Measurement, monitoring and testing : Rotor Imbalance, Automatic 1P measurement,

Rotor Imbalance Detection from automated 1p analysis and measurement : Real case study during a long period for different large size WTG

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One of the main goals in WTG industry is the optimisation of O&M costs. This cost for onshore WTG is around 10-15% of the total cost of the generated electricity[1]. About 25-35% of the maintenance cost is related to preventive maintenance and 65-75% to corrective maintenance[2]. The development of a predictive maintenance becomes increasingly necessary to focus on the fault. The optimisation of O&M costs could come through the use of automatic system to highlight the predictive maintenance.

Between 20% and 50% of WTG's present significant rotor imbalances that can cause severe damage on the turbine and on its components[3,4]. Early and accurate rotor imbalance detection could be a good way to optimise the O&M cost. A classical approach to detect the rotor imbalance is to examine the WTG behaviour in the frequency domain on a specific frequency related to this phenomenon. An imbalance induces a difference in the efforts of the three blades. This difference produces a specific vibration at the 1p frequency : the rotor rotating speed[1,5].

In this context, we developed a smart sensing system. This system is installed on the wind turbine weather mast. From this system, numerous data, namely accelerometer data, are transmitted to our servers to be processed and analysed. The collected data represent more than 50 millions raw values per day for a WTG. During this process of big data analysis, the time series data are automatically transformed to frequency domain, with specific algorithms, in order to isolate, detect and measure both the axial and transverse acceleration at the specific 1p frequency. Using specific algorithms, the information and the diagnosis of the mass and the aerodynamic imbalance can be calculated from these accelerations[3,6]. The complete system is called Windfit.
After the presentation of our specific method of data analysis to obtain the rotor imbalance levels (mass and aerodynamic), we present some examples of results that were obtained for different wind farms and WTG brands during a significant period of several months (3-6 months). The results of mass and aerodynamic rotor imbalance that our system provides are based on the automatic analysis of 250 10 minutes periods of nominal rotor speed that represent approximatively between 30 000 and 75 000 rotor rotations. We present an example of WTG with a detected aerodynamic rotor imbalance that has been confirmed on-site. The results before and after correction are presented to show how we can do a predictive and preventive maintenance for an O&M cost optimisation.

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