Analysis of Anholt offshore wind farm SCADA measurements

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Publication date:
2017

Document Version
Peer reviewed version

Citation (APA):
Analysis of Anholt offshore wind farm SCADA measurements.

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SCADA measurements from the Danish Anholt offshore wind farm (ANH) for a period of 2½ years have been qualified. ANH covers 12 km × 22 km and is located between Djursland and the island Anholt in Kattegat, Denmark. This qualification encompasses identification of curtailment and idling periods, start/stop events and a power curve control for each wind turbine in the wind farm. Data also include wind speed measurements from a nearby WindCube lidar and simulations from the WRF model for the same period as the SCADA. An equivalent wind speed (\textit{wsi}) is derived from the combined power and pitch signals for each wind turbine. Furthermore, the local wind direction is derived for a number of wake-free turbine groups. By combining the \textit{wsi} and wind direction, the undisturbed wind speed and direction inflow conditions of the wind farm (\(U_{\text{park}}\) and \(WD_{\text{park}}\)) are estimated for all 360 degrees.

The preliminary analysis reveals a significant wind gradient along the North-South direction for the western row of the wind farm – for westerly inflow, together with a distinct wind speed reduction caused by coastal effects. Figure 1 shows how the coast influences the wind speed gradient along the western row of turbines. Furthermore, a minor wind speed reduction is identified for easterly inflow, caused by the island Anholt. The internal wake effects are small, due to the large “variable” spacing based on the arch-based layout compared to other wind farms. A comparison between simulated WRF and measured wind speeds shows good correlation. The power deficit along the rows of turbines demonstrates a significant difference between unstable and stable conditions.

Figure 1: Wind speed variation along western row A as function of mean inflow angle and wind speed in the range 8 - 10 m/s. Each curve represents one of the 30 wind turbines in row A.

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