

Chinese wind turbine manufacturer Goldwind uses Vensys plant design and PC-based control from Beckhoff

High-quality, proven control components for Vensys wind turbines



The gearless Vensys wind turbines are characterized by their simplicity and quality. The turbines are proof that a few high-quality and proven components are sufficient for building state of the art wind energy converters. With the 70, 77 and 82 series, Vensys offers advanced wind turbines in the 1.5 MW range with different hub heights and rotor diameters. New 2.5 MW plants will follow near the end of 2010. All Vensys wind turbines use PC-based control technology from Beckhoff. To date, more than 6,200 wind turbines based on the Vensys design with Beckhoff technology have been delivered worldwide.

Vensys Energy AG specializes in gearless wind turbines. In addition to manufacturing facilities at Neunkirchen (Saarland, Germany), the company has manufacturing capacities for more than 2000 wind energy converters through licensees around the world. At Diepholz, Lower Saxony in Germany, the subsidiary Vensys Elektrotechnik GmbH produces frequency converters, low-voltage distribution boards and pitch systems for the Vensys wind power units.

In addition to the development and manufacturing of wind turbines, Vensys sells expertise in the form of licenses. The licensees have the right to manufacture and sell wind turbines according to Vensys designs. Over recent years the companies Goldwind in China, Eozen in Spain, Regen Powertech in India and Enerwind/IMPISA Wind in Brazil have become the license partner of Vensys. Vensys wind turbines can be found in all major emerging markets around the world.

Vensys originated from the wind energy research team (FGW) at the University of Saarbrücken in Germany, which was established in 1990. The first Vensys 70/77 type 1.5 MW wind energy converters started operating in spring 2007. In September 2009 Vensys presented its newly developed 2.5 MW wind turbine generator. The design is based on established Vensys technology: At the core of the gearless wind energy converter is a synchronous generator with permanent magnet technology that is driven directly by the rotor. The direct drive avoids the need for gearboxes which are maintenance-intensive and susceptible to faults. The characteristic Vensys generator design achieves a high

efficiency. The market introduction of the Vensys series 90 and 100 with 2.5 MW rated power is planned for the end of 2010.

Versatile and robust operations management permits application anywhere and under extreme environmental conditions

The control systems for all Vensys wind turbines are developed and manufactured in Diepholz by Vensys Elektrotechnik GmbH in close cooperation with Beckhoff. This is where the pilot production for the control cabinets and systems takes place before the licensees and/or their manufacturing partners commence series production. In order to be successful internationally, wind turbine manufacturers need high-performance and flexible control systems: Rapidly changing system states under different, and in some cases extreme climatic and environmental conditions result in complex demands for the control systems. Wind turbines must be suitable for the locational conditions found in Central European lowlands and climatically extreme conditions, as they occur in China, for example: Deserts naturally present different conditions than coastal locations or mountain regions. The control systems must withstand heat, cold, humidity, sand, extreme wind forces, turbulence and other demanding influences and respond reliably. The system must always face the right way relative to the wind; data must be collected and evaluated; state or error messages must be exact and meaningful; grid feed-in must be correct and grid-supportive. All this requires a high-performance and adaptable control system.

The gearless Vensys wind turbines are controlled by a CX1020 Embedded PC. To date more than 6,200 wind turbines based on the Vensys design with Beckhoff control platform have been delivered worldwide.

At the Diepholz, Germany facility Vensys Elektrotechnik GmbH builds the "pilot series" for the control cabinets before the licensees and/or their partners commence series production.





Hans Beckhoff, managing director of Beckhoff Automation, on the Vensys windmill

	Rated power	Rotor diameter
Vensys 70	1.500 kW	70 m (230 ft)
Vensys 77	1.500 kW	77 m (253 ft)
Vensys 82	1.500 kW	82 m (262 ft)
Vensys 90	2.500 kW	90 m (295 ft)
Vensys 100	2.500 kW	100 m (328 ft)

Lean control architecture integrates standard and safety I/O in a single system

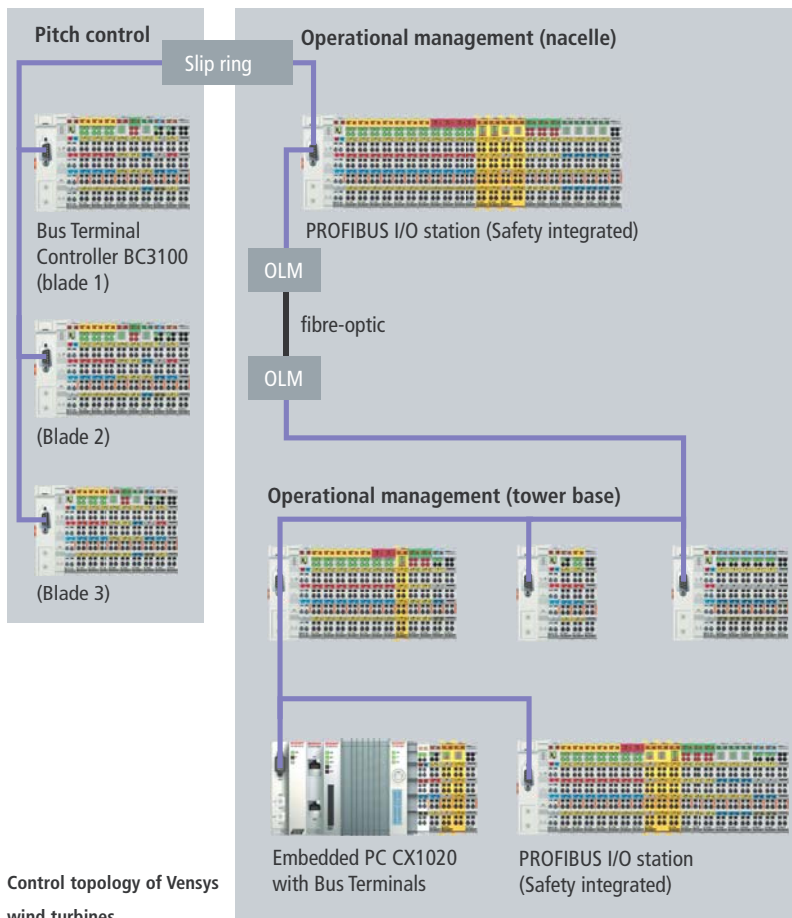
The Vensys system design, which is based on just a few components, is matched by the “lean” Beckhoff control concept with a single PC (see topology diagram). The master computer is a Beckhoff CX1020 Embedded PC to which two Bus Terminal stations in the tower base, two stations in the nacelle and the pitch controllers in the hub are connected via PROFIBUS. The central Embedded PC collects and processes the operational management and pitch controller data, controls the grid feed-in and communicates with the control room via Ethernet.

Compared with conventional solutions the PC-based control system from Beckhoff has the advantage that only one PC is required for control purposes and data interfaces. The Bus Terminals are attached directly to

the Embedded PC, so that PC technology and modular I/O level form a cohesive unit.

The safety functions are also directly integrated in the Bus Terminal system. TwinSAFE terminals are distributed to the different I/O stations. A central KL6904 TwinSAFE logic terminal serves as the link unit between the safe input and output terminals. The logic terminal integrates safety function blocks which are configured accordingly. In the Vensys wind turbines, the overspeed relay, vibration sensor and the emergency off button are integrated in the safety circuit.

Robert Müller, wind power expert from the Beckhoff branch office in Lübeck, Germany explains the benefits of the integrated safety technology: “The merger of standard and safety I/O into a single streamlined system simplifies project planning, programming, cabling and diagnostics significantly. The TwinSAFE Bus Terminals permit the connection of all common safety sensors and actuators. The TwinSAFE protocol is used for secure communication. This enables safety-related data to be transferred via any media. In the case of Vensys systems, PROFIBUS is used for transferring the safe signals.” The use of TwinSAFE technology makes multi-wire copper cabling between the nacelle and the tower base, which is required for a conventional hard-wired safety chain, unnecessary. The safety chain is integrated in the optical fiber used for system automation.



Control topology of Vensys wind turbines

Compact pitch controllers and flexible IEC-61131 programming

The pitch controllers are coupled with PROFIBUS via slip rings. Each rotor blade features a Beckhoff BX3100 Bus Terminal Controller with various Bus Terminals. The pitch box with integrated controller automatically collects and analyzes the ambient data, decides independently and communicates with the other pitch boxes in order to coordinate the initiated actions. At the same time the data are transferred to the Embedded PC in the nacelle. The rotor blades are pitched via external toothed belts – a solution developed in-house at Vensys that developers are quite proud of.

“Crucial factors for choosing the Beckhoff systems were the flexibility of the comprehensive Bus Terminal I/O kit, the small footprint of the controllers and I/O systems, the user-friendly programming via

Dirk Kordtomeikel, wind power sector manager at Beckhoff, and Nicole Grote, purchasing manager at Vensys Elektrotechnik GmbH, on the windmill



TwinCAT, and ultimately the low system costs," said Frank Becker, director of control technology at Vensys.

Another argument in the decision for Beckhoff as control equipment supplier was the global positioning of the company in more than 60 countries. Beckhoff has wind power experts in its subsidiary branches in important wind power regions such as China.

Goldwind relies on German technology

The main licensee of Vensys wind energy converters is the company Goldwind Science and Technology Co Ltd., based in Urumqi in northwest China. Goldwind Windenergy GmbH, a German subsidiary of Goldwind, has been the main shareholder of Vensys Energy AG since April 2008 with 70% of the shares. Goldwind has become the industry leader among Chinese wind turbine manufacturers and is set for further growth.

Goldwind's main activities include the development, manufacturing and sale of wind turbines. Goldwind also offers comprehensive technical and consulting services for the construction and operation of wind turbines for windfarm operators and investors. More than 6,000 Goldwind wind turbine generators are currently in operation in China. Goldwind supplied wind turbines for the Olympic Park near Beijing, which was built for the Summer Olympics in 2008. The company is also successful in the international wind energy market: The first networked 1.5 MW wind turbines at the UILK windfarm in Minnesota (United States) were commissioned in February 2010.

"Goldwind and Beckhoff have had a successful working relationship for many years," said Dr. Yuwen Bo, deputy director of the Goldwind wind energy technology center: "Beckhoff has extensive expertise in the wind energy industry and is able to supply complete system solutions. In addition, PC Control offers us a high degree of flexibility for programming and facilitates modifications of the control system according to application- or customer-specific requirements."

The increasing demands for efficiency and energy yield have resulted in strong growth for high-performance wind turbines: 1.5 MW systems are currently the standard in China. For the 2.5 MW systems, which will

The Guanting windfarm near Beijing is located at an elevation of approx. 460 to 479 m (1509 to 1572 ft) and is spread over an area of 6 x 14 km (3.7 x 8.7 mi). It has an installed wind power capacity of 155 MW. Guanting II, with a capacity of 50 MW, is currently under construction.

commence production towards the end of this year, Goldwind will use EtherCAT as communication system instead of PROFIBUS.

"The control algorithms for the systems are getting more and more complex," said Dr. Yuwen Bo: "In order to cope with difficult geographic and climatic conditions and varying requirements, the performance of the main controller – which represents the 'brain' of the wind turbine – must be able to 'grow.'" The Embedded PCs from Beckhoff are able to process very complex algorithms, which means all wind turbine control tasks can run on an integrated platform.

Vensys Energy AG

Goldwind Science and Technology Co Ltd.

Goldwind International

www.vensys.de

www.goldwind.cn

www.goldwindglobal.com

