Technical Appendix 10.2: Noise Prediction Methodology

Contents

Appendix 10.2. Noise Prediction Methodology

Introduction

A10.2.1 This technical appendix describes the operational noise prediction methodology that has informed the operational noise assessment for Glenouther Wind Farm (the Proposed Development) and supports **Chapter 10: Noise and Vibration** of the EIA Report. This technical appendix relates solely to the Proposed Development (as defined in **Chapter 4: Development Description** of the EIA Report). The Likely Grid Connection Route (as defined in **Chapter 4**) is addressed in **Chapter 10** of the EIA Report.

Methodology

A10.2.2 The ISO 9613-2 standard is used for predicting sound pressure levels in the far-field resulting from the operation of wind turbines for downwind propagation conditions by taking the source sound power level for each turbine in separate octave bands and subtracting a number of attenuation factors according to the following:

- Predicted Octave Band Noise Level = Lw + D - Ageo - Aatm - Agr - Abar – Amisc

A10.2.3 These factors are discussed in detail below together with an additional term for taking wind direction into account where required. The predicted octave band levels from each turbine are summed together to give the overall ‘A’ weighted predicted sound level.

L_W - Source Sound Power Level

A10.2.4 The sound power level of a noise source is normally expressed in decibels (dB) (relative to 1 pW). Noise predictions for the Proposed Development are based on sound power levels detailed in **Table 10.10** of **Chapter 10** of the EIA Report. The source sound power levels for other wind turbine developments included in the cumulative operational noise impact assessment are included in **Technical Appendix 10.4**.

D – Directivity Factor

A10.2.5 The directivity factor allows for an adjustment to be made where the sound radiated in the direction of interest is higher than that for which the sound power level is specified. In this case the sound power level is measured in a downwind direction, corresponding to the worst-case propagation conditions considered here and needs no further adjustment.

A_{geo} – Geometrical Divergence

A10.2.6 The geometrical divergence accounts for spherical spreading in the free-field from a point sound source resulting in an attenuation depending on distance according to:

$$A_{geo} = 20 \times \log(d) + 11$$

where d = distance from the turbine

A10.2.7 The wind turbine may be considered as a point source beyond distances corresponding to one rotor diameter.

A_{atm} - Atmospheric Absorption

A10.2.8 Sound propagation through the atmosphere is attenuated by the conversion of some of the sound energy into heat. This attenuation is dependent on the temperature and relative humidity of the air through which the sound is travelling and is frequency dependent with increasing attenuation towards higher frequencies. The attenuation depends on distance according to:

$$A_{atm} = d \times \alpha$$

where d = distance from the turbine,

and α = atmospheric absorption coefficient in dB/m.

A10.2.9 Values of ‘α’ from ISO 9613 Part 1 corresponding to a temperature of 10ºC and a relative humidity of 70%, the values specified in the UK Institute of Acoustics, A Good Practice Guide to the Application of ETSU-R-97 for the

Assessment and Rating of Wind Turbines Noise (IOA GPG), which give relatively low levels of atmospheric attenuation and correspondingly worst-case noise predictions, as given at **Table A10.2.1** below.

Table A10.2.1 Frequency dependent atmospheric absorption coefficients

Octave Band Centre	63	125	250	500	1k	2k	4k	8k
Atmospheric Absorption Coefficient (dB/km)	0.122	0.411	1.04	1.93	3.7	9.66	32.8	117

A_{gr} - Ground Effect

A10.2.10 Ground effect is the interference of sound reflected by the ground with the sound propagating directly from source to receiver. The prediction of ground effects are inherently complex and depend on the source height, receiver height, propagation height between the source and receiver and the ground conditions. The ground conditions are described according to a variable G which varies between 0 for ‘hard’ ground (includes paving, water, ice, concrete & any sites with low porosity) and 1 for ‘soft’ ground (includes ground covered by grass, trees or other vegetation). The IOA GPG states that where wind turbine source noise data includes a suitable allowance for uncertainty, a ground factor of G = 0.5 and a receptor height of 4 m should be used.

A_{bar} - Barrier Attenuation

A10.2.11 The effect of any barrier between the noise source and the receiver position is that noise will be reduced according to the relative heights of the source, receiver and barrier and the frequency spectrum of the noise. The barrier attenuations predicted by the ISO 9613 model have, however, been shown to be significantly greater than that measured in practice under downwind conditions. The results of a study of propagation of noise from wind farm sites carried out for ETSU concludes that an attenuation of just 2 dB(A) should be allowed where the direct line of sight between the source and receiver is just interrupted and that 10 dB(A) should be allowed where a barrier lies within 5m of a receiver and provides a significant interruption to the line of sight. In this case, no barrier corrections have been applied to predicted operational noise levels from the Proposed Development.

A_{misc} – Miscellaneous Other Effects

A10.2.12 ISO 9613 includes effects of propagation through foliage, industrial plants and housing as additional attenuation effects. These have not been included here and any such effects are unlikely to significantly reduce noise levels below those predicted.

Concave Ground Profile

A10.2.13 Sound propagation across a concave ground profile, for example valleys or where the ground falls away significantly between the turbine and the receptor, incurs an additional correction of +3 dB(A) to the overall A-weighted noise levels. This correction is implemented in order to take account of the reduced ground effects and, under some rare circumstances, the potential for multiple reflection paths caused by the concave profile.

A10.2.14 A criterion is recommended in the IOA GPG for indicating where this correction should be applied:

$$h_m \geq 1.5 \times \left(\frac{\text{abs}(h_s + h_r)}{2}\right)$$

where h_m is the mean height above ground along the direct path between the source and the receptor, h_s is the absolute source height above ground level and h_r is the absolute receptor height above ground level.

A10.2.15 Whilst this condition is useful at highlighting where the ground profile beneath a source – receptor path may be concave, it is inherently non-robust and can produce false positives. It should therefore be used in conjunction with a visual assessment of the ground profile when determining whether a correction should be applied.

A10.2.16 A computer programme is used to generate the ground profiles beneath each source – receptor path. From these plots it is possible to determine where a correction is appropriate. In this case, no such propagation paths have been identified and no corrections have been made to predicted noise levels from the Proposed Development.

Wind Direction Effects

A10.2.17 In this case wind direction effects have not been included in the modelling, and therefore the modelling presented represents conservative assumptions, particularly in the cases where noise-sensitive receptors cannot be downwind of different wind turbine developments simultaneously.

Conversion to L_{A90}

A10.2.18 The equivalent L_{A90} has been calculated by subtracting 2 dB from the calculated L_{Aeq}.