One of the ancillary services the wind farms are required to provide to the system operators is reserve power, which is achieved by down-regulating the wind farm from its possible power. In order to estimate the reserves, the possible power needs to be calculated by correcting the reduced wake effects behind the down-regulated turbines. The most recent grid codes dictate the quality of the possible power at the wind farm level to be assessed within 1-min intervals for offshore wind power plants. Therefore, the necessity of a fast and reliable wake model is more prominent than ever. Here we investigate the performance of two engineering wake models with 1-sec resolution SCADA data on three different offshore wind farms, given the quantified input uncertainty. The preliminary results show that, even wind farm specific training of the model parameters might fail to comply with the strict criteria stated in the grid codes, especially for the layouts with significant wake losses. In order to tackle the inadequacy of the engineering wake models to capture some of the dynamics in the wind farm flow due to the embedded assumptions, purely data-driven techniques are evaluated. The flexibility of such an on-line model enables ‘site-turbine-time-specific’ modelling, in which the parameters are defined per turbine and updated with each time-step in a specific wind farm.