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Control of a variable speed and permanent magnet wind turbine: GARBI 150

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Variable speed wind turbine with multipole permanent magnet synchronous generator (PSMG) and full-scale power converter is being used more frequently in wind turbine application. A multipole synchronous generator connected to a power converter can operate at low speeds. A dynamical modelling scheme is compound by wind, aerodynamic and mechanical model as well as for the electric system and its converter and the wind turbine control

The objective of this work is to describe the implantation of a permanent magnet synchronous generator to a new wind turbine of medium power 150 kW. The design of this new wind turbine GARBI 150 tries to respond to the necessities of little industry beyond the electrical energy produced by eolic parks. After reviewing wind turbine basic technical characteristics, we present the control architecture and the strategies used to maximize energy capture.

The wind turbine is designed as a three bladed, variable speed with gearbox and synchronous generator.

The blade geometry has been designed for best aerodynamic performance and optimal structural design. Hub height is 35m and rotor diameter 28 m. The system has been provided with multiple sensors to its control and supervision.

Power regulation is realized by a hydraulic collective pitch system based on one hydraulic cylinder located in the shaft. Rotor and nacelle are up-wind oriented and are aligned to the wind direction by means of an active yaw system compound of four electrical motors.

The electrical system is based on a synchronous geared drive generator and a converter for full power conversion: The converter system is used for he adaptation of the voltage frequency in the rotor circle of the generator. This allows synchronization between the grid frequency and the rotational frequency of the generator. The generator side converter controls generator frequency (speed), torque and voltage, the grid side converter regulates the DC bus voltage of the intermediate circuit and provides the required active and reactive power to the grid combined with a power quality control for low harmonic distortion of the currents. The converter control has been made specifically for this wind turbine by a leading commercial brand.

The control system of variable speed GARBI turbine implemented corresponds to an indirect control of speed. In this system the pitch control has like objective to limit the speed of the generator instead of limiting its power. It contains two controllers: torque and speed control.

The wind turbine control systems were simulated using MATLAB/SIMULINK tool to evaluate the performance of system.