AQSystem
Remote sensing technique

AQSystem SoDARs play key role in energy assessment for one of Sweden's largest Windfarms

On 6th of September 2015 Swedish wind power company Nordisk Vindkraft (a RES Group Company) and Stadtwerke München of Munich, Germany, inaugurated the Sidensjö Wind Farm in Sweden.

Summary

This summary outlines the key role that SoDAR systems from AQSystem of Sweden played in the successful development of this major wind project.

RES/Nordisk Vindkraft have a ten plus year history working with SoDAR systems from AQSystem and due to their proven reliability, accuracy and un-rivalled winter capabilities were the first choice for wind shear verification.

The combination of mast and SoDAR helped to reduce the uncertainty in the vertical extrapolation of the wind speed measurement to hub height resulting in a lower total uncertainty in the estimated energy yield and therefore enhanced project value.

Measurement campaign

Sidensjö Wind Farm is one of Sweden's largest wind farms with 48 turbines and a total installed capacity of 144MW. Situated approximately 15 km west of Örnsköldsvik and 440 km north of Stockholm, this wind farm will produce renewable electricity and prevent emission of 380.000 tonnes of CO2 into the atmosphere annually. Hence, it will contribute considerably to the supply of environmentally friendly electricity and to Sweden's target for reduced climate impact. After developing and constructing the wind farm, Nordisk Vindkraft will continue to manage the operation of the wind farm and handle local contacts.

The objectives

- *To verify that wind shear measurements from the five 80m masts were valid.*
- *To measure across a number of seasons to capture climatic variations.*
- *To achieve a good understanding of the uncertainties created by local forestry and other topography.*
- *To understand the characteristics of wind shear across the entire rotor diameter.*
- *To reduce extrapolation uncertainties between mast height (80m) and wind turbine hub height (115m).*
- *To assess rotor equivalent wind speed when compared with hub height measured wind speed.*
- *All combining to contribute to an accurate energy assessment.*

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The process

The SoDAR measurement campaign lasted for six months with measurements collected during three seasons, winter, spring and summer. Five AQSystem SoDARs were deployed at approximately 120m to 150m from five 80m met masts in forested and moderately complex terrain. Low ambient turbulence intensity (<10%) was used as a proxy for stable atmospheric conditions. Rotor equivalent wind speed (REWS), using 5 measurement heights across the rotor diameter, was compared with hub height measured wind speed (HHWS) data collected from the sodars to give a shear correction factor (SCF), which was then plotted against Turbulence Intensity (TI). The combinations of methods 2 and 3 were used to determine the validity of using an Energy Loss Adjustment Factor (ELAF).

BBB Umwelttechnik did the Technical Due Diligence for SWM including a full bankable wind report based on the measurement data on site. BBB then supported SWM in the negotiation of the project agreements and were subsequently contracted as Owners Engineer during construction with permanent on site presence.

The results

For each mast location, the data collected by the SoDAR verified that the met mast shear was valid for extrapolation to hub height, resulting in a reduction in the vertical extrapolation uncertainty. While at low Turbulence Intensity (TI) the shear does change, this change is consistent across the full range of shear measurements. It was found that the shear correction factors do not vary strongly with TI and there was no dramatic deviation at low TI. Changes in atmospheric stability and shear variations were successfully captured. At Sidensjö, the presence of low TI, and by proxy stable atmospheric conditions, does not lead to an overestimation of hub height wind speed and the shear profile is not significantly over estimated by using below hub height measurements. The justification for use of a universal ELAF is not evident on this site. Therefore, what has been observed elsewhere, for example in the USA, cannot simply be applied in other regions where stable atmospheric conditions prevail and not all stable atmospheric conditions result in an overestimation of energy through the rotor diameter. Each region should be treated separately and each individual site should be considered on its own merits. The use of high quality remote sensing devices combined with long term site assessment masts will indicate whether the use of an ELAF is appropriate for the project.

Conclusions

Without SoDAR measurements it would not have been possible to make this assessment and may have led to a high uncertainty assessment/reduced energy yield. The AQSystem SoDAR's very high levels of data availability in all atmospheric conditions combined with its ability to measure simultaneously at a wide range of heights across the entire rotor diameter played a key role in the successful outcome of the project.

Alan Derrick, Head of Technical Services, RES Group stated "The ability of the AQSystem SoDARS to operate reliably and autonomously in a challenging environment was the key to delivering a technically comprehensive but economic wind measurement strategy on this large, remote site."

Joachim Binotsch, General Manager, BBB Umwelttechnik stated "The AQS 510 is an exceptional SoDAR technology providing high quality data and thus real added value to projects."