Wind Turbine Power Performance Verification by Anemometer on the Nacelle

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Introduction:
The power curve verification is important for both power output optimization and contractual promising check for wind energy producers. However, the traditional power curve verification by IEC61400-12A is costly and time consuming due to the meteorological met mast tower installation on test sites. The newly published IEC61400-12B gives the possibility of verifying the power curve and AEP (Annual Energy Production) by the existing anemometers on the wind turbine nacelle. The purpose of this project is to investigate how is the validation of anemometers on the wind turbine nacelle. The purpose of this project is to investigate how is the validation of anemometers on the wind turbine nacelle. The newly published IEC61400-12B gives the possibility of verifying the power curve and AEP (Annual Energy Production) by the existing anemometers on the wind turbine nacelle.

Test Turbine and Test Site:

Determine free, undisturbed sectors. Surrounding landscape, terrain, obstacles influence power production.

A = 6.7
K = 2.07

Unvalid Wind Direction Data Elimination.

Discard data where anemometer is within WT downstream sector. Discard data affected by obstacles. Manually discard wrong data due to abnormal WT operation or measurement system errors.

Wind Shear’s Influence to Power Curve & AEP

Wind shear is the change in wind speed or direction with height in the atmosphere. The data was divided into 3 groups, representing the different wind shear scope to compare the power curves.

- Extreme high: τ>0.4 (LOOP 3)
- High: 0.4>τ>0.3 (LOOP 2)
- Normal: 0.3>τ>0.1 (LOOP 1)
- Low: τ<0.1

In the higher wind speed sections, different wind shear did not bring significant impact to the NTF based Power Curve. In lower wind speed, different wind shear brings slight deviation to power curve & AEP.

The 5 cup anemometer types for performance evaluation.

Different TI did not bring significant impact to the NTF based Power Curve by IEC61400-12B.

Complex Terrain NTF Analysis

Hilly test site presents obstacles and neighbouring WT. Site calibration was executed according IEC61400-12-1 due to topographical variations of complex terrain.

Conclusion:

- The IEC61400-12B power performance evaluation method has acceptable variation with IEC61400-12A.
- Different wind shear / temperature / Turbulence intensity / wind direction variation and different types of terrain (complex or flat) will NOT bring significant deviation to power curve & AEP. (less than 3.5% at wind speed 4m/s @ complex terrain.)