



Certificate No.

IECRE.WE.TC.19.0026-R1

IECRE - IEC System for Certification to Standards Relating to Equipment for Use in Renewable Energy Applications

TYPE CERTIFICATE

Wind Turbine

This certificate is issued to

Vestas Wind Systems A/S
Hedeager 42
8200 Aarhus N
Denmark

for the wind turbine

Vestas V116-2.0 MW 60 Hz Mk11

wind turbine class (class, standard, year)

WT class S, IEC 61400-1:2005+Amd1: 2010

This certificate attests compliance with IEC 61400 Series as specified in subsequent pages . It is based on the following reference documents:

Design basis evaluation conformity statement
Dated

DB-DNVGL-SE-0074-03923-0
2019-09-18

Design evaluation conformity statement
Dated

IECRE.WE.CS.19.0007-R1
2019-10-25

Type test conformity statement
Dated

TT-DNVGL-SE-0074-03925-0
2019-09-18

Manufacturing conformity statement
Dated

ME-DNVGL-SE-0074-03926-0
2019-09-18

Final evaluation report
Dated

FER-TC-DNVGL-SE-0074-03924-1
2019-10-25

The conformity evaluation was carried out in accordance with the rules and procedures of the IECRE System www.iecre.org

The wind turbine type specification begins on page 2 of this certificate.

Changes in the system design or the manufacturer's quality system are to be approved by the Certification Body. Without approval, the certificate loses its validity.

This certificate is valid until:
2024-09-17

Approved for issue on behalf of the IECRE
Certification Body:



Renewables Certification
Brooktorkai 18
20457 Hamburg, Germany

Mark Wollenberg/Bente Vestergaard:
Project Manager/Service Line Leader:
Hellerup 2019-10-25



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Machine parameters:

Power regulation:	Pitch-controlled
Rotor orientation:	Upwind
Number of rotor blades:	3
Rotor tilt:	6°
Cone angle:	-3°
Rated power:	2000 kW
Rated wind speed V_r :	9.1 m/s
Rotor diameter:	116 m
Hub height(s):	80m, 95m 124m
Hub height operating wind speed range $V_{in} - V_{out}$:	3 m/s – 20 m/s
Design life time:	20 years
Software version:	2018.13

Wind conditions:

Characteristic turbulence intensity I_{ref} at $V_{hub} = 15$ m/s:	0.14
Annual average wind speed at hub height V_{ave} :	8.5 m/s
Reference wind speed V_{ref} :	36.2 m/s
Mean flow inclination:	8°
Hub height 50-year extreme wind speed V_{e50} :	50.68 m/s

Electrical network conditions:

Normal supply voltage and range:	34.5 kV
Normal supply frequency and range:	60 Hz
Voltage imbalance:	< 3%
Maximum duration of electrical power network outages:	Not design driving
Number of electrical network outages	Max 120 times per year



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Other environmental conditions (where taken into account):

Design conditions in case of offshore WT (water depth, wave conditions, salinity, etc.):	NA
Normal and extreme temperature ranges:	<u>Normal temperature turbine</u> Normal temperature: -20°C to +45°C Extreme temperature: -40°C to +50°C
Relative humidity of the air:	<u>Low temperature turbine (LT)</u> Normal temperature: -30°C to +45°C Extreme temperature: -40°C to +50°C 100% (max. 10% of the lifetime)
Air density:	1.225 kg/m ³ * * Note for LT: The -30°C minimum operating temperature has been verified for loads and structural integrity by considering an air density of 1.325 kg/m ³ The turbine shall resist solar radiation (including UV) with 1000 W/m ² throughout the design lifetime
Solar radiation:	Designed acc. to IEC 61400-24, Protection Level I
Lightning protection system (standard and protection class):	
Earthquake model and parameters (standard and key parameters e.g. spectrum, model, seismic zone, soil class, etc.):	NA
Other design conditions (such as sand-storm):	NA



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Major components:

**If not otherwise stated, the certificate holder is the manufacturer.

Blade:

Type:	Structural shell
Material:	Carbon and pre preg glass fibre reinforced epoxy construction
Blade length:	57 m
Number of blades:	3
Manufacturer:	Vestas Wind Systems A/S
Drawing / Data sheet / Part No.:	0063-9573.V06

Blade bearing:

Type:	3 row roller bearing
Manufacturer:	TMB
Drawing / Data sheet / Part No.:	29099950.V01

Pitch System:

Motor / Actuator Type:	Hydraulic
Pitch Controller Type:	Hydraulic
Manufacturer:	LJM, Glual and Hengli

Main shaft:

Type:	Forged hollow trumpet shaft
Manufacturer:	Taewoong
Material:	42CrMo4
Drawing / Data sheet / Part No.:	29085835

Main bearing:

Type:	Two double row spherical roller bearing
Manufacturer:	SKF
Drawing / Data sheet / Part No.:	230/630 CA/HM2 W33 24188 ECA/HM2 W33



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Type: Two double row spherical roller bearing
Manufacturer: KOYO
Drawing / Data sheet / Part No.: 230/630 RHAW33T
24188 RHAW33

Type: Two double row spherical roller bearing
Manufacturer: FAG
Drawing / Data sheet / Part No.: F-582558.PRL-WPO
F-582559.PRL-WPO

Gearbox:

Type: 3 stage planetary gearbox
Gear Ratio: 1:89.75
Manufacturer: Winergy
Drawing / Data sheet / Part No.: PEAB 4440

Type: 3 stage planetary gearbox
Gear Ratio: 1:89.8
Manufacturer: ZF
Drawing / Data sheet / Part No.: Atlas 1.21

Yaw System:

Drive Type: Electrical motor
Manufacturer: ABB or Lafert
Drawing / Data sheet / Part No.: 29095420

Bearing Type: Friction Bearing (PETP slide plate)
Manufacturer: Vestas Wind System A/S
Drawing / Data sheet / Part No.: 29095702.V00

Gear Type: Planetary-/worm gear combination,
3 step planetary / 1 step worm gear
Manufacturer: Bonfiglioli or Comer
Drawing / Data sheet / Part No.: 29014048(left) / 29014049(right)



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Brake Type: Friction brake, motor brake included in the motor unit
Manufacturer: ABB or Lafert (motor brake)
Drawing / Data sheet / Part No.: 29094938

Generator:

Type: Asynchronous generator with wound rotor
Manufacturer: Vestas wind system A/S
Drawing / Data sheet / Part No.: DVSG 500/6M/V2
0069-4743.V01
Rated Power: 2260 kW
Rated Frequency: 60 Hz
Rated Speed: 1344 rpm
Max. speed: 2600
Rated Voltage: 690 V
Rated Current: Stator 1945 A
Insulation Class: H/H
Degree of Protection: IP 54

Converter:

Type: Full-quadrant IGBT converter
Manufacturer: Vestas Wind Systems A/S
Drawing / Data sheet / Part No.: 0042-3461.V06
Rated Voltage (grid side): 480 V
Rated Current (grid side): 300A
Degree of Protection: IP 54

Transformer:

Type: Dry-type transformer
Manufacturer: SGB
Drawing / Data sheet / Part No.: DTTHIL 1600/30
0056-7859.V00
Rated Voltage: 34.5 kV
Rated Power: 2300 kVA
Degree of Protection: IP00



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Location:	Nacelle rear
Type:	Dry-type transformer
Manufacturer:	Siemens
Drawing / Data sheet / Part No.:	4GT6499-8ZY, Basic+ 0056-7859 V00
Rated Voltage:	34.5 kV
Rated Power:	2300 kVA
Degree of Protection:	IP00
Location:	Nacelle rear
Type:	Dry-type transformer
Manufacturer:	JST
Drawing / Data sheet / Part No.:	SCLB10-2300/34.5 0056-7859.V00
Rated Voltage:	34.5 kV
Rated Power:	2300 kVA
Degree of Protection:	IP00
Location:	Nacelle rear
Tower:	
Type:	Tubular steel
Manufacturer:	Vestas Wind Systems A/S
Sections:	3
Length:	78.1 m
Drawing / Data sheet / Part No.:	0043-5737.V00 (T2X103)
Type:	Tubular steel
Manufacturer:	Vestas Wind Systems A/S
Sections:	3
Length:	78.1 m
Drawing / Data sheet / Part No.:	0063-6008.V00 (T745000)
Type:	Tubular steel



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Manufacturer: Vestas Wind Systems A/S
Sections: 4
Length: 92.1 m
Drawing / Data sheet / Part No.: 0063-6009.V00 (T745E00)

Type: Tubular steel
Manufacturer: Vestas Wind Systems A/S
Sections: 5
Length: 122.1 m
Drawing / Data sheet / Part No.: 0063-6011.V03 (T747C00)

Foundation:

Type: NA
Manufacturer: NA
Drawing / Data sheet / Part No: NA

Foundation Adaptor:

Type: NA
Manufacturer: NA
Drawing / Data sheet / Part No.: NA

Manuals:

Operation & maintenance manual: 0001-1995.V27 and 0072-8177.V1
Transport manual: 0070-1964.V06
Installation & commissioning. manual: 0070-1969.V6 and 0071-1732.V02