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Date:	**Our reference**:	**Your reference**:
2019-12-16	DNV GL Doc. No.: LTR-139102-20191216	Ellen Hyldgaard

Verification Letter

Vestas V105/V112/V117-3.45/3.60 MW, V126-3.45 MW LTq wind turbines – Design Evaluation of Winergy gearbox PZAJ3530,1 with i=104.9 and i=112.632 (with journal bearings)

Dear Mrs. Ellen Hyldgaard,

DNV GL has reviewed the documentation listed in the Appendix 1 of this verification letter for Winergy gearbox PZAJ3530,1 with a ratio of i=104.9 and 112.632 (with journal bearings) for use in Vestas V105/V112/V117-3.45/3.60 MW and V126-3.45 MW LTq wind turbines. The documentation is found to be in compliance with IEC 61400-4 Ed.1 for Design Evaluation.

The Winergy gearbox PZAJ3530,1 with i=104.9 and 112.632 shows sufficient static and fatigue strength.

This gearbox Winergy PZAJ3530,1 is intended to be included in the next revisions of

Wind Turbine Type	**DNV GL Type Certificate**
Vestas V105-3.45 MW / V105-3.60 MW Vestas V105-3.3 MW / V105-3.45 MW (BWC) Vestas V105-3.3 MW / V105-3.45 MW	TC-DNVGL-SE-0074-01306-1
Vestas V112-3.45 MW / V112-3.60 MW Vestas V112-3.3 MW / V112-3.45 MW (BWC)	TC-DNVGL-SE-0074-00870-5
Vestas V117-3.45 MW / V117-3.60 MW Vestas V117-3.3 MW / V117-3.45 MW (BWC)	TC-DNVGL-SE-0074-00820-4
Vestas V126-3.45 MW LTq Vestas V126-3.3 MW / V126-3.45 MW (BWC)	TC-DNVGL-SE-0074-00337-6

Wind Turbine Type	DNV GL Maschinengutachten
Vestas V112-3.3 MW / V112-3.45 MW	M-00908-4
Vestas V117-3.3 MW / V117-3.45 MW	M-00852-3
Vestas V126-3.3MW / V126-3.45MW	M-00808-7

Due to possible ongoing assessment of other items, with direct or indirect technical interfaces to the scope mentioned above, further need for evaluation may arise.

Sincerely
for Germanischer Lloyd Industrial Services GmbH

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Appendix 1 - List of reviewed documentation:

Basis for the evaluation

Applied codes and standards:

Document No.	Revision	Title
IEC 61400-4	Ed. 1 (2012)	Wind turbines – Part 4: Design requirements for wind turbine gearboxes

The evaluation has been based on the following loads, design basis as well as other specific criteria:

Document No.	Revision	Title
0034-8236	05	3MW Mk2A Design Loads Envelope, V112/V117/V126 3.3MW
0034-8236	06	3MW Mk2A Design Loads Envelope, V112/V117/V126 3.3MW
0034-8236	07	3MW Mk2A Design Loads Envelope, V112/V117/V126 3.3MW
-	-	Mk3A Load Envelope (several .txt files dated 06.10.2016)
0001-6728	05	General Design Requirement Specification for Gearboxes
0002-7568	09	3MW Platform – Requiremnet Specification – Component Design RS for Vx Gearboxes

Documentation from customer

List of reports:

Document No.	Revision	Title
P5F00735428		Gear calculation (ISO 6336)
P5F00735428		Gears
P5F00735429		KA calculation
P5F00735430		RIKOR-Calculations
P5F00735431		Fatigue, Rupture, Scuffing, Yield
P5F00735433		Shaft-wheel-connections
P5F00735435		Circlips
P5F00735436		Shrink fits
P5F00735437		Shafts
PZAJ3530,1	-	Concept Design Review – Journal bearing
CAE-FEM 295	2	Bearings
84-121-433/2013	8	Bearing calculation for a Wind Turbine Gearbox Winergy PZAB 3530,1 for Vestas Vx MK3A (from SKF)
383923		Winergy Project PZAB3530.1 – V105/112/117/126Mk3a Bearing Calculations i=104.905i=112.632 (from Timken)
PZAB 3530,1 i=104,9 & i=112,6, Vestas		Calculation / Installation Proposal (from FAG)
P5F00735439		Structure elements
P5F00735440		Planet carriers
P5F00735441		Torque arm
P5F00853218		Flanges
P5F00735442		Screws and pins calculation
P5F00735443		Loss power calculation
P5F00735444		Teeth-couplings
P5F00735445		Teeth frequencies
P5F00735446		Drive train analysis
P5F00735447		Torque Arm Pin
0037-8458	1	Strength verification report, 3.3 MW Mk2 V112/V117/V126 Gear stay blocks and M48 bolts
0037-8459	00	3MWMk2 CenterPart GlobalModel
0021-9963	03	Drive Train Acoustics & Vibration Test - WTG

Document No.	Revision	Title
0026-9201	01	DT prototype WTG field observation
0070-4104	00	DVRE Type Testing PZAJ3530.1 (by Vestas)

List of drawings:

Document No.	Revision	Title
A5E37780806A	AA	Overview drawing
A5E38116129A	AA	Assembly – drawing
6355872	A	Lubrication system (see ass.-dwg.)
6355871		Painting Drawing
6355870		Spare Part Drawing
6355874	B	Housing
6355873		Housing
6358081		Pinion, Part No. 100 (i= 112,632)
6360615		Pinion, Part No. 100 (i= 100,735)
A5E37409682A	AA	Pinion, Part No. 227
A5E37409952A	AA	Pinion, Part No. 327
6238037	B	Pinion, Part No. 400
A5E37376225A	AA	Wheel, Part No. 206
A5E36586075A	AE	Wheel, Part No. 241
A5E37385699A	AA	Wheel, Part No. 306
A5E36588490A	AE	Wheel, Part No. 341
6358072	B	Wheel, Part No. 402, (i= 112,632)
6360617	A	Wheel, Part No. 402, (i= 100,735)
6358004		Torque arm, Part No. 202
6358005	A	Torque arm, Part No. 202
A5E36728055A	AB	Planet carrier, Part No. 253
A5E36588532A	AB	Planet carrier, Part No. 353
A5E36586070A	AA	Planet shaft, Part No. 239
A5E36588478A	AB	Planet shaft, Part no. 339
6244767	A	Bearing cover, Part No. 130
A5E3761416A	AB	Bearing cover, Part No. 201
6238042	C	Bearing cover, Part No. 218
6344536		Bearing cover, Part No. 430
6238025	H	Flange, Part No. 201
6238024	C	Flange, Part No. 201
6238040	K	Flange, Part No. 301
6238044	C	Flange, Part No. 301
6238026_	C	PZAB3530,0 T202 raw part
6358005	A	PZAB3530,1 T202 raw part
6359872_	A	Pin
10208218	07	Gear stay block upper drawing
10208219	06	Gear stay block lower drawing
085133	01	Gear Stay block, Casted
10209593	03	Gear Stay block upper BFC
29010905	00	Gear Stay block raw material
A5E36592868A	AA	Slide Bearing
A5E36592982A	AB	Slide Bearing
A5E37720156A	AA	Stator, Part No. 270
A5E37704504A	AA	Stator, Part No. 370
A5E34985173A	002	PINION SHAFT RP 550.0/3.393
6407844	004	CYL GEAR LP 550.0/3.393

List of specifications/manuals/instructions:

Document No.	Revision	Title
P5F00735421		Winergy Spezifikation
P5F00735422		Customer specification
P5F00735423		Declaration of component manufacturer
0001-6728	05	Genearal Design Requirement Specification for Gearboxes
0002-7568	05	Component Requirement Specification Main Gearbox - Vx Platform
1000 en 07/2016	7.00	Gearbox for win-energy conversion systems
P5F06083286	001	Technical data Operating and Maintenance VESTAS PZAJ3530,1

List of documents taken for information only:

Document No.	Revision	Title
ER-DB-SE0074-00785	0	Calculation procedure for journal bearings
0043-6076	06	Replacement of gearbox
P5F04402887	0	Inspection report Gear unit PZAJ 3510,1 4.874.417-110 / 210