An investigation on wind turbine resonant vibrations

Wind turbine resonant vibrations are investigated based on aeroelastic simulations both in frequency and time domain. The investigation focuses on three different aspects: the need of a precise modeling when a wind turbine is operating close to resonant conditions; the importance of estimating wind turbine loads also at low turbulence intensity wind conditions to identify the presence of resonances; and the wind turbine response because of external excitations. In the first analysis, three different wind turbine models are analysed with respect to the frequency and damping of the aeroelastic modes. Fatigue loads on the same models are then investigated with two different turbulence intensities to analyse the wind turbine response. In the second analysis, a wind turbine model is excited with an external force. This analysis helps in identifying the modes that might be excited, and therefore, the frequencies at which minimal excitation should be present during operations. The study shows that significant edgewise blade vibrations can occur on modern wind turbines even if the aeroelastic damping of the edgewise modes is positive. When operating close to resonant conditions, small differences in the modeling can have a large influence on the vibration level. The edgewise vibrations are less visible in high turbulent conditions. Using simulations with low-level turbulence intensity will ease this identification and could avoid a redesign. Furthermore, depending on the external excitation, different aeroelastic modes can be excited. The investigation is performed using aeroelastic models corresponding to a 1.5 MW class wind turbine with slight variations in blade properties. Copyright © 2015 John Wiley & Sons, Ltd.

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Contributors: Tibaldi, C., Kim, T., Larsen, T. J., Rasmussen, F., Rocca Serra, R. D., Sanz, F.
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