

## Article

## PCS100 STATCOM - ABB helps one of the world's largest wind turbine companies connect their wind turbines to the grid



Three 2 MVar PCS100 STATCOM containers for a 54-megawatt onshore wind farm located in Fakken, in the far north of Norway

Connecting wind turbines to the grid is not as straightforward as many people may think. The R&D teams of ABB (Power Electronics team in Australia and Poland) and Vestas have jointly developed a reliable and cost-effective solution, which has been successfully installed at the Fakken wind farm in Norway.

While wind power is increasing its share in the energy mix, several issues need to be addressed when connecting wind turbines to the grid. For consumers of electrical power it is important that the power is available with a stable voltage and frequency. To make sure that this is the case, grid operators issue requirements for connecting power generating equipment to the grid. Collectively these requirements are known as the grid code, and equipment that meets these requirements is called grid compliant.

A typical requirement by the grid operators is that generators should be able to vary their reactive power output dependent on the grid voltage level. This and other requirements necessitate the deployment of devices that can control reactive power. A static var compensator (SVC) is such a device. The term var is derived from the unit of measurement for reactive power, VAr or volt-ampere reactive.

An SVC can be implemented in different ways. The implementation employed at Fakken is a hybrid solution that makes use of classical reactive power compensation and of dynamic reactive power compensation that is based on voltage source inverter technology. The latter type of SVC is usually referred to in the industry as STATCOM (static compensator). Compared with other technologies the STATCOM has a number of benefits: a smaller footprint, a smaller parallel capacitor bank, faster dynamic performance, active filtering of harmonic currents, and more.

At the Fakken onshore wind farm in the far north of Norway, ABB has installed three PCS100 STATCOMs. These are low voltage STATCOMs each with a rating of 2 megavolt-amperes reactive (MVar), and two ABBACUS metal enclosed mechanically switched capacitor banks (MSC), each with a rating of 2.5 MVar. The wind farm consists of 18 wind turbines with a rating of 3 megawatt (MW) each. The ABB installation helps Vestas, the world's leading wind turbine manufacturer, to comply with the Norwegian grid code.

The entire project is a joint effort by the R&D teams of ABB and Vestas. The Fakken wind farm is used as a qualification of the PCS100 STATCOM. The qualification includes extensive verification testing and standardizing of interfaces and controls. A similar qualification was carried out last year for the PCS 6000 STATCOM, a medium voltage STATCOM, which means that ABB has both a low voltage and a medium voltage solution depending on the size of the wind park.

Once the qualification has been completed the Vestas plant control group can do all their system modeling with ABB's STATCOMs, so becoming a preferred solution for Vestas.

Vestas chose ABB for this project because one of the salient characteristics of the PCS100 STATCOM is its modular construction, which makes the platform very reliable: If one of the power modules fails, the system will not trip, but will continue to operate at reduced capacity. Because the granularity is small, the customer can get full redundancy at very small cost by adding one more module to the system. This level of reliability at such low cost is unique in the industry.

The project also involved the integration of ABB's control system for the PCS100 and Vestas' Power Plant Controller. Freddie



**Fakken wind farm in Norway**

Andreasen, Vestas Technology R&D Director stated, “For the first time VestasOnline™ Power Plant Controller has an ABB STATCOM in the loop via an advanced and standardized communication scheme. We have experienced a very successful and professional cooperation with ABB on this controller integration project.” The result is a fast and dynamic response where the STATCOM acts as reactive power source controlled in parallel with the wind turbine generators by the Vestas Power Plant Controller.

“This project is an important milestone for ABB. The integration of wind power into the grid is one of the challenges the wind industry is facing and its importance is growing as the percentage of wind energy increases in the total energy mix. ABB is well positioned with a wide range of technologies to help the industry to address this challenge. In addition, this cooperation with Vestas shows how important it is that relevant component suppliers and turbine manufacturers are working together to offer solutions that reduce the cost of wind energy,” commented Alfredo Parres, head of Wind Power in ABB.

ABB’s PCS100 STATCOM technology ranges from 100 kilovolt-amperes reactive (kVar) to 10 MVar and offers power factor control, voltage regulation and high- and low-voltage ride through support. The STATCOM system has overload up to 260 percent for three seconds, and higher overload requirements can be met by adding extra modules while having advanced capability of flicker mitigation. The turnkey solution means the STATCOM is easy to relocate as the container incorporates a power converter, switchgear and a standard-type transformer with no special windings or specification for reduced maintenance requirements.

Vestas Wind Systems A/S is a Danish manufacturer, seller, installer, and servicer of wind power plants. The company operates manufacturing plants in Denmark, Germany, India, Italy, Romania, Britain, Spain, Sweden, Norway, Australia, China, and the United States, and employs more than 20,000 people globally.



**A crane positioning one of the PCS100 STATCOM containers into place**

Fakken wind farm will generate 135 gigawatt-hours (GWh) per year. To make this possible ABB will supply Vestas with a full reactive power plant consisting of medium-voltage (MV) switchgear and all related services in addition to the STATCOM containers and MSC.

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