Certificate No.

IECRE.WE.TC.20.0037-R0

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	Siemens Gamesa Renewables Energy Inc. 4400 Alafaya Trail Orlando, FL 32817 USA
for the wind turbine	SG 2.9-129, B64-00, 60 Hz
wind turbine class (class, standard, year)	IEC S (details see Annex), 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	Included in the Design Evaluation Conformity Statement
Design evaluation conformity statement Dated	IECRE.WE.CS.20.0037-R0 12.06.2020
Type test conformity statement Dated	44 220 19693505-T-IEC, Rev.1 12.06.2020
Manufacturing conformity statement Dated	44 220 17336641-M-IEC, Rev.4 12.06.2020
Final evaluation report Dated	8118 005 388-20 E, Rev.0 12.06.2020

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:
11.06.2025

Approved for issue on behalf of the IECRE Certification Body:

Dipl.-Ing., Dr. M. Broschart
Deputy Specialist Manager Wind Energy
Essen, 2020-06-12

TÜV NORD CERT GmbH
Langemarckstraße 20
45141 Essen

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Machine parameters:

Power regulation:	Independent hydraulic pitch system for each blade
Rotor orientation:	Upwind
Number of rotor blades:	3
Rotor tilt:	6°
Cone angle:	4°
Rated power:	2900 kW with PowerBoost 2750 kW without Power Boost (with optional operation modes, see Annex 1)
Rated wind speed V_r:	10 m/s
Rotor diameter:	129 m
Hub height(s):	87 m
Hub height operating wind speed range V_{in} – V_{out}:	3 – 27 m/s (with HWRT active from 22 to 27 m/s)
Design life time:	25 years (The safety relay shall be exchanged after 20 years.)
Software version:	Controller version 32.7.0 (WTC3) with software version 132.0.0.0.

Wind conditions:

Characteristic turbulence intensity I_{ref} at V_{hub} = 15 m/s:	See Annex 2
Annual average wind speed at hub height V_{ave} :	See Annex 2
Reference wind speed V_{ref} :	42.5 m/s
Mean flow inclination:	8°
Hub height 50-year extreme wind speed V_{e50}:	59.5 m/s

Electrical network conditions:

Normal supply voltage and range:	690 V ± 10%
Normal supply frequency and range:	60 Hz (-3 / +2 Hz)
Voltage imbalance:	3%
Maximum duration of electrical power network outages:	No limits when requirements in manuals are followed
Number of electrical network outages	24 per year

Other environmental conditions (where taken into account):

Design conditions in case of offshore WT :	n/a
Normal and extreme temperature ranges:	-20 °C to +30 °C (normal operation) -25 °C to +45 °C (extreme operation)
Relative humidity of the air:	Up to 95%
Air density:	See Annex 2
Solar radiation:	1000 W/m²
Lightning protection system (standard and protection class):	I
Earthquake model and parameters (standard and key parameters e.g. spectrum, model, seismic zone, soil class, etc.):	n/a
Other design conditions :	Max. installation altitude of generator 1000 m.

Major components:

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

Blade:

Type:	B64-00
Material:	Glass fibre reinforced epoxy
Blade length:	63.525 m
Number of blades:	3
Manufacturer:	Siemens Gamesa Renewable Energy Inc.
Drawing / Data sheet / Part No.:	D1723745, ECN no. C01019382 (See final evaluation report for applied γ_M)

Blade bearing:

Type:	Ball bearing slewing ring
Manufacturer:	Thyssenkrupp Rothe Erde GmbH
Drawing / Data sheet / Part No.:	090.60.2406.000.49.142D, Rev. D, dated 2019-04-01

Blade bearing:

Type:	Ball bearing slewing ring
Manufacturer:	TMB Tianma (Chengdu) Railway Bearing Co., Ltd.
Drawing / Data sheet / Part No.:	B030.60.2414K2, Rev. -, dated 2019-04-15

Blade bearing:

Type:	Ball bearing slewing ring
Manufacturer:	ZWZ Wafangdian Bearing Group Corp., Ltd.
Drawing / Data sheet / Part No.:	FL-HSB2410DK-C3, Rev. -, dated 2019-05-14

Blade bearing:

Type:	Ball bearing slewing ring
Manufacturer:	Liebherr Monterrey
Drawing / Data sheet / Part No.:	KUD02414-060WO18-001-900, Rev. 01.1, dated 2020-02-17

Blade bearing:

Type:	Ball bearing slewing ring
Manufacturer:	Laulagun Bearings S.L.
Drawing / Data sheet / Part No.:	FD2677M00DST0125PXA, Rev. 00, dated 2019-07-15

Pitch System:

Motor / Actuator Type:	Two hydraulic cylinders per blade
Pitch Controller Type:	Hydraulic
Manufacturer:	Fritz Schur Teknik A/S; Hydratech Industry Wind Power A/S

Main shaft:

Type:	Forged part
Manufacturer:	Jinlei Technology Co. Ltd.; Taiyuan Heavy Industry Co. Ltd.
Material:	42CrMo4+QT
Drawing / Data sheet / Part No.:	D2069363, Rev. 001, ECN no. C01065795

Main bearing:

Type:	Spherical roller bearings (rotor and generator side)
Manufacturer:	JTEKT Corporation (Koyo)
Drawing / Data sheet / Part No.:	230/900RHAW33TS1CS (rotor side) 231/630RHAW33TS1 (generator side)

Main bearing:

Type:	Spherical roller bearings (rotor and generator side)
Manufacturer:	Schaeffler Romania S.R.L.
Drawing / Data sheet / Part No.:	F-623409.01.PRL-WPOS-R500-600 (rotor side) F-623394.01.PRL-WPOS-C2H (generator side)

Main bearing:

Type:	Spherical roller bearings (rotor and generator side)
Manufacturer:	The Timken Company
Drawing / Data sheet / Part No.:	WE-1936-A (rotor side) WE-1937-A (generator side)

Main bearing:

Type:	Spherical roller bearings (rotor and generator side)
Manufacturer:	ZKL Bearings CZ
Drawing / Data sheet / Part No.:	230/900EW33MH TPF 11575-19 (rotor side) 231/630EW33MH TPF 11575-19 (generator side)

Gearbox:

Type:	Planetary helical gearbox (FD3190S)
Gear Ratio:	1:128.7
Manufacturer:	Nanjing High Speed Gear Manufacturing Co., Ltd.
Drawing / Data sheet / Part No.:	FD3190S-000-00R1, Rev. B (with heater) FD3190S-000-00R2, Rev. A (without heater)

Yaw System:

Drive Type:	6 active yaw motors mounted on gears
Manufacturer:	Lafert S.p.A.
Drawing / Data sheet / Part No.:	MZ10/A6A-53734

Bearing Type:	Yaw bearing ring (slide solution)
Manufacturer:	Niebuhr Tandhjulsfabrik A/S; Liebherr Monterrey; CS Bearing Co. Ltd.
Drawing / Data sheet / Part No.:	D2051892, Rev. 001, ECN no. C01064744

Gear Type:	4-stage planetary gearbox (709T4)
Manufacturer:	Bonfiglioli Trasmital S.p.A.
Drawing / Data sheet / Part No.:	I7090T004704, Rev. A, dated 2020-01-10

Gear Type:	4-stage planetary gearbox (PG2504)
Manufacturer:	Comer Industries S.p.A.
Drawing / Data sheet / Part No.:	N06771_00, Rev. -, dated 2015-05-21
Brake Type:	16 hydraulic yaw bearing clamps mounted on yaw bearing ring
Manufacturer:	AH Industries A/S
Drawing / Data sheet / Part No.:	D2084692, Rev. 001, ECN no. C01066763

Generator:

Type	Asynchronous induction
Manufacturer:	Siemens AG
Drawing / Data sheet / Part No.:	JGSA-500LR-04A
Rated Power:	2930 kW (3070 kW with PowerBoost)
Rated Frequency:	53.3 Hz (56.2 Hz with PowerBoost)
Rated Speed:	1612 rpm (1700 rpm with PowerBoost)
Max. speed:	-
Rated Voltage:	750 V
Rated Current:	2506 A (2626 A with PowerBoost)
Insulation Class:	F
Degree of Protection:	IP 54

Generator:

Type:	Asynchronous induction
Manufacturer:	Indar Electric S.L.
Drawing / Data sheet / Part No.:	IG500S4B
Rated Power:	2930 kW (3070 kW with PowerBoost)
Rated Frequency:	53.3 Hz (56.1 Hz with PowerBoost)
Rated Speed:	1612 rpm (1700 rpm with PowerBoost)
Max. speed:	-
Rated Voltage:	750 V

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Rated Current:	2497 A (2606 A with PowerBoost)
Insulation Class:	H
Degree of Protection:	IP 54

Converter:

Type:	Liquid cooled full power converter
Manufacturer:	ABB A/S
Drawing / Data sheet / Part No:	ACS880-87CC-2580A-2750A-7
Rated Voltage (grid side):	690 V ± 10 %
Rated Current (grid side):	2750 A
Degree of Protection:	IP21

Transformer:

Type:	n/a
Manufacturer:	n/a
Drawing / Data sheet / Part No.:	n/a
Rated Voltage:	n/a
Rated Power:	n/a
Degree of Protection:	n/a
Location (e.g. tower bottom):	outside of tower

Tower:

Type:	Tubular steel tower (T86.8-1204)
Manufacturer:	Broadwind Towers & Heavy Industries Inc.; Valmont SM A/S; Arcosa Wind Towers Inc.
Sections:	3
Length:	84.78 m (HH 87 m)
Drawing / Data sheet / Part No.:	D1966972, ECN no. C01058691

Foundation:

Type:	n/a
Manufacturer:	n/a
Drawing / Data sheet / Part No:	n/a

Foundation Adaptor:

Type:	n/a
Manufacturer:	n/a
Drawing / Data sheet / Part No.:	n/a

Manuals:

Operation & maintenance manual:	X00363016, ECN no. C01079834
Transport manual:	Covered by maintenance manual and basic health/safety manual (SI 545781, Rev. 21)
Installation & commissioning. manual:	D2392621, ECN no. C01095576 (Comm.) See Design Evaluation Conformity Statement for installation manuals.

Annex 1

Derated power operation with optional low noise modes.

Low Noise Mode	Attenuation	Rated power [kW]	Rated rotor speed [rpm
Mode 1	0 dB	2750	12.5
Mode 2	Not used		
Mode 3	-2.5 dB	2380	10.8
Mode 4	-3 dB	2380	10.8
Mode 5	-4 dB	2290	10.4
Mode 6	-5 dB	2180	9.9
Mode 7	-6 dB	2090	9.5

Annex 2

Annual average wind speed, turbulence and air densities for approved RNA loads:

IEC class*	Wind turbine	Annual average at HH V_{ave}	Expected turb. int. I_{15} at V_{hub} = 15 m/s	Air densities [kg/m³]		
				Annual average	Max. operation	Max. survival
S_1 (IIS**)	SG-2.9-129	9.0 m/s**	0.125	1.180	1.288	1.336
S_2 (IIS**)	SG-2.9-129	9.5 m/s**	0.125	1.120	1.216	1.260

Explanations to wind conditions table:
* IEC classes for the RNA with wind directional distribution of tower and foundation fatigue loads and increased operation temperature range as per section “other environmental conditions”.
** Annual average at hub height is increased from 8.5 m/s (IEC II class) to 9.0 m/s and 9.5 m/s.
S** means turbulence intensities are different to the standard ones.
S_1 bases on annual average air density of 1.18 kg/m³
S_2 bases on annual average air density of 1.12 kg/m³

Extreme loads for tower: IEC S_1 acc. to the table above.

Fatigue loads for tower and foundation (wind rose):

Wind direction	Probability
0°	40.0 %
30°	10.0 %
60°	5.0 %
90°	2.5 %
120/150/180/210/240°	5.0 % each sector
270°	2.5 %
300°	5.0 %
330°	10.0 %

The tower and therewith this Certificate is valid for the S1 load configuration.