Appendix 11.1 Noise and Vibration Guidance

Contents

Introduction 1

IoA GPG – A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise 1

British Standard 5228-1: 2009+A1:2014: Code of practice for noise and vibration control on construction and open sites. Noise 2

British Standard 5228-2: 2009+A1: 2014: Code of practice for noise and vibration control on construction and open sites. Vibration 3

British Standard 4142: 2014: Methods for rating and assessing industrial and commercial sound 5

This page is intentionally blank.

Noise and Vibration Guidance

Introduction

IoA GPG – A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise

A summary of this document is included within the Original ES. Additional information is presented here which is relevant to the revised cumulative noise assessment.

The IoA GPG includes advice on appropriate assessment methodologies to be followed under a number of different cumulative development scenarios. These scenarios include '*concurrent applications*', '*existing wind farm consented with less than total ETSU-R-97 limits*', '*existing wind farm/s consented to the total ETSU-R-97 limits currently operating*', and '*permitted wind farm consented to total ETSU-R-97 limits but not yet constructed*'.

In the section entitled '*Existing wind farm/s consented with less than total ETSU-R-97 limits'* it is stated that:

"If an existing wind farm is consented to noise limits of less than the total ETSU-R-97 limits, a future wind farm applicant can then use these limits as a base within their predictions. Whether the existing wind farm is currently operating or not is immaterial to the assessment, as it will not be able to exceed its own conditions. It is becoming more common to apply noise limits which are less than total ETSU-R-97 limits because of cumulative considerations.

This should be undertaken in consultation with the LPA and relevant applicant(s). An example of this in practice is the apportionment of the ETSU-R-97 noise limit between concurrent applications. It may be the case that conditioning the scheme to the exact predicted noise levels (at all wind speeds) for the candidate turbine presented within the submitted noise impact assessment may constrain the applicant in future turbine procurement options. Therefore, a constant margin above the predicted noise levels (or below the total ETSU-R-97 limits) could be chosen which provides the applicant with procurement options but in combination with the neighbouring wind farm/s can still achieve the ETSU-R-97 limits."

In practical terms it is necessary to account for the noise levels which are permitted to be generated / could realistically be generated by the approved development within the completed cumulative noise assessment.

In the section entitled '*Concurrent applications*' it is stated that where there are no pre-existing wind farms, this scenario permits the apportionment of the ETSU-R-97 limits between the concurrent developments, i.e. each of the developments could be subject to noise limits below the full ETSU-R-97 guidance, such that even if the individual limits applied to each development were utilised 'in full', the combined effect would be that the ETSU-R-97 guidance would not be exceeded cumulatively.

In the section entitled '*Existing wind farm/s, consented to the total ETSU-R-97 limits currently operating*', the concept of a '*controlling property*' is introduced. This concerns situations where compliance with the applicable noise limit at the '*controlling property*' would result in noise levels never realising the noise level limit 'in full' at another property (e.g. because the second property is further removed from the development), thereby leaving a proportion of the conditioned limit available for use at the second property by the subsequently proposed development/s.

The IoA GPG also provides advice / sample methodologies for how wind direction can be taken into account in noise level predictions. It is recognised that using the prediction method detailed within ISO 9613-2:1996: *Acoustics – Attenuation of sound during propagation outdoors* – Part 2: *General method of calculation* results in worst case (downwind) propagation conditions from the source to the receiver, but that when considering cumulative developments it can be appropriate to consider the effects of other wind directions. For example, if a receptor is located directly between two developments, it cannot be subject to downwind propagation from all turbines. When downwind conditions prevail for one of the developments, upwind conditions will prevail for the other. The example methodologies provided can result in a significant correction for upwind conditions

(up to -13 dB) depending upon the geography of the local area, and the receptor distance with respect to the sources.

The IoA GPG also requires that appropriate corrections are accounted for where propagation is '*across a valley*' or where '*the ground falls away significantly between the turbine and the receiver*'. A methodology is provided for determining where such corrections should be applied, and the level of correction is also stipulated.

British Standard 5228-1: 2009+A1:2014: Code of practice for noise and vibration control on construction and open sites. Noise

The latest (2014) release of this document was published following completion of the Original ES. This latest release is not a 'full revision' of the standard but a re-release of the 2009 version with textural amendments / alterations. The fundamental guidance remains unchanged, but an updated summary is provided below, which accounts for the minor amendments.

This standard provides guidance on appropriate methods for minimising noise from construction activities.

Techniques for predicting the likely noise effects from construction works are given; these are based on detailed information on the type and number of plant items being used, their location and the length of time they are in operation. The noise prediction method is used to establish likely noise levels in terms of the $L_{Aeq,T}$ over the core working day. A database of information is also provided, including measured noise data for a variety of different construction plant undertaking various common activities, which can be used to estimate levels of noise generated by typical construction works.

Three methods are presented for the assessment of the significance of noise effects. In summary, the assessment could adopt either a series of fixed noise limits, be concerned with ambient noise level changes as a result of the construction operations, or consider a combination of these approaches.

With respect to absolute fixed noise limits, BS 5228-1: 2009+A1: 2014 discusses those included within the Department of the Environment Advisory Leaflet 72: *Noise Control on Building Sites* (Department of the Environment, 1976). Those limits are presented according to the nature of the surrounding environment, for a 12 hour working day. The presented limits are:

- 70 dB(A) in rural, suburban and urban areas away from main road traffic and industrial noise;
- 75 dB(A) in urban areas near main roads and heavy industrial areas.

The Standard goes on to provide methods for determining the significance of construction noise levels considering the change in the ambient noise level with the construction noise. Two example assessment methods are presented. These are the ABC method (as summarised in Table 11A1.1) and the 5 dB(A) change method.

Table 11A1.1 – Example Threshold of Potential Significant Effect at Dwellings – ABC Method (BS 5228-1: 2009+A1: 2014)

Assessment Category and Threshold Value Period	Threshold Value, in decibels (dB) ($L_{Aeq,T}$)		
	Category A[A)]	Category B[B)]	Category C[C)]
Night-time (2300 – 0700)	45	50	55
Evenings and weekends[D)]	55	60	65
Daytime (0700 – 1900) and Saturdays (0700 – 1300)	65	70	75

NOTE 1: A potential significant effect is indicated if the $L_{Aeq,T}$ noise level arising from the site exceeds the threshold level for the category appropriate to the ambient noise level.

NOTE 2: If the ambient noise level exceeds the Category C threshold values given in the table (i.e. the ambient noise level is higher than the above values), then a potential significant effect is indicated if the total $L_{Aeq,T}$ noise level for the period increases by more than 3 dB due to site noise.

NOTE 3: Applied to residential receptors only

A) Category A: threshold values to use when ambient levels (when rounded to the nearest 5 dB) are less than these values.

B) Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as Category A values.

C) Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than Category A values.

D) 19.00-23.00 weekdays, 13.00-23.00 Saturdays and 07.00-23.00 Sundays

With respect to the 5 dB(A) change method, the guidance states,

"Noise levels generated by site activities are deemed to be potentially significant if the total noise (pre-construction ambient plus site noise) exceeds the pre-construction ambient noise by 5 dB or more, subject to lower cut-off values of 65 dB, 55 dB and 45 dB LAeq,T from site noise alone, for the daytime, evening and night-time periods, respectively; and a duration of one month or more, unless works of a shorter duration are likely to result in significant effect."

British Standard 5228-2: 2009+A1: 2014: Code of practice for noise and vibration control on construction and open sites. Vibration

The latest (2014) release of this document was published following completion of the Original ES. This latest release is not a 'full revision' of the standard but a re-release of the 2009 version with a number of textural amendments / alterations to provide additional clarity. The fundamental guidance remains unchanged but an updated summary is provided below which accounts for the minor amendments.

This Standard provides recommendations for basic methods of vibration control relating to construction and open sites. The legislative background is described and guidance is provided on methods of measuring vibration and assessing its effects on the environment.

Guidance criteria are suggested for the assessment of both human and building response to vibration. The criteria are stated in terms of Peak Particle Velocity (PPV); those concerned with human response to vibration are shown in Table 2.

Table 1 – Guidance Criteria for the Assessment of Vibration (BS 5228-2: 2009+A1: 2014)

Vibration Level PPV [A), B), C)]	Effect
0.14 mm·s^{-1}	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.
0.3 mm·s^{-1}	Vibration might be just perceptible in residential environments.
1.0 mm·s^{-1}	It is likely that vibration of this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents.
10 mm·s^{-1}	Vibration is likely to be intolerable for any more than a very brief exposure to this level in most building environments.

A) The magnitudes of the values presented apply to a measurement position that is representative of the point of entry into the recipient.

B) A transfer function (which relates an external level to an internal level) needs to be applied if only external measurements are available.

C) Single or infrequent occurrences of these levels do not necessarily correspond to the stated effect in every case. The values are provided to give an initial indication of potential effects, and where these values are routinely measured or expected then an assessment in accordance with BS 6472-1 or -2, and/or other available guidance, might be appropriate to determine whether the time varying exposure is likely to give rise to any degree of adverse comment.

The BS 5228-2 criteria applicable to the transient vibration response of buildings are presented in Table 3. It should be noted that the values in Table 3 are applicable to cosmetic damage only. It is stated within BS 5228-2: 2009+A1: 2014 that minor damage is possible at vibration magnitudes greater than twice those given in the table.

Table 2 –Transient Vibration Guide Values for Cosmetic Damage (BS 5228-2:2009+A1:2014)

Type of Building	Peak Component Particle Velocity in Frequency Range of Predominant Pulse	
	4 Hz to 15 Hz	15 Hz and above
Reinforced or framed structures	50 mm·s^{-1} at 4 Hz and above	50 mm·s^{-1} at 4 Hz and above
Industrial and heavy commercial Unreinforced or light framed structures	15 mm·s^{-1} at 4 Hz increasing to 20 mm·s^{-1} at 15 Hz	20 mm·s^{-1} at 15 Hz increasing to 50 mm·s^{-1} at 40 Hz and above

NOTE 1: Values referred to are at the base on the building.

NOTE 2: At frequencies below 4 Hz, a maximum displacement of 0.6 mm (zero to peak) is not to be exceeded.

British Standard 4142: 2014: Methods for rating and assessing industrial and commercial sound

This standard replaces the previous BS 4142: 1997: *Method for rating industrial noise affecting mixed residential and industrial areas*, as summarized within the Original ES.

This standard is applicable for use in the assessment of any non-turbine fixed plant associated with the operational phase, e.g. electrical substation noise. It sets out a method for rating and assessing sound of an industrial and/or commercial nature, including "*sound from fixed installations which comprise mechanical and electrical plant and equipment*".

The assessment procedure contained within BS 4142 requires that initially the 'rating level' ($L_{Ar,Tr}$) that is (or would be) generated by the source under assessment is determined, externally, at the assessment location. Where this source does not include any acoustic features, such as tonality, impulsivity or intermittency etc., then the rating level ($L_{Ar,Tr}$) equals the specific sound level (L_s), which is the sound pressure level produced by the source using the $L_{Aeq,T}$ noise index. Where the source under assessment does include acoustic characteristics, then a series of corrections are added to the specific sound level to determine the rating level. The degree of correction applied to determine the rating level depends upon the results of either subjective or objective appraisals.

The background sound level at the assessment location, measured using the $L_{A90,T}$ index, is then subtracted from the rating level. The result provides an indication of the magnitude of impact, where the greater the difference, the greater the magnitude of impact.

The following scale is presented:

- A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.
- A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.
- The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.

It can be seen from the above that the magnitude of impact is also dependent upon the context in which the sound arises. Factors that are considered with respect to context include: the absolute level of sound, and the character and level of the residual sound (that in absence of the source under assessment) compared to the character and level of the specific sound.

With regards to the absolute level, it is stated, amongst other points, that "*where background sound levels and rating levels are low, absolute levels might be as, or more relevant than the margin by which the rating level exceeds the background. This is especially true at night*".

The former 1997 version of BS 4142 stated that rating levels below 35 dB and background noise levels below 30 dB(A) were considered to be '*very low*'.

This page is intentionally blank.