TUGE20

Small wind turbine technical specification

This document is for potential project developers that plan to include TUGE20 small wind turbine in scope of their project. This document contains more detailed description of turbine components and functions, as well as additional information that can be useful for project planning.

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Contents

1.TUGE20 general specification

TUGE20	
Rotor axis direction	Horizontal
IEC SWT Class	II (V_{ref}=42,5 m/s, V_{ave}=8,5 m/s)
Rated power	20 kW
Rated wind speed	9 m/s
Cut-out wind speed	25 m/s
Rated rotation speed	51 rpm
Rotor diameter / area	15 m / 177 m^2
Blades	3, fixed angle, upwind, stall control and tip-brake
Ambient temperature	-25…+40°C
Generator and drivetrain type	Asynchronous, planetary gearbox
Grid connection	Direct with reactive power compensation
Grid parameters	EN50549
Tower height and type options	18 m tubular tower with hyd. Lift system 36 m lattice tower with maintenance platform
Designed lifetime and maintenance interval	20 years / 2 years
Data connection	4G or Ethernet (OrbiScada)
Brakes	Stall, electro mechanic failsafe rotor brake, tip-brakes

Assumed Average Energy Production

Yearly average wind speed m/s	Energy kWh
3,5	26300
4,0	35000
4,5	43800
5,0	52400
5,5	60500
6,0	68000
6,5	74900
7,0	81000
7,5	86600
8,0	91500
8,5	95900
9,0	99700
9,5	103000
10,0	106000

The main parts of the wind turbine are foundation, tower and nacelle with rotor and tail, electric panels and cables necessary for energy transfer and turbine control. Wind turbine has free yaw with tail. The turbine rotation speed is constant. For safe operation blade tip-brakes will activate with rotor over speed and mechanical rotor brake is used to stop the rotor. All these methods allow for safe operation and control of the turbine.

2.Faulty operation

During any faults two things can happen according to the specific scenario:

Hard stop – generator is disconnected from the grid simultaneously with applying shaft brake to the rotating shaft.

Tip brake over speed limitation – during shaft brake failure turbine brakes with blade tip brakes. Tip brakes reset automatically once rotation speed is down to nominal.

Error list:

Error	Conditions	Stop	Reset
Wind speed instant	10 second average > 27 m/s	Hard	10 minute average below 25 m/s
Wind speed average	10 minute average > 25 m/s	Hard	10 minute average below 25 m/s
Generator temp	Generator temperature > 120 °C	Hard	Automatic
Over speed	Rotor speed > 59 rpm	Hard	Automatic
Grid	Grid protection error	Hard	Automatic
Manual stop	Manual input from emergency button	Hard	Manual

3.Safety systems

Main danger to the turbine is from rotor over speed events, when rotation speed is out of control. To prevent these, there are three separate systems to prevent that:

1. Special geometry of the blade that creates a stall effect and doesn't let rotor speed to grow over the limit. Special calculations were performed by blade manufacturer Olsen Wings (Denmark), Denmark University of Technology (DDU) and Northwind Engineering.
2. Electromechanical rotor brake applies to rotor shaft and holds the turbine in place during danger. The brake is applied by default and is disengaged by the control system, so the rotor is always braked during grid failure event.
3. Every blade has a special tip-brake that activates at certain speed – because of excessive centrifugal force tips of each blade rotate perpendicular to the wind and slows the turbine down. This is unique and time-proven technology of blade manufacturer Olsen Wings (Denmark).

Control system monitors for all other signals in the system (temperatures, rotor and generator speed sensors feedback) and acts accordingly in case of failure.

4. Turbine grid connection

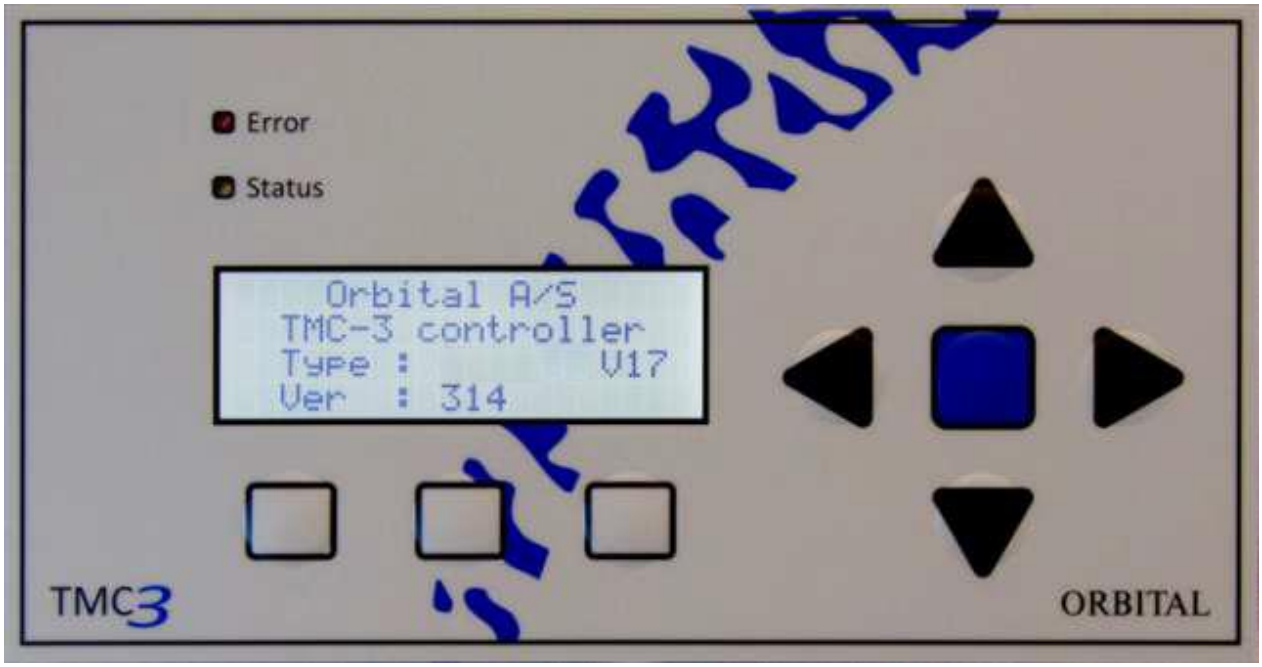
22 kW generator is asynchronous generator from VEM (Germany).

Generator is connected directly to the planetary gearbox.

Generated energy is fed to the grid directly via a thyristor coupling module, also system includes two-stage reactive power compensation device. System can be adapted to any grid code using transformers and grid relays or if necessary with grid inverter.

5. Control system

TUGE20 utilizes TMC3 controller from Orbital A/S (Denmark) as its main user interface.



Monitoring submenus:

- Wind speed, power, rotor speed, mode (manual or auto), system status and operation status
- Grid feed state and control status
- Grid voltages (three phase)
- Grid currents (three phase)
- Grid power (three phase)
- Grid frequency (three phase)
- Grid protection state, uptime and software version
- Grid protection fault bit status
- Grid protection fault bit status

- Grid condition bit status
- Grid condition bit status
- Grid protection bit status
- Operation mode (manual or auto), brake state and stop type
- Brake shaft output status, input feedback status, brake time and brake time peak
- Energy counter for grid feed
- Turbine error free run hour counter, error hour counter and availability in %
- Power averages for 1, 10, 60 and 600 seconds
- Power peak averages for 1, 10, 60 and 600 seconds
- Wind speed averages for 1, 10, 60 and 600 seconds
- Wind speed peak averages for 1, 10,60 and 600 seconds
- Rotor and generator rpm speed
- Cable twist
- Vibration
- Temperature of generator
- Time and date
- GSM, TCP and overall connection statuses
- Connection status, IP address and service status
- APN and TCP connection counters
- Software versions for main board of the controller, display, counter and thyristor
- Information GSM modem
- Modem transmit and read data
- Controller mainboard software and firmware versions
- Digital inputs
- Digital outputs

Control submenus:

- Motor-start, manual stop or reset the turbine
- Toggle main or auto mode

More information and logging can be accessed if the client wishes to connect the turbine to the Internet by installing a SIM card in the built-in modem or providing Ethernet cable to the controller.

Turbine has an optional motor start feature, when turbine can be started as a motor during low winds, which allows bringing the cut-in wind speed down. This feature is available in automatic and manual modes.

Temperature of generator is being monitored. Rotation speeds of generator and rotor are being monitored.

Wind speed is measured by mechanical anemometer (speed is indicative, precise measurement is impossible due to interference of rotating blades).

6. Maintenance

Yearly – visual check of general condition.

Every 2 years – gearbox oil change, slew bearing and generator bearings greasing.

7. Initial cost

Full set price according to the latest price list in EUR EXW Tallinn, Estonia.

Additional costs:

1. Transport
2. Foundation
3. Installation equipment and machinery
4. Civil and grid works and permissions

Useful resource for wind data assessment:

https://globalwindatlas.info