Effective turbulence models and fatigue reliability in wind farms

Modeling of turbulence within wind farms with 100 or more wind turbines is important both for extreme and fatigue limit states. Behind a wind turbine a wake is formed where the mean wind speed decreases slightly and the turbulence intensity increases significantly. This increase in turbulence intensity in wakes behind wind turbines can imply a significant reduction in the fatigue lifetime of wind turbines placed in wakes. In this paper the design code model in the wind turbine code [IEC 61400-1, Wind turbine generator systems - Part 1: Safety requirements. 2005] is evaluated from a probabilistic point of view, including the importance of modeling the SN-curve by a bi-linear model. Fatigue models relevant for welded, cast steel and fiber reinforced details are considered. Further, the influence on the fatigue reliability is investigated from modeling the fatigue response by a stochastic part related to the ambient turbulence and the eigenfrequencies of the structure and a deterministic, sinusoidal part with frequency of revolution of the rotor. (C) 2008 Elsevier Ltd. All rights reserved.