



TeSuCon

Technical Support & Consultancy

REPORT TURBINE INSPECTION
SN 15401272, WINDPARK SLUFTER WEST 6



Report No. GE15002015006

20-11-2015

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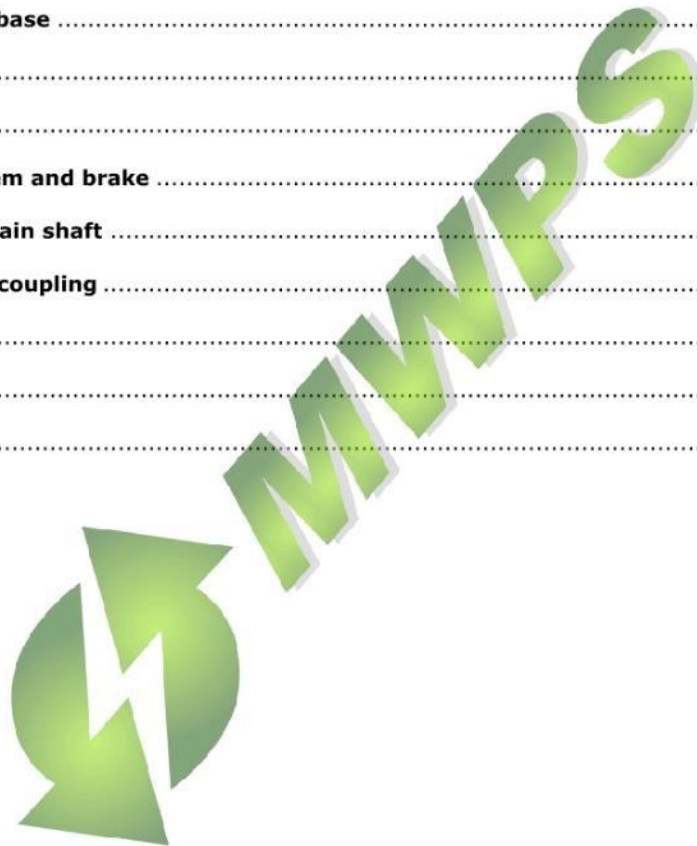
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1 Purpose


On behalf of Vattenfall an inspection has been executed on the wind turbine. The purpose of the inspection is to determine the technical state of the wind turbine.

2 Abbreviations

ok	okay
nok	not okay
na	not applicable
nav	not available
nc	not checked
info	for information purpose

Items marked with "ok" and "info" show no visual irregularities. All issues which are not acceptable are marked with "**nok**". Items which are "**nok**" will be classified in three different classes.

Class	Clarification	Description in report
Priority Low	An irregularity, which is not a safety issue, and is relatively easy to solve.	<i>Low</i>
Priority High	An irregularity, which is not a safety issue, and is more serious and is more time and/or money consuming to solve.	<i>High</i>
Safety Issue	Issues which concern the safety of the people working in the turbine.	<i>Safe</i>


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3 General information

Wind turbine name:	Windpark Slufter West 6
Wind turbine type:	GE1.5S
Wind turbine S/N:	15401272
Location:	Rotterdam-Maasvlakte, NL
Hub height:	65
Nominal power [kW]:	1500
Year of installation:	2003
Date of inspection:	19-10-2015
Inspectors:	D. Lagerweij J. Langenbach


4 Wind turbine main components

Component	Type	Year	Serial number
Convertor	GE Power Convertor 151X1228KA02SA01	-	DS009VIA
Gearbox	Eickhoff CPNHZ-195 HLU / G 48960XA	-	18910 R1
Revision gearbox	-	-	-
Gearbox oil	Castrol Optigear Synthetic A 320	2007	-
Generator	Winergy JFEA-500SR-04A	2003	5133496
Blade 1	GE Rotor Blades	-	2325
Blade 2	GE Rotor Blades	-	2350
Blade 3	GE Rotor Blades	-	2360

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5 Documents

	Component	Remark	
1	Operator manual	<p>Operating manual is available at the turbine.</p> <p>Machine directive 2006/45/EC, 1.7.4.2 states as part of the Contents of instructions:</p> <p><i>"(e) the drawings, diagrams, descriptions and explanations necessary for the use, maintenance and repair of the machinery and for checking its correct functioning;"</i></p>	ok
2	Wiring diagram	<p>Wiring diagrams are not available at the turbine.</p> <p>Machine directive 2006/45/EC, 1.7.4.2 states as part of the Contents of instructions:</p> <p><i>"(e) the drawings, diagrams, descriptions and explanations necessary for the use, maintenance and repair of the machinery and for checking its correct functioning;"</i></p>	ok
3	Hydraulic diagram	<p>Hydraulic diagrams are not available at the turbine.</p> <p>Machine directive 2006/45/EC, 1.7.4.2 states as part of the Contents of instructions:</p> <p><i>"(e) the drawings, diagrams, descriptions and explanations necessary for the use, maintenance and repair of the machinery and for checking its correct functioning;"</i></p>	nok
4	Maintenance manual	<p>Maintenance manual is not available at the turbine.</p> <p>Machine directive 2006/45/EC, 1.7.4.2 states as part of the Contents of instructions:</p> <p><i>"(e) the drawings, diagrams, descriptions and explanations necessary for the use, maintenance and repair of the machinery and for checking its correct functioning;"</i></p>	nok
5	Logbook	<p>Logbook is available at the turbine.</p>	ok


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6 Logbook: Overview of recent maintenance






Year	Type of maintenance	Date of execution	Maintenance schedule
	Commissioning	09-2003	2003
...
9	1 year service	23-11-2012	2012
9½	½ year service	06-03-2013	
10	1 year service	29-08-2013	2013
10½	½ year service	05-05-2014	
11	1 year service	26-11-2014	2014
11½	½ year service	19-05-2015	
12	1 year service	<i>no service record</i>	2015


7 Logbook: Notable events

Date	Event
24-09-2007	Gearbox exchange
28-01-2009	Slip ring generator exchanged
11-09-2014	Leakage HSS repaired
12-05-2015	Replaced high speed bearings



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8 Tower and towerbase


Item	Remark		
1	Tower outside	<p>Light at the outside is broken and has damaged the paint of the tower.</p> 	<p> Low</p>
2	Controller overview	<p>UPS is not connected (1st picture).</p> 	<p> High</p>
3	Tower inside		<p>Info</p>
4	Miscellaneous		ok

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9 Yaw system


	Item	Remark	
1	Yaw section		ok
2	Yaw ring teeth	Yaw ring shows no irregularities. 	ok
3	Yaw pinions	Yaw pinions show no irregularities. 	ok







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4	Yaw gears	<p>The gear at the left at the front is polluted with oil. Some corrosion visible at the gear at the front at the right. Leakage at the gear at the rear.</p> 	 Low
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10 Nacelle






	Item	Remark	
1	Nacelle overview		Info
2	Frame	Turbine is equipped with a cast-iron frame.	Info


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3	Nacelle housing	<p>Parts of the insulation are damaged.</p> <p>Bolt connections of the nacelle frame are corroded (2nd picture).</p> 	<p>nok</p> <p>Low</p>
4	Weather station	<p>One (redundant) anemometer is damaged.</p> 	<p>Info</p>
5	Controller overview		<p>Info</p>


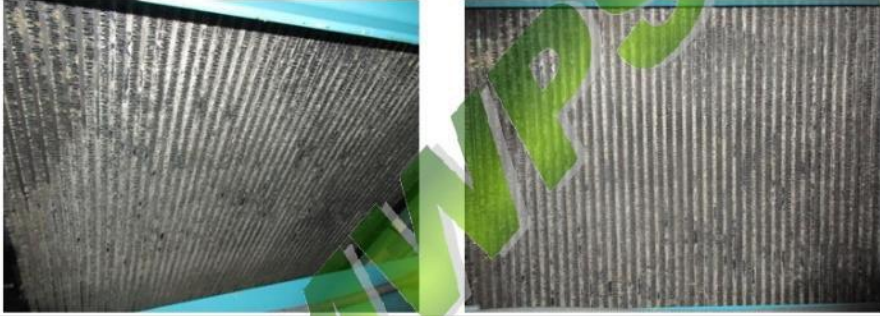


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11 Hydraulic system and brake

	Item	Remark	
1	Overview		Info
2	Leakage	<p>Hydraulic brake and the area around it are polluted with oil (1st and 2nd picture). The frame under the brake is also polluted (3rd picture).</p>   	<div style="text-align: center;">  High </div>
3	Miscellaneous		ok


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12 Gearbox and main shaft

	Item	Remark	
1	Main shaft bearings	<p>Grease of the main bearing is not magnetic.</p> 	ok
2	Radiators	<p>Parts of the radiator are covered with dust.</p> 	<div style="text-align: center;">  Low </div>
3	CCJ-unit	<p>No CCJ-filter present in the turbine.</p>	Info
4	Gear oil system		Info

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5	Hoses and pipes	<p>Pipe for draining the gearbox oil is leaking.</p> 	<p>nok High</p>
6	Paint / Corrosion		ok
7	General leakage	<p>Area around the oil level sensor and the heaters is polluted with oil. Drops of oil are visible at the connector of the sensor.</p> 	<p>nok High</p>
8	Slip ring for hub		Info


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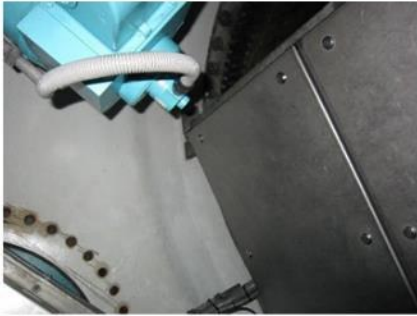







13 Generator and coupling

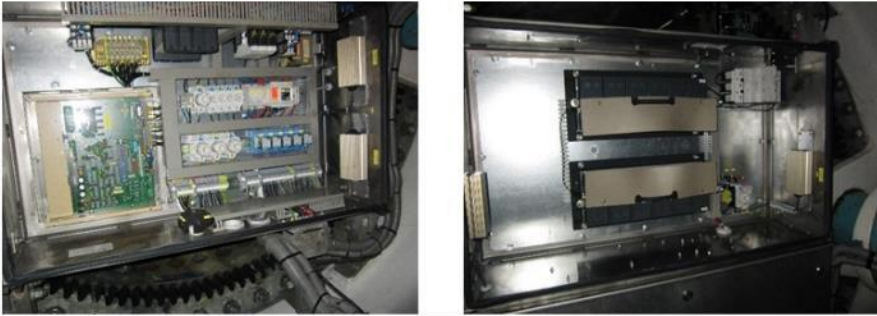


	Item	Remark	
1	Coupling	The coupling shows no irregularities. 	Info
2	Paint / Corrosion		ok
3	Slip ring	The slip ring shows no visual irregularities. 	Info


14 Hub

	Item	Remark	
1	Blade bearing	Several small cracks are visible at the caps of the blade bearing bolts. 	<div style="background-color: red; color: white; padding: 2px; display: inline-block;">nok</div> Low


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2	Overview inside	<p>In general, the hub is clean and there is no excessive corrosion present.</p> 	Info
3	Hub cabinet overview	<p>Inside of the cabinet shows no irregularities. One bolt connection of the cover is broken (2nd picture).</p>  	 Low
4	Boxes blade 1	<p>Sand is leaking at one fuse of the control box.</p>   	 Low


5	Boxes blade 2	<p>Control box and battery box show no irregularities.</p> 	ok
6	Boxes blade 3	<p>Control box and battery box show no irregularities.</p> 	ok
7	Mounting of the electrical boxes	<p>The mounting of the boxes shows no irregularities.</p> 	ok

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8	Pinions of pitch gears	<p>Wear on one tooth of the pinions of the pitch gears.</p> 	<p>not High</p>
9	Pitch teeth at zero of blade 1	<p>The tooth at zero shows wear.</p> 	<p>not High</p>
10	Pitch teeth at zero of blade 2	<p>The tooth at zero shows wear.</p> 	<p>not High</p>


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11	Pitch teeth at zero of blade 3	The tooth at zero shows wear.		<p style="text-align: center;">nok High</p>
12	Grease system pitch teeth	There is an automatic grease system present in the hub. The system is not operational.		<p style="text-align: center;">nok High</p>
13	Pitch gears	Some corrosion visible at the base of the pitch gears.		<p style="text-align: center;">nok Low</p>
14	Miscellaneous	The light in the hub is defect.		<p style="text-align: center;">nok Low</p>

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15 Rotor blades

1	Blades	<p>Repaired parts are visible on the leading edges of the blades.</p> 	Info
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16 Conclusion

The logbook shows that the turbine has been maintained on a regular basis, according to the maintenance schedule of GE.

The gearbox has been replaced in 2006 and the high speed bearings have been replaced in 2015. The original generator is present in the turbine.

The blades have been maintained recently.

The wear of the zero-tooth of the pitch ring is serious, but it is possible to solve this problem by assigning another tooth to be the zero-tooth. Dismounting and remounting of the blades is necessary to achieve this. The same thing can be done with the pinions, although replacing the pitch gears (with the pinions) is also an option.


The overall condition of the turbine is quite acceptable for a twelve year old turbine. There are however several issues (marked as **red** in this report) present and it is recommended to solve these, in order to improve the condition of the turbine.



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20-11-2015

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REPORT GEARBOX INSPECTION
SN 15401272, WINDPARK SLUFTER WEST 6



Report no. GE15002015016

24-11-2015

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1. Purpose


On behalf of Vattenfall an inspection has been executed on the wind turbine gearbox. The purpose of the inspection is to determine the technical state of the gearbox. The visual inspection of the gearbox has been executed with a GE Everest XLG3 Videoscoop.

2. General Information

Turbine Information	
Wind turbine name:	Windpark Slufter West 6
Wind turbine type:	GE1.5S
Wind turbine serial no:	15401272
Location:	Rotterdam-Maasvlakte, NL
Hub height:	65
Nominal power [kW]:	1500
Year of installation:	2003
Date of inspection:	19-10-2015
Inspectors:	D. Lagerweij J. Langenbach

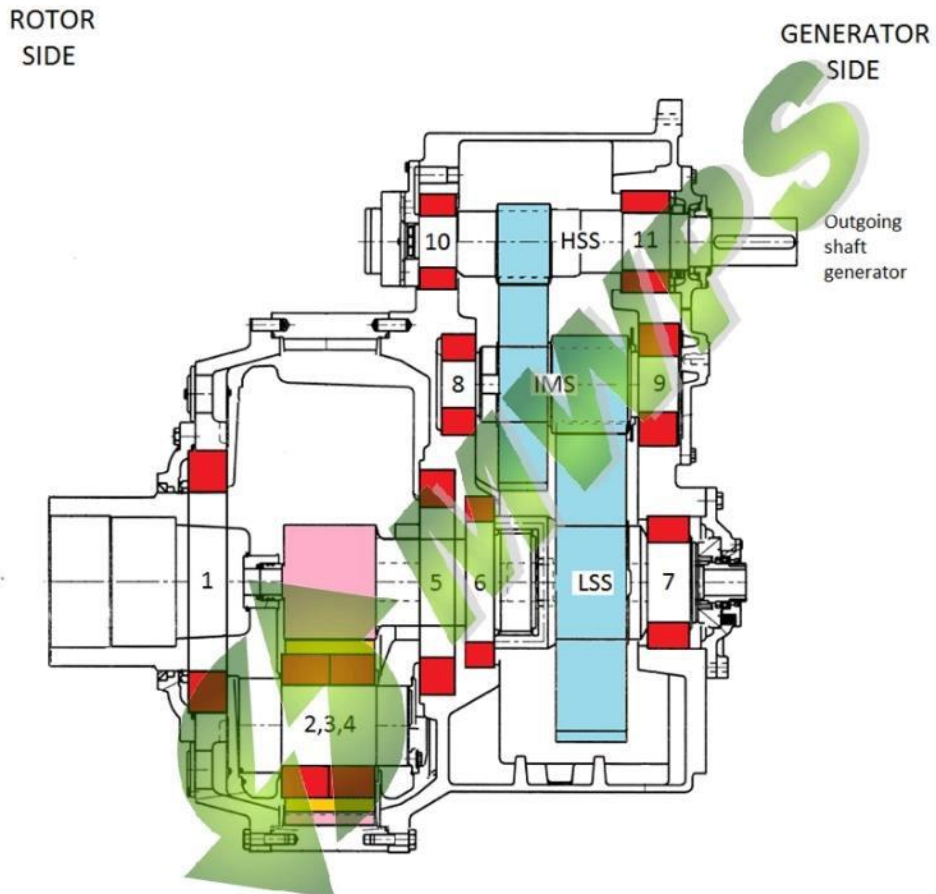
Gearbox Information	
Gearbox type:	Eickhoff CPNHZ-195 HLU / G 48960XA <i>i = 90,298</i>
Gearbox serial number:	18910 R1
Production year gearbox:	-
Revision:	-
Revision number:	-
Oil type:	Castrol Optigear Synthetic A 320
Date of last oil change:	at gearbox exchange

- **Gearbox has been exchanged in 2007**

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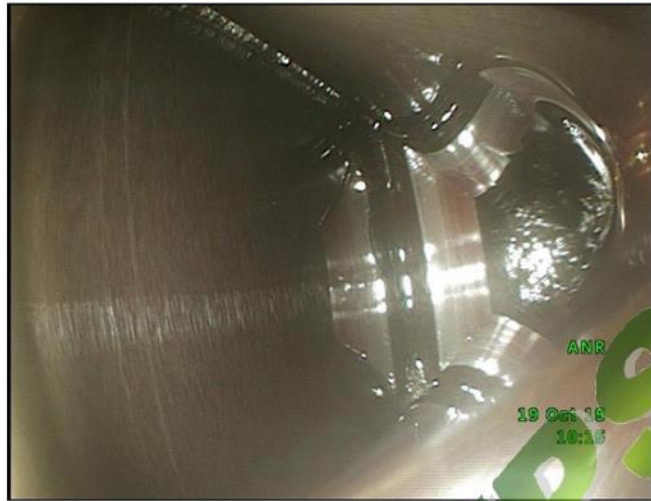
3. Reporting setup

The next drawing shows a cross-section of a planetary gearbox with two linear stages with corresponding bearing positions. The drawing should be used as a reference for the bearing position only.



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4. Inspection results



Picture 1

Picture 1 shows bearing position no. 1, the bearing of the planet carrier at rotor side. No irregularities.



Picture 2

Picture 2 shows the bearing of the first planet wheel. No irregularities.

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Picture 3

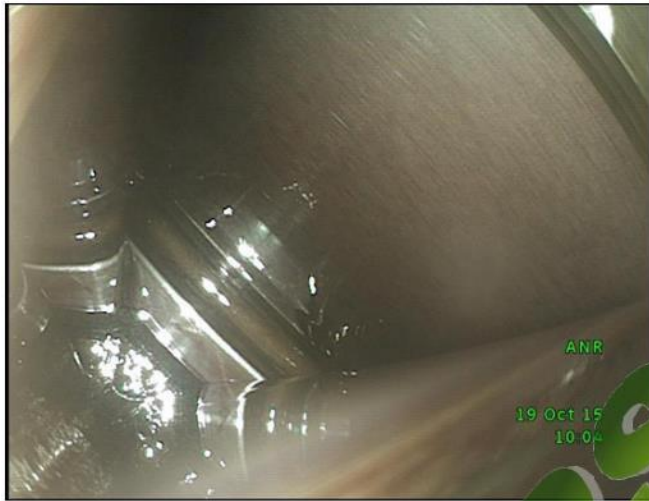
Picture 3 shows the bearing of the second planet wheel. Several significant indentations visible at the raceway.



Picture 4

Picture 4 shows the bearing of the third planet wheel. Several very small indentations visible at the raceway.

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Picture 5

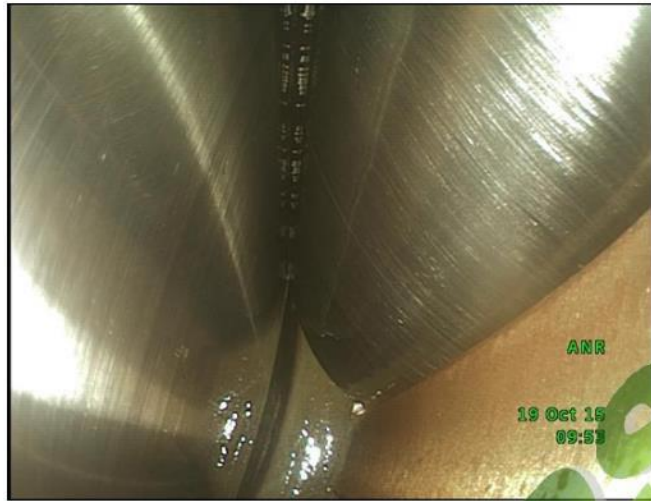
Picture 5 shows bearing position no. 5, the bearing of the planet carrier at generator side. The bearing shows no irregularities.



Picture 6

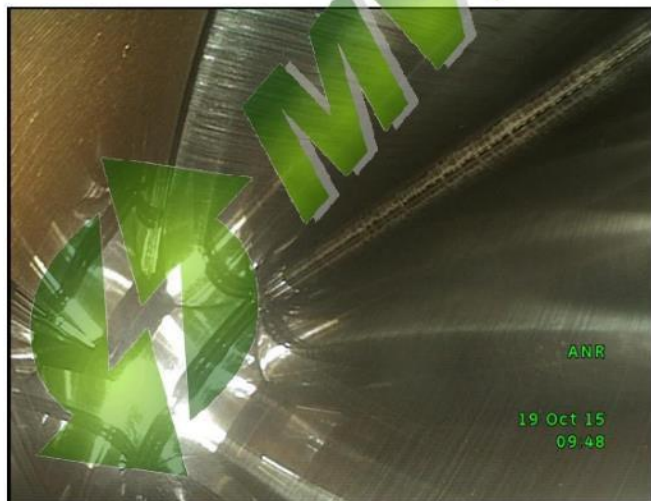
Picture 6 shows bearing position no. 6, the bearing of the low speed shaft at rotor side. The bearing shows no irregularities.

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Picture 7

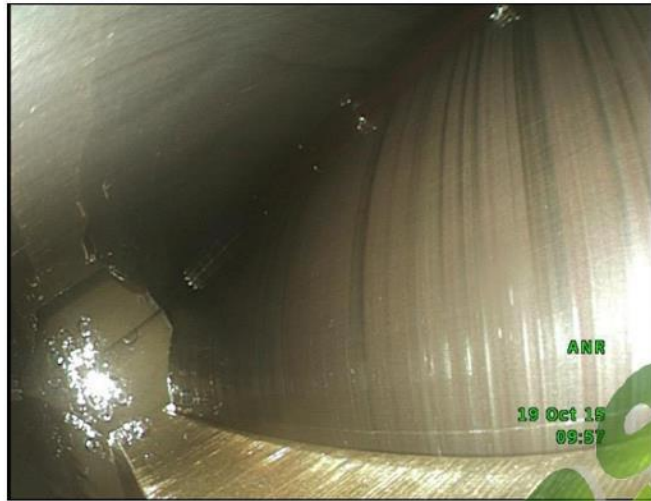
Picture 7 shows bearing position no. 8, the bearing of the intermediate shaft at rotor side. The bearing shows no irregularities.



Picture 8

Picture 8 shows bearing position no. 9, the bearing of the intermediate shaft at generator side. The bearing shows no irregularities.

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Picture 9

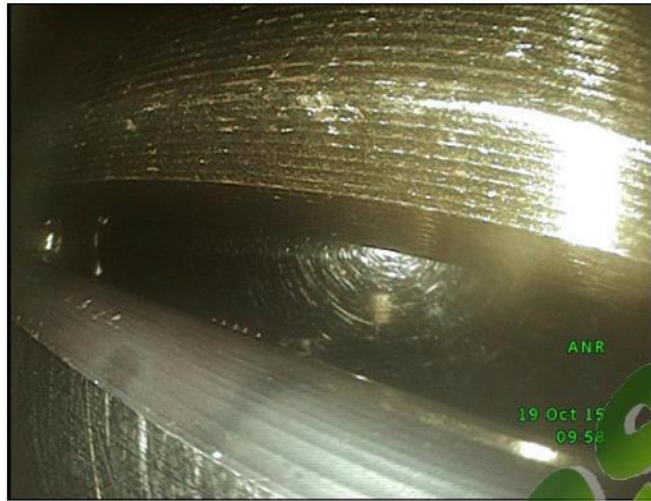
Picture 9 shows bearing position no. 10, the bearing of the high speed shaft at rotor side. The bearing shows no irregularities.



Picture 10

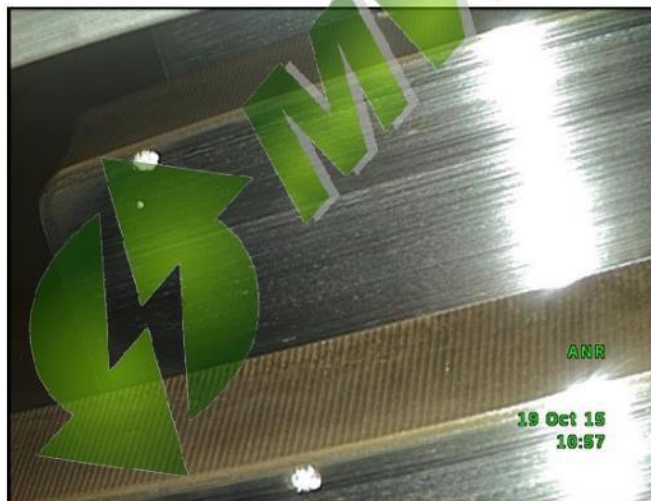
Picture 10 shows bearing position no. 11, the radial bearing of the high speed shaft at generator side. The bearing shows no irregularities.

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Picture 11

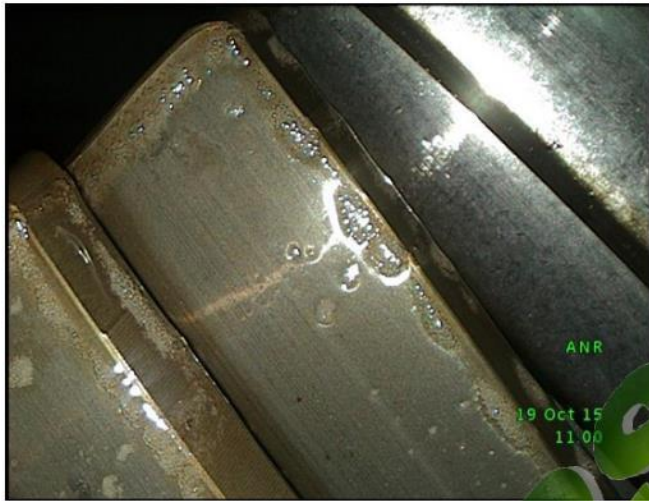
Picture 11 shows bearing position no. 11, the axial bearing of the high speed shaft at generator side. The bearing shows no irregularities.



Picture 12

Picture 12 shows the active flank of the ring gear. No irregularities.

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Picture 13

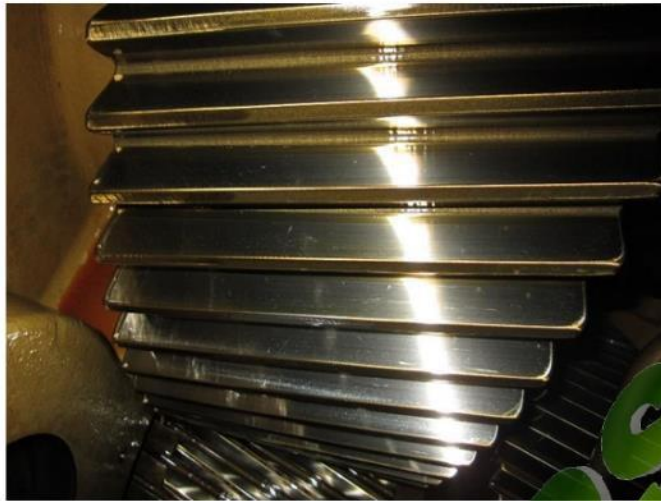
Picture 13 shows one of the planet wheels. None of the planet wheels show irregularities.



Picture 14

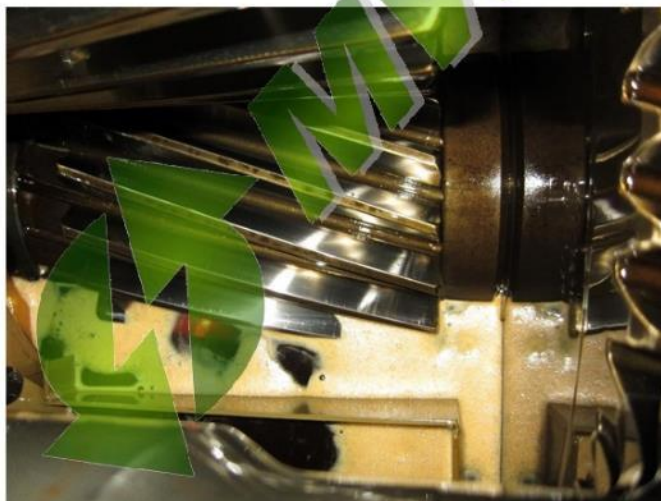
Picture 14 shows the active flanks of the sun pinion. No irregularities.

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Picture 15

Picture 15 shows the active flanks of the wheel of the low speed shaft in the linear stage. No irregularities.



Picture 16

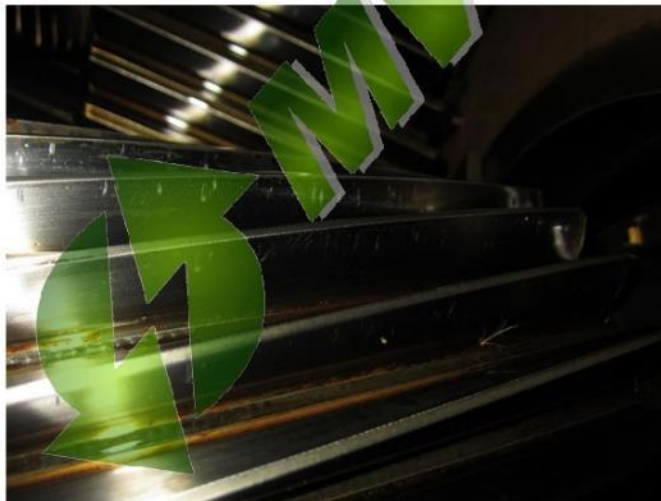
Picture 16 shows the active flanks of the pinion of the intermediate shaft in the linear stage. No irregularities.

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Picture 17

Picture 17 shows the active flanks of the wheel of the intermediate shaft in the linear stage. No irregularities.



Picture 18

Picture 18 shows the active flanks of the pinion of the high speed shaft in the linear stage. Several scratches visible on the active flank.

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Picture 19

Picture 19 shows the oil level of the gearbox. The oil level is correct.



Picture 20

The inside and bottom of the gearbox have been searched with a magnet. Two small steel particles were found.

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5. Summary

The bearing of the second planet wheel shows several significant indentations at the raceway.

The bearing of the third planet wheel shows several very small indentations at the raceway.

Two small steel particles were found by using a magnet.

No irregularities were found at the other inspected bearings and gears.

6. Conclusion

The condition of the gearbox is good enough to keep the gearbox in operation for this moment, but this gearbox has issues which will become a problem in the future.

The indentations at the planet wheel are a strong indication that there is a larger damage present somewhere in the bearing. The damage is probably located at the load bearing part of the inner ring. This part of the inner ring is not accessible for visual inspection.

An inspection interval with a maximum of 6 months is recommended to prevent additional damage at the gears of the gearbox box, caused by the steel particles from the damaged planet bearing.

Dennis Lagerweij

Barneveld, 24-11-2015

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