



Blair Hill Wind Farm

Technical Appendix 12.2: Calculating Standardised Wind Speed

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1.1 Introduction

1.1.1 In order to derive appropriate noise limits the ETSU-R-97 guidance requires the correlation of background noise survey data with wind speed data referenced to 10 m height. In contrast, acoustic emission measurements on wind turbines are undertaken in accordance with international standard IEC 61400-11, 'Wind Turbine Generator Systems - Part 11: Acoustic Noise Measurement Techniques'¹, which specifies that the turbine noise emission should be reported as a function of hub height wind speed. In practice this involves extrapolating hub-height wind speed down to 10 m height using a specified, and fixed, relationship. The resulting 'standardised' 10 m wind speed is essentially a proxy for hub-height wind speed which is the primary driver of noise emission from the turbine.

1.1.2 The use of a fixed relationship between hub height and 10 m wind speed means that potential exists for the background noise data and acoustic emission data to be misaligned i.e. a wind speed measured at 10 m height is not necessarily equivalent to a 'standardised' 10 m wind speed of the same magnitude, with the difference depending upon the site specific shear exponent (the rate of change of wind speed with height).

1.2 Methodology

1.1.3 To allow a direct comparison between noise limits and the predicted noise levels, the background noise data is referenced to the same wind speed as the acoustic emission data. The approach used is consistent with that recommended in an article published in the Institute of Acoustics Bulletin and the subsequent Good Practice Guide (option a in paragraph 2.6.3).

1.1.4 To account for the difference in wind speed reference height in accordance with the aforementioned approach, the standardised 10 m wind speed is found by:

1.1.5 The corresponding 'standardised' 10 m wind speeds are calculated from the measured hub height wind speed using the following formula and it is this resultant standardised 10 m wind speed that shall be used in correlation with the measured background noise levels:

$$v_s = v_{hh} \left[\frac{\ln \frac{z_{ref}}{z_0}}{\ln \frac{hh}{z_0}} \right]$$

Where:

- v_s is the 'standardised' 10 m wind speed
- v_{hh} is the hub height wind speed
- z_0 is the reference roughness length (0.05 m)
- z_{ref} is the reference height (10 m)
- hh is the maximum proposed hub height (165 m)

1.1.6 The resulting 'standardised' 10 m wind speed is correlated with the measured background noise survey data.

1.1.7 Referencing the background noise levels to standardised 10 m wind speed calculated from the measured wind speed at 165 m height means that the resulting noise limits will also be referenced to wind speed at this height.

¹ 'Wind turbine generator systems - Part 11: Acoustic noise measurement techniques', IEC 61400-11:2012