Assessment of Gearbox Operational Loads and Reliability under High Mean Wind Speeds - DTU Orbit (21/10/2019)

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This paper investigates the dynamic loads occurring in the drivetrain of wind turbines with a focus on offshore applications. Herein a model of the gearbox of the 5 MW wind turbine is presented. The model is developed in a multi-body framework using commercial software MSC ADAMS. Validation of the model was based on the experimental data provided by NREL for 750 kW prototype gearbox. Failures of gearboxes caused by high dynamic loads have a significant influence on the cost of operation of wind farms. For these reasons in the study, the probability of failure of the gearbox working in an offshore wind turbine that operates in storm conditions with mean wind speeds less than 30 m/s is presented. In the study, normal shut-downs of a wind turbine in storm conditions were investigated. The analysis were conducted for two storm control strategies and different wind conditions from an extreme operating gust, normal turbulence model and extreme turbulence model. In the paper, loads in the planetary gear are quantified as well as the torsional moments in the main shaft. On the basis of simulation results the annual probability of failure of the gearbox in a wind turbine with soft storm controller is calculated, and compared with the one had the gearbox working in a wind turbine operating with hard storm controller. In the study, it was found that normal shut-downs do not have a significant influence on the ultimate loads in the gearbox, since they are related mostly to the gusts occurring during turbulence. Application of the storm controller with reduction of the wind turbine power allowed the decrease of the probability of failure for ultimate stresses.

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