUSTOMER:	EthosEnergy Field Services, LLC		
PO #:	40-PO15231	SURFACE CONDITION:	In Service / Cleaned
PROCEDURE/SPEC:	QCI-1004, Rev. 1.1	ACCEPTANCE STD:	Report all indications
MATERIAL DESCRIPTION:	Dresser-Rand Generator Rotor Bearings		

MATERIALS / EQUIPMENT

UT SCOPE:	COUPLANT
MFG: USM GO S/N: 9080158 CAL DUE: 09/08/18	SAE 30
TRANSDUCER: LONGITUDNAL	
MFG: GEIT Benchmark .750"x.750" Bearing Frequency: 2.25MHz. S/N: 00XKBB	DELAY: 25.42
TRANSDUCER: SHEAR WEDGE:	
MFG: n/a	DELAY:
CAL BLOCK: Bearing: E-UT-261	LINEARITY PERFORMED: OK

INSPECTION RESULTS

Ultrasonic Inspection of Generator Rotor Bearings yielded the following results:

Turbine End - Upper - No reportable indications.

Turbine End - Lower - No reportable indications.

Generator End - Upper - No reportable indications.

Generator End - Lower - No reportable indications.

NDT Technician: Stewart Wardlaw - MT/PT/VT II UT I | n/a

n/a | n/a

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Project: CF-5321
Site: Verso Duluth, 100 N. Central Ave, Duluth, MN
Date: 7/25/2018 Page 9 of 16

LIQUID PENETRANT INSPECTION

CUSTOMER:	EthosEnergy Field Services, LLC		
PO #:	40-PO15231	SURFACE CONDITION:	In Service / Cleaned
PROCEDURE/SPEC:	KT-NDE-3002, Rev. 3	ACCEPTANCE STD:	Report all indications
MATERIAL DESCRIPTION:	Dresser-Rand Gear Bearings		

MATERIALS / EQUIPMENT

CLEANER/REMOVER MFG / BATCH:	Magnaflux SKC-S / 18C20K		
PENETRANT MFG / BATCH:	Magnaflux SKL-SP2 / 18C02K		
DEVELOPER MFG / BATCH:	Magnaflux SKD-S2 / 18B06K		
OTHER MATERIALS:	n/a		
BLACKLIGHT METER:	n/a		
BLACKLIGHT:	n/a	READING:	n/a µW/cm2
BLACKLIGHT:	n/a	READING:	n/a µW/cm2
WHITELIGHT METER:	Spectroline AccuMAX XRP-3000 S/N: 1915223/4	Cal Due: 01/05/19	
WHITELIGHT:	Flashlight: Energizer	READING:	258 fc.
WHITELIGHT:	n/a	READING:	fc.

PROCESS: [X] Color Contrast [ ] Fluorescent [X] Solvent Removable [ ] Water Washable

INSPECTION RESULTS

Liquid Penetrant Inspection of Gear Bearings yielded the following results:

High Speed Turbine End - Upper - No reportable indications.

High Speed Turbine End - Lower - No reportable indications.

Low Speed Turbine End - Upper - No reportable indications.

Low Speed Turbine End - Lower - No reportable indications.

High Speed Generator End - Upper - No reportable indications.

High Speed Generator End - Lower - No reportable indications.

Low Speed Generator End - Upper - No reportable indications.

Low Speed Generator End - Lower - No reportable indications.

NDT Technician: Stewart Wardlaw - MT/PT/VT II UT I | n/a

n/a | n/a

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ULTRASONIC INSPECTION

CUSTOMER:	EthosEnergy Field Services, LLC		
PO #:	40-PO15231	SURFACE CONDITION:	In Service / Cleaned
PROCEDURE/SPEC:	QCI-1004, Rev. 1.1	ACCEPTANCE STD:	Report all indications
MATERIAL DESCRIPTION:	Dresser-Rand Gear Bearings		

MATERIALS / EQUIPMENT

UT SCOPE:	COUPLANT
MFG: USM GO S/N: 9080158 CAL DUE: 09/08/18	SAE 30
TRANSDUCER: LONGITUDNAL	
MFG: GEIT Benchmark .750"x.750" Bearing Frequency: 2.25MHz. S/N: 00XKBB	DELAY: 25.42
TRANSDUCER: SHEAR WEDGE:	
MFG: n/a	DELAY:
CAL BLOCK: Bearing: E-UT-261	LINEARITY PERFORMED: OK

INSPECTION RESULTS

Ultrasonic Inspection of Gear Bearings yielded the following results:

High Speed Turbine End - Upper - No reportable indications.

High Speed Turbine End - Lower - No reportable indications.

Low Speed Turbine End - Upper - No reportable indications.

Low Speed Turbine End - Lower - No reportable indications.

High Speed Generator End - Upper - No reportable indications.

High Speed Generator End - Lower - No reportable indications.

Low Speed Generator End - Upper - No reportable indications.

Low Speed Generator End - Lower - No reportable indications.

NDT Technician: Stewart Wardlaw - MT/PT/VT II UT I | n/a

n/a | n/a

3angles Inc.
2 Access Road
Albany, NY 12205
P: (518) 640-3000
F: (518) 218-0490

VISUAL INSPECTION REPORT

CUSTOMER:	EthosEnergy Field Services, LLC		
PO #:	40-PO15231	SURFACE CONDITION:	In Service
PROCEDURE/SPEC:	KT-NDE-4005, Rev. 1	ACCEPTANCE STD:	Report all indications
MATERIAL DESCRIPTION:	Dresser-Rand Steam Turbine		

INSPECTION RESULTS

WHITELIGHT METER: Spectroline AccuMAX XRP-3000 S/N: 1915223/4 Cal Due: 01/05/19

WHITELIGHT:	Borescope: Mentor Visual IQ	READING:	325 fc.
WHITELIGHT:	n/a	READING:	n/a fc.

Remote Visual Inspection of Dresser-Rand Steam Turbine using Video Borescope through upper portals and Control valves #4 &5 yielded the following results:

Left Side Portal - Pitting and deposits on turbine blading.

Right Side Portal - Pitting and deposits on turbine blading.

Control Valve #5 - Yellow deposits on lower valve chest.

Control Valve #4 - Debris in lower valve chest.

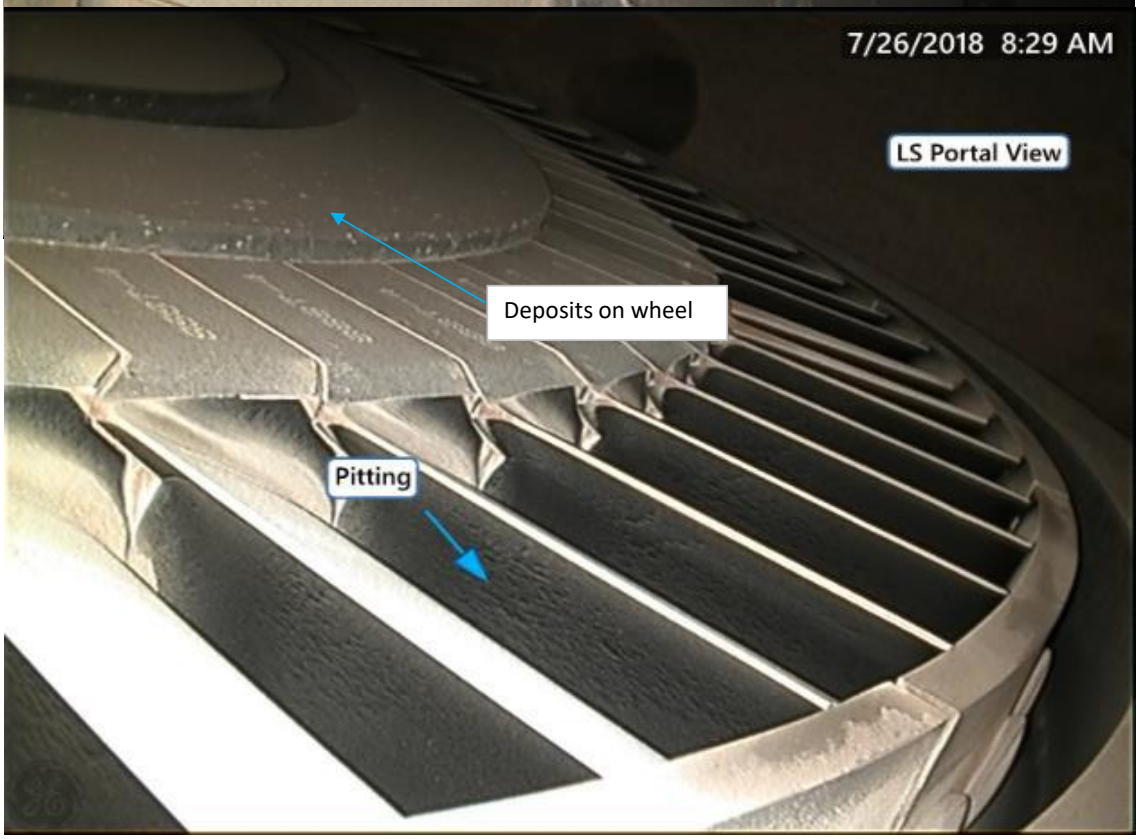
Photos of findings on next pages.

NDT Technician: Stewart Wardlaw - MT/PT/VT II UT I n/a

n/a n/a

3angles Inc.
2 Access Road
Albany, NY 12205
P: (518) 640-3000
F: (518) 218-0490

CUSTOMER:	EthosEnergy Field Services, LLC
PO #: 40-PO15231	SURFACE CONDITION: In Service
MATERIAL DESCRIPTION:	Dresser-Rand Steam Turbine

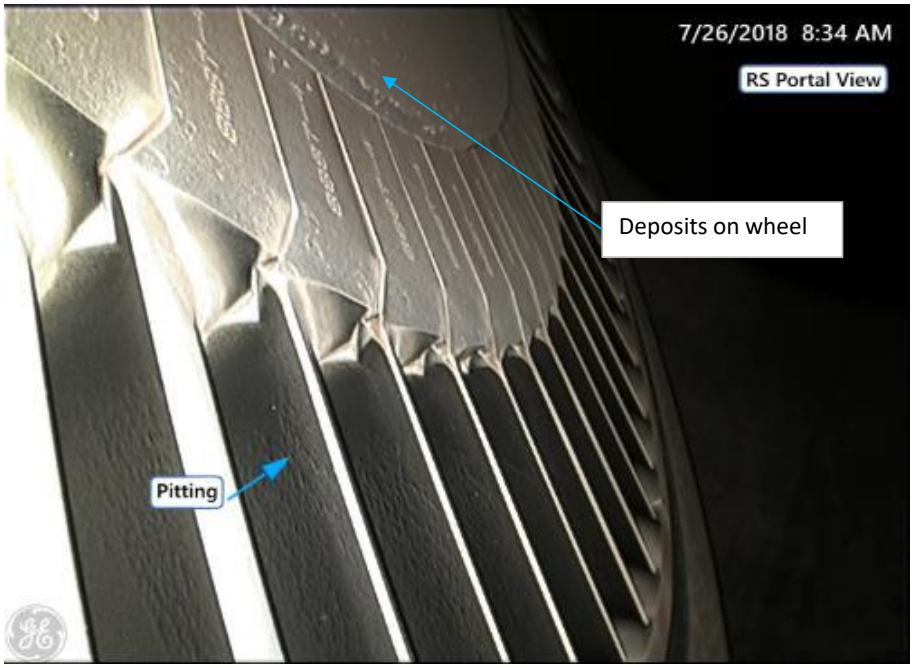


NDT Technician: Stewart Wardlaw - MT/PT/VT II UT I n/a

n/a n/a

3angles Inc.
2 Access Road
Albany, NY 12205
P: (518) 640-3000
F: (518) 218-0490

CUSTOMER:	EthosEnergy Field Services, LLC
PO #: 40-PO15231	SURFACE CONDITION: In Service
MATERIAL DESCRIPTION:	Dresser-Rand Steam Turbine



NDT Technician: Stewart Wardlaw - MT/PT/VT II UT I n/a

n/a n/a

3angles Inc.
2 Access Road
Albany, NY 12205
P: (518) 640-3000
F: (518) 218-0490

CUSTOMER:	EthosEnergy Field Services, LLC
PO #: 40-PO15231	SURFACE CONDITION: In Service
MATERIAL DESCRIPTION:	Dresser-Rand Steam Turbine

NDT Technician: Stewart Wardlaw - MT/PT/VT II UT I n/a

n/a n/a

3angles Inc.
2 Access Road
Albany, NY 12205
P: (518) 640-3000
F: (518) 218-0490

Project: CF-5321
Site: Verso Duluth, 100 N. Central Ave, Duluth, MN
Date: 7/25/2018 Page 15 of 16

ULTRASONIC INSTRUMENT LINEARITY RECORD

UT SCOPE:

MFG: USM GO S/N: 9080158 CAL DUE: 09/08/18

TRANSDUCER:

MFG: GEIT Gamma .500" Round Frequency: 5MHz. S/N: 14A0010A

CALIBRATION STANDARD:

IIW: E-UT-491

AMPLITUDE CONTROL LINEARITY

ORIGINAL AMPLITUDE	CONTROL FUNCTION	ACTUAL RESULT	ACCEPTABLE RANGE
80%	-6db	40	32-48%
80%	-12db	20	16-24%
40%	+6db	80	64-96%
20%	+12db	81	64-96%

Procedure No.: KT-NDE-1018, Rev 2.1

Date Linearity Was Performed: 7/25/2018

Acceptable: X

Rejectable:

SCREEN HEIGHT LINEARITY

	UPPER SIGNAL	ACCEPTABLE RANGE	ACTUAL LOWER SIGNAL
1	100%	55-45%	50
2	90%	50-40%	46
3	80%	N/A	40%
4	70%	40-30%	35
5	60%	35-25%	29
6	50%	30-20%	25
7	40%	25-15%	20
8	30%	20-10%	15
9	20%	15-5%	10

SCREEN WIDTH LINEARITY

	SET POINTS	ACCEPTABLE RANGE	SIGNAL READING
1	0%	-02-02%	0
2	20%	N/A	20%
3	40%	38-42%	40%
4	60%	58-62%	60
5	80%	N/A	80%
6	100%	98-102%	100

Comments:

Acceptable

NDT Technician: Stewart Wardlaw - MT/PT/VT II UT I n/a

n/a n/a

3angles Inc.
2 Access Road
Albany, NY 12205
P: (518) 640-3000
F: (518) 218-0490

Project: CF-5321
Site: Verso Duluth, 100 N. Central Ave, Duluth, MN
Date: 7/26/2018 Page 16 of 16

ULTRASONIC INSTRUMENT LINEARITY RECORD

UT SCOPE:

MFG: USM GO S/N: 9080158 CAL DUE: 09/08/18

TRANSDUCER:

MFG: GEIT Gamma .500" Round Frequency: 5MHz. S/N: 14A0010A

CALIBRATION STANDARD:

IIW: E-UT-491

AMPLITUDE CONTROL LINEARITY

ORIGINAL AMPLITUDE	CONTROL FUNCTION	ACTUAL RESULT	ACCEPTABLE RANGE
80%	-6db	40	32-48%
80%	-12db	21	16-24%
40%	+6db	79	64-96%
20%	+12db	80	64-96%

Procedure No.: KT-NDE-1018, Rev 2.1

Date Linearity Was Performed: 7/26/2018

Acceptable: X

Rejectable:

SCREEN HEIGHT LINEARITY

	UPPER SIGNAL	ACCEPTABLE RANGE	ACTUAL LOWER SIGNAL
1	100%	55-45%	50
2	90%	50-40%	45
3	80%	N/A	40%
4	70%	40-30%	36
5	60%	35-25%	30
6	50%	30-20%	25
7	40%	25-15%	21
8	30%	20-10%	15
9	20%	15-5%	11

SCREEN WIDTH LINEARITY

	SET POINTS	ACCEPTABLE RANGE	SIGNAL READING
1	0%	-02-02%	0
2	20%	N/A	20%
3	40%	38-42%	40%
4	60%	58-62%	60
5	80%	N/A	80%
6	100%	98-102%	100

Comments:

Acceptable

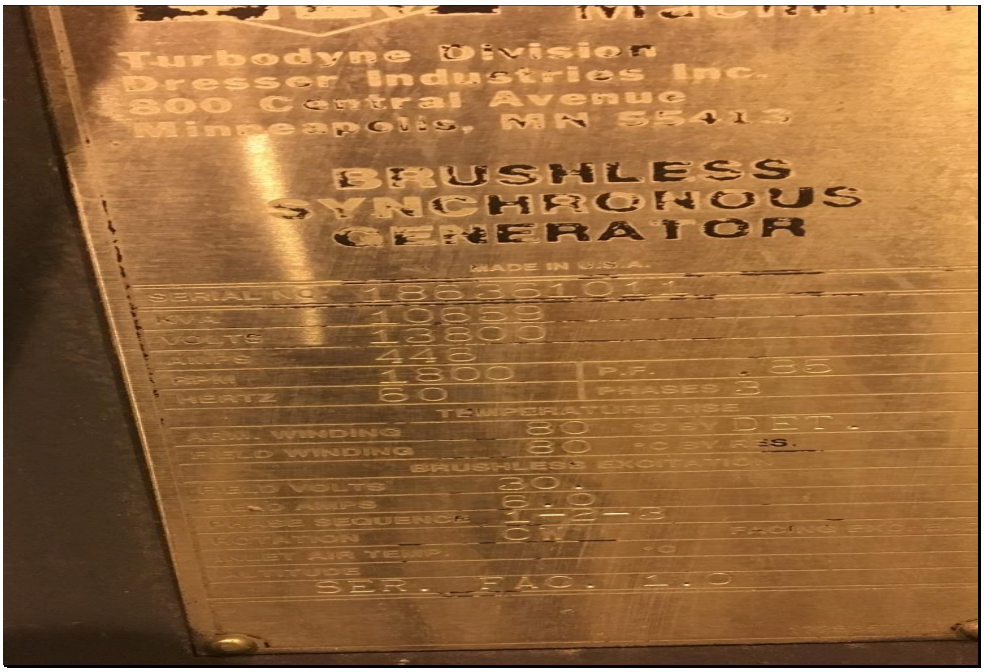
NDT Technician: Stewart Wardlaw - MT/PT/VT II UT I n/a

n/a n/a

APPENDIX C – GAP 1 REPORT

EthosEnergy

Verso Paper Holdings
Duluth Paper Mill Unit 1



EM, 10,659kVA, 13,800V, 1800RPM

GAP 1
Final Report 08/13/18

PO: 184345
SO: 44523

Generator / Motor Shop
1113 Camina Entrada
Farmington, NM 87401
Phone (505) 327-6363
Fax (505) 327-7515

Table of Contents

General Information

A. Introduction

This is the final GAP 1 Inspection and Testing Report
for a EM, 10,659kVA, 13,800V, 1800RPM generator.

Customer:	Verso Paper Holdings	PO Number:	184345	Prepared By:	Marcos Moreno
Plant:	Duluth Paper Mill	SO Number:	44523	Approved By:	Anthony Digiacomo
Unit Number:	1	Serial Number:	186361011	Date:	8/13/2018
OEM:	EM				

B. Job Dates

07/24/18 through 07/26/18

C. Customer Personnel

Name	Email Address
Gary Winters	Gary.winters@ethosenergygroup.com

D. EthosEnergy Personnel

Name	Email Address
Greg Martin - General Manager	gregory.martin@ethosenergygroup.com
Tony DiGiacomo - Field Service Manager	anthony.digiacomo@ethosenergygroup.com
Mandie Sutherlin - Field Service Administrator	amanda.sutherlin@ethosenergygroup.com
Marcos Moreno- Field Service GS	marcos.moreno@ethosenergygroup.com

E. Generator Information

Stator Rating:	10,659kVA	PF:	0.85	RPM:	1,800	Rotor Volts:	30
Stator Voltage:	13,800V			Hz:	30	Rotor Amps:	6
Stator Amps:	446					Rotor Poles:	2

F. Visual Inspections

1. Stator Winding
2. Rotor
3. Exciter

G. Tasks Performed

Incoming

1. Performed As found stator testing.
2. Performed As found rotor testing.
3. Performed As found exciter testing.

Conclusions/Recommendations

Stator

RTDs resistance is acceptable.

Stator winding resistance is high (contamination) but acceptable and consistent among all phases. Compare with previous results to look for trends.

Stator winding IR is acceptable.

PI test are acceptable

Step Voltage Test is acceptable

Rotor

The rotor IR, pole drop, winding resistance, is acceptable

Based on the limited testing, the unit temporarily meets operational expectations from an electrical standpoint. It is recommended that a thorough stator cleaning be performed during the next available outage schedule, and retest both stator and rotor for improvements. It is recommended to monitor the units condition in the future to look for trends

As Found Stator Slots/Core

Date: 7/25/18
By: Marcos

N/A	★	★★	★★★	★★★★	★★★★★
			x		
x					
x					
x					
x					
x					
x					
x					
x					
x					
x					
x					
x					

Cleanliness: _____

Clear of Foreign Objects on Core/Vents: _____

Lamination Condition: _____

Core Tight, Laminations not Loose: _____

Core Plate/Finger Condition: _____

Core Compression Bolts/Nuts: _____

Corona Suppression in Slot Section: _____

Bar fit to Slot: _____

Bars Bottomed in Slot: _____

Bar Condition: _____

No Insulation Oozing/Distortion in Slot: _____

Slot Filler Position: _____

Wedges Positioned and Staked: _____

Wedge Condition: _____

Type of wedges: Flat [x] Split [ ] Camelback [ ] Flat [ ] _____

Asphalt Insulation: Yes [ ] No [x] _____

As Found Stator End-Winding and Casing

Date: 7/25/18
By: Marcos

N/A	★★★★★	★★★★★	★★★	★★	★	
			x			Cleanliness:
x						Clear of Foreign Objects on Core/Vents:
	x					Clear of Foreign Objects in Casing:
	x					Corona Condition on End-Windings:
	x					Condition of End-Windings:
	x					Condition Circuit Rings:
x						Condition of Bushings:
x						Condition of Supports:
x						Condition of Coil/Bushing/Ring:
	x					Condition of Insulation:
x						Coolers in Acceptable Condition:

Stator As Found Testing

RTD Readings and IR

Date:	7/25/18
By:	Marcos
Ambient Temperature:	80.0°F
Humidity:	50.0%

	RTD Resistance				Temperature		500 V Megger	
RTD	AB	AC	BC	(AB+AC)/2-BC	°F	°C	Value	Units
1	114.1	114.9	0.7	113.8	96.5	35.8	9.5	GΩ
2	114.7	114.7	0.7	114	97.5	36.4	9.5	GΩ
3	114.6	114.6	0.6	114	97.5	36.4	9.5	GΩ
4	114.8	114.8	0.6	114.2	98.4	36.9	9.5	GΩ
5	115.1	115.1	0.8	114.3	98.9	37.1	9.5	GΩ
6	115.1	115.1	0.7	114.4	99.3	37.4	9.5	GΩ
7	115.2	115.2	0.8	114.4	99.3	37.4	9.5	GΩ
8	114.9	114.9	0.8	114.1	97.9	36.6	9.5	GΩ
9	115.1	115.1	0.7	114.4	99.3	37.4	9.5	GΩ
10	114.6	114.6	0.7	113.9	97.0	36.1	9.5	GΩ
11	114.7	114.7	0.6	114.1	97.9	36.6	9.5	GΩ
12	115.1	115.1	0.6	114.5	99.8	37.7	9.5	GΩ

DC Winding Resistance

Date:	7/25/18
By:	Marcos
Ambient Temperature:	94.0°F
Core Temperature:	98.0°F
Humidity:	50.0%

Phase	Resistance	Units
A	55.02	mΩ
B	55.01	mΩ
C	55.04	mΩ

5,000V Insulation Resistance

Date:	7/25/18
By:	Marcos
Ambient Temperature:	94.0°F
Humidity:	50.0%

Phase	Resistance	Units
A	10.8	GΩ
B	10.2	GΩ
C	10.1	GΩ

Stator As Found Testing

10,000V Polarization Index

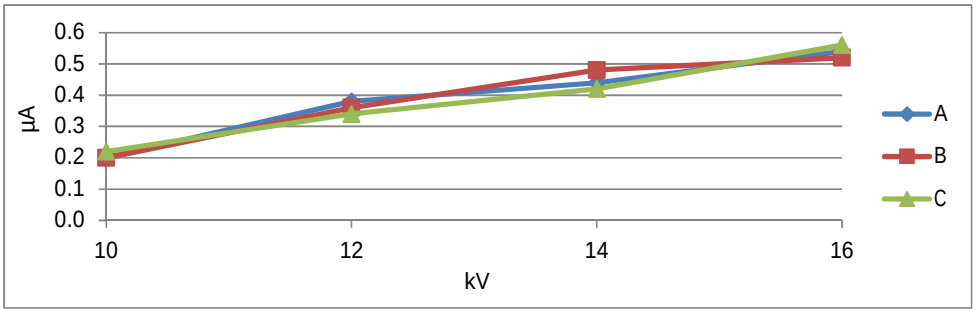
Date:	7/25/18					
By:	Marcos					

	T1/T4 (A Phase)		T2/T5 (B Phase)		T3/T6 (C Phase)	
Minutes	µA	MΩ	µA	MΩ	µA	MΩ
1.0	0.9	11111.1	0.8	12500.0	0.9	11111.1
2.0	0.7	14285.7	0.6	16666.7	0.8	13157.9
3.0	0.6	18181.8	0.5	20000.0	0.6	16129.0
4.0	0.5	20833.3	0.5	20833.3	0.5	19230.8
5.0	0.4	25000.0	0.4	25000.0	0.4	23809.5
6.0	0.4	26315.8	0.3	29411.8	0.4	27777.8
7.0	0.3	33333.3	0.3	33333.3	0.3	31250.0
8.0	0.3	35714.3	0.3	35714.3	0.3	35714.3
9.0	0.2	41666.7	0.3	38461.5	0.3	35714.3
10.0	0.2	50000.0	0.2	50000.0	0.2	45454.5
PI	4.5		4.0		4.1	

	Temp. (°F)	Humidity
A Phase:	93.0°F	42.0%
B Phase:	94.0°F	40.0%
C Phase:	94.0°F	40.0%

Step Test

T1/T4 (A Phase)			T2/T5 (B Phase)			T3/T6 (C Phase)		
Time	kV	µA	Time	kV	µA	Time	kV	µA
#DIV/0!	10	0.20	#DIV/0!	10	0.20	10:00	10	0.22
#DIV/0!	12	0.38	#DIV/0!	12	0.36	13:14	12	0.34
#DIV/0!	14	0.44	#DIV/0!	14	0.48	15:56	14	0.42
#DIV/0!	16	0.54	#DIV/0!	16	0.52	18:17	16	0.56



As Found Rotor

Date: 7/25/18
By: Marcos

N/A	★★★★★	★★★★★	★★★	★★	★		
		x				Cleanliness of Rotor:	Dust and minimal greasing
x						Cleanliness Under Retaining Rings:	
		x				Rotor Body Condition:	
x						Rotor Wedge Condition:	
x						Journal Condition:	
x						Seal Area Condition:	
x						Retaining Ring Condition:	
x						End Winding Condition:	
		x				Turn Insulation Condition:	Dusting
	x					Pole/Lead/Coil Connections Condition:	
		x				Blocking Placement:	
x						End Wedge Placement:	
x						Balance Weights & Plugs Secured/Staked:	
x						Locking Keys Secured/Staked:	
x						Rotor Bore Plugs Secured/Staked:	
x						(Axial) Lead Wedges Secured/Staked:	
x						Radial Leads Secured/Staked:	
x						Slot Radial Ventilation Not Offset/Blocked:	
x						Slot Axial Ventilation Not Offset/Blocked:	

Rotor As Found Testing

DC Winding Resistance

Resistance	Units
50.1	mΩ

Date:	7/25/18
By:	Marcos
Ambient Temperature:	85.0°F
Winding Temperature:	98.7°F
Humidity:	50.0%

250V Insulation Resistance

Resistance	Units
6.12	GΩ

Date:	7/25/18
By:	Marcos
Ambient Temperature:	94.0°F
Humidity:	50.0%

250V Polarization Index

Minutes	Resistance	Units
1	33.5	GΩ
2	52.4	GΩ
3	66.7	GΩ
4	80.5	GΩ
5	90.2	GΩ
6	97.4	GΩ
7	104	GΩ
8	110	GΩ
9	120	GΩ
10	132	GΩ
PI	3.94	

Date:	7/25/18
By:	Marcos
Ambient Temperature:	94.0°F
Humidity:	50.0%

As Found Exciter

Date: 7/25/18
By: Marcos

N/A

Brushless Exciter

		x				Cleanliness:	Dusting no greasing could be cleaned at next outage
x						Fuse/Diode Condition:	
x		x				Diode Wheel Insulation Condition:	
		x				Exciter Rotor Condition:	Dust can be cleaned until next outage
		x				Exciter Stator Condition:	Dust can be cleaned nextb scheule outage
x						PMG Stator Condition:	
		x				PMG Rotor Condition:	Dust can be cleaned next outage
x						Exciter Journal Condition:	
x						Exciter Seal Area Condition:	
x						Slip Ring Condition:	

Exciter As Found Testing

Exciter Rotor 250V IR

Resistance	Units
6.12	GΩ

Date:	7/25/18
By:	Marcos
Ambient Temperature:	94.0°F
Humidity:	50.0%

Exciter Stator 250V IR

Resistance	Units
6.12	GΩ

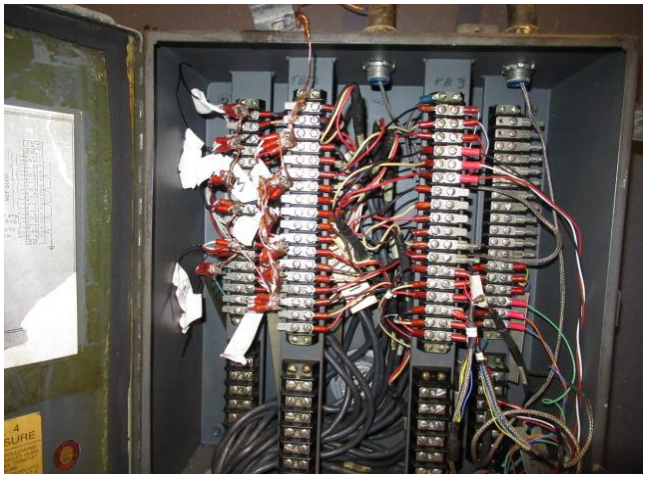
Date:	7/25/18
By:	Marcos
Ambient Temperature:	94.0°F
Humidity:	50.0%

PMG Stator 250V IR

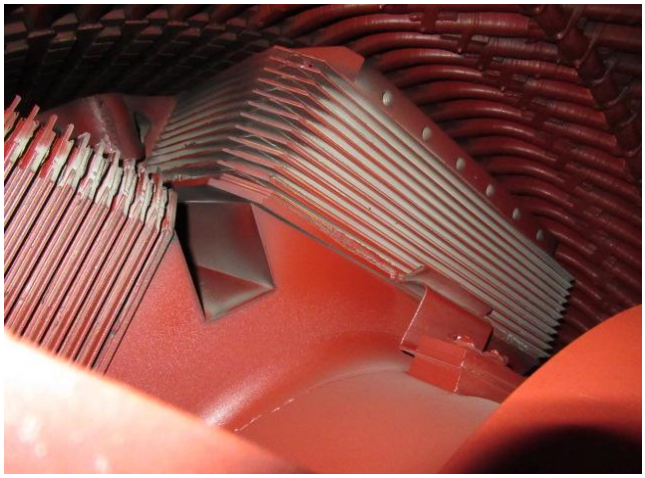
Resistance	Units
6.1	GΩ

Date:	7/25/18
By:	Marcos
Ambient Temperature:	94.0°F
Humidity:	50.0%

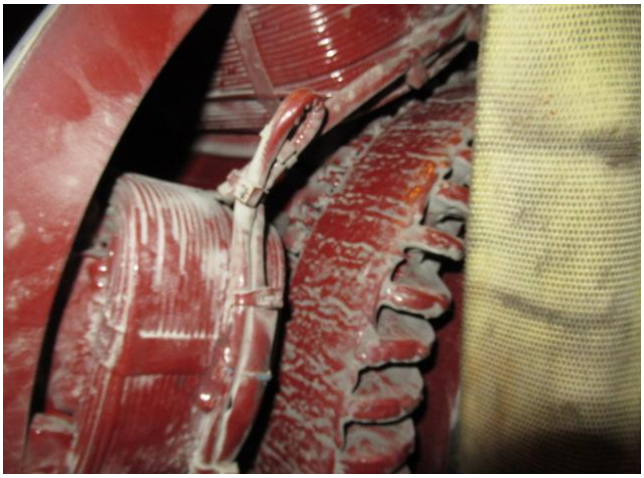
Photo Log



Stator RTD's disconnected, labeled and tested.

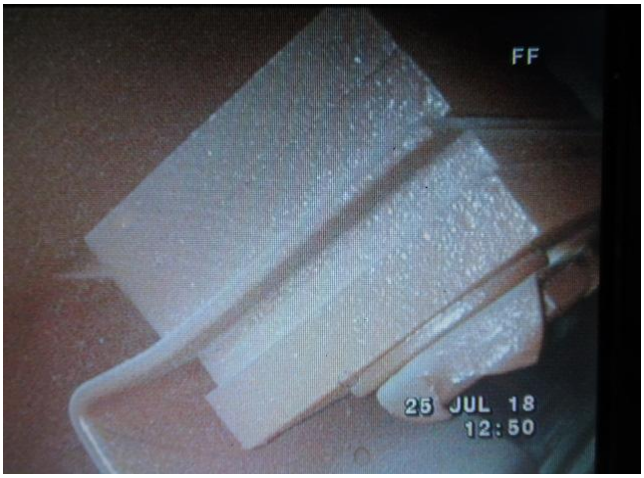


Turbine end rotor and end windings



PMG contamination

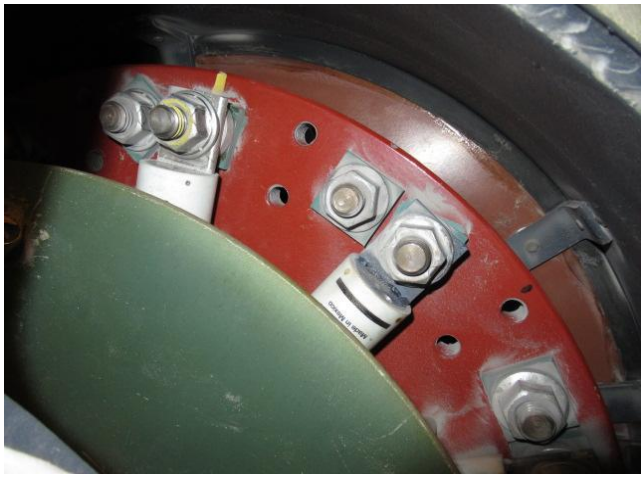
Exciter end rotor and end windings.



Rotor lead secured

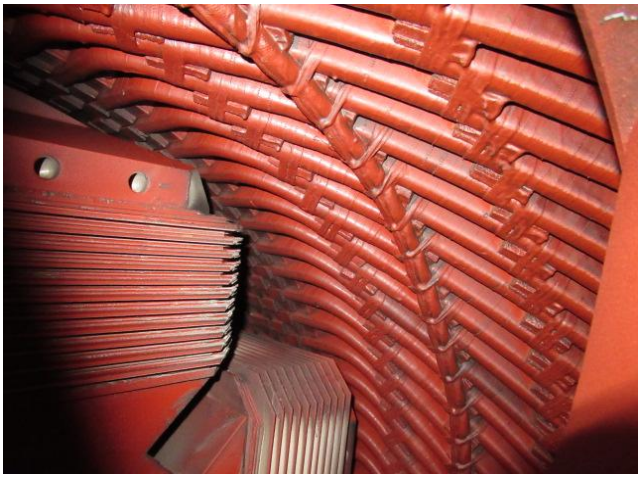
Rotor connection lead hardware secured

Photo Log



Diode components

End windings contamination



End windings contamination

APPENDIX D – DAILY LOGS

Daily Job Report

To: Gary Winters, Dan Henderson, Craig Tanner, Kenny Reiter, Mark Peltier, Dominic Volpe, Rick Wright, Brian Johnson, Mike O'Brien, Karen Turnboom, Bill Scott, Jim Hicks

Station: VERSO DULUTH

Steeam Tubine Unit 1 Minor Inspection

EthosEnergy Field Service

Daily Report, FMN-4-0600 Rev 01

Date: 7/23/2018

Submitted By: Dominic Volpe

Table of Contents

1. Project Summary

Customer: Verso Duluth	Project Title: Steam Turbine Minor Inspection Unit 1
EEFS Job Number: 40-J12994	Report Date: 7/23/2018
Report Author: Dominic Volpe	Report #: 1

Date	Project Summary Log
7/23/2018	Prior to Arrival Completed Reuired Safety Training Unloaded Staged Personnel Tooling Walked & Signed On To LOTO T-2 LP Bearing, Unbolted UH Pedestal Cover, Removed Removed UH T-2 Bearing, Removed UH/LH Oil Deflectors I & C Disconnected T-2 TC Unbolted UH Gearbox Cover, Removed Cover Control Valves Removed Camshaft, Removed Levers and Springs Started Removal of Stems and Discs from Valve Chest Started Unbolting Gear Box to Generator Coupling

2. Safety Summary

Safety Summary

3. Project Concerns / Action Items

Project Concerns / Action Items				
Concern / Action	Assigned To:	Date Assigned	Date Due	Date Completed

4. Project Personnel

Personnel Names	Position	Phone	Email
Dominic Volpe	TFA	201-602-0060	dominic.volpe@ethosenergygroup.com
Bill Scott	Outage Coordinator	218-591-0143	william.scott@versoco.com

5. Change Order Log for Contract

Change Authorization #	Description	Status	Amount
1			

6. Photograph Log

	
T-2 LP Bearing	T-2 TC in Bottom of Standard
	
Control Valves Prior to Disassembly	Control ValvesPrior to Disassembly
	
Camshaft and Levers	UH Gearbox Cover Removed

	
Disc’s in Valve Chest	Stem and Disc Removed

Daily Job Report

To: Gary Winters, Dan Henderson, Craig Tanner, Kenny Reiter, Mark Peltier, Dominic Volpe, Rick Wright, Brian Johnson, Mike O'Brien, Karen Turnboom, Bill Scott, Jim Hicks, Gwen Chapman

Station: VERSO DULUTH

Steam Tubine Unit 1 Minor Inspection

EthosEnergy Field Service

Daily Report, FMN-4-0600 Rev 01

Date: 7/24/2018

Submitted By: Dominic Volpe

Table of Contents

1. Project Summary

Customer: Verso Duluth	Project Title: Steam Turbine Minor Inspection Unit 1
EEFS Job Number: 40-J12994	Report Date: 7/24/2018
Report Author: Dominic Volpe	Report #: 2

Date	Project Summary Log
7/24/2018	Signed On To LOTO, JSA Completed Completed Removal of Control Valves from Steam Chest Completed cleaning, bolts, seats, disc's and sealing surfaces Generator Collector End, Removed outer endshield, pedestal cover Generator Turbine End, Removed outer endshield, pedestal cover Cleaning and Mic-up Generator Oil Deflectors CE Unbolted, removed Front Standard Cover, Thrust Bump 0.013" Removed UH T-1 Bearing, Disaassembled Thrust, Started Cleaning Lost 1 Hour Station Was Using Crane

2. Safety Summary

Safety Summary

3. Project Concerns / Action Items

Project Concerns / Action Items				
Concern / Action	Assigned To:	Date Assigned	Date Due	Date Completed

4. Project Personnel

Personnel Names	Position	Phone	Email
Dominic Volpe	TFA	201-602-0060	dominic.volpe@ethosenergygroup.com
Bill Scott	Outage Coordinator	218-591-0143	william.scott@versoco.com

5. Change Order Log for Contract

Change Authorization #	Description	Status	Amount
1			

6. Photograph Log

	
Control Valves	Control Valves
	
Valve Chest	Valve Chest
	
Generator CE Bearing	Generator CE

	
CE Insulated Bearing	CV Disc’s

	
CV Disc’s	TE Generator
	
Station Machined Mandrel for T-2	Valve Chest

	
Thrust Pads	Thrust Pads & T-1 Journal

	
Thrust Pads	Thrust Pads

Daily Job Report

To: Gary Winters, Dan Henderson, Craig Tanner, Kenny Reiter, Mark Peltier, Dominic Volpe, Rick Wright, Brian Johnson, Mike O'Brien, Karen Turnboom, Bill Scott, Jim Hicks, Gwen Chapman

Station: VERSO DULUTH

Steam Tubine Unit 1 Minor Inspection

EthosEnergy Field Service

Daily Report, FMN-4-0600 Rev 01

Date: 7/25/2018

Submitted By: Dominic Volpe

Table of Contents

1. Project Summary

Customer: Verso Duluth	Project Title: Steam Turbine Minor Inspection Unit 1
EEFS Job Number: 40-J12994	Report Date: 7/25/2018
Report Author: Dominic Volpe	Report #: 3

Date	Project Summary Log
7/25/2018	Signed On To LOTO, JSA Completed Three Angles NDE and Generator People on Site Remove UH Generator TE & CE Bearing Rolled Out LH CE Bearing, Cleaned & Dimensionally Checked, NDE Rolled In LH CE Bearing Rolled Out LH TE Bearing, Cleaned & Dimensionally Checked, NDE Rolled In LH TE Bearing Parted LS Coupling (Gearbox to Generator), Cleaning Out Grease/Oil Opened Borescope Ports

	Removed UH HS Gearbox Bearings TE & GE Removed UH LS Gearbox Bearings TE & GE Cleaned & Dimensionally Checked Generator Oil Deflectors (4) Rolled Out LH LP Turbine Bearing, NDE Rolled Out LH HP Turbine Bearing, NDE

2. Safety Summary

Safety Summary

3. Project Concerns / Action Items

Project Concerns / Action Items				
Concern / Action	Assigned To:	Date Assigned	Date Due	Date Completed

4. Project Personnel

Personnel Names	Position	Phone	Email
Dominic Volpe	TFA	201-602-0060	dominic.volpe@ethosenergygroup.com
Bill Scott	Outage Coordinator	218-591-0143	william.scott@versoco.com

---

5. Change Order Log for Contract

Change Authorization #	Description	Status	Amount
1			

6. Photograph Log

	
Pinion and Bull Gear	Low Speed Coupling
	
Low Speed Coupling	Low Speed Coupling

	
LH TE Generator Bearing	LH TE Generator Bearing

	
TE Journal	

Daily Job Report

To: Gary Winters, Dan Henderson, Craig Tanner, Kenny Reiter, Mark Peltier, Dominic Volpe, Rick Wright, Brian Johnson, Mike O'Brien, Karen Turnboom, Bill Scott, Jim Hicks, Gwen Chapman

Station: VERSO DULUTH

Steam Tubine Unit 1 Minor Inspection

EthosEnergy Field Service

Daily Report, FMN-4-0600 Rev 01

Date: 7/26/2018

Submitted By: Dominic Volpe

Table of Contents

1. Project Summary

Customer: Verso Duluth	Project Title: Steam Turbine Minor Inspection Unit 1
EEFS Job Number: 40-J12994	Report Date: 7/26/2018
Report Author: Dominic Volpe	Report #: 4

Date	Project Summary Log
7/26/2018	Signed On To LOTO, JSA Completed Three Angles NDE On Site, NDE and Borescope of Unit Performed T-1 HP Bearing Clearance & Contact Checks Rolled in LH T-1, Installed UH Bolted, Assembled Thrust Bump Check As Built 0.013” Blue Checked Control Valve Disc’s to Seats All Satisfactory Removed Coupling Spacer Turbine to Gearbox Assembling Control Valves To Valve Chest Removed Bull and Pinion Gear From Gearbox Miked-up HS & LS Bearings & NDE Completed Reinstalled Bullgear

2. Safety Summary

Safety Summary

3. Project Concerns / Action Items

Project Concerns / Action Items				
Concern / Action	Assigned To:	Date Assigned	Date Due	Date Completed

4. Project Personnel

Personnel Names	Position	Phone	Email
Dominic Volpe	TFA	201-602-0060	dominic.volpe@ethosenergygroup.com
Bill Scott	Outage Coordinator	218-591-0143	william.scott@versoco.com

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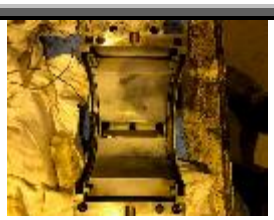
5. Change Order Log for Contract

Change Authorization #	Description	Status	Amount
1			

6. Photograph Log

	
Thrust Assembled	Contact Checks T-1
	
Contact Check T-1	Contact Check T-2
	
Contact on Bearing Pads T-2	Contact on Bearing Pads T-1

	
Control Valve Blue Checks	Control Valve Blue Checks

	
Bull Gear	Pinion Gear

Daily Job Report

To: Gary Winters, Dan Henderson, Craig Tanner, Kenny Reiter, Mark Peltier, Dominic Volpe, Rick Wright, Brian Johnson, Mike O'Brien, Karen Turnboom, Bill Scott, Jim Hicks, Gwen Chapman

Station: VERSO DULUTH

Steam Tubine Unit 1 Minor Inspection

EthosEnergy Field Service

Daily Report, FMN-4-0600 Rev 01

Date: 7/27/2018

Submitted By: Dominic Volpe

Table of Contents

1. Project Summary

Customer: Verso Duluth	Project Title: Steam Turbine Minor Inspection Unit 1
EEFS Job Number: 40-J12994	Report Date: 7/27/2018
Report Author: Dominic Volpe	Report #: 5

Date	Project Summary Log
7/27/2018	Signed On To LOTO, JSA Completed Installed Flanges and Bolted Borescope Holes Support Bentley Nevada Floating Rotor, Setting Axial Positon/Thrust Dimensionally Checked Front Standard OD Dimensionally Checked T-2 OD'S Completed Dimensional Checks on Gearbox Installed Front Standard Cover & Bolted Assembling Control Valves To Valve Chest Two Trumpets (leakoff piping assemblies pipe broke at crosshead) Removed Damaged Pipe and Replaced Cleaned up All Work Areas

2. Safety Summary

Safety Summary

3. Project Concerns / Action Items

Project Concerns / Action Items				
Concern / Action	Assigned To:	Date Assigned	Date Due	Date Completed

4. Project Personnel

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Dominic Volpe	TFA	201-602-0060	dominic.volpe@ethosenergygroup.com
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5. Change Order Log for Contract

Change Authorization #	Description	Status	Amount
1			

6. Photograph Log

	
Bull Gear Installed	Control Valve Assembly
	
Front Standard Prior To Cover	Front Standard Cover Installed
	
Control Valve Assembly	

Daily Job Report

To: Gary Winters, Dan Henderson, Craig Tanner, Kenny Reiter, Mark Peltier, Dominic Volpe, Rick Wright, Brian Johnson, Mike O'Brien, Karen Turnboom, Bill Scott, Jim Hicks, Gwen Chapman

Station: VERSO DULUTH

Steam Tubine Unit 1 Minor Inspection

EthosEnergy Field Service

Daily Report, FMN-4-0600 Rev 01

Date: 7/28/2018

Submitted By: Dominic Volpe

Table of Contents

1. Project Summary

Customer: Verso Duluth	Project Title: Steam Turbine Minor Inspection Unit 1
EEFS Job Number: 40-J12994	Report Date: 7/28/2018
Report Author: Dominic Volpe	Report #: 6

Date	Project Summary Log
7/28/2018	Signed On To LOTO, JSA Completed Removed CV Hydraulic Operator Installed/Set LH T-2 Oil Dflectors Installed CV Cam Shaft Installed Pinion Gear, Thrust Check, End Float, Backlash Completed Blue Checked Pinion Gear to Bull Gear Bull Gear Installed UH Bearings Pinion Gear Installed UH Bearings Rigged and Cleaned Gearbox Cover Installed Gearbox Cover

2. Safety Summary

Safety Summary

3. Project Concerns / Action Items

Project Concerns / Action Items				
Concern / Action	Assigned To:	Date Assigned	Date Due	Date Completed

4. Project Personnel

Personnel Names	Position	Phone	Email
Dominic Volpe	TFA	201-602-0060	dominic.volpe@ethosenergygroup.com
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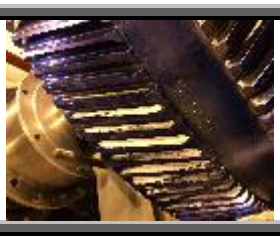
5. Change Order Log for Contract

Change Authorization #	Description	Status	Amount
1			

6. Photograph Log

	
Control Valve Hydraulic Operator	Control Valve Hydraulic Operator
	
Operator Removed	T-2 Oil Defllectors Installed
	
Gear Blue Checks	Gear Blue Checks

	
Bullgear UH Bearings Installed	Pinion Gear UH Bearings Installed

	
Bullgear UH Bearings Installed	

Daily Job Report

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Station: VERSO DULUTH

Steam Tubine Unit 1 Minor Inspection

EthosEnergy Field Service

Daily Report, FMN-4-0600 Rev 01

Date: 7/29/2018

Submitted By: Dominic Volpe

Table of Contents

1. Project Summary

Customer: Verso Duluth	Project Title: Steam Turbine Minor Inspection Unit 1
EEFS Job Number: 40-J12994	Report Date: 7/29/2018
Report Author: Dominic Volpe	Report #: 7

Date	Project Summary Log
7/29/2018	Signed On To LOTO, JSA Completed Installed CV Hydraulic Operator Completed Bolting Gearbox, Installed Endplates and Oil Seals Generator TE Tilt,Twist, Installed/Set Inner & Outer Oil Deflectors Pinch Checked Bearing to Pedestal Cover, Installed Cover Installed Outer EndShield TE & Bolted Installed Fine Mesh Screens in Bearing & Generator Feed Lines Installed Fine Mesh Screens in Gearbox and Hydraulic Feed Lines

		Assigned		Completed

4. Project Personnel

Personnel Names	Position	Phone	Email
Dominic Volpe	TFA	201-602-0060	dominic.volpe@ethosenergygroup.com
Bill Scott	Outage Coordinator	218-591-0143	william.scott@versoco.com

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5. Change Order Log for Contract

Change Authorization #	Description	Status	Amount
1			

6. Photograph Log

	
Assembling TE Generator	Gearbox Assembled
	
New Hydraulic Operator Installed	Greasing Valve CamShaft

Daily Job Report

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Station: VERSO DULUTH

Steam Tubine Unit 1 Minor Inspection

EthosEnergy Field Service

Daily Report, FMN-4-0600 Rev 01

Date: 7/30/2018

Submitted By: Dominic Volpe

Table of Contents

1. Project Summary

Customer: Verso Duluth	Project Title: Steam Turbine Minor Inspection Unit 1
EEFS Job Number: 40-J12994	Report Date: 7/30/2018
Report Author: Dominic Volpe	Report #: 8

Date	Project Summary Log
7/30/2018	Signed On To LOTO, JSA Completed Generator CE Tilt,Twist, Installed/Set Inner & Outer Oil Deflectors Pinch Checked Bearing to Pedestal Cover, Installed Cover Installed Outer EndShield CE & Bolted Installed Cover over Rotating Exciter Installed Outer End Shield Installed replacement trumpets on CV's Installed leakoff header on CV trumpets Insulators installed insulation blankets I & C Tech installing instrumentation Pinch Checked T-2 Bearing Installed Pedestal Cover & Bolted

	Set up for alignment checks Turbine to Gearbox Gearbox to Generator

2. Safety Summary

Safety Summary

3. Project Concerns / Action Items

Project Concerns / Action Items				
Concern / Action	Assigned To:	Date Assigned	Date Due	Date Completed

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5. Change Order Log for Contract

Change Authorization #	Description	Status	Amount
1			

6. Photograph Log

	
CE Generator	CE Generator
	
TE Generator	T-2 New RTD Penetration

	
T-2 Closed	Front Standard Instrumentation

	
TE Generator	

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Station: VERSO DULUTH

Steam Tubine Unit 1 Minor Inspection

EthosEnergy Field Service

Daily Report, FMN-4-0600 Rev 01

Date: 7/31/2018

Submitted By: Dominic Volpe

Table of Contents

1. Project Summary

Customer: Verso Duluth	Project Title: Steam Turbine Minor Inspection Unit 1
EEFS Job Number: 40-J12994	Report Date: 7/31/2018
Report Author: Dominic Volpe	Report #: 9

Date	Project Summary Log
7/31/2018	Signed On To LOTO, JSA Completed Lube Oil System in Service 7:00 AM for flush Shutdown 11:00 AM Screen Inspection On Again 12:00 PM Alignment checks Turbine to Gearbox Completed, Started Assembly Gearbox to Generator Completed, Greased Coupling, Started Assem.

2. Safety Summary

Safety Summary

3. Project Concerns / Action Items

Project Concerns / Action Items				
Concern / Action	Assigned To:	Date Assigned	Date Due	Date Completed

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5. Change Order Log for Contract

Change Authorization #	Description	Status	Amount
1			

6. Photograph Log

EthosEnergy

	
Generator Coupling Assembly	Screen from Oil Feed Line
	
Screen from Hydraulic Actuator	Screen From Hydraulic Actuator
	
Screen from Oil Feed Line	

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Station: VERSO DULUTH

Steam Tubine Unit 1 Minor Inspection

EthosEnergy Field Service

Daily Report, FMN-4-0600 Rev 01

Date: 8/1/2018

Submitted By: Dominic Volpe

Table of Contents

1. Project Summary

Customer: Verso Duluth	Project Title: Steam Turbine Minor Inspection Unit 1
EEFS Job Number: 40-J12994	Report Date: 8/1/2018
Report Author: Dominic Volpe	Report #: 10

Date	Project Summary Log
8/1/2018	Signed On To LOTO, JSA Completed Lube Oil System in Service flushed all night Shutdown 10:00 AM Screen Inspection Good Restored Lube Oil System Completed Greasing Gearbox to Generator Coupling & Torqued Torqued Turbine to Gearbox Coupling Cleaning all Work Areas

2. Safety Summary

Safety Summary

3. Project Concerns / Action Items

Project Concerns / Action Items				
Concern / Action	Assigned To:	Date Assigned	Date Due	Date Completed

4. Project Personnel

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Dominic Volpe	TFA	201-602-0060	dominic.volpe@ethosenergygroup.com
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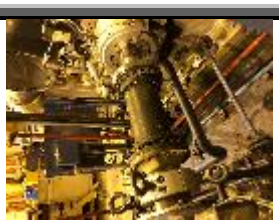
5. Change Order Log for Contract

Change Authorization #	Description	Status	Amount
1			

6. Photograph Log

Coupling Guard Low Speed



High Speed Spool Installed

Final Screen Hydraulic Supply

Typical of other lube supply lines

Daily Job Report

To: Gary Winters, Dan Henderson, Craig Tanner, Kenny Reiter, Mark Peltier, Dominic Volpe, Rick Wright, Brian Johnson, Mike O'Brien, Karen Turnboom, Bill Scott, Jim Hicks, Gwen Chapman

Station: VERSO DULUTH

Steam Tubine Unit 1 Minor Inspection

EthosEnergy Field Service

Daily Report, FMN-4-0600 Rev 01

Date: 8/2/2018

Submitted By: Dominic Volpe

Table of Contents

1. Project Summary

Customer: Verso Duluth	Project Title: Steam Turbine Minor Inspection Unit 1
EEFS Job Number: 40-J12994	Report Date: 8/2/2018
Report Author: Dominic Volpe	Report #: 11

Date	Project Summary Log
8/2/2018	Signed on & off LOTO, JSA Completed TTV would not stroke (this was performed by others) Removed oil feed and drain lines, found FME plug in supply line Reassembled feed and drain lines Station I & C stroked verified valve functionally Unit Initial Roll 9:36 AM, OS Testing Performed, Unit Tripped 2nd Roll 9:53 AM Bentley's Adjusted 3rd Roll10:48, FSNL 10:57, Trip on Generator Reverse Power Relay 4th Roll11:07, FSNL 11:09, Breaker Closed 11:11 Successfully Demob and Ship tools

2. Safety Summary

Safety Summary

3. Project Concerns / Action Items

Project Concerns / Action Items				
Concern / Action	Assigned To:	Date Assigned	Date Due	Date Completed

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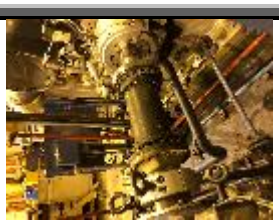
5. Change Order Log for Contract

Change Authorization #	Description	Status	Amount
1			

6. Photograph Log

Coupling Guard Low Speed



High Speed Spool Installed

Final Screen Hydraulic Supply

Typical of other lube supply lines