TUNING WIND TURBINES FOR GREATER GRID STABILITY

Dr. Claudio Cañizares

One of the crucial jobs of North American grid operators is keeping the frequency of the electricity as close to 60 hertz as possible. Mismatches between electricity generation and demand can shift that number higher or lower, damaging equipment, triggering blackouts and causing other problems.

To keep the system within safe margins, operators temporarily speed up or slow down the massive turbines at conventional generating plants, releasing or absorbing energy as required. But with renewables making up a growing share of the electricity grid, wind farms need to start help regulating frequency as well.

The question is how. Although the output of wind turbine generators can be controlled with virtual inertial controllers, releasing energy when wind speeds are low may stall the rotors and create even greater grid instability.

That's where the group of WISE researcher Dr. Claudio Cañizares comes in. They started by developing a nonlinear analytical model that describes how wind turbine generators respond to frequency disturbances in the grid, and then proposed two methods for tuning virtual inertial controllers. The first ensures wind turbines don't lose stability at lower wind speeds, even when faced with large power disturbances, while the second maximizes the contribution of wind farms to system-wide frequency regulation.

To validate their approaches, the researchers ran several simulations, testing their equations against a variety of wind speeds and load changes. The results show that the new model and tuning techniques are effective — opening the door to better frequency regulation as the use of wind power grows.

Researchers: Mohammad Hasan Ravanji, Claudio A. Cañizares, and Mostafa Parniani

Source: Ravanji, M., Cañizares, C., & Parniani, M. (2020). Modeling and Control of Variable Speed Wind Turbine Generators for Frequency Regulation. IEEE Transactions on Sustainable Energy, 11(2), 916-927.

READ ARTICLE