Wind Plant Power Optimization and Control under Uncertainty.
PANKAJ JHA, DEMET ULKER, KYLE HUTCHINGS, GREGORY OXLEY, Envision Energy USA Ltd. — The development of optimized cooperative wind plant control involves the coordinated operation of individual turbines co-located within a wind plant to improve the overall power production. This is typically achieved by manipulating the trajectory and intensity of wake interactions between nearby turbines, thereby reducing wake losses. However, there are various types of uncertainties involved, such as turbulent inflow and microscale and turbine model input parameters. In a recent NREL-Envision collaboration, a controller that performs wake steering was designed and implemented for the Longyuan Rudong offshore wind plant in Jiangsu, China. The Rudong site contains 25 Envision EN136-4 MW turbines, of which a subset was selected for the field test campaign consisting of the front two rows for the northeasterly wind direction. In the first row, a turbine was selected as the reference turbine, providing comparison power data, while another was selected as the controlled turbine. This controlled turbine wakes three different turbines in the second row depending on the wind direction. A yaw misalignment strategy was designed using Envision's GWCFD, a multi-fidelity plant-scale CFD tool based on SOWFA with a generalized actuator disc (GAD) turbine model, which, in turn, was used to tune NREL's FLORIS model used for wake steering and yaw control optimization. The presentation will account for some associated uncertainties, such as those in atmospheric turbulence and wake profile.

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Date submitted: 01 Aug 2017   Electronic form version 1.4