Certificate No.

IECRE.WE.TC.20.0087-R1

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

PROVISIONAL TYPE CERTIFICATE RNA

Rotor Nacelle Assembly

This certificate is issued to	MHI Vestas Offshore Wind A/S Dusager 4 8200 Aarhus N Denmark
for the rotor nacelle assembly	V174-9.5MW with Power Mode up to 9.6MW
wind turbine class (class, standard, year)	Class IB IEC 61400-1:2019 adapted to offshore conditions as specified on page 3 of this certificate Class IB, T IEC 61400-1:2019 adapted to offshore conditions as specified on page 3 of this certificate

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-0074-05542-2 2020-11-27
Design evaluation conformity statement Dated	IECRE.WE.CS.20.0051-R1 2020-11-27
Type test conformity statement Dated	TT-B-DNVGL-SE-0074-06453-1 2020-12-01
Manufacturing conformity statement Dated	ME-B-DNVGL-SE-0074-06452-1 2020-11-27
Final evaluation report Dated	FER-TC-B-DNVGL-SE-0074-06218-1 2020-12-01

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

The rotor nacelle assembly 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 DNV GL. Without approval, the certificate loses its validity.

This certificate is valid until:
2021-07-30

Approved for issue on behalf of the IECRE Certification Body:

Johan Olaison/Bente Vestergaard
Project Manager / Service Line Leader, Type Certification
Hellerup 2020-12-01

DNV·GL

Renewables Certification
Brooktorkai 18
20457 Hamburg, Germany

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Machine parameters:

Power regulation:	Pitch-controlled
Rotor orientation:	Upwind
Number of rotor blades:	3
Rotor tilt:	6°
Cone angle:	-6°
Rated power:	9.5 MW with power mode up to 9.6 MW
Rated wind speed V_r:	12.0 m/s
Rotor diameter:	174 m
Hub height(s):	Reference HH 107 m, please see interfaces below
Hub height operating wind speed range V_{in} – V_{out}: Max Storm (High Wind Operation) derating linearly to 4.3 MW at 31 m/s	3 –31 m/s 25-31 m/s
Design life time:	25 years
Software version:	SW 2020.15

Wind conditions:

Characteristic turbulence intensity I_{ref} at V_{hub} = 15 m/s:	0.14
Annual average wind speed at hub height V_{ave} :	10 m/s
Weibull shape factor, K:	See adaption to offshore conditions
Reference wind speed V_{ref} :	50.0 m/s
Reference wind speed V_{refT} :	57.0 m/s
Mean flow inclination:	See adaption to offshore conditions

Electrical network conditions:

Normal supply voltage and range:	Up to 66 kV
Normal supply frequency and range:	50, 60 Hz
Voltage imbalance:	2 %
Maximum duration of electrical power network outages:	Not dimensioning
Number of electrical network outages	50

Other environmental conditions (where taken into account):

Design conditions in case of offshore WT :	Site specific
Normal and extreme temperature ranges:	See adaption to offshore conditions
Air density:	1.225 kg/m^3
Solar radiation:	1000 W/m^2
Lightning protection system (standard and protection class):	Designed acc. to IEC 61400-24, Protection Level I

Adaption to offshore conditions

Normal and extreme temperature ranges: As per IEC 61400-3-1: 2019	-15°C to +35°C (normal) -20°C to +50°C (extreme)
Mean flow inclination: As per IEC 61400-3-1: 2019	0°
Wind shear profile: As per IEC 61400-3-1: 2019	0.14
Weibull shape factor, K: Adjusted for typical offshore conditions	2.24

Interfaces:

The certification covers RNA including yaw section (upper tower top) excluding bolt connection to tower top.

Load calculations are valid for system frequency range [0.191;0.264] Hz

The interface between the power control module and the tower is not included

Commissioning manuals have not been evaluated, as these are site specific

Major components:

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

Blade:

Type:	Structural shell
Material:	Carbon fibre reinforced epoxy and glass fibre reinforced epoxy
Blade length:	85 m
Number of blades:	3
Manufacturer:	MHI Vestas Offshore Wind A/S
Drawing / Data sheet / Part No.:	300041245 V0

Blade bearing:

Type:	Three row slew roller bearing
Manufacturer:	Liebherr
Drawing / Data sheet / Part No.:	300023040 V01

Type:	Three row slew roller bearing
Manufacturer:	Rollix
Drawing / Data sheet / Part No.:	300052307 V00

Pitch System:

Motor / Actuator Type:	Two double acting hydraulic cylinders per blade
Pitch Controller Type:	Hydraulic
Manufacturer:	Lind Jensens Maskinfabrik A/S (LJM)
Drawing / Data sheet / Part No.:	300024225 rev. 0

Main shaft:

Type:	Hollow shaft
Manufacturer:	MHI Vestas Offshore Wind A/S
Material:	Cast iron, EN-GJS-500-14
Drawing / Data sheet / Part No.:	300026486 V01

Main bearing:

Type:	Two pretensioned tapered roller bearings
Manufacturer:	Schaeffler Technologies AG & Co. KG
Drawing / Data sheet / Part No.:	F-615869.01.TR1-WPOS F-615870.01.TR1-WPOS
Manufacturer:	Timken
Drawing / Data sheet / Part No.:	NP596934 – 90WA2 (E-55904, Rev. C) NP746013 – 90WA2 (E-55905, Rev. C)

Gearbox:

Type:	2 stage planetary gearbox
Gear Ratio:	1:40.8
Manufacturer:	Winergy
Drawing / Data sheet / Part No.:	PZFB 2780.1

Yaw System:

Drive Type:	10 electrical yaw motors incl. gearbox and motor brake
Manufacturer:	Lafert
Drawing / Data sheet / Part No.:	300009451 (motor), Rev. 0
Bearing Type:	Slide bearing
Manufacturer:	MHI Vestas Offshore Wind A/S
Drawing / Data sheet / Part No.:	300010675 (support beam machined), Rev. 1
Gear Type:	Internal ring gear
Manufacturer:	Comer Industries
Drawing / Data sheet / Part No.:	M_29031014 (yaw gear), Rev. 2

Brake Type:	Braking capacity is based on bearing friction and electrically activated friction brake onmotors
Manufacturer:	MHI Vestas Offshore Wind A/S Lafert
Drawing / Data sheet / Part No.:	300009494 (brake), Rev. 0

Generator:

Type	Medium-speed low voltage 3-phase synchronous permanent magnet generator
Manufacturer:	The Switch
Drawing / Data sheet / Part No.:	PMM1500B10
Rated Power:	10.4 MW
Rated Speed:	400 rpm
Rated Voltage:	730 V
Insulation Class:	H
Degree of Protection:	IP54

Type	Medium-speed low voltage 3-phase synchronous permanent magnet generator
Manufacturer:	The Switch
Drawing / Data sheet / Part No.:	PMM1500D00
Rated Power:	10.4 MW
Rated Speed:	425 rpm
Rated Voltage:	730 V
Insulation Class:	H
Degree of Protection:	IP54

Converter:

Type:	Full scale converter
Manufacturer:	Vestas Wind Systems A/S
Rated Voltage (grid side):	710 VAC machine-side 640 VAC line-side
Rated Current (grid side):	2 x 5000 A
Rated grid frequency:	50 / 60 Hz

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Transformer:

Type:	Three-winding three-phase liquid-immersed HV transformer
Manufacturer:	Siemens Energy Austria AG
Drawing / Data sheet / Part No.:	TDU-104K03W6A-99
Rated Voltage:	33 or 34 kV (HV) 640 V (LV)
Rated grid frequency:	50 Hz
Degree of Protection:	IP54
Location (e.g. tower bottom):	PCM module, bottom half of tower

Type:	Three-winding three-phase liquid-immersed HV transformer
Manufacturer:	ABB Oy Transformers
Drawing / Data sheet / Part No.:	KTAU/M 42 FA 11111
Rated Voltage:	34 kV (HV) 640 V (LV)
Rated grid frequency:	50 Hz
Degree of Protection:	IP54
Location (e.g. tower bottom):	PCM module, bottom half of tower

Type:	Three-winding three-phase liquid-immersed HV transformer
Manufacturer:	ABB Oy Transformers
Drawing / Data sheet / Part No.:	KTAU/M 72 FA 11120
Rated Voltage:	66 kV (HV) 640 V (LV)
Rated grid frequency:	50/60 Hz
Degree of Protection:	IP54
Location (e.g. tower bottom):	PCM module, bottom half of tower

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Rotor Nacelle Assembly

Type:	Three-winding three-phase liquid-immersed HV transformer
Manufacturer:	Siemens Energy Austria AG
Drawing / Data sheet / Part No.:	TDU-114K07W6K-TU
Rated Voltage:	66 kV (HV) 640 V (LV)
Rated grid frequency:	50 Hz
Degree of Protection:	IP54
Location (e.g. tower bottom):	PCM module, bottom half of tower

Switchgear:

Manufacturer	ABB
Type	SafePlus 36
Part no protection relay	ABB REF 615
Rated grid voltage	Up to 36 kV
Rated grid frequency	50 / 60 Hz

Manufacturer	Siemens AG
Type	8DN8
Part no protection relay	SIPROTEC 4 7SJ85
Rated grid voltage	Up to 72.5 kV
Rated grid frequency	50 / 60 Hz

Manufacturer	Mitsubishi Electric
Type	HG-VG-A
Part no protection relay	ABB REF 620
Rated grid voltage	Up to 72.5 kV
Rated grid frequency	50 / 60 Hz

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Manufacturer	Schneider Electric Sachsenwerk GmbH
Type	WIA 6/72.5-2/628
Part no protection relay	MiCOM P14x
Rated grid voltage	Up to 72.5 kV
Rated grid frequency	50 / 60 Hz

Manuals:

Operating manual	0054-0948.V04
Service manual	0054-0949.V09
Installation manual	0054-0943.V15
Commissioning Manual	Site specific

Outstanding issues:

Design Evaluation:

- Final blade documentation to be provided.
- Full bondline fracture mechanics analysis on the blade to be completed.
- Final manuals for the V174-9.5 MW to be provided.

Manufacturing Evaluation:

- Manufacturing inspection of the V174 blade to be performed. Currently, the plan is to carry out the inspection in November 2020.

Type testing:

- Full V174 blade test needs to be completed