Ensuring that the expansion of the wind farm reliably supplies the major city of Glasgow, Scotland with power, the operator relies on fast EtherCAT communication together with the corresponding control components. The picture shows a group of Alstom ECO 100 wind turbines.

Fiber optic EtherCAT networking for efficient and flexible wind turbines

Real-time communication enables fast reaction times for wind farm applications

The European Wind Energy Association expects further dynamic expansion of wind power in Europe through 2020, predicting a 64 % increase to installed wind power capacity. Part of this development includes dozens of turbines with a total output of 217 MW, recently installed on a wind farm in Scotland by the French company, Alstom. Fast EtherCAT communication and the corresponding Beckhoff I/O components form the backbone of this onshore project, one of the largest in Europe.

One of Alstom's latest wind power projects was put into service near Glasgow, Scotland, with the expansion of the Whitelee wind farm. The additional 217 MW of installed output is sufficient to supply 124,000 households with power. This onshore expansion set new standards for the entire European continent, in addition to being the first large-scale project for Alstom's powerful ECO 100 wind turbine. An installation totalling 69 of these 3 MW turbines is in operation at this site, along with six ECO 74s, each of which generates 1.67 MW.

Advanced control technology ensures reliable wind farm operation

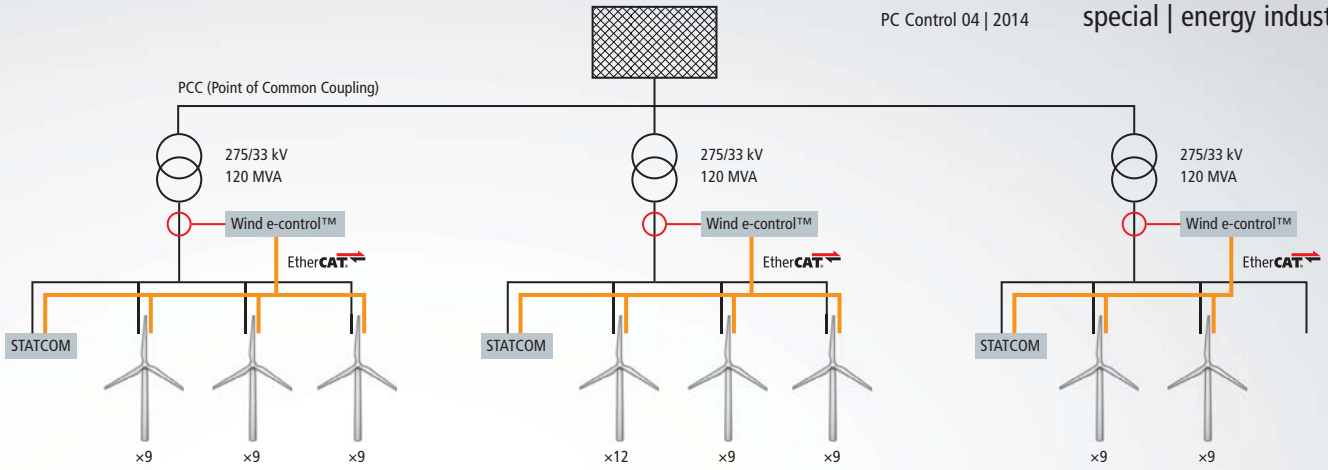
Alstom's Wind e-control™ system assumes the control tasks within the wind farm, e.g. with regard to voltage, power, and frequency control. For example, in order to check the reactive power at the transfer point of the wind farm to the grid, the Wind e-control™ system takes a wide range of measurements from the farm. The grid codes of each respective country can be reliably fulfilled through the control system. The requirements described in the grid code serve to stabilize the grid, which is imperative above all as the renewable energy industry continues to expand. Beyond that, the control system permits operational management on-site in the control room or remotely via data communication to the Scada system. The Wind e-control™ system was installed and successfully used for the first time in this wind farm.

Vicenç Casadevall, Grid Integration Design Engineer at Alstom, describes some key details about the control system: "On the one hand, we have the Reactive Power Control (RPC), which has three regulation modes. By controlling the reactive power in the 'Voltage control' mode, it is possible to adjust the voltage at the transfer point, i.e. the Point of Common Coupling (PCC), to the specifications of the wind farm operator. In the 'Power Factor control' mode, the power factor at the PCC can be controlled. The 'Reactive Power control' mode permits the wind farm operator to have a defined amount of reactive power. On the other hand we have the Active Power Control (APC), which has two regulation modes. By controlling the active power in the 'Active Power limitation' mode, it is possible to limit the active power output of the wind farm. In the 'Frequency control' mode the active power output is curtailed if the frequency goes beyond a certain level."

EtherCAT as the foundation for fast and cost-effective data communication

EtherCAT represents another core technology of the Wind e-control™ system. This powerful network for data communication is recommended not only for each individual wind turbine, it is also particularly important for farm networking. The 5 ms cycle times of the farm and turbine controls, which are synchronized to each other, enable response times lower than 200 ms for the wind farm voltage control.

Vicenç Casadevall recalls: "Because of the challenging time requirements that we had to meet, the R&D team from Alstom sought a communication protocol that operated deterministically. Ultimately, we chose the EtherCAT protocol. It fully meets our needs because of its reliable, high-speed operation."



A Wind e-control™ system is provided for each transformer station, securing the EtherCAT data transmission between the individual wind turbines in the wind farm.

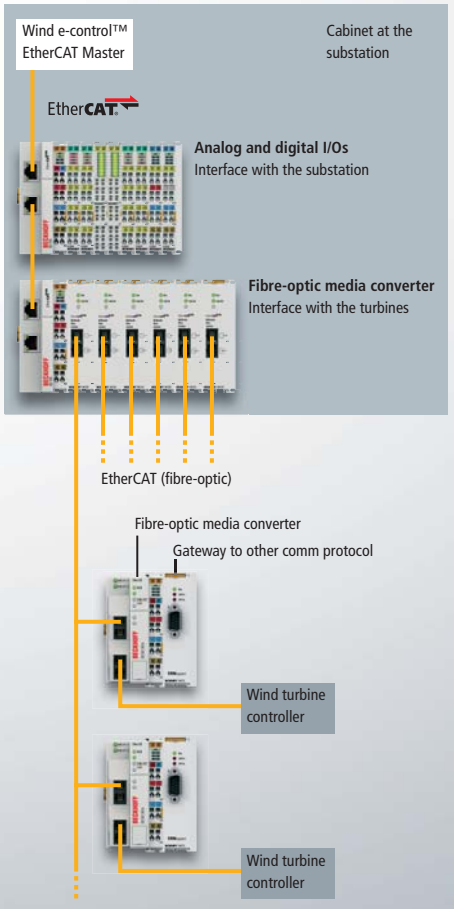
Dirk Kordtomeikel, Business Manager Wind Energy at Beckhoff, stresses the cost advantages of the EtherCAT system, in addition to its speed: "Today, wind farm networking equipment is largely based on fiber optic cables. These fiber optic cables are EtherCAT-compliant, allowing use of the existing cable network without auxiliary expenditure during set-up. In addition, our EtherCAT-based farm network meets the requirements for cable redundancy. In turn, interfaces to other bus systems also promote total system openness and flexibility. The operator gets all of these benefits at a lower cost than with other real-time Ethernet protocols."

EtherCAT capably spans long distances

An EK1100 EtherCAT Coupler connects the I/O level in the control station. The wide range of EtherCAT Terminals can process all signal forms occurring in the automated operation of wind farms. Another EK1100 Coupler communicates with various EK1521 EtherCAT optical fiber junction terminals. Together with the EK1501 EtherCAT Couplers with fiber optic connectors, these establish flexible and extensive fiber optic networks in the individual wind turbines. Whereas standard Ethernet cables permit a distance of up to 100 m between two stations, the distance between two optical fiber devices can be much longer: up to 2 km, due to the multimode glass fiber connection, and even up to 20 km with a single-mode glass fiber connection.

Hardware and software components working in harmony

In addition to the requirements for fast data communication, the operational reliability of hardware and software is absolutely vital, especially in wind turbines where harsh environmental conditions such as intense vibrations and work temperatures between -60 °C to +55 °C are common. Close cooperation with Beckhoff Automation was an important factor for Vicenç Casadevall: "Since Beckhoff invented EtherCAT, it was clear to us that the best hardware and software solutions would also be available from the company, optimally matched to this fieldbus system. Not only that, Beckhoff has a long history in automation technology, particularly in the wind industry, and a very good reputation at Alstom."



A general schematic diagram of the EtherCAT topology shows the functions handled by the individual modules in the wind farm.

Further information:

www.power.alstom.com
www.beckhoff.com/Wind
www.beckhoff.com/EtherCAT