An electronic converter that improves the electrical power output of larger wind turbines

November 13 2017

An electronic converter developed by the NUP/UPNA-Public University of Navarre enables the energy produced by larger wind turbines (of up to 6.6 kilovolts) to be inserted into the power grid. These devices cut energy losses and can operate with a higher output, like that of the turbines currently being deployed, offshore ones in particular.

The power of wind turbines is growing, and increasingly powerful turbines are planned for offshore deployment. Existing land-based wind turbines mostly work at a voltage of 0.6 kilovolts; new turbines producing up to 3.3 kilovolts are already being deployed offshore.

These wind turbines work by turning the kinetic energy from the wind into mechanical energy through a propeller, and into electrical power via an alternator. "To be able to insert that energy into the power grid, it has to be transformed by means of electronic converters that adapt the waveform of the current. These converters are made up of transistors, which are semiconductor devices with voltage and current limitation," explained Eduardo Burguete, the designer of the device.

When the power of wind turbines is increased, the transistors cannot convert all the power because of the voltage and current limitation. To increase the power of the converter, the parallelization and serialization of semiconductors has been used. Both processes entail power limitations and losses.

That is why a third option is to use the so-called multilevel converters, structures made up of transistors that are able to increase the working voltage by reducing losses and ensure that the transistors block the voltage for which they have been designed (not a higher one). Additionally, these converters require less filtering of the current for it to be injected into the power grid.

Eduardo Burguete is proposing five-level converters that include one or two large condensers in addition to a four small ones for each phase. "What is particularly new about these models are the small condensers that avoid the serializing of the transistors, while ensuring voltage distribution between them and reducing the surges that occur when the transistors are switched off and switched on. These small condensers allow the transistors to switch more rapidly, thus reducing losses and enabling the converter to work with a bigger current and therefore power ," he said.

The proposed converters were tested by means of simulation, and a scale prototype was also built to check that they functioned correctly and to validate their advantages. "The results showed that these converters can reduce voltage stress withstood by the transistors when they are switched off; this enables losses to be reduced or the transformed energy to be increased, apart from not requiring additional components to guarantee the distribution of the clamping voltage of the transistors," concluded Burguete.

Provided by Elhuyar Fundazioa