80 total M5000 wind turbines for "Global Tech I" offshore wind farm

Full-load test stand ensures smooth commissioning of offshore wind turbines

Areva Wind specialises in the construction of offshore wind turbines. The 5 MW systems, which have already been tried and tested in Germany's first offshore wind farm, "Alpha Ventus", are equipped with Beckhoff control technology throughout. The full-load test stand which Areva uses to subject their wind turbines to extensive tests, also features PC- and EtherCAT-based control technology from Beckhoff. Areva uses the facility to test their wind turbines for the "Global Tech I" project, located in the German part of the North Sea, approx. 180 kilometres from Bremerhaven, at a water depth of 40 metres.

The operators of Germany's first offshore wind farm, "Alpha Ventus", look back on a successful year of 2011. The wind farm generated 267 gigawatt hours of electricity, around 15% more than predicted. The high yield was achieved thanks to continuously favourable wind conditions and high system availability of up to 97 %. Six of the 5 MW offshore turbines for the Alpha Ventus project were built by Areva Wind GmbH in Bremerhaven, Germany. The company is currently producing 80 offshore M5000 wind turbines for the "Global Tech I" project, the first commercial wind farm in the German part of the North Sea, which is expected to be operational by the end of 2013. The wind farm will have a total capacity of 400 megawatts and will extend over an area of 41 square kilometres and is expected meet, on average, the electricity demand of around 445,000 households.

Full-load test stand with PC-based Control

The M5000 was specially developed for operation on the high seas and has been continuously improved by Areva. In order to offer maximum output and availability, the company subjects its wind turbines to thorough quality tests. Each system is extensively tested in a full-load test stand equipped with PC-based automation technology from Beckhoff.

The tests involving the drivetrain and nacelle under partial and full load conditions and the electrical tests of the generator and converter last 48 hours. The test schedule covers several hundred items, such as checking the cabling, and tests under different operating conditions, including a 12-hour heat run under full load. The components are checked between the individual test runs. An endoscope is used to check the gear unit for wear. A voltage drop is simulated in order to ensure

In the full-load test stand, which is equipped with PC-based automation technology from Beckhoff, each Areva M5000 offshore wind turbine is subjected to extensive tests.

compliance with the current grid requirements. During the test phase the wind turbines are monitored with a Scada system integrated in the controller. The data from each test point are entered into databases and represent the first operational data during the lifetime of the turbines. The company operates in twelve-hour shifts, in order to be able to test two turbines per week. Once the tests have been completed successfully, the tasks involved in commissioning the wind turbine are reduced to a minimum, which means that the failure rates and the associated economic risks are reduced significantly.

Control system and simulation for "Global Tech I" offshore wind farm

A dedicated grid control system is being developed for the "Global Tech I" wind farm to ensure effective management and power supply control of the 80 total M5000 turbines. A real-time simulator was developed in collaboration with the Fraunhofer Institute for Wind Energy and Energy System Technology (IWES) in Kassel, Germany, based on the TwinCAT 3 automation software platform from Beckhoff, to test and optimise the system prior to commissioning. This simulator, which can also be used for other wind farms, enables the grid connection conditions at different locations to be simulated and scrutinised for compliance with the requirements. The findings from the simulation will be incorporated into the design of future wind farms and will help ensure the profitability of the wind farms as well as the individual wind turbines in the long term. The simulator is based on 11 Beckhoff Industrial PCs (IPCs), 10 of which are used for the wind farm simulation while a further PC simulates the control system. The Beckhoff control cabinet PCs of the type C5102 are synchronised with microsecond-level precision via the EL6692 EtherCAT bridge terminal and exchange the simulation results via a dedicated network and the EtherCAT Automation Protocol (EAP).

Eight PCs are used to represent up to 20 wind turbines each (see Fig. 1). Each system consists of three Simulink® models, which are integrated via the TwinCAT Matlab®/Simulink® Target. The models for mechanics, generator and converter are coupled with the operational management/control module, which was developed in "Structured Text" based on IEC 61131-3 and deals with the system control. These 80 TcCOM modules are distributed over the four cores of the CPU to ensure uniform load. A further Industrial PC deals with the network simulation, i.e. all voltages and currents in the wind farm cabling and the entire telecontrol that emulates the connection to the wind farm operator. Since the "Global Tech I" wind farm already uses two grid feed-in points, each of which with two transformers, it was possible to subdivide the model into four Simulink® modules for distribution to the individual CPU cores.

The 10th PC calculates the wind conditions and distribution across the wind farm and includes a simulation manager. It stores processes, so that special situations can be re-modelled and repeated. The wind farm control system (PLS) runs on a Beckhoff C6515 Industrial PC, which is also used in the field. In addition, this IPC also deals with other tasks such as data provision for the grid operator via an IEC 60870-5-104 server, data provision for the Scada system via an OPC UA server and monitoring of the circuit breaker for the wind farm network.

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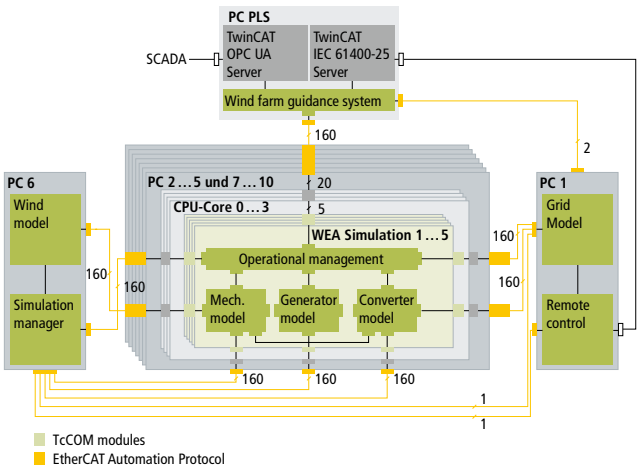

Further information:
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