

Avantis achieves higher efficiency and improved operational reliability with gearless wind turbines

## Innovative technology meets modern design

Wind energy has come of age and is developing rapidly: New concepts, new companies and new success stories are emerging. The Avantis Group, represented in Europe through German-based Avantis Europe GmbH, is among the newcomers in the international wind energy market. The company develops, produces and sells gearless wind turbines with capacities between 2.3 and 3.5 MW featuring cutting-edge technology and appealing aesthetics. Designer Luigi Colani is behind the design of the nacelle for the Avantis windmill. With their PC- and EtherCAT-based control platform, the wind turbines are the ideal products for a high tech industry.

The Avantis Group was founded in 2004 and is active worldwide with subsidiaries in Asia, the United States/Canada, Brazil and Europe. In addition to the development and production of wind turbines, Avantis also acts as a service provider in the areas of maintenance, support planning, site evaluation and investor relations management. In 2004 Avantis started developing its own control system concept. Five years later the first 2.5 MW turbine was commissioned at Beihai in southern China. After a highly successful test phase, series production started in 2010 in China. The Beihai facility is designed for an annual production capacity of 300 to 400 turbines.

### **Water-cooled generators and converters offer improved performance and operational reliability**

Avantis wind turbines are characterized by a specially developed, water-cooled permanent magnet generator with very high efficiency and a water-cooled converter. The innovative concept and the modular design enable system configurations for different climatic and geographic conditions. The AV 928, a windmill with a capacity of 2.5 MW, a rotor diameter



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of just over 93 meters and a hub height of 80 meters, is approved for wind speeds according to the IEC IIa standard. Its larger „sister,” the AV 927 with a capacity of 3.5 megawatts, is designed for wind speeds up to typhoon strength according to IEC Ia and is suitable for offshore application. The next generation system from Avantis, the AV 1010 with a slightly modified generator and larger blades (49 m), is a class III turbine with a capacity of 2.3 MW. Avantis is also working on systems in the capacity class between 5 and 6 megawatts. The drive train concept of the AV wind turbine series enables integration of generators with different sizes without resulting in additional mechanical loads on the components. Many components are identical across the whole range, which leads to lower production and stock-keeping costs.

The water cooling system of the converters in the nacelle generates an overpressure that results in hermetic sealing of the system and prevents ingress of dust, contaminants or moisture. This makes the wind turbines suitable for application in extremely arid regions (deserts) as well as in the offshore sector.

The streamlined nacelle designed by industrial designer Luigi Colani perfectly combines aesthetics and function. Yet another new blade design is planned for the future.

AV 928 windmill with a capacity of 2.5 MW, a rotor diameter of just over 93 meters and a hub height of 80 meters



### Higher system availability through gearless system design

Avantis uses state-of-the-art technology and has a wealth of experience. The system design was developed by German Drive Systems (GDS), an Avantis Group company. As in most new system concepts no gearbox is used. The direct drive system with variable rotor speed enables very high efficiency, particularly at part load, under which wind turbines operate most of the time.

The small generator diameter of five meters leads to relatively small system dimensions and simplifies transport and assembly. The water cooling of the generator enables precise temperature control of the permanent magnets. The converter and the control system are positioned at the center of the nacelle. This reduces the vibration stress, resulting in higher availability and lower windmill failure rates.

The tower base only contains the control cabinet with the system communication equipment. Optionally, the power switches and the control cabinet can be positioned on the first platform of the windmill, which may be useful for offshore applications.

### Embedded PC as an integrated control platform

Avantis decided to use Beckhoff as the solution provider for developing the control system. "The hardware and software of the control system come from one source and are optimally adapted to each other," said Klaus Bodenstein, co-founder of Avantis. A Beckhoff CX1020 Embedded PC with TwinCAT automation software forms the "heart" of the automation platform, which, in addition to system control, also integrates monitoring and control of the subsystems such as gearing or cooling and logging of operational data for maintenance and diagnostic purposes. EtherCAT as a high-performance communication system enables integration of subordinate fieldbuses such as CANopen or PROFIBUS.

"The integration of the control system development into the plant design takes place in close cooperation between the development teams of Avantis and Beckhoff," said Klaus Bodenstein. "Through the disclosure of the source code we are able to optimally adapt the control system to the very different, specific ambient conditions and to respond flexibly to the plant system states under normal operating conditions."

"Where other control manufacturers use special hardware, we use stan-



Assembly of the permanent magnet generator at the nacelle



Avantis wind turbines are characterized by a specially developed, water-cooled permanent magnet generator with very high efficiency. The direct drive concept enables high efficiency, particularly at partial load.



## The Avantis Group

The Avantis Group was founded in 2004 and has subsidiaries in China (Hong Kong), Europe (Hamburg) and Brazil. In these respective countries, Avantis Energy aims to produce and market its gearless wind energy turbines with the key components they developed in Germany.

Ralf Breuer, an experienced wind power expert, has been managing director of Avantis Energy Ltd. since 2009 and is pushing the expansion of European market share from the company headquarters in Hamburg. Avantis has big plans for the future and is targeting the potential-filled markets of Asia, the United States and Europe. The young company can boast German system design and that it is internationally organized and works with production and licensed partners in Asia. Usually European industrialists work in the other direction, but Avantis co-founder Klaus Bodenstein, who has been working in Asia for more than 30 years and in the wind energy sector for about 10 years, intends to penetrate North American and European markets from Asia. This enables large production capacities and at the same time secures stable, high sales volume locally. These are ideal conditions for economic success.

Avantis Energy has signed a partnership agreement for the production of wind turbines with the southern Chinese company Yinhe Avantis Wind Power Co. Ltd. and has production capacities for approx. 400 units per year at Beihai. The facility has a new 6000 sqm assembly shop and a 40,000 sqm blade production hall. Avantis currently still receives the rotor blades for its wind turbines from Europe, although the company's own design concept is in preparation.

standard components, resulting in significantly lower costs. The shifting of functionality into software results in transfer of know-how to the wind turbine manufacturer. This represents a further, significant advantage for our customers, who can easily integrate their own functions in TwinCAT," said Dirk Kordtomeikel, industry manager for wind energy at Beckhoff. For the prototype system Beckhoff carried out the factory test for the control systems and the complete commissioning procedure of the plant in the field on behalf of Avantis.

### System design combines aesthetics and function

Avantis managed to pull off an impressive coup with the nacelle design by eminent star designer Luigi Colani. Industrial designer Colani, whose customers include renowned companies such as Ferrari, gave the nacelle of the Avantis windmills a distinctive, streamlined shape. Avantis also worked with Colani on the blade design. Yet another new revolutionary blade design is scheduled to be launched in two years at the latest.