Balmeanach Wind Farm Limited

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Technical Appendix 13.1
Amplitude Modulation, Low Frequency Noise and Tonal Noise

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Contents

1 Introduction

1.1.1 This Technical Appendix provides a brief overview of published studies into Amplitude Modulation (AM), as well as low frequency and tonal noise. These are topics which have been scoped out of the assessment of effects from operational noise.

2 Amplitude Modulation

2.1.1 Amplitude modulation (AM) is the periodic variation in the amplitude of aerodynamic noise generated during the operation of a wind turbine. The noise assessment methodology presented in ETSU-R-97, sets out noise limits which already account for typically encountered levels of amplitude modulation from wind turbines.

2.1.2 A study was carried out on behalf of the Department for Business, Enterprise and Regulatory Reform (BERR) by the University of Salford, which investigated the incidence of noise complaints associated with wind farms and whether these were associated with AM (University of Salford, 2007). This report defined AM as aerodynamic noise fluctuations from wind turbines at blade passing frequency. Its aims were to ascertain the prevalence of AM on UK wind farm sites, to try to gain a better understanding of the likely causes, and to establish whether further research into AM is required.

2.1.3 The study concluded that AM with a greater degree of fluctuation than normal had occurred at only a small number of wind farms in the UK (4 of 133), and only for between 7% and 15% of the time. It also states that, at the time of writing, the causes of this were not well understood and that prediction of the effect was not currently possible.

2.1.4 This research was updated in 2013 by an in-depth study undertaken by Renewable UK, which considered ‘other AM’ (OAM) defined as AM with atypical characteristics which could not be explained by standard causal factors. The study identified that many of the previously suggested causes of OAM have little or no association to the occurrence of OAM in practice. The generation of OAM was likely based upon the interaction of several factors, the combination and contributions of which are unique to each site. With the current knowledge, it is not possible to predict whether any particular site is more or less likely to give rise to OAM.

2.1.5 In 2016, the IOA proposed a measurement technique to quantify the level of AM present in any particular sample of wind farm noise (Institute of Acoustics, 2016). This technique is supported by the Department of Business, Energy & Industrial Strategy (BEIS, formerly the Department of Energy & Climate Change) who have published guidance, which follows on from the conclusions of the IOA study in order to define an appropriate assessment method for AM, including a penalty scheme and an outline planning condition (BEIS, 2016).

2.1.6 Section 7.2.1 of the Institute of Acoustics document Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise (IOA 2013) remains current, stating: "The evidence in relation to 'Excess' or 'Other' Amplitude Modulation (AM) is still developing. At the time of writing, current practice is not to assign a planning condition to deal with AM".

2.1.7 In 2022, WSP undertook a review of UK noise guidance for onshore wind turbines on behalf of the Department for Business, Energy and Industrial Strategy, which included AM. The review concluded that whist it has been possible to simulate AM occurring at long ranges using computationally intensive numerical and analytical methods, detailed information on a wide range of parametric inputs is required, and the results are likely to be very sensitive to the model assumptions. It is therefore confirmed that that reliable predictions of AM in the context of development planning and noise assessment guidance are unlikely to be practically feasible in the near future.

2.1.8 At present there is no reliable method for predicting OAM and as such it is current practice to not carry out an AM assessment.

3 Infrasound and Low Frequency Noise

3.1.1 Low frequency noise is noise that occurs within the frequency range of 10 Hz to 160 Hz. Infrasound is noise occurring at frequencies below that at which sound is normally audible, that is, less than about 20 Hz, due to the significantly reduced sensitivity of the ear at such frequencies. In this frequency range, for sound to be perceptible, it must be at very high amplitude, and it is generally considered that when such sounds are perceptible then they can cause considerable annoyance.

3.1.2 A study, published in 2006 by acoustic consultants Hayes McKenzie on the behalf of the Department of Trade and Industry (DTI), investigated low frequency noise from wind farms (Hayes McKenzie, 2006). This study concluded that there is no evidence of health effects arising from infrasound or low frequency noise generated by wind turbines.

3.1.3 Further, in February 2013, the Environmental Protection Authority of South Australia published the results of a study into infrasound levels near wind farms (Environment Protection Authority, 2013). This study measured infrasound levels at urban locations, rural locations with wind turbines close by, and rural locations with no wind turbines in the vicinity. It found that infrasound levels near wind farms are comparable to levels away from wind farms in both urban and rural locations. Infrasound levels were also measured during organised shut downs of the wind farms; the results showed that there was no noticeable difference in infrasound levels whether the turbines were active or inactive.

3.1.4 Bowdler et al. (2009) concludes that: "...there is no robust evidence that low frequency noise (including 'infrasound') or ground-borne vibration from wind farms generally has adverse effects on wind farm neighbours."

4 Tonal Noise

4.1.1 Tonal noise is the concentrations of acoustic energy over relatively small bands of frequency. Tonality found in wind turbine sound is most often of mechanical origin, which over the years has been engineered out of modern machines, and is generally caused by structural resonances in the mechanical parts of the turbine. Modern day wind turbines are highly unlikely to generate tonal noise unless there is a fault with a mechanical component such as the gearbox as a result of poor maintenance.

4.1.2 The Environmental Impact Assessment (**Chapter 13: Noise**) does not take into account any tonal penalty for the candidate wind turbine. During the selection process for the final turbine choice, it would be confirmed by the manufacturer that there is either no tonal component that would require a penalty in accordance with ETSU-R-97, or that with the inclusion of any such penalty the derived noise limits within the assessment would still be achieved.

5 References

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