



Certificate. No.

**IECRE.WE.TC.20.0089-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

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

for the wind turbine

Vestas V155-3.3 MW

wind turbine class (class, standard, year)

IEC 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-0074-05928-0  
03.04.2020

Design evaluation conformity statement  
Dated

IECRE.WE.CS.20.0052-R0  
18.09.2020

Type test conformity statement  
Dated

TT-B-DNVGL-SE-0074-06622-0  
18.09.2020

Manufacturing conformity statement  
Dated

ME-B-DNVGL-SE-0074-06621-0  
18.09.2020

Final evaluation report  
Dated

FER-TC-B-DNVGL-SE-0074-06623-0  
18.09.2020

The conformity evaluation was carried out in accordance with the rules and procedures of the IECRE System [www.iecre.org](http://www.iecre.org)

The wind turbine type specification begins on page 2 of this certificate. Outstanding issues in the case of a provisional type certificate are listed in the last page of this certificate.

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

This certificate is valid until:  
17.09.2021

Approved for issue on behalf of the IECRE  
Certification Body:

Pablo Buriticá / Bente Vestergaard  
Project Manager / Service Line Leader, Type  
Certification  
Hamburg / Hellerup 18.09.2020



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:  | 6.0°  |
| Cone angle:  | -5.5°   |
| Rated power:   | 3300 kW   |
| Rated wind speed $V_r$ :                                   | 9.3 m/s   |
| Rotor diameter:  | 154.7 m   |
| Hub height(s):   | 105 m / 142 m / 162 m   |
| Hub height operating wind speed range $V_{in} - V_{out}$ : | 3 – 21.0 m/s<br>Following HWO wind speeds:<br>$V_{HWO1}=17.0$ m/s<br>$V_{HWO2}=19.0$ m/s<br>$V_{HWO3}=21.0$ m/s |
| Design life time:  | 20 years  |
| Software version:  | 2020.06   |

#### Wind conditions:

|  |          |
|--|----------|
| Characteristic turbulence intensity $I_{ref}$ at $V_{hub} = 15$ m/s: | 0.14     |
| Annual average wind speed at hub height $V_{ave}$ :                  | 6.0 m/s  |
| Reference wind speed $V_{ref}$ :                                     | 37.5 m/s |
| Mean flow inclination:   | 8°       |

#### Electrical network conditions:

|   |  |
|---|--|
| Normal supply voltage and range:                      | 650 V (rated grid voltage)<br>800 V (rated generator<br>voltage) |
| Normal supply frequency and range:                    | 50 Hz  |
| Voltage imbalance:                                    | IEC 61000-3-6 TR max 2 %   |
| Maximum duration of electrical power network outages: | Two 3 months periods   |
| Number of electrical network outages                  | Max 52 per year  |



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#### **Other environmental conditions (where taken into account):**

Normal and extreme temperature ranges:

Normal: -20°C to +45°C\*

Relative humidity of the air:

Extreme: -30°C to +50°C

100% (max 40% of time)  
and 90% (rest of life time)

Air density:

1.200 kg/m<sup>3</sup> and for selected  
load cases 1.273 kg/m<sup>3</sup>

Solar radiation:

1000 W/m<sup>2</sup>

Lightning protection system (standard and protection  
class):

Designed acc. to IEC 61400-24,  
Protection Level 1 and IEC  
61312-1

\*de-rating strategy above +30°C for V155-3.3 MW



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#### Major components:

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

#### Blade:

|                                  |   |
|----------------------------------|---|
| Type:                            | TMT76A                                      |
| Material:                        | Glass fibre reinforced epoxy                |
| Blade length:                    | 76 m  |
| Number of blades:                | 3   |
| Manufacturer:                    | Zhuzhou Times Material Technology Co., Ltd. |
| Drawing / Data sheet / Part No.: | TMT76A SS lamination TX5F3801-10200         |

#### Blade bearing:

|                                  |                             |
|----------------------------------|-----------------------------|
| Type:                            | Triple row cylinder bearing |
| Drawing / Data sheet / Part no.: | 29110524, Rev. 5            |
| TPS no.:                         | 0023-3088, Rev. 5           |

#### Pitch System:

|                                   |                      |
|-----------------------------------|----------------------|
| Type:                             | Hydraulic power unit |
| Manufacturer:                     | LJM/Glual/Liebherr   |
| Hydraulic Cylinder (180/110x922): | 29111326, Rev. 1     |

|                                 |                         |
|---------------------------------|-------------------------|
| Type                            | Pitch Actuation Module  |
| Manufacturer                    | Vestas Wind Systems A/S |
| Drawing / Data sheet / Part no. | 29111583, Rev. 1        |

#### Main shaft:

|                                  |                  |
|----------------------------------|------------------|
| Type:                            | Cast iron        |
| Material:                        | EN-GJS-500-14    |
| Drawing / Data sheet / Part No.: | 29085300, Rev. 4 |

#### Main bearing:

|       |                          |
|-------|--------------------------|
| Type: | Spherical Roller Bearing |
|-------|--------------------------|



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Manufacturer: FAG  
Drawing / Data sheet / Part No.: F-582562.PRL-WPO 000

Type: Spherical Roller Bearing  
Manufacturer: SKF  
Drawing / Data sheet / Part no.: 240/950 CA / C3LW33VQ113

Type: Spherical Roller Bearing  
Manufacturer: JTKET / KOYO  
Drawing / Data sheet / Part no.: 240/950 RHAW33TS1CS

#### **Gearbox:**

Type: 2 stage planetary and 1 helical stage  
gearbox  
Manufacturer: ZF (EH1052A)  
Gear Ratio: 1:143.37  
Drawing / Data sheet / Part No.: 096-EH1052A001, Rev. A

Type: 2 stage planetary and 1 helical stage  
gearbox  
Manufacturer: Winergy (PZAB 3580)  
Gear ratio: 1:142.76  
Drawing / Data sheet / Part no.: A5E45622888A, rev.2

#### **Yaw System:**

Drive type: 7 x 2.7 kW, 400 V, 50 Hz asynchronous  
motors  
Drive manufacturer: Bonfiglioli  
Drawing / Data sheet / Part no.: CD00006614-02

Gear type: Bevel stage and three planetary stages, i  
= 952.3  
Gear manufacturer: Bonfiglioli  
Drawing / Data sheet / Part no.: I7090T010300



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Gear type: Bevel stage and three planetary stages, i  
= 935  
Gear manufacturer: Comer  
Drawing / Data sheet / Part no.: N07297\_01

Bearing type: Preloaded sliding bearing, PETP pads  
Bearing manufacturer: Vestas Wind Systems A/S  
Drawing / Data sheet / Part no.: 29104726, Rev. 0

**Generator:**  
Type: DASG 560/6M, Induction generator  
Manufacturer: Vestas Nacelles Deutschland (VND)  
Rated power: 4450 kW  
Rated frequency: 74 Hz  
Rated speed: 1485 rpm  
Rated voltage: 800 V  
Rated current: 3650 A  
Insulation class: H  
Degree of protection: IP54  
Drawing / Data sheet / Part no.: 0071-4454, Rev. 0

**Converter:**  
Type: Full quadrant IGBT – Cubepower3313  
Manufacturer: Vestas Wind Systems A/S  
Rated voltage machine/grid: 650 Vrms / 800 Vrms  
Rated current: 3900 A / 3900 A  
Degree of protection: IP54  
Drawing / Data sheet / Part no.: 0090-1447, Rev. 0

**Transformer:**  
Type: 3900kVA/35kV/650/Dyn5/50Hz



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|                                     |  |
|-------------------------------------|--|
| Manufacturer:                       | JST  |
| Rated voltage:                      | 35 / 0.65 kV                                     |
| Degree of protection:               | IP00   |
| Drawing / Data sheet / Part no.:    | A006-9082, Rev. 1                                |
| <b>Tower:</b>                       |  |
| Type:                               | Tubular / Conical steel                          |
| Number of sections:                 | 4  |
| Length:                             | 102.6 m  |
| Drawing / Data sheet / Part no.:    | A007-0736, Rev. 1                                |
| <b>Tower:</b>                       |  |
| Type:                               | Tubular / Conical steel                          |
| Number of sections:                 | 6  |
| Length:                             | 139.6 m  |
| Drawing / Data sheet / Part no.:    | A007-1516, Rev. 0                                |
| <b>Tower:</b>                       |  |
| Type:                               | Tubular / Conical steel                          |
| Number of sections:                 | 7  |
| Length:                             | 159.6 m  |
| Drawing / Data sheet / Part no.:    | 0074-2828, Rev. 01                               |
| <b>Manuals:</b>                     |  |
| Operating manual:                   | 0079-9811, Rev. 1                                |
| Transportation and handling manual: | 0079-9801, Rev. 2                                |
| Installation manual:                | 0079-9663, Rev. 2                                |
| Commissioning manual:               | 0079-9665, Rev. 0                                |
| <b>Service lift:</b>                |  |
| Manufacturer:                       | Avanti   |
| Type:                               | Avanti Shark / Avanti Dolphin / Avanti<br>Beluga |
| Manufacturer:                       | Power climber                                    |
| Type:                               | Sherpa-SD4                                       |



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**Crane:**

Manufacturer:

Star 071/95 Liftket

Maximum lifting capacity:

max 800 kg





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#### **Outstanding issues:**

The following outstanding issues are pending for final Type Certificate:

#### **Design Evaluation**

##### **Blade:**

- Fatigue strength verification of the bonded socket is to be completed.
- Validation of Aerodynamic data and evaluation of the transportation load case should be completed.
- The review of fatigue test results for the H-Glass are to be completed.

##### **Tower:**

HH 142 m / HH 162 m:

- For this tower a 2nd mode damper is required and will be implemented. The analysis leading to this conclusion as well as the specification of the 2nd mode damper shall be included into the tower strength calculation.

#### **Manufacturing Evaluation**

- All open comments during the Manufacturing Evaluation of Rotor blade TMT76A should be closed for final Type Certificate.
- Manufacturing Evaluation of Hub and Nacelle Assembly is pending for final Type Certificate.

#### **Type Testing**

- Results of full-scale rotor blade tests shall be approved.
- The Power curve measurements for Vestas V155-3.3 MW wind turbine is pending for Type Certification.
- The load measurements for Vestas V155-3.3 MW wind turbine is pending for Type Certification.

#### **Final Evaluation**

- Final set of manuals for Vestas V155-3.3 MW wind turbine shall be approved.