



DDIS60
Direct drive wind turbine - Energy in the wind

DDIS60- 800kW WIND TURBINE

Rated power : 800 kW
 Wind class : III A
 Output voltage : 690 V - 50 Hz
 Acoustic power : < 100 db(A)
 Certification : Germanisher Lloyd

ROTOR

Diameter : 60 m
 Swept area : 2830 m²
 Number of blades : 3
 Rotation speed : 24.2 rpm
 (3 to 26.6 rpm)
 Power control : pitch control

GENERATOR

Type : permanent magnet, synchronous,
 axial flux and air-cooled in closed loop IP54

POWER CONVERTER

Type : AC-DC-AC
 Rectifier - chopper - inverter
 Full power
 IGBT
 Water cooled
 PWM control

OPERATIONAL DATA

Starting wind speed : 3m/s
 Rated wind speed : 10.3 m/s
 Shutdown wind speed : 20m/s

TOWER

Hub height : 50m 60m

WEIGHT

Nacelle : 20 t
 Rotor : 25 t
 Total Head Mass : 45 t

All specifications subject to change without notice.



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Technology for performance

The DDIS60 - 800 kW wind turbine developed by the company DDIS (Direct Drive Systems) is a 3 blade wind turbine with a rotor diameter of 60 meters intended to be located in areas of low to moderate winds. This wind turbine is equipped with an axial flux permanent magnet synchronous generator, directly coupled to the rotor (direct drive concept) and associated with a full power electronic converter to fit the energy on the characteristics of the grid to which it is connected.

DDIS direct drive concept

The generator developed by DDIS is an axial field generator with a permanent magnet rotor. This technology enables a very high power density and thus leads to a generator with a remarkable compactness perfectly suited to its integration in the wind turbine. The generator is directly coupled to the wind turbine rotor and rotates at the same speed. It is electrically connected to an IGBT power converter including a rectifier, a chopper and an inverter. The inverter regulates the DC bus by transferring energy to the grid at the appropriate frequency (50 or 60 Hz). The modular concept is the key design rule for this wind turbine. So by this modular concept we can easily manufacture these big components as generator and power converter. We can warranty the availability ratio due to the natural redundancies of the modular concept.

This concept developed and patented by DDIS offers many advantages compared with traditional technologies :

Efficiency of energy generation

The design of this wind turbine is driven by the maximum output power production, especially for the low wind speed, due to the 60m diameter blade rotor. The full power converter allows the running of the wind turbine over its entire speed range (0 to 24.2 rpm). The power-speed operation point is optimized to extract as much energy as possible according to wind speed. The drive of torque on the generator rotor with the IGBT rectifier enables fast adaptation to changes in wind and also to maximize the energy produced when wind is gusty. For higher wind, output power is regulated very accurately in order to supply the grid at constant power without fluctuation.

Grid-Friendly Wind Turbine

This wind turbine is a Grid-friendly Wind Turbine. The IGBT inverter associated with the chopper on the DC bus allows overcoming shortcomings of grid without disturbing the mechanical running of the wind turbine. In case of FRT (Fault Ride-Through on the grid), the inverter stops supplying. Thus the energy produced by the wind turbine and powering the DC bus is discharged into a resistance connected on the chopper. Once the grid failure, the inverter resumes normal operation. In case of temporary voltage drop on one or more grid phases, the inverter limits the current supplied to the grid at its rated value and the chopper evacuates the extra power. This mode of operation on transient grid failure prevents the shutdown of the wind turbine which avoids in one hand a loss of energy generation both for the operator of the wind turbine and for the utility and on another hand mechanical stress on the wind turbine due to a fast stop.

Low noise level

Optimized torque drive combined with the control of the blade pitch ensures the running of the wind turbine at its optimal performance all the time. The blades operate at optimal efficiency which minimizes the noise emission. The noise of the wind turbine is particularly low due to low tip speed.

Reliability

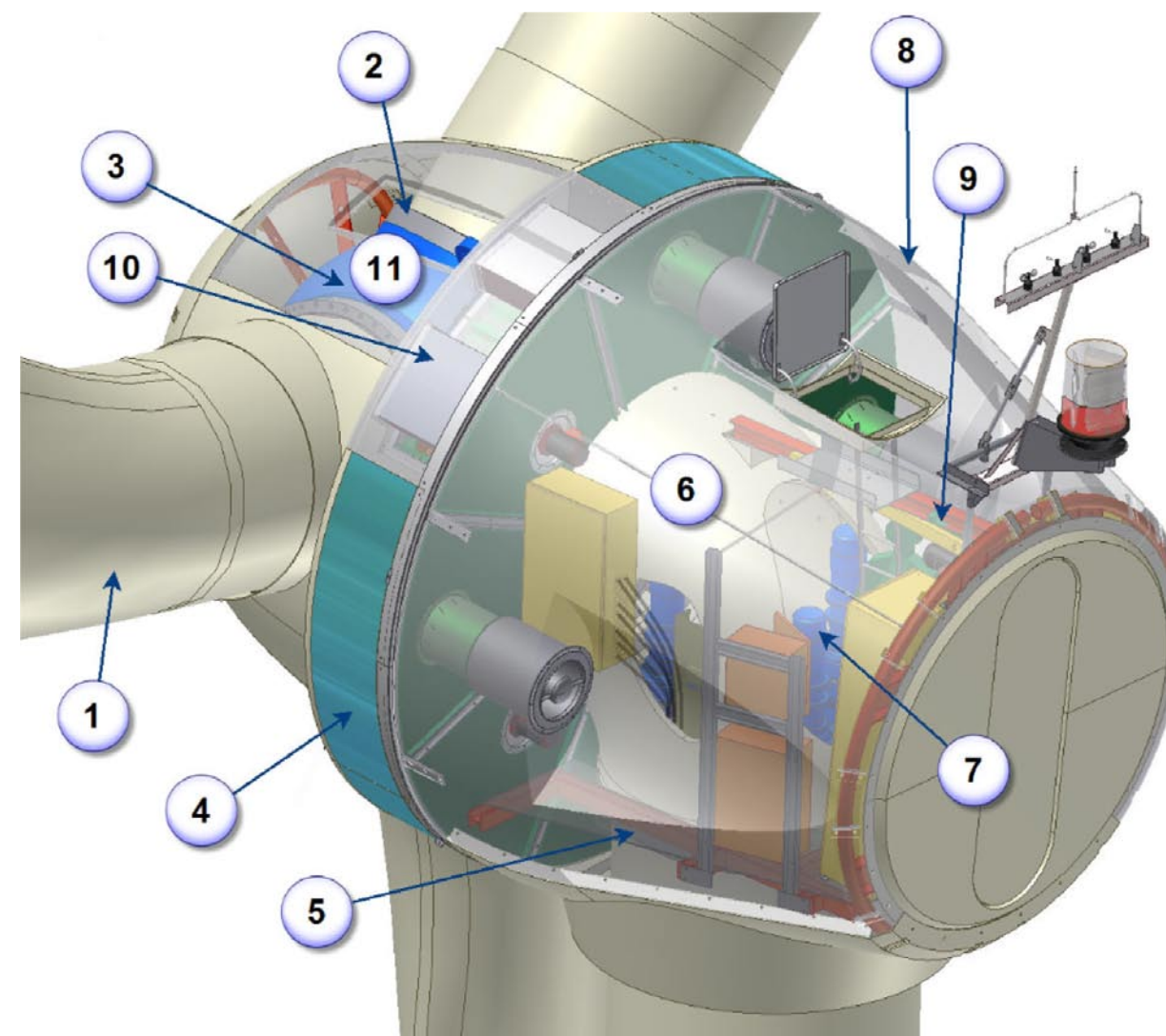
The direct drive system is based on a simple principle : fewer and lighter rotating components reduce mechanical stress, so increase the life time of the equipment. Maintenance and service costs are lower (fewer wearing parts, no gearbox, multi phases windings and modular power converter units) and operating costs are reduced. The air cooling system has been implemented on this wind turbine in order to improve the long term running without any over costs for the maintenance, all cooling equipment respect the modular concept and it's easy to retrofit if necessary. But in order to avoid humidity coming from outside, the air cooling system integrates two independent circuits. The primary air circuit in direct contact with windings is completely tightened from the outside atmosphere. Before to start the wind turbine an automatic control of windings is performed, in case of bad result an automatic heating sequence starts in order to recover the right value for the windings. For the full power IGBT converter the water cooled systems is selected. The electrical power is delivered from the generator to the tower bottom where the converter is located. This arrangement limits the equipment in the nacelle and locates most of them at the tower bottom where they are not subject to nacelle vibrations generated by the wind fluctuations. Moreover, permanent torque drive allows damping the impact of gusty winds thanks to flexibility on the rotation speed. This feature minimizes mechanical stress on the wind turbine and increases its lifetime. At last, use of permanent magnets on the rotor provides a passive excitation of the generator independent of any external system with no risk of loss of excitation. This ensures the torque drive on the rotor of the wind turbine in any situation.

Safety

The safety of the DDIS60 wind turbine is ensured by permanent torque drive with the IGBT rectifier. In case of grid failure, the chopper dissipates energy and provides resistant torque during the shutdown and so prevents any overspeed. In case of failure of the power converter the generator is automatically connected to an electrical resistance load which ensures as previously a resistant torque and prevents any overspeed due to the permanent magnet technology associated with a specific power control. Pitch angle of each of the three blades is driven by an independent system. In case of grid failure the 3 systems are supplied independently by battery so that each blade has the ability to feather and to ensure the wind turbine shutdown.

Smooth line

The setting-up of most of components inside the tower bottom has offered the possibility to DDIS to minimize the size of the nacelle of the DDIS60 wind turbine. As a result, DDIS was able to design a compact nacelle without unsightly forms to focus on a smooth and non-aggressive line in order to improve the visual impact and integration in landscapes.



1. Blade
2. Pitch bearing
3. Pitch motor
4. Axial flux generator
5. Yaw bearing
6. Nacelle frame

7. Yaw motor
8. Nacelle cover
9. Crane
10. Secondary air-air cooler
11. Hub

Power generation scheme

