

Wind energy helps keep the future bright for China

Mingyang relies on Beckhoff wind industry expertise

→ In recent years China has been experiencing a wind power boom. Now that the main international wind turbine manufacturers have established production plants in China, Chinese machine manufacturers are racing to gain a foothold in the wind energy sector. The Mingyang Group, originally based in southern China, started with a 1.5 megawatt system using control technology and industry expertise from Beckhoff.



Meanwhile China has become the country with the world's most wind farms. The reasons for using wind energy are obvious: With a population of more than 1.3 billion or approx. a quarter of the world's population, China uses around 10 percent of the global primary energy resources. Coal is the main energy source for China, with all the consequences associated with generating electricity from coal. Existing coal-fired power plants have a very poor environmental balance, due to their high CO₂ emissions and other polluting attributes. Economic growth creates an incredible challenge: China must build new clean, advanced power plant capacities faster than the dramatic increase in energy consumption. Wind energy is becoming one of the assets in China's dynamic energy market, with up to 40 GW of capacity expected to be installed by 2020. By the end of 2007, around 6 GW capacity had already been installed, of which approx. 3.3 GW were installed in 2007 alone.

Mingyang: wind turbines for the domestic market and abroad

Mingyang Electric Group Co., based in the southern Chinese province of Guangdong, was established in 1993 and became active in the wind energy sector several years ago. Last year the company built its first wind turbine with a nominal capacity of 1.5 MW at Zhanjiang in the far south of China. An additional 33 units are expected. Mingyang is currently establishing production capacities not only to satisfy the Chinese market, but also for export: In 2008 the company expects to export 72 systems to the USA. Over the coming years Mingyang intends to build systems with a total capacity of 2,000 MW, around half of which destined for the United States. In addition to the lower price, high system performance and reliability are further key arguments in favor of this wind energy market newcomer.

System design made in Germany

Mingyang relies on a tried and tested design originating from Aerodyn Energiesysteme GmbH, a firm of consulting engineers based in Rendsburg, Germany, who have been developing wind turbines since the early 1980s. Beckhoff supplies the control and automation system. "The basic design is proven and has been used successfully in the market for years," said Robert Müller, Beckhoff project manager and wind power branch manager, commenting on the basic idea for the Mingyang system. The wind turbine has a nominal capacity of 1.5 MW, with a hub height and a rotor diameter of 80 meters. Mingyang offers the system in strong wind and light wind versions as well as a cold climate version. The pitch-controlled, variable-speed system is equipped with a double-fed induction generator. All these features are familiar and have been proven in the market. The project was nevertheless ambitious: The order for the development of the control system was issued in late autumn 2006. A prototype was built only a year later and commissioned in October 2007.

Extreme conditions: the control system must adapt to the harsh, rapidly varying ambient temperatures and weather conditions such as wind speed and direction in order for the installation to meet the stringent electrical quality requirements.

PC controller in the tower:
CX1020 Embedded PC with
TwinCAT automation software



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Control concept for extreme operating conditions

The specific operating conditions for automation components in the wind energy sector differ from other industrial applications and require special automation expertise: harsh, rapidly varying ambient temperatures and weather conditions such as wind speed and direction have to be mastered in order for the systems to meet stringent electrical quality requirements. While the wind quality in the southern Chinese province of Zhanjiang is generally high and uniform, the region is at risk from typhoons all year round. Two typhoons already passed through during the construction phase and left their mark. The wind turbines have to cope with wind speeds in excess of 50 m/s (180 km/h) in conjunction with strong precipitation. The South China Sea location just north of the 20th degree of latitude generally has a more extreme climate than Central European locations.

"The control system has to be adapted to such extreme conditions," said wind power expert Robert Müller. "It must be able to respond very quickly, the emergency systems must be designed with redundancy in mind, and the installation must meet stringent safety criteria." The automation system automatically responds to changes in environmental parameters. The operating states are monitored both locally and remotely via remote data communication in order to enable full control of the system. The data are stored for retrospective fault analysis, for example following disruptions in system communication.

PC-based control platform offers openness for future developments

The PC Control system in the tower is based on a CX1020 Embedded PC with TwinCAT automation software. The modular CX system is equipped with a CAN bus interface for communication with the autonomous converter for the double-fed induction generator and standard interfaces (USB, DVI and Ethernet TCP/IP). Further I/O stations for interfacing sensors and actuators are connected

via the high-speed EtherCAT communication system. The autonomous pitch system with PROFIBUS master is integrated into the EtherCAT I/O system via suitable fieldbus terminals. The safety sensors and actuators in the nacelle and the tower base are also directly integrated into the EtherCAT system. Therefore, an additional safety bus system is not required.

Current and historic operational data can be displayed on Beckhoff Control Panels in the nacelle and the tower base. The individual units can be integrated into a wind farm communication system or a control master station for remote monitoring, although this has not yet been implemented in the Zhanjiang installation. This functionality can be retrofitted if required.

In addition to the automation components, Beckhoff also supplied the application software and provided support for Mingyang's engineers during commissioning. The open nature of the application program enables Mingyang to adapt and refine the software. This is a big advantage of open, PC-based control technology. The use of Windows as an operating system and Ethernet as the communication platform opens up new potential in terms of communication and data processing speed. Control or communication components such as laptops can be connected at any time. In the future, any component can be replaced with state-of-the-art modules as required.

→ Guangdong Mingyang Wind Power Technology Co., Ltd
www.mingyang.com.cn