Certificate No.

IECRE.WE.TC.23.0146-R0

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

PROVISIONAL TYPE CERTIFICATE
Wind Turbine

This certificate is issued to	Siemens Gamesa Renewable Energy A/S Borupvej 16 Brande, DK-7330 Denmark
for the wind turbine	SG DD-236
wind turbine class(es) (class, standard, year)	SG DD-236, class S, IEC 61400-1:2019

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:	44 220 23936015-TDB-IECRE, Rev.0 2023-10-05
Design evaluation conformity statement Dated:	IECRE.WE.CS.23.0216-R0 2023-10-05
Type test conformity statement Dated:	44 220 23936015-PT-IECRE, Rev.0 2023-10-05
Manufacturing conformity statement Dated:	44 220 22153952-M-IECRE, Rev.0 2023-03-27
Final evaluation report Dated:	ER-8119936015-020-001-00, Rev.0 2023-10-05

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. Outstanding issues are listed in the last page(s) 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:
2024-10-05

Approved for issue on behalf of the IECRE Certification Body:

Messer,Federica
Deputy Specialist Manager Wind Energy

Essen 2023-10-05

TÜV NORD CERT GmbH
Am TÜV 1
Essen 45307
Germany

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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:	1.5°
Rated power:	14 MW (PowerBoost:15 MW)
Rated wind speed V_r:	12 m/s
Rotor diameter:	236 m
Hub height(s):	n/a (HH 150 m considered in load evaluation)
Hub height operating wind speed range V_{in} – V_{out}:	4-32 m/s (with HWO active from 24 -32 m/s, V_{out} for operation with ice is 15 m/s)
Design lifetime:	25 years
Software version:	STC1 version 155.x.x.x (load set configuration 1)

Wind conditions:

Characteristic turbulence intensity I_{ref} at V_{hub} = 15 m/s:	Extreme: 0.14 (until 15 m/s) and 0.12 (above 15 m/s) Fatigue: 0.12 for fatigue
Annual average wind speed at hub height V_{ave} :	10 m/s
Reference wind speed V_{ref} :	50 m/s ($V_{ref, typhoon}$ 57 m/s acc. to IEC 61400-1 Ed.4)
Mean flow inclination:	0°
Hub height 50-year extreme wind speed V_{e50}:	70 m/s ($V_{ref, typhoon}$ 79.8 m/s acc. to IEC 61400-1 Ed.4)

Electrical network conditions:

Normal supply voltage and range:	66 kV +-10% and 690 V ± 15%
Normal supply frequency and range:	50 ± 3%
Voltage imbalance:	Max. 2% acc. to IEC 60146
Maximum duration of electrical power network outages:	No limitation if 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 Wind Turbine:	As defined in IEC 61400-3-1 (2019), chapter 6.3.5: Other environmental conditions
Normal and extreme temperature ranges:	Normal: -10 °C to +40 °C Extreme: -20 °C to +45 °C Operational: -10 °C to +20 °C* (*with HTRT up to +35°C)
Relative humidity of the air:	Up to 95%
Air density:	1.225 kg/m^3
Solar radiation:	1000 W/m^2
Lightning protection system (standard and protection class):	IEC 61400-24, protection level I
Earthquake model and parameters (standard and key parameters e.g. spectrum, model, seismic zone, soil class, etc.):	n/a
Other design conditions:	Typhoon class T considered. Icing conditions assumed for 750 hours/years for configuration 1

Interfaces:

The following load set configuration is considered:

- Load set D7NG12LR30 (rotor blade B115-00)

The design evaluation covers the rotor nacelle assembly (RNA) including the tower top adapter (with its bolt connection to the yaw ring) and the tower top flange which is connected beneath the tower top adapter. The welded connection between tower top flange and steel tower shell was assessed assuming weld inside detail category 112 and weld outside detail category 112 according to Eurocode 1993-1-9.
TTF drawing no.: D2941118, Rev. 001, ECN No.: C01158361 and TTF drawing no.: D2941128, Rev. 001, ECN No.: C01158361 (min. preload $F_{V,min}$ of TTF bolts 772 kN)

The permissible load of the roof of the Nacelle Cover is limited to 204 kg/m^2.

The RNA load calculation of load set (1) is valid for a tower (coupled) frequency range of 0.143 Hz +/-5% (fore-aft) with a 3° geometric tolerance in tower verticality (tubular steel tower).

The tower internals (tower platform ladder system) have been evaluated concerning the design requirements according to OD-501 Ed.2 (TÜV NORD Letter LE-8121534800-008-001-00 Rev.0, dated 2023-10-05). The design of the tower internal is generic, their suitability (geometries, detail categories, etc.) shall be checked within the individual tower design evaluations and with respect to site-specific particularities.
Included is a segmented full-size slosh damper (sFSD1), realized as passive tower damper. The design of the support structure of the sFSD1 was evaluated by TÜV NORD (LE-8121663689-008-001-00, dated 2023-08-07), the efficiency was evaluated by DNV (LTR-09313-20230120).
An optional slosh damper (version 4.0), realized as a passive tower damper (consisting of several slosh 4.0 discs) was evaluated. The design of the support structure of the slosh damper 4.0 (excluding the structural integrity of the slosh damper itself and of the tower structure) was evaluated by TÜV NORD (CLR 8120730773-8 E Rev.0, dated 2022-12-13). The efficiency of one single disc for a frequency range from 0.137 Hz to 0.160 Hz was evaluated by DNV LTR-08624-20221103, dated 2022-11-03).

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Editions of IECRE operational documents and IEC 61400 series standards applied for this certification:

Document	Edition	Year-Month	Notes
OD-501	2.0	2018-05	
OD-501-1	1.0	2017-09	
OD-501-4	1.0	2017-09	
OD-501-5	1.0	2017-09	
OD-501-7	1.0	2019-03	
IEC 61400-1	4.0	2019-02	
IEC 61400-3-1	1.0	2019-04	
IEC 61400-5	1.0	2020-06	
IEC 61400-13	1.0	2015-12	
IEC 61400-23	1.0	2014-04	
IEC 61400-24	2.0	2019-07	

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

Blade:

Type:	B115-00
Material:	E-glas fibre reinforced epoxy with spar cap of pultruded carbo and core material of balsa and PET
Blade length:	115.0 m
Number of blades:	3
Manufacturer:	Siemens Gamesa Renewable Energy A/S, Aalborg, Denmark
Drawing / Data sheet / Part No.:	D3124396, Rev. 001 (master specification; applied material factor for blade deflection γ_M of 1.035)
Standard:	IEC 61400-5:2020
Note:	Load assumptions are valid only with the attachments Vortex Generators and Dino Shells.

Blade bearing:

Type:	Double-row ball bearing slewing ring
Manufacturer:	Thyssenkrupp rothe erde Germany GmbH, Lippstadt,Germany
Drawing / Data sheet / Part No.:	090.80.4480.110.49.140D, Rev. A

Pitch system:

Motor / Actuator Type:	2 hydraulic cylinders per blade
Pitch Controller Type:	hydraulic
Manufacturer:	Hine Renovables S.L. Olaberria, Spain

Main shaft:

Type:	Cast part
Manufacturer:	HegerFerrit GmbH, Sembach, Germany
Material:	EN-GJS-400-18C-LT-Z
Drawing / Data sheet / Part No.:	D3118999, Rev. 004, ECN No.: C01243997 (mach.)

Main bearing:

Type:	Tapered roller bearing
Manufacturer:	Thyssenkrupp rothe erde Germany GmbH, Lippstadt,Germany
Drawing / Data sheet / Part No.:	140.99.4290.011.62.130D, Rev. C

Gearbox:

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

Yaw system:

Drive Type:	Active yaw motos mounted on gears
Manufacturer:	ABB
Drawing / Data sheet / Part No.:	PRT133125SG3 (50 Hz)
Bearing Type:	Yaw bearing ring (slide solution) with mounted friction pads (yaw clamps)
Manufacturer:	Reducel S.L., Zaragoza, Spain
Drawing / Data sheet / Part No.:	Yaw Ring: D2364556, Rev. 007, ECN No.: C01237904 Yaw clamps: D2914242, Rev. 004, ECN No.: C01237904
Gear Type:	4-stage planetary gear drive
Manufacturer:	Comer Industries S.p.A., Reggiolo, Italy
Drawing / Data sheet / Part No.:	N07824_01, Rev. 01
Brake Type:	Integrated motor brakes to the yaw motors
Manufacturer:	ABB Sp. z.o.o., Aleksandr.w L.dzki, Poland
Drawing / Data sheet / Part No.:	See yaw motor

Generator:

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Type	Permanent magnet synchronous direct drive generator
Manufacturer:	Flender D.o.o, Subotica, Serbia (formerly Siemens D.o.o) (structural elements); KK Wind Solutions Polska Sp.z.o.o Szczecin, Poland (electrical parts)
Drawing / Data sheet / Part No.:	DD11
Rated Power:	15.4 MW (max)
Rated Frequency:	14 – 15 Hz
Rated Speed:	7.7 to 8.1 rpm
Max. speed:	not defined
Rated Voltage:	820 V
Rated Current:	2*6.1 kA
Insulation Class:	H
Degree of Protection:	IP44

Converter:

Type:	Liquid cooled, full power converter
Manufacturer:	KK Wind Solutions Polska Sp.z.o.o Szczecin, Poland
Drawing / Data sheet / Part No.:	AA1-1 (master)
Rated Voltage (grid side):	AA1-2 (slave)
Rated Current (grid side):	690 V
Degree of Protection:	7000 A

Transformer:

Type:	Ester-immersed
Manufacturer:	Siemens Energy Austria GmbH, Weiz, Austria
Drawing / Data sheet / Part No.:	TDU-184A07W6N-TU
Rated Voltage:	66 kV
Rated Power:	16731 kVA
Degree of Protection:	Not defined
Location (e.g. tower bottom):	Inside nacelle

Tower:

Type:	Out of scope / site specific
Manufacturer:	n/a
Sections:	n/a
Length:	n/a
Drawing / Data sheet / Part No.:	n/a

Foundation:

Type:	Out of scope /site specific
Manufacturer:	n/a
Drawing / Data sheet / Part No.:	n/a

Foundation adaptor:

Type:	Out of scope / site specific
Manufacturer:	n/a
Drawing / Data sheet / Part No.:	n/a

Manuals:

Operation & maintenance manual:	D2895801/017 (Operation manual) D3077803, Rev.002 (User manual) X00980557, Rev.002 (Maintenance plan, referenced documents in their revisions as evaluated) X00886478, Rev.002 (Maintenance plan SST, referenced documents in their revisions as evaluated)
Transport manual:	MK6 Transport matrix (“SG DD-222 Transport matrix“)
Installation & commissioning manual:	D2281944/0004 (“Turbine-specific safety instructions”) D2281948/007 (“Tightening specification – Offshore”) D2446369/003 (“Prepare nacelle for installation”) D2446372/004 (“Install nacelle”) D2891682/002 (“Blade installation using 2 cranes”) D2282136/003 (“Install HV cable in nacelle – 66kV NKT”) D2282232/003 (“Electrical completion of nacelle”) D3772887/001 (“Mechanical completion”) D2282246/004 (“Commission nacelle”) D2446375/002 (“500h Inspection”)

Outstanding issues:

Design Evaluation:

Safety system and manuals:
Fault design load case definition to be revised;
Manuals for operation, commissioning, maintenance and installation to be finalized and evaluated;
Exchange of safety related components (for lifetime extension to 25 years) shall be included in maintenance manual.

Rotor blade:
Blade specification, drawings, test specifications and test results;
Blade manuals;
structural verification of the vortex generators and dino shells;
Evaluation of transport and installation load cases and of the repair process;
Tightening procedure test for blade bolts;
Test results for the barrel nuts;
Test results for the T-bolt connection against Bearing failure, Shear-Out Failure and Cleavage; Evaluation of blade bolt s/n-curves

Machinery Components:
With regard to design lifetime of 25 years more detailed evaluations need to be performed.
verification of the reaction forces between MDT model and BHawC load simulation model shall be submitted and evaluated for final release;
demonstration that assumptions and conditions in the design capacity of the yaw locking system are in accordance with the final safety or maintenance manual

Electric equipment and lightning protection:
Documentation and parameters of generator, converter, transformer and yaw motor to be completed;
Data sheet and test reports for the bus ducts;
Data sheet and ampacity calculation of the tower cable;

	Chopper design calculation and insulation coordination study; Overall turbine schematics which includes the complete SST panel documentation; Explanation concerning the HV switch gear and connection cables between transformed and HVSG;
Type Testing Evaluation:	Update the Load measurements and safety and function test according to test plan; Power performance to be submitted for evaluation; EMCS measurements test reports Blade fatigue and post-fatigue static test