Impact on wind turbine loads from different down regulation control strategies - DTU Orbit

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This paper presents a study on derating wind turbine power levels in a wind farm and the associated loads on down wind placed wind turbines. This is done by derating the wind farm power output for certain periods of time. Derating can be done in different ways by adjusting the rotor speed and blade pitch on the individual turbines which also has a direct impact on the turbine component loads. The paper studies three characteristic derating strategies on the upstream wind Turbine (WT) and the corresponding load impact on the downstream one. These are defined as minimum/maximum rotor speeds (minRS, maxRS) and minimum thrust (minT) modes. Derating factors of 20% and 40% on available power are applied together with 4 and 7 diameters WT interspace. The study is based on aeroelastic simulations of a 2MW generic WT model including wake effects. The results show that below rated wind speed (8m/s) the downstream WT blade flap fatigue loads are minimized when the upfront WT is derated with the minRS or minT strategy. The maxRS mode returns around 2% percent higher loads. The load levels for minRS and minT strategies are almost equal. Above rated wind speed (16m/s) the trend is the same as at 8m/s with a bit higher difference on load levels, up to 6% percent at tighter interspace between maxRS strategy and the other two. The fore-aft fatigue loads on the tower base and the main bearing yaw moment follow the same trends as the blade for both below and above rated wind speed. Finally, it is also found that there is a correlation on the load levels and the wind deficit values. In all cases up to around ±10 degrees incoming wind direction the wake deficit from the maxRS control strategy is higher and the load levels follow the same trend. This is an important outcome and links the control strategies directly to the wake deficit due to the upstream WT operation.

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