



# TeSuCon

Technical Support & Consultancy

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REPORT TURBINE INSPECTION  
SN 15401274, WINDPARK SLUFTER WEST 8



Report No. GE15002015008

20-11-2015

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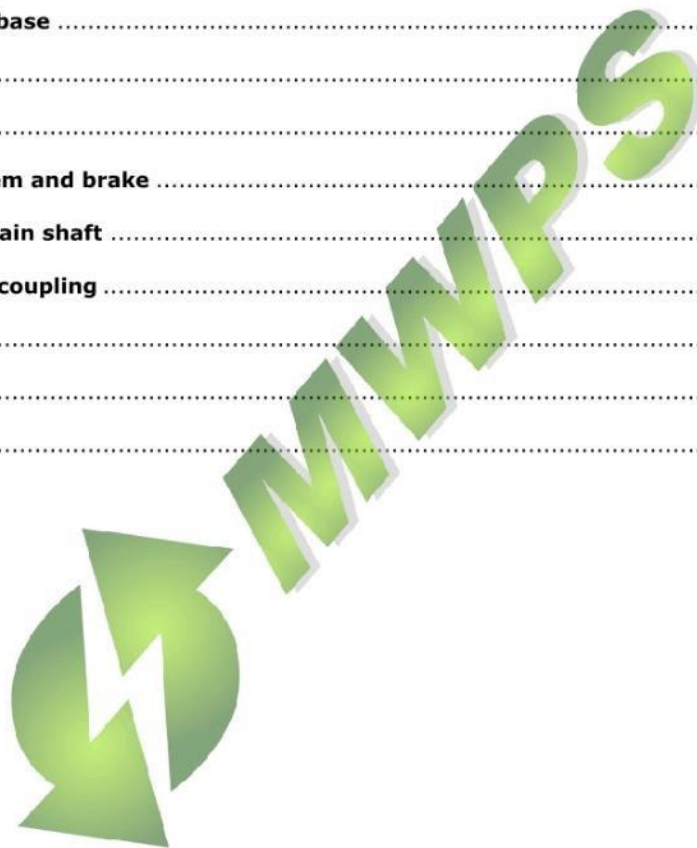
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## 1 Purpose


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
<b>nok</b>	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.

<b>Class</b>	<b>Clarification</b>	<b>Description in report</b>
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 8
Wind turbine type:	GE1.5S
Wind turbine S/N:	15401274
Location:	Rotterdam-Maasvlakte, NL
Hub height:	65
Nominal power [kW]:	1500
Year of installation:	2003
Date of inspection:	20-10-2015
Inspectors:	D. Lagerweij J. Langenbach


### 4 Wind turbine main components

Component	Type	Year	Serial number
Convertor	GE Power Convertor 151X1228KA02SA01	-	EW019VIA
Gearbox	Winergy PEAS 4390,2	-	4801084 - 0020 - 2
Revision gearbox	BGS Gear Service	2013	12113
Gearbox oil	Mobilgear SHC XMP 320	2013	-
Generator	VEM DASAA 5023-4UJ	2003	2345807
Blade 1	GE Rotor Blades	-	2445
Blade 2	GE Rotor Blades	-	2447
Blade 3	GE Rotor Blades	-	2369

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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 <b>use, maintenance and repair</b> 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 <b>use, maintenance and repair</b> 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 <b>use, maintenance and repair</b> 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 <b>use, maintenance and repair</b> of the machinery and for checking its correct functioning;"</i></p>	nok
5	Logbook	Logbook is available at the turbine.	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	19-11-2012	2012
9½	½ year service	18-03-2013	
10	1 year service	25-09-2013	2013
10½	½ year service	18-04-2014	
11	1 year service	02-12-2014	2014
11½	½ year service	20-05-2015	
12	1 year service	<i>no service record</i>	2015

**7 Logbook: Notable events**

Date	Event
08-08-2008	Coupling replaced and generator aligned
19-04-2013	Gearbox and main bearing exchanged




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**8 Tower and towerbase**


Item	Remark	
1	Tower outside	ok
2	<div style="display: flex; justify-content: space-around;">   </div>	Info
3	<div style="display: flex; justify-content: space-around;">   </div>	Info
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
4	Yaw gears	Paint work of the gears is not acceptable. 	<div style="color: red; font-weight: bold;">nok</div> Low

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**10 Nacelle**

	Item	Remark	
1	Nacelle overview		Info
2	Frame	Turbine is equipped with a cast-iron frame.	Info
3	Nacelle housing	Parts of the insulation are damaged. 	<div style="text-align: center;">             Low         </div>
4	Weather station		Info
5	Controller overview		Info


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### 11 Hydraulic system and brake

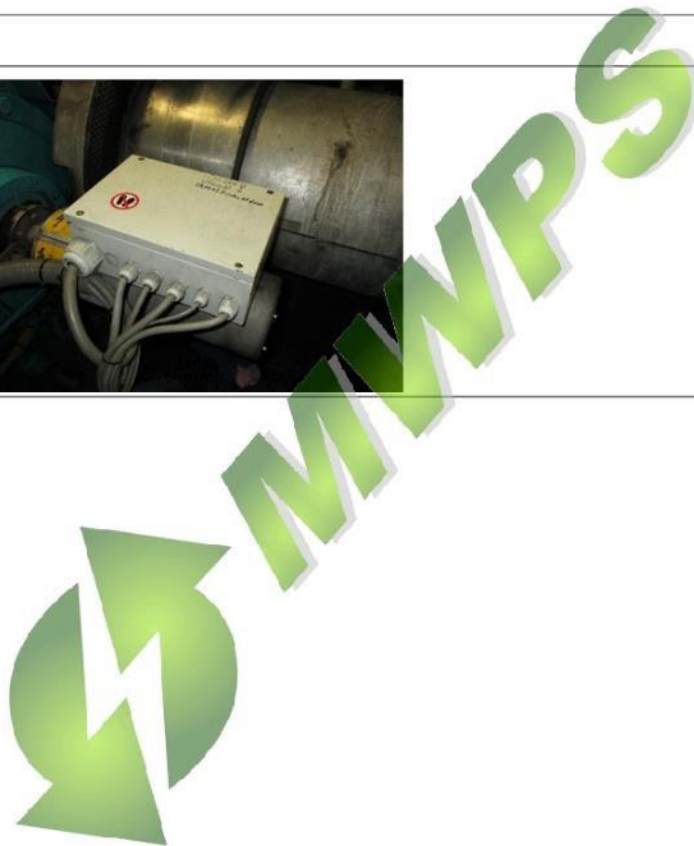
	Item	Remark	
1	Overview		<i>Info</i>
2	Leakage		ok
3	Miscellaneous		ok


### 12 Gearbox and main shaft

	Item	Remark	
1	Main shaft bearings	Grease of the main bearing is not magnetic. 	ok
2	Radiators	The radiator is polluted with dust. 	<b>NOK</b>  <i>Low</i>
3	CCJ-unit	No CCJ-filter present in the turbine.	<i>Info</i>

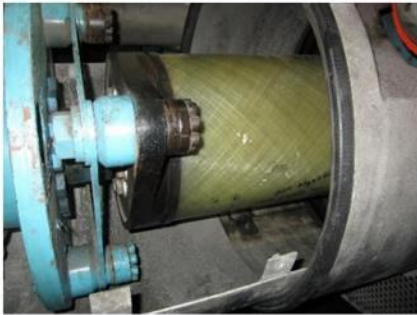



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4	Gear oil system		<i>Info</i>
5	Hoses and pipes		ok
6	Paint / Corrosion		ok
7	General leakage		ok
8	Slip ring for hub		<i>Info</i>



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### 13 Generator and coupling





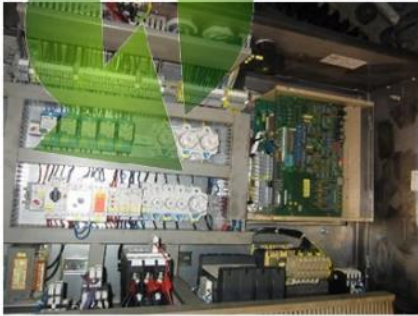
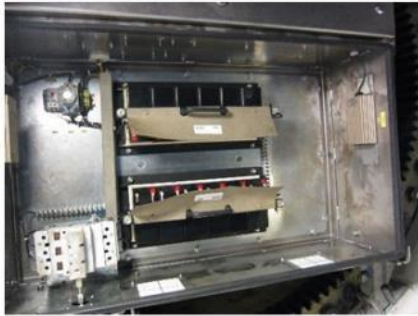
	Item	Remark	
1	Coupling	<p>Minor damage at the surface of the composite tube. It looks like handling damage and it is considered to be acceptable.</p> <div style="display: flex; justify-content: space-around;">   </div>	Info
2	Paint / Corrosion		ok
3	Slip ring	<p>The insulating parts between the phases are covered with black carbon dust.</p> <div style="display: flex; justify-content: space-around;">   </div>	<div style="text-align: center;"> <span style="color: red; font-weight: bold;">nok</span>              High         </div>
4	Miscellaneous		ok


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**14 Hub**


	Item	Remark	
1	Blade bearing	<p>Several caps of the nuts of the bearing are worn.</p> 	<p><b>ok</b> Low</p>
2	Overview inside	<p>In general, the hub is clean and there is no excessive corrosion present.</p> 	<p>ok</p>
3	Hub cabinet overview		<p>Info</p>
4	Boxes blade A	<p>Sand is leaking at one fuse of the control box.</p> 	<p><b>ok</b> Low</p>

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5	Boxes blade B	<p>Sand is leaking at one fuse of the control box.</p>   	<p><b>ok</b></p> <p>Low</p>
6	Boxes blade 3	<p>Control box and battery box show no irregularities.</p>  	<p>ok</p>
7	Mounting of the electrical boxes	<p>The mounting of the boxes shows no irregularities.</p>	<p>ok</p>

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8	Pinions of pitch gears	Wear on one tooth of the pinions of the pitch gears.  	 High
9	Pitch teeth at zero of blade 1	The tooth at zero shows wear.  	 High

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10	Pitch teeth at zero of blade 2	The tooth at zero shows wear. 		nok High
11	Pitch teeth at zero of blade 3	The tooth at zero shows wear. 		nok High
12	Grease system pitch teeth	There is an automatic grease system present in the hub. The system is not operational. 		nok High
13	Pitch gears			ok
14	Miscellaneous			ok

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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 and the main bearing have been replaced in 2013. 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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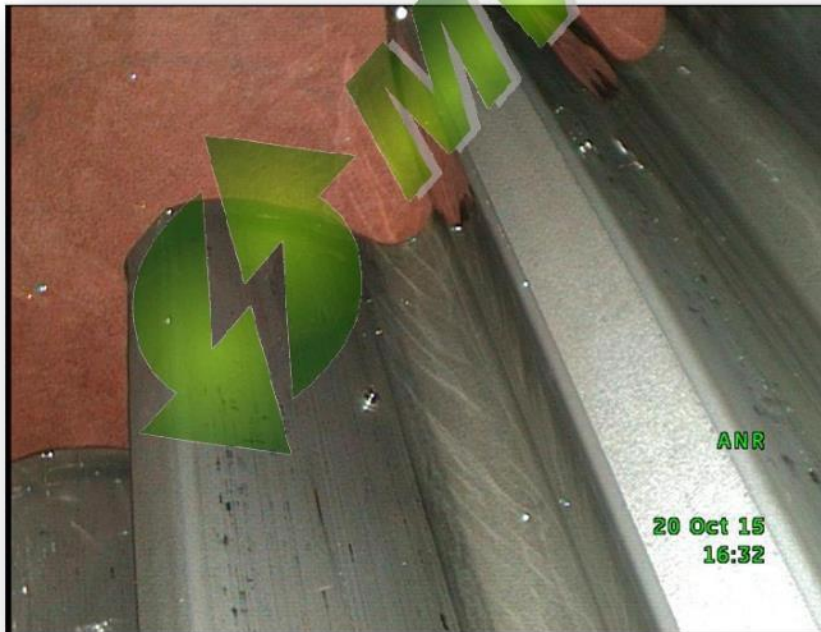


# TeSuCon

Technical Support & Consultancy

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REPORT GEARBOX INSPECTION  
SN 15401274, WINDPARK SLUFTER WEST 8



Report no. GE15002015018

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

<b>Turbine Information</b>	
Wind turbine name:	Windpark Slufter West 8
Wind turbine type:	GE1.5S
Wind turbine serial no:	15401274
Location:	Rotterdam-Maasvlakte, NL
Hub height:	65
Nominal power [kW]:	1500
Year of installation:	2003
Date of inspection:	20-10-2015
Inspectors:	D. Lagerweij J. Langenbach

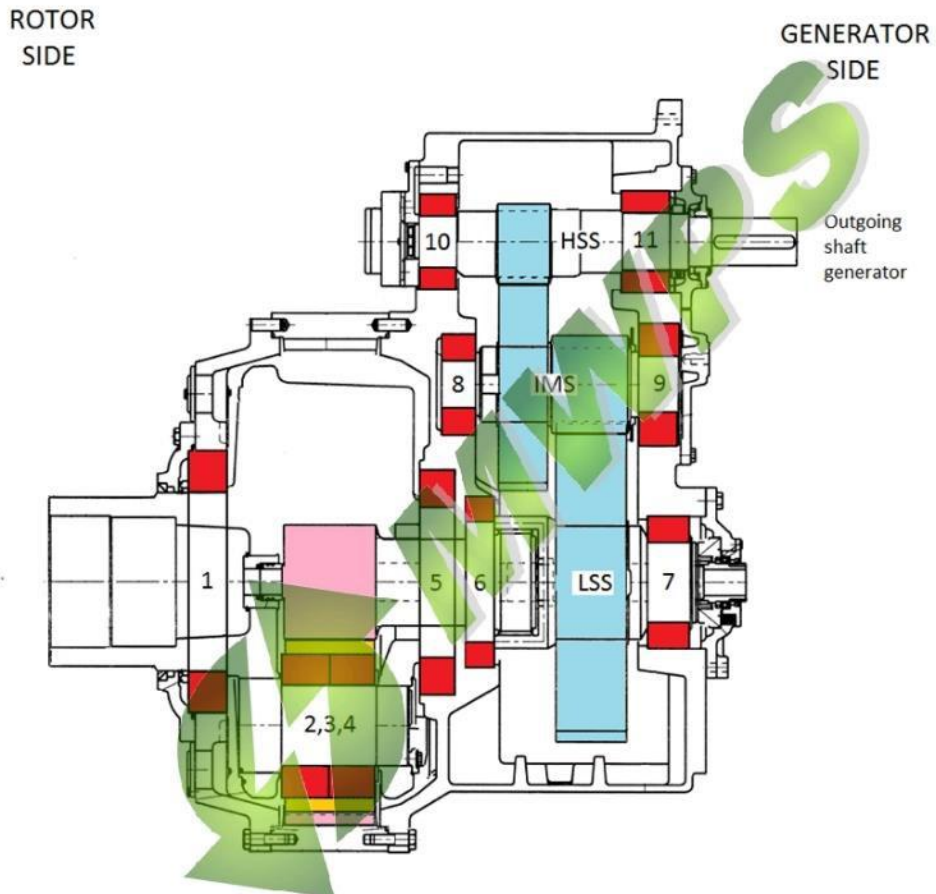
<b>Gearbox Information</b>	
Gearbox type:	Winergy PEAS 4390,2 <i>i = 90,302</i>
Gearbox serial number:	4801084 – 0020 – 2
Production year gearbox:	-
Revision:	BGS Gear Service 01-03-2013
Revision number:	12113
Oil type:	Mobilgear SHC XMP 320
Date of last oil change:	at revision

- **Gearbox has been exchanged in 2013**

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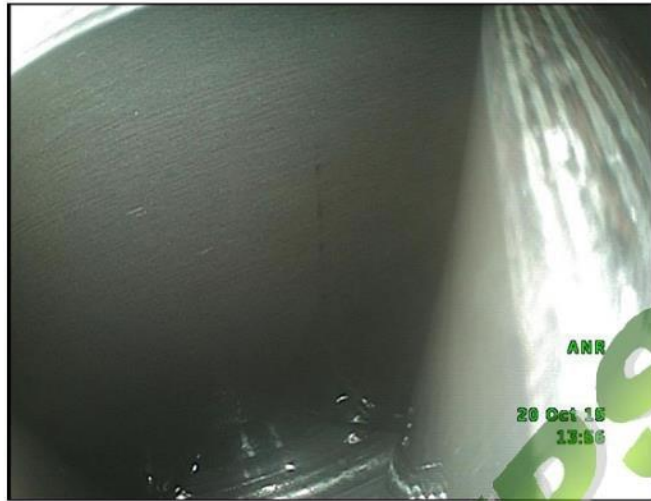
### 3. Reporting setup

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.



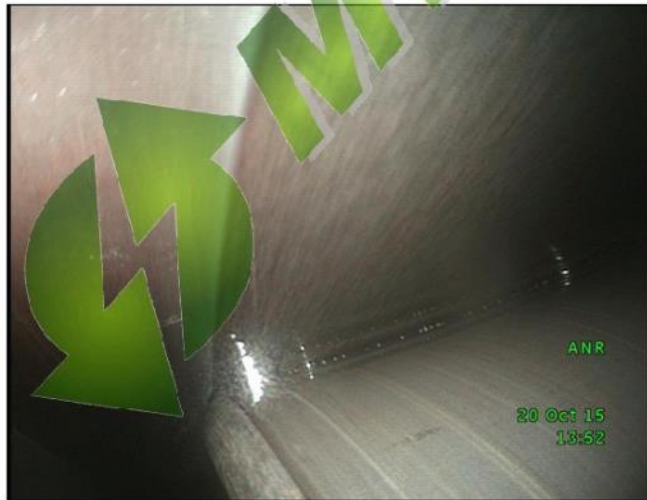
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#### 4. Inspection results



Picture 1

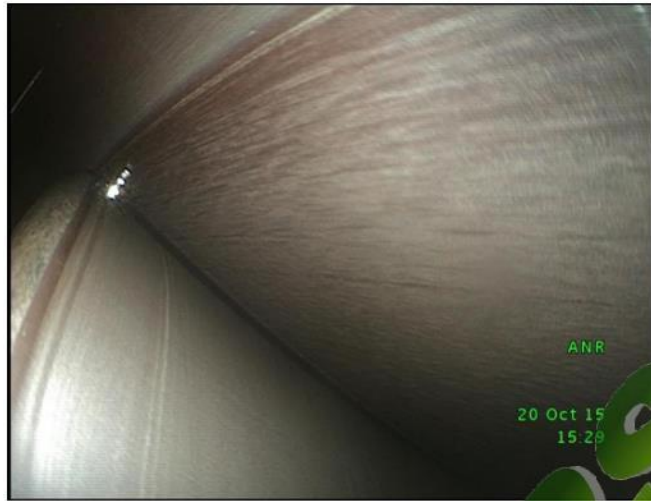
Picture 1 shows bearing position no. 1, the bearing of the planet carrier at rotor side. No irregularities.



Picture 2

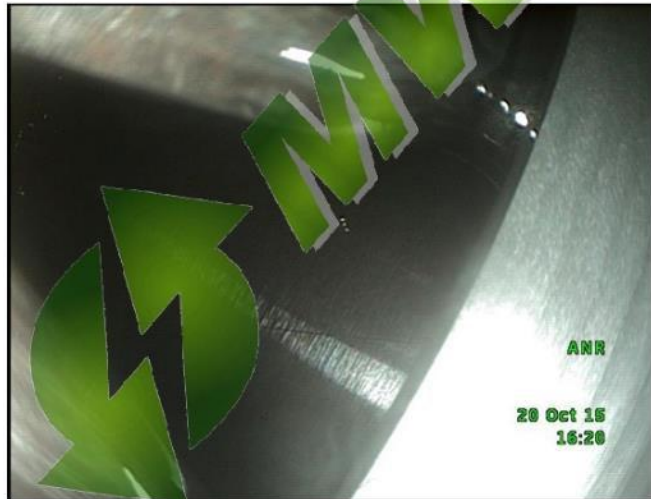
Picture 2 shows the bearing of the first planet wheel. No irregularities.

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**Picture 3**

Picture 3 shows the bearing of the second planet wheel. No irregularities.

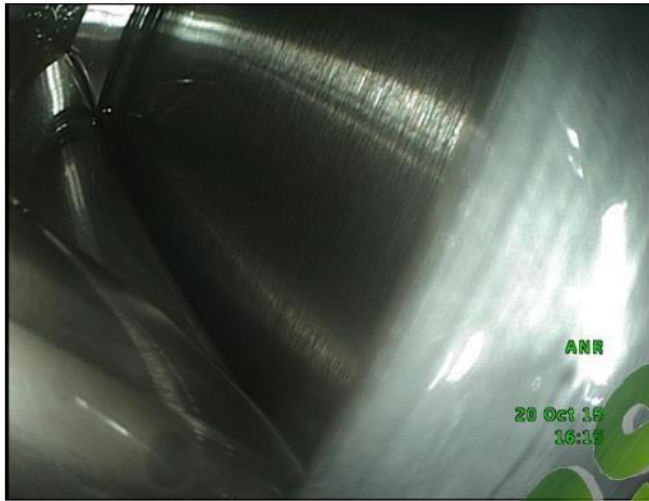


**Picture 4**

Picture 4 shows the bearing of the third planet wheel. No irregularities.

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**Picture 5**

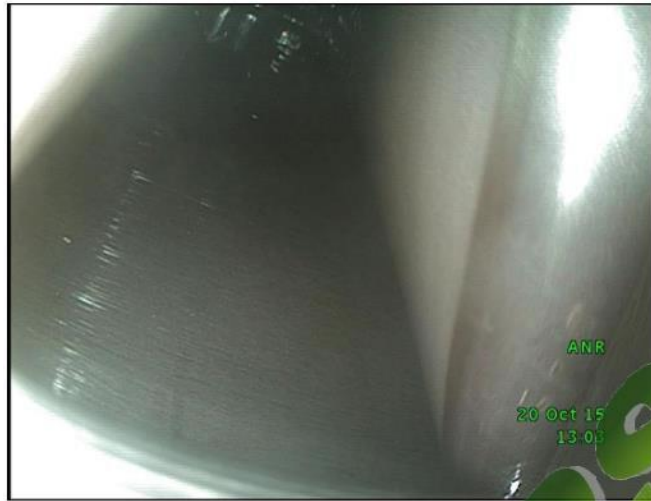
Picture 5 shows bearing position no. 5, the bearing of the planet carrier at generator side. The bearing shows no irregularities.



**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. 7, the bearing of the low speed shaft at generator side. The bearing shows no irregularities.



**Picture 8**

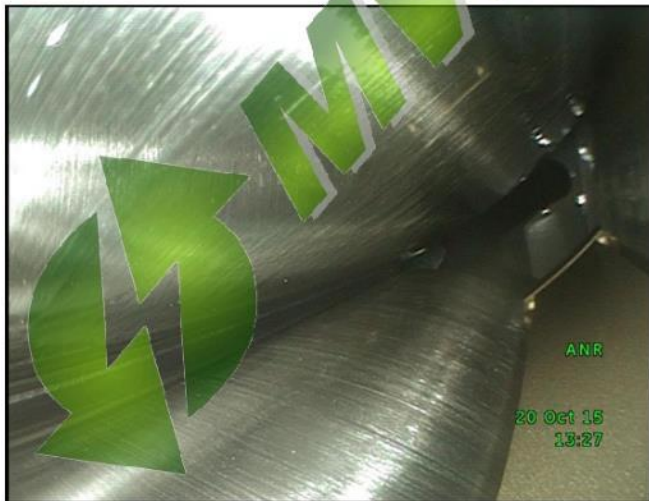
Picture 8 shows bearing position no. 8, the bearing of the intermediate shaft at rotor side. The bearing shows no irregularities.

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**Picture 9**

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



**Picture 10**

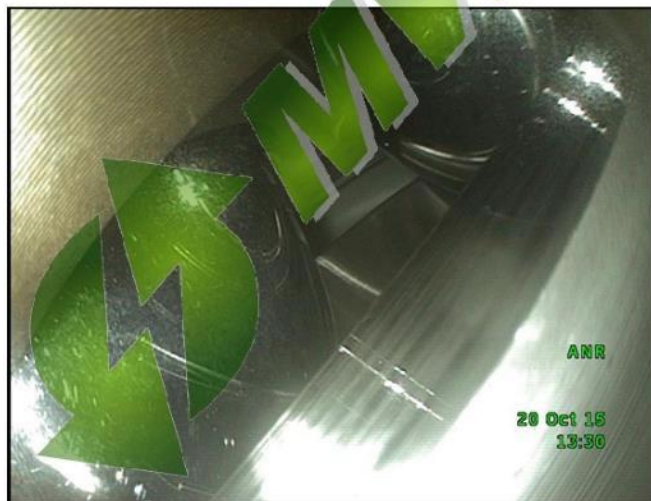
Picture 10 shows bearing position no. 10, the bearing of the high speed shaft at rotor side. The bearing shows no irregularities.

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**Picture 11**

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



**Picture 12**

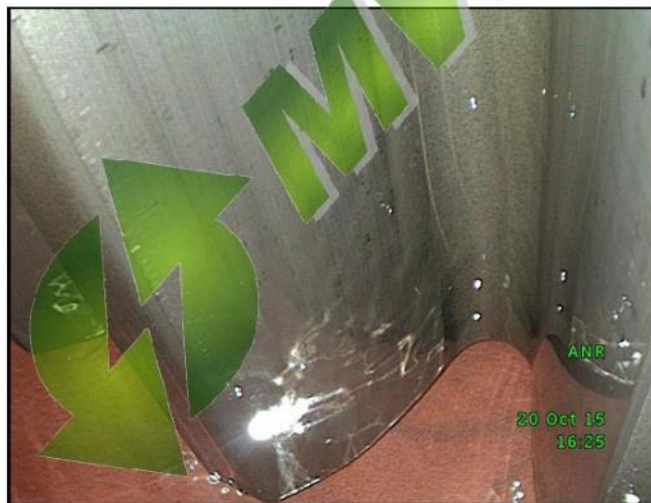
Picture 12 shows bearing position no. 11, the axial bearing of the high speed shaft at generator side. The bearing shows no irregularities.

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**Picture 13**

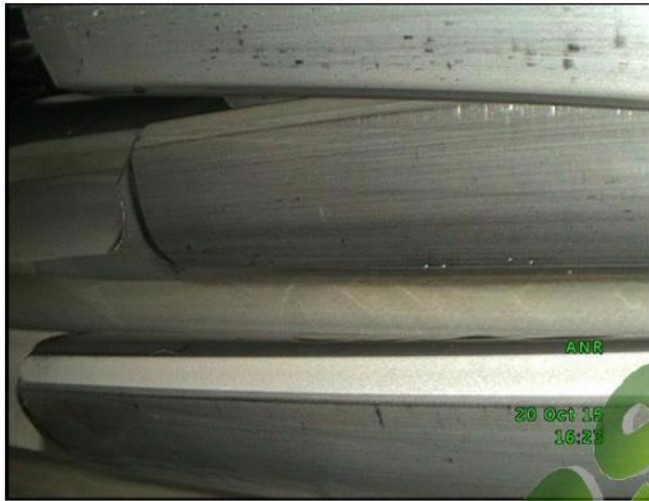
Picture 13 shows the active flank of the ring gear. Small repeating irregularity visible at the flanks.



**Picture 14**

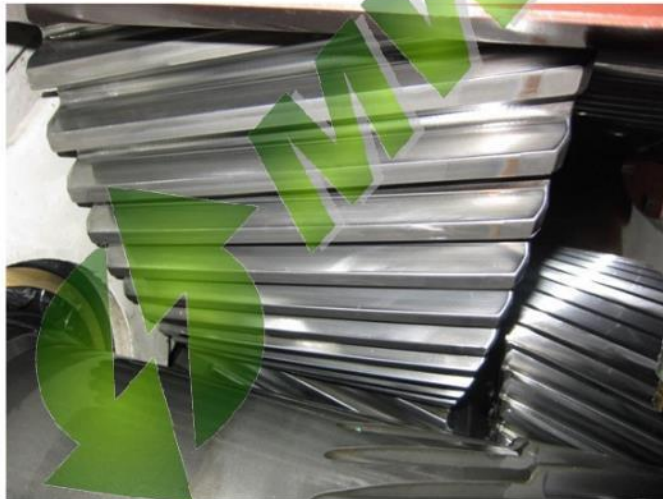
Picture 14 shows one of the planet wheels. None of the planet wheels show irregularities.

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**Picture 15**

Picture 15 shows the active flanks of the sun pinion. No irregularities.



**Picture 16**

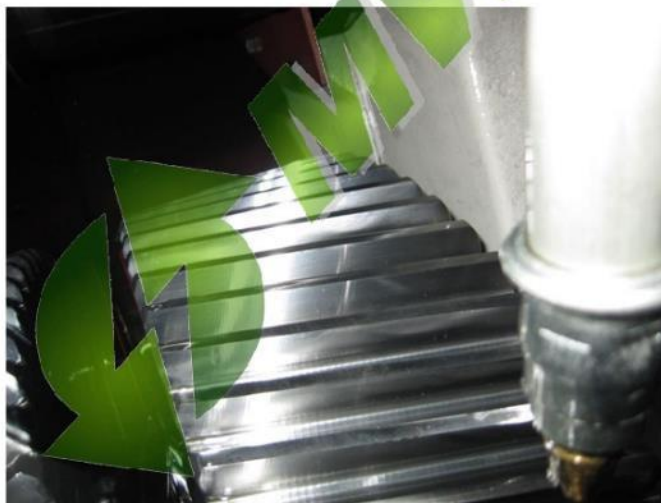
Picture 16 shows the active flanks of the wheel of the low speed shaft in the linear stage. No irregularities.

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**Picture 17**

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



**Picture 18**

Picture 18 shows the active flanks of the wheel of the intermediate shaft in the linear stage. No irregularities.

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Picture 19

Picture 19 shows the active flanks of the pinion of the high speed shaft in the linear stage. No irregularities.



Picture 20

Picture 20 shows the oil level of the gearbox. The oil level is correct.

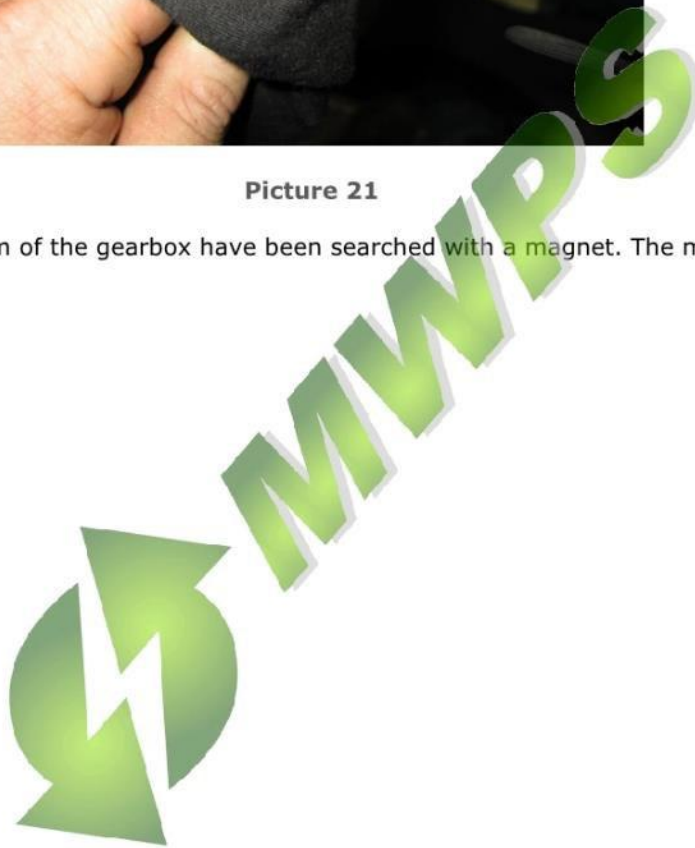
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Picture 21

The inside and bottom of the gearbox have been searched with a magnet. The magnet shows no steel particles.



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## 5. Summary

The active flank of the ring gear shows a small repeating irregularity at each flank.

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

The oil level is correct and no steel particles were found in the gearbox.

## 6. Conclusion

The condition of the gearbox is acceptable.

The small irregularities at the flanks of the ring gear were probably generated before the gearbox was revised in 2013. It is likely that the gear has been re-used. There is no reason to assume that an active defect is present at this moment. The clean magnet supports this conclusion.

Dennis Lagerweij

Barneveld, 24-11-2015

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