

1 MW

normal, operational setting. Each blade has its own independent actuating system.

The fibre glass blades are manufactured by LM Glasfiber A/S. The blade tips are fitted with lightning protection, substantially reducing the risk of damage in case of a direct hit.

Machine Design

The Bonus 1 MW has the most recent type of machine arrangement developed by Bonus. The nacelle bedplate is a one-piece steel structure with no welds. The main shaft is long, thereby reducing the reaction forces on the nacelle structure, and the reaction supports are located symmetrically around the tower axis. The result is a simple, rugged, and attractive machine structure, enclosed in a steel canopy.

The transmission system consists of a three-stage planetary/helical gearbox and a two-speed asynchronous generator. A separate oil cooler provides gearbox cooling and the generator has a special air cooling system, combining generator and nacelle ventilation with an efficient exhaust silencer. Both the low speed and the high-speed windings of the generator have been optimised to provide maximum efficiency at low and medium power levels.

The turbine has two independent safety systems, the aerodynamic brakes and a mechanical disc brake. Both systems are fail-safe and each system is capable of shutting down the turbine even in the unlikely situation that the other system should fail. The disc brake has two-level braking, using a moderate torque for ordinary stops and a high torque for emergency situations only.

Features which have been characteristic of Bonus for years are applied to the 1 MW turbine also: Consistent attention to noise control, a heavy-duty structure with ample design margins, and a uniform high level of quality maintained throughout the machine, from the overall concept to minute details.

Controller

The 1 MW turbine has a microprocessor control with liquid crystal display and a portable hand terminal. All controller activities for operation, service and statistics are provided both at the tower base and in the nacelle. Optional remote monitoring is Windows-based and offers operational status, statistics, and changes of operating parameters from the owner's facilities.

The Bonus 1 MW wind turbine is one of the largest turbines in the product range of Bonus. The basic design of the machine is similar to that of the 600 kW Mk IV turbine but the dimensions are significantly larger. A new feature is the power regulation by CombiStall® where the simple and efficient stall regulation known from earlier Bonus turbines is combined with automatic optimising of the blade pitch setting. As a consequence, the average power output in high winds is always precisely 1 MW, irrespective of the weather conditions.

Rotor

Like all other turbines from Bonus, the 1 MW is a three-bladed, stall regulated machine. This concept is simple, reliable, and efficient, and the application of recent aerodynamic advances offers an attractive combination of low noise and high output.

The 1 MW turbine has CombiStall® power regulation. The blades can be pitched 90 degrees and during operation in high winds, the pitch setting is continuously adjusted to maintain an average output of 1 MW. The blade adjustment is used also for optimising at lower wind speeds. When the turbine is shut down, the blades act as aerodynamic brakes, turning 90 degrees from the

Tower

The 1 MW turbine is mounted on a tubular steel tower. Internal tower platforms are spaced sufficiently close to allow ascent without additional safety harness (under typical European safety regulations). A special version has built-in transformer and switchgear for direct connection to the high voltage grid.

Rotor

Rotor diameter.....54,2 m
Swept area.....2300 m²
Rotor speed.....15/22 rpm
Power regulation.....CombiStall®
Blade length.....26 m
Blade type.....LM 26.1

Generator

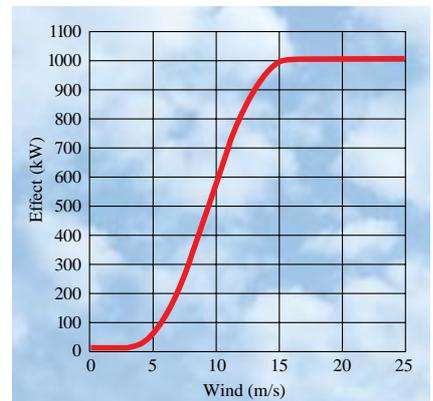
Type.....Asynchronous
Nominal power.....0,2/1 MW
Speed.....1000/1500 rpm
Voltage.....690 V
Protection.....IP 54
Supplier.....ABB

Transmission

Gearbox type.....Planetary/helical
Gearbox supplier.....Flender

Brake Systems

Air brakes.....Blade pitch
Mechanical brake.....Dual disk brake
Activation.....Fail-safe (both)



Tower

Type.....Conical, tubular
Hub heights.....45, 50, 60, 70 m
Corrosion protection.....Painted

Noise

Noise level (8 m/s, 10 m).....< 101 dB
Tonal penalty.....None (Joint Nordic Method)



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