Technical note
ABB medium voltage wind turbine converters enable island mode operation

In periods with no wind, the electricity required by a wind turbine's auxiliary systems is normally supplied from the grid. If there is no grid connection, the auxiliary systems are often powered by a diesel generator, which is neither cost efficient nor environmentally friendly.

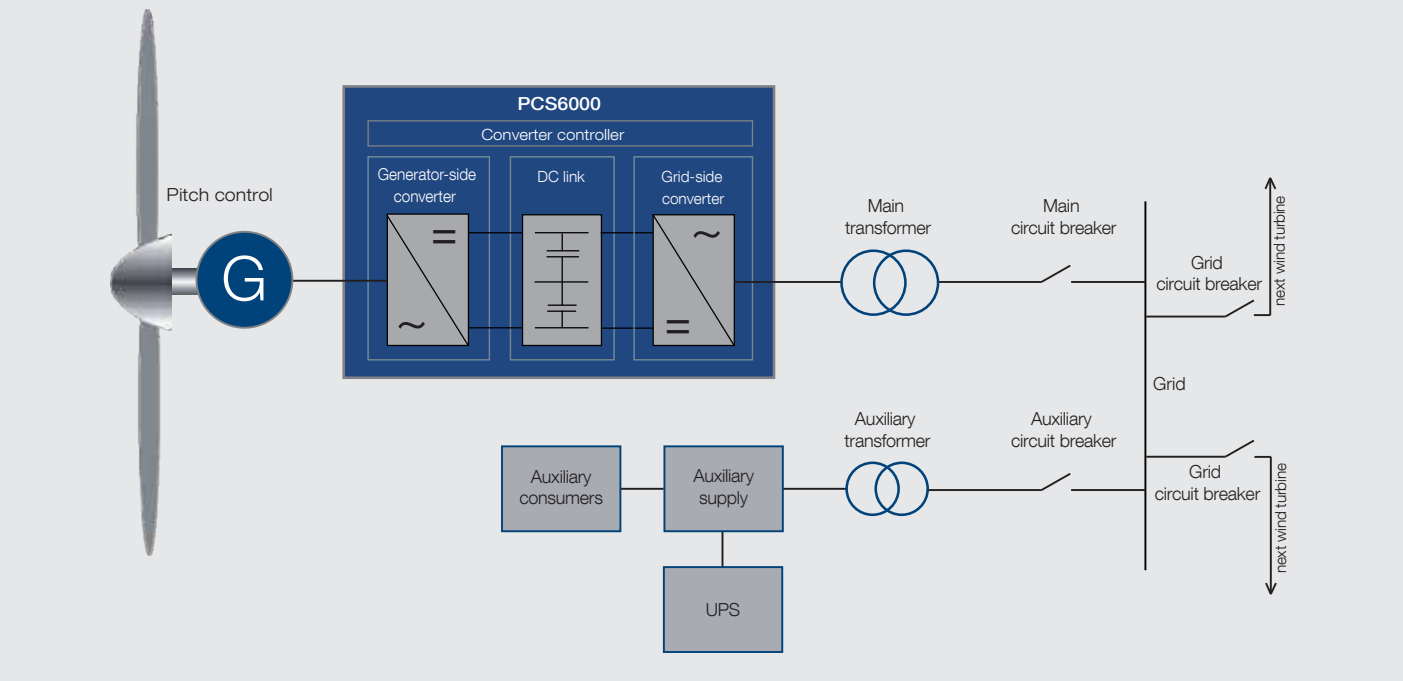
ABB's PCS6000 medium voltage wind turbine converter, in combination with an UPS, enables island mode operation of the wind turbine. Thus, it can produce enough electricity for its auxiliary systems without being connected to the grid.

Background

In order for a wind turbine to generate electrical energy and feed it to the grid, it requires its own auxiliary power to drive a variety of motors controlling loads such as blade and turbine positioning, oil pumps, cooling, ventilation together with controllers, communication systems and navigation lights. These loads are called auxiliary consumers.

When there is no wind, the wind turbine normally receives its auxiliary power from the grid. In such a situation the wind turbine is a consumer, rather than a producer. However, should the wind farm, or some of the wind turbines, become disconnected from the electrical grid through, for example, long-term blackouts or through planned periods of maintenance, an alternative auxiliary supply is required to keep the auxiliary systems alive.

After detection of a blackout, the grid circuit breaker disconnects the wind turbine from the grid. This wind turbine is then referred to as "island". Each disconnected wind turbine sets itself to a state, in which the turbine typically continues to rotate in idle mode to avoid bearing damages. This state lasts until the islanded wind turbine can be reconnected to the grid.



Simplified single-line diagram of turbine in island mode operation

In idle mode, it is important that the auxiliary consumers remain operational. To ensure auxiliary power supply, the turbines, especially those of offshore wind farms, are at present usually equipped with diesel generators. Diesel generators, however, are neither cost efficient as they require maintenance and refueling, nor environmentally friendly. Wind farm developers and operators are therefore looking for a viable alternative.

Technical solution

An highly effective solution is ABB's PCS6000 wind turbine converter, in combination with a local, battery-based auxiliary power source, such as an uninterruptible power supply (UPS). This enables the wind turbine to establish an island network in which it can supply enough electricity to its auxiliary systems.

To create the island network, the wind turbine controller starts operating the turbine and initiates the island mode operation command to start up the PCS6000 wind turbine converter. The power to start the converter is drawn from the UPS.

The grid-side converter of the PCS6000 now acts as master, generating either 50 or 60 Hz, while keeping the voltage at nominal value, thus establishing an island network. The generator-side converter loads the wind turbine with a torque value equivalent to the required auxiliary power. In this operating mode, the wind turbine controller controls the speed of the wind turbine with the pitch system.

Once the island network is fully operational, the UPS is no longer needed and will be recharged by the wind turbine. The recharged UPS system will then be ready again to back-up auxiliary power supply in periods with no wind.

Estimated savings

It is assumed that the maximum backup power time for periods with no wind is between 12 and 48 hours. During this time, an UPS has to provide sufficient power to sustain the wind turbine in power safe mode and enable the start of the island mode operation.

Compared to a grid loss back-up system using a diesel generator, it is estimated that an UPS-based back-up system results in savings between 2.5 and 4 million euros over a 25-year long lifetime of a wind farm with 80 wind turbines.[1]

[1] Most of these savings can be attributed to lower OPEX (operational expenditure). About the same CAPEX (capital expenditure) is assumed for both solutions.

For more information contact your local ABB representative or visit:

www.abb.com/converters-inverters
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