

[RE]built

TECHNICAL
DESCRIPTION

[RE]built wind turbine

BONUS-600 kW

BONUS 600KW

Where performance
meets economy

The BONUS 600kW is one of the industry's most reliable turbines in the kW range – a high-performing and versatile turbine suitable for high and medium wind sites.

With more than 2,700 of these turbines erected around the globe, the BONUS 600kW is a tried-and-tested piece of technology – rigorously proven in the field, robustly constructed and with an enviable track-record.

Investors can be confident its easily transportable design features make it an ideal choice for remote areas or sites with challenging access.





[RE]built

on experience

The BONUS-600 KW [RE]built turbine is the classical workhorse for utility-scale wind turbine projects. It is the result of BONUS/SIEMENS experience from more than 25 years of leading-edge design and construction of wind turbines and represents the best of the qualities for which we are known throughout the wind industry. It is an efficient and reliable machine combining a solid and conservative design approach with high-performance technical features, such as the Full Converter system with variable speed concept and the LM Blade technology.

The BONUS 600KW [RE]built wind turbine is suited for tough and demanding applications onshore, particularly for high wind speed sites.

[RE]built PROCESS

- All components are removed for cleaning and inspection.
- Any component not meeting OEM manufacturer specifications is repaired or replaced.
- The nacelle frame is inspected for cracks and overall structural integrity. Any deficiencies are repaired and tested.
- The machine base and frame are stripped of all paint, cleaned of dirt and lubricant, and repainted.
- All critical rotating components (cylinders, rollers, etc.) are inspected for run-out. Any component not meeting OEM manufacturer specifications are repaired or replaced.
- All bearings (roller or plain) are repaired or replaced with new.
- All belting is repaired or replaced with new.
- All rubber hydraulic lines are repaired or replaced with new.
- All polymer couplings are repaired or replaced with new.
- All hardware is repaired or replaced with new.
- All gear boxes are cleaned, inspected, and new seals installed. Gears are inspected and repaired or replaced if needed.
- All generators are cleaned, inspected, and 100% rewound.
- Brake calipers are rebuilt, including new brake rotor and brake pads.
- Bull (Yaw) gear is repaired or replaced with new having a wider face than the OEM gearing.
- Pinion gear is repaired or replaced with new having a wider face than the OEM gearing.
- All Oil on wear blocks are replaced with new.
- All blades are inspected for defects, including wear, cracks, and blemishes. Deficiencies are repaired and the surface profiles returned to OEM manufacturer specifications.
- All blades are protected with a new covering of gel coat.
- All blades are weighed, balanced, and matched.
- Blade over-speed mechanisms are inspected. Any component not meeting OEM manufacturer specifications are repaired or replaced.
- All electrical wiring and components are new and upgraded above and beyond original manufacturer specifications.
- The main control system is repaired or replaced for new.
- Wind vane and anemometer are repaired or replaced with new.
- ABB full power converter

Technical description



Rotor

The BONUS-600 kW [RE]built rotor is a three blade self-supporting construction, mounted upwind of the tower. The power limitation is by stall regulation.

Blades

The blades are made of fibreglass reinforced polyester and are supplied by LM Hub The hub is cast in nodular cast iron and is mounted on the main shaft with a large Main shaft and main bearing The main shaft is forged in alloy steel. It is centre-bored for the transfer of Gearbox The gearbox is a custom-built three-stage industrial design. The first, high torque Coupling The coupling between the gearbox and the generator is a universal coupling with Generator The generator is a fully enclosed double-winding asynchronous generator. The Glasfiber A/S of Denmark. The blade tip can be turned 85 degrees relative to the main blade, thereby acting as an aerodynamic brake. The blade tip shaft material is carbon fibre and all other load supporting parts are manufactured in highgrade stainless steel. The blade tip is actuated hydraulically from the hub, and hydraulic pressure is required to keep the tip in the operating position. A built-in spring turns the tip to the brake position and during rotation the centrifugal force acts in the same direction. Any release of the hydraulic pressure, either intentionally by the control system or unintentionally by failure of the hydraulic system, will cause the tips to deploy and the turbine to shut down.

The blocking of one tip will not prevent the two remaining tips from functioning, and the turbine can always shut down with only two tips deployed.

Hub

The hub is cast in nodular cast iron and is mounted on the main shaft with a large flange.

Main shaft and main bearing

The main shaft is forged in alloy steel. It is centre-bored for the transfer of hydraulic pressure to the blade tip brakes. The main bearing absorbs the rotor thrust and reaction forces from gravity and bending moments. It is a spherical roller bearing, fitted in a custom-built bearing housing. The bearing is grease lubricated and it is protected with labyrinth seals requiring no maintenance.

Gearbox

The gearbox is a custom-built three-stage industrial design. The first, high torque stage is a planetary design, providing a compact high-performance construction. The intermediary and high speed stages are helical, providing the lowest possible noise level. The gearbox is splash lubricated and is cooled with a separate oil cooler. It is shaft-mounted with a shrink disk connection. The gearbox is supported on the nacelle with flexible rubber bushings which serve to reduce structural noise transfer. Temperature sensors are fitted to the high speed shaft bearing and in the oil sump to shut down the turbine in the event of insufficient lubrication.

Coupling

The coupling between the gearbox and the generator is a universal coupling with two flexible elements. The coupling has good damping and shock-absorbing properties. It can tolerate moderate misalignments.

Generator

The generator is a fully enclosed asynchronous generator. The rotor design and the stator windings are specially designed for high efficiency at partial loads. The generator is protected with thermal switches and analogue temperature measurement. The generator is fitted with a separate thermostat-controlled ventilation arrangement. By having a very efficient surface cooling the generator can be operated at temperatures well below the normal level of the standard insulation class, thereby providing the best possible lifetime of the winding insulation.

Easy to transport and install:

Thanks to our advanced design techniques, the BONUS-600 kW [RE]built can be dispatched to almost any location around the world – and all components comply with local and international limits for standard transportation. The nacelle requires no on-site assembly, further lowering your costs.



Peak Performance

for medium and high wind sites

Disc brake

The mechanical brake is fitted to the gearbox high speed shaft. It is failsafe and has a spring-loaded hydraulic caliper. The brake application system has two stages, one for normal shut-downs and the other for emergency shut-down in case of malfunctioning air brakes.

Nacelle bedplate

The nacelle bedplate is a massive steel construction without weldings. It is cut out of a 120 mm steel plate. The top side has machined surfaces for the bearing and the gearbox supports, and the bottom side has similar surfaces for the yaw bearing.

Yaw system

The yaw bearing is an externally geared ring with a friction bearing. The yawing motion is driven by two electric planetary gear motors. The yaw brake is passive, based on the friction of the yaw bearing. It keeps the yaw system rigid under most loading conditions. In case of highly eccentric peak loads the yaw brake will slide and the yaw motors will follow the motion passively, thereby unloading the system.

Controller

A standard industrial computer is the basis of the turbine controller. The controller is self-diagnosing and includes a keyboard and display for easy status readout and adjustment of settings.

Power conversion

The FullConverter power conversion system allows generator operation at variable speed, frequency and voltage while supplying power at constant frequency and voltage to the MV transformer. The power conversion system is a modular arrangement for easy maintenance.

Tower

The BONUS 600 kW [RE]built turbine is mounted on a tapered tubular steel tower. The tower can be fitted with a personnel hoist as an option.

Operation

The wind turbine operates automatically, self-starting when the wind reaches an average speed of about 3–5 m/s. During operation below rated power, the pitch angle and rotor speed are continuously adjusted to maximize the aerodynamic efficiency. Rated power is reached at a wind speed of about 13–14 m/s, and at higher wind speeds the output is regulated at rated power. If the average wind speed exceeds the maximum operational limit of 25 m/s, the turbine is shut down by feathering of the blades. When the wind drops back below the restart speed, the safety systems reset automatically.

Remote control

The BONUS 600 kW [RE]built turbine is equipped with the unique WebWPS SCADA system. This system offers remote control and a variety of status views and useful reports from a standard Internet web browser. The status views present electrical and mechanical data, operation and fault status, meteorological data and grid station data.

Turbine Condition Monitoring

In addition to the SCADA system, the turbine is equipped with a web-based Turbine Condition Monitoring (TCM) system. The TCM system carries out precise condition diagnostics on main turbine components continuously and in real time. It gives early warning of possible component failures by continuous comparison of current vibration spectra with previously established reference spectra. The TCM system has various alarm levels, from informative through alerting level to turbine shutdown.

Grid compliance

The BONUS 600 kW [RE]built supports grid requirements in a wide range of markets and territories. Advanced control of reactive power capability stabilises the frequency and voltage of the grid.

Reliable, competitive and compliant

Re-built the future of wind

Cheaper to transport, quicker to install

The light weight of the BONUS-600 kW minimises construction and transportation costs.

The BONUS-600 kW features a compact style of blade transportation which allows the safe transportation of three blades at one time using existing trucks and cranes. This makes installation quicker and minimises transportation costs.

Lowering maintenance costs for greater profitability

Maintenance and repairs can now be performed faster and cheaper up-tower, and with greater technical ease, thanks to our updated ergonomic nacelle design with increased access and working environment.

With a ABB full scale converter, the [Re]built BONUS-600 kW complies with even the most challenging grid requirements of the modern energy market.

Low Balance of Plant (BOP)

Installation and transportation costs Just like BONUS-600 KW [RE]built is designed to be transported easily (by rail, truck or barge) to virtually any site around the world. In terms of weight, height and width, all of its components comply with local and international limits for standard transportation.

Specifically, not one of its components weighs more than 40 tonnes. Your foundation costs are also lowered with the BONUS-600 KW [RE]built due to its improved load control. The innovative power system provides excellent grid support and is highly adaptable for future technical requirements. It also enables substations to be simpler and therefore more cost-effective.

Easy-access serviceability

The BONUS-600 KW [RE]built nacelle is ergonomically. This extra space also makes it easier for maintenance crews to gain access – reducing the time and cost spent on servicing and therefore maximising uptime. The automatic lubrication of the yaw system, main bearing and generator delivers the triple benefit of increased reliability, reduced maintenance time and less frequent servicing. Combined, these factors save you

The technology you need

– wherever you need it

Grid requirements

The [Re]built BONUS-600 kW turbines are designed for optimum compliance with grid standards worldwide. The Full Power Converter of ABB advanced grid compliance system provides active and reactive power regulation, fast response to changes in frequency, and fault ride-through capabilities to support grid levels and stability in the event of grid fluctuations.

Investing in a [Re]built BONUS-600 kW means investing in turbines that can adapt to even the most challenging grid codes.



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December 20, 2011 | 01008 16



Full Converter

A brand new ABB full converter transforms the energy output to DC and inverts again to AC allowing the generator to produce electricity at all the range of Capacitors and reactors provide reactive energy transferring all active power to the grid.

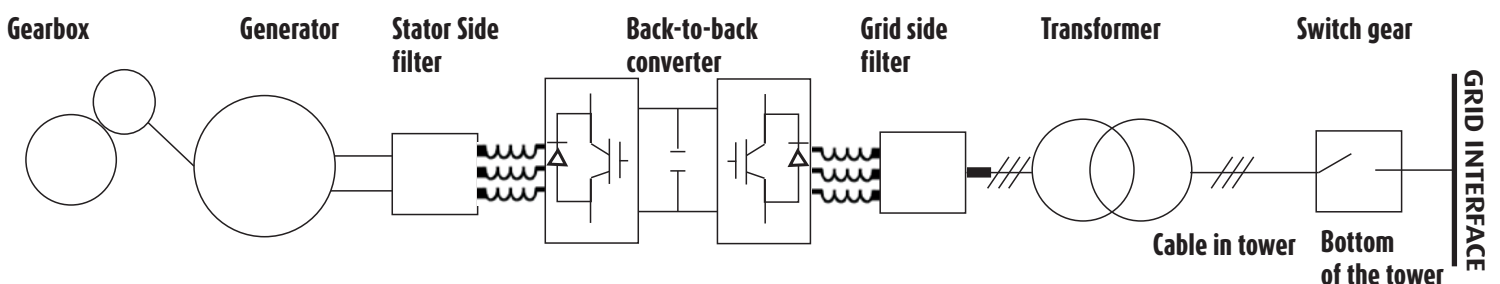
LCL filters control the THD injection in the grid keeping low additions and being compliant in all grid codes.

Robust control can keep the turbine connected during a low voltage helping the grid stability.

Advantages of Full Converter

1. Reactive compensation from 0.8Cap to 0.8ind
2. LCL filter for Harmonics limiting THD emissions into the grid
3. Low Voltage Ride Through capabilities.
4. Dynamic power factor control and voltage control
5. Primary response in frequency control
6. Crow bar optional for safety breaking

Excellent grid support



The experience to secure

your wind energy investment

275.000 €

2 year guarantee
EXWORK terms of sale

Optimise energy production

- Designed for high productivity
- Excellent grid support

Reduce energy costs

- Low Balance of Plant (BOP), installation and transportation costs
- Designed for serviceability
- Innovative ABB full Power Converter uses the wind's own energy

Secure your investment

- Proven technology
- Reliable and robust product



**Sageguarding
your
investment,**
powering your profits

BONUS-600 KW [RE]built

some impressive data

Rotor

Type	3-bladed, horizontal axis
Position	Upwind
Diameter	43 / 44 m
Swept area	1520 m ²
Synchronous rotor speed	27 / 18 rpm.
Power regulation	Stall regulation
Rotor tilt	4 degrees

Blades

Type	Self-supporting
Blade length	19 m
Tip chord	0.40 m
Root chord	1.65 m
Aerodynamic profile	FFA3 - NACA 632xx
Coning	0 degrees
Material	Glass fibre
Surface gloss	Semi-mat, gloss 5-15 / ISO 2813
Surface colour	Light grey, Jotun 8091
Blade designation	LM 19-1
Blade manufacturer	LM Glasfiber A/S

Aerodynamic brakes (Blade tip brakes)

Type	Turning blade tips
Activation	Passive, with release of hydraulic pressure

Load-supporting parts in the nacelle

Hub	Nodular cast-iron
Main bearing	Spherical roller bearing
Transmission shaft	Alloy steel
Nacelle bedplate	Steel

Transmission system Coupling,

hub/main shaft	Flange
Coupling, main shaft/gearbox	Shrink disc
Gearbox type	Three stage planetary/helical
Gearbox ratio	1 : 55
Gearbox lubrication	Splash lubrication
Oil volume	60 l
Gearbox cooling	Separate cooler
Gearbox designation	PEAC 4280
Gearbox manufacturer	Flender AG
Coupling gear/generator	Double flexible coupling

Brake (mechanical brake)

Type	Fail-safe, brake disc
Position	On the gearbox high-speed shaft
No. of calipers	1

Generator

Type	Asynchronous
Nominal power	600 / 120 kW
Synchronous speed	1500 / 1000 o/min
Voltage	690 V
Frequency	50 Hz / 60Hz
Protection	IP 54
Cooling	Thermostatically controlled fan
Isolation class	F
Generator designation	M2BG 400 XL 4/6 B3
Generator manufacturer	ABB Motor A/S

Nacelle cover

Type	Totally enclosed
Material	Steel
Yaw system	
Type	Active
Yaw bearing	Externally geared slew-ring
Yaw drive	Twin electric gear motors with combined gear/planet-gear.
Yaw brake	Passive friction brake

Tower

Type	Conical tubular tower
Hub height	40m / 45m / 50m / 55m 58m / 60m
Corrosion protection	Painting
Surface gloss of the painted tower	Semi-mat, gloss 15 - 35 ISO 2813
Colour of painted tower	Light grey, Hempel 55210-01050

Operating data

Cut-in wind speed	3 m/s
Nominal power at approx	15 m/s
Cut-out wind speed	25 m/s
Max. 2 s. wind gust	55 m/s

BONUS-600 KW [RE]built

some impressive data

Estimated CAPEX Bonus 600kW + Full Converter

BONUS-600 KW + Full Converter	275.000 €
Foundations (420m3)	60.000 €
Erection & commissioning	75.000 €
Transport	95.000 €
Elec. Connection (1km+CB)	40.000 €
Insurance	8.000 €
TOTAL	553.000 €

Assumptions

Electrical connection 1km underground cable at 11kV+
Circuit Breaker
Foundation 420m3
No mayor civil works on roads required
Cranes available national for erection

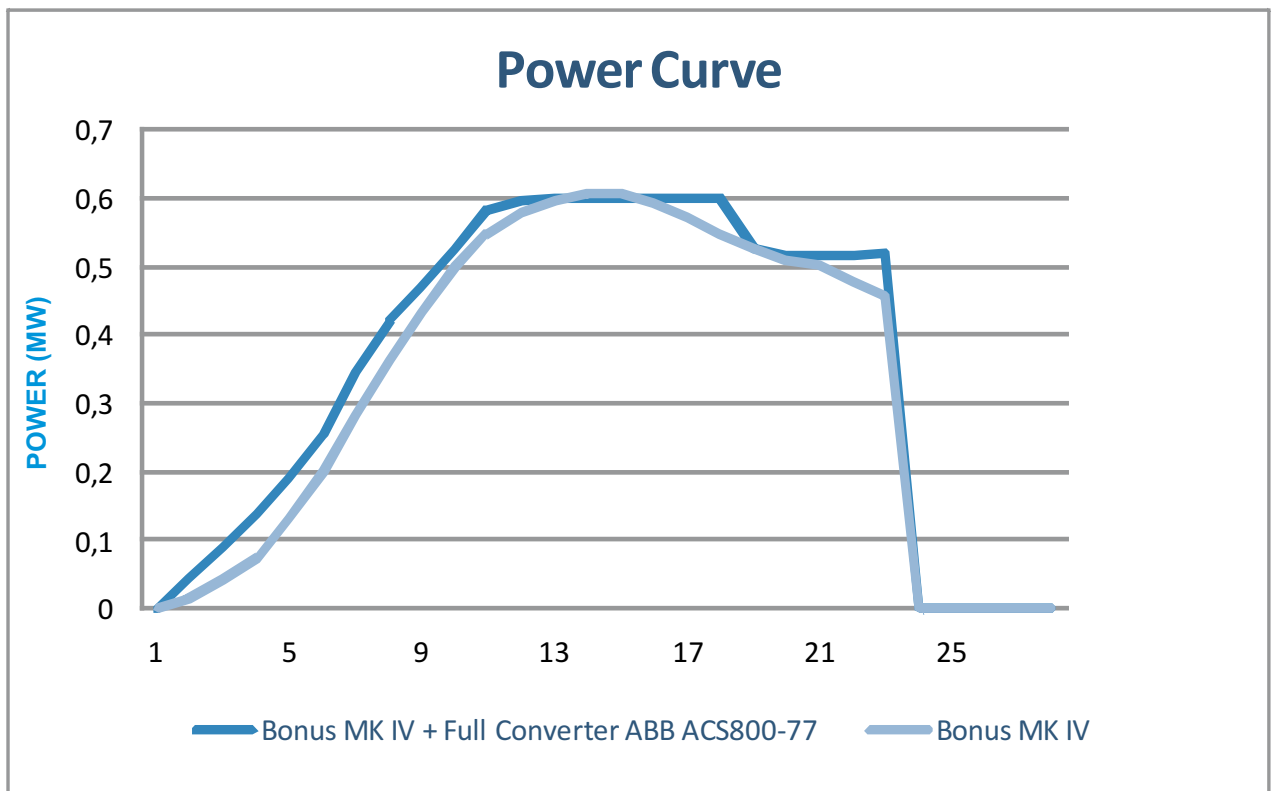
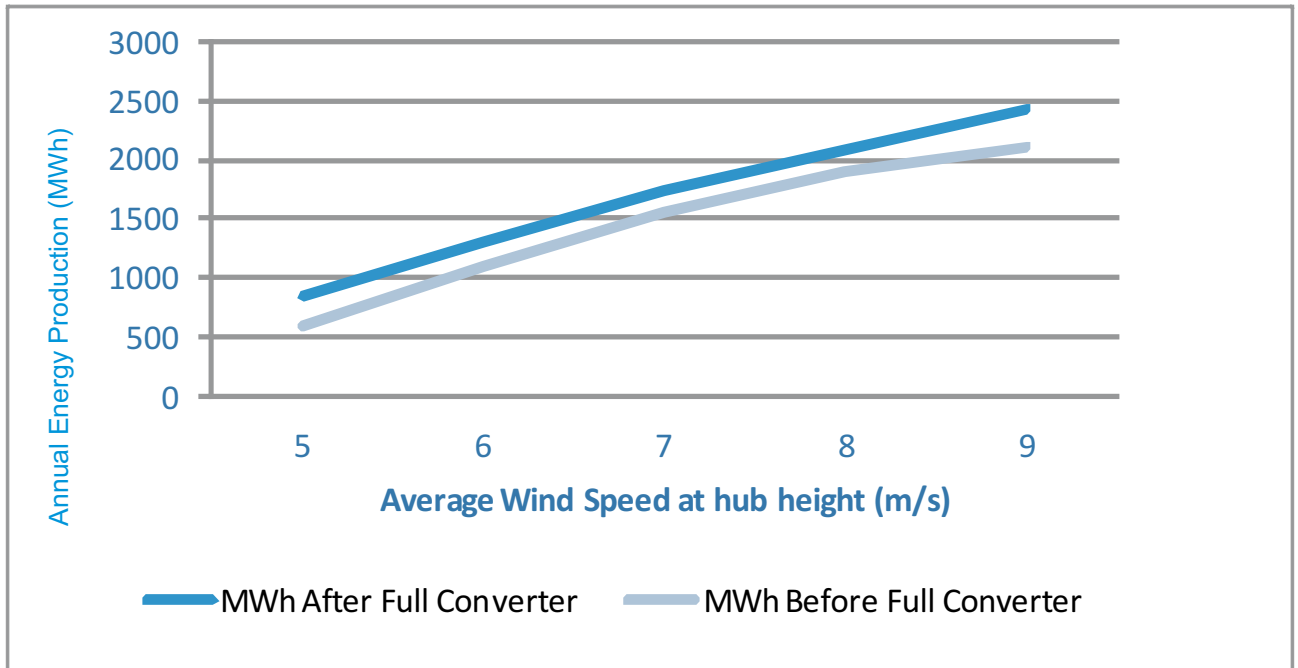
Advantages

Generator and Full Converter ABB
Robustness and Simplicity of moving parts
Up to 3WTGs connected to 11kV, 13kV or 20kV with no major issues
LCL filter for THD
Power Factor 0,8 cap to 0,8 ind at full Active Power
Low Voltage Ride Through compliant
Grid Code Compliant with highest standards
Cost turnkey 1,05 m EUR/MW



BONUS-600 KW [RE]built

some impressive data



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general descriptions of the technical options
available, which may not apply in all cases.
The required technical options should therefore
be specified in the contract.