More stable grid connection for wind generators operating at very high potential

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Wind energy has an initial advantage over its competitors in the renewable energy sector. The presence and size of turbines are increasingly larger and require updating for a number of reasons. Firstly, because the new wind generators need to operate at very high potentials, over and above that of present electronic and structural limits. Also, because updated regulations have been implemented to keep up with the current high penetration of wind energy in the electric grid, and demand a more exhaustive control of the turbines for a more stable electric grid network. Engineer at Tecnalia, Ms Eider Robles, has designed a series of solutions so that the turbines can comply with these requisites. Her PhD thesis, defended at the University of the Basque Country (UPV/EHU), is entitled, *Grid connection and control of multipole synchronous wind turbines*.

Ms Robles opted for a direct operation mechanism (which has no need for a speed multiplier) accompanied by a converter for all potentials. This will be the basis to accede to greater levels of potential and efficiency. This mechanism is, in turn, very exigent as regards the properties of the elements that make up the system, for which the engineering company has proposed a design to this end.

Generator and converters

As regards the type of generator, the thesis puts forward the permanent magnet synchronous generator (PMSG) with external rotor as the most appropriate. The PMSG is a type of generator that does not require chafing rings to transmit the electricity. Thus, the gyratory movement of the rotor does not cause friction, the loss of copper is reduced and maintenance needs diminished. Moreover, the fact that the rotor is external allows the direct coupling of the blades, which enables minimising the weight of the mechanical structure.

The thesis also proposes an alternative for working at greater power. Currently, the semiconductor devices are limited in voltage and current, so the incorporation of converters for all voltages (the basis of Ms Robles' thesis) would be impossible in wind generators of various megawatts. Therefore, the thesis puts forward the use of multilevel converters, given that these enable the use in series of semiconductors and, in this case, it would be feasible to overcome the limitations and obtain higher voltages: For even greater quality, the researcher has proposed adding a system that counteracts external perturbations such as variations in the wind. These are feedforward controls, having the capacity to react to changes in their surroundings.

Detectors of positive sequence — the main contribution

Notable amongst the exigencies that a power system connected to the grid has to

comply with are the control tasks for contrasting the imbalances and distortions occurring with the grid voltage. This control is an indispensable requisite for complying with the new norms, which require a continuous operation of the turbines, independently of imbalances, distortions and other perturbations.

To achieve stability and greater efficiency in the grid connection, the main aim of this thesis was, precisely, the design of robust methods for detecting positive sequence. Grid tension is made up of positive sequence (the useful part), but also of other components caused by imbalances and distortions. The detectors, made up of algorithmic sequences, isolate the positive sequence.

Ms Robles has undertaken an exhaustive review of the current detectors of positive sequence and of techniques of synchronisation. As explained in her thesis, the main disadvantage found in this analysis is that, in general, these detectors are specialised in one type of perturbation or another, but not simultaneously in all of them. Finally, Ms Robles resolved this problem by employing four positive sequence detectors, based on filters known as Moving Average Filters (MAF). These detectors prove to have a rapid and constant settling time in the presence of any type of perturbation, even if various perturbations occur simultaneously.

SOURCE [1]

Links:
[1] http://www.eurekalert.org/pub_releases/2011-01/ef-msg012511.php