Thurrock Flexible Generation Plant

Environmental Statement
Appendix 11.5: Standards and Guidance Relevant to Noise and Vibration

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Environmental Impact Assessment

Environmental Statement

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Appendix 11.5

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Summary

This Appendix provides supporting information on the Standards and Guidance used within the noise and vibration assessment.

Qualifications

This document has been prepared by Jon Baldwin, a Senior Acoustic Consultant and full Member of the Institute of Acoustics, who has six years’ experience of environmental noise impact assessment.

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1. Relevant Guidance and Standards

1.1 BS 5228-1:2009+A1:2014 'Code of practice for noise and vibration control on construction and open sites' - Noise

1.1.1 British Standard (BS) 5228 is a two part standard which comprises:

- BS 5228-1:2009+A1:2014 'Code of practice for noise and vibration control on construction and open sites – Part 1: Noise' (British Standards Institution (BSI), 2014a); and
- BS 5228-2:2009+A1:2014 'Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration' (BSI, 2014b);

1.1.2 The Standard provides guidance, information and procedures on the control of noise and vibration from demolition and construction sites. The Control of Noise (Code of Practice for Construction and Open Sites) (England) Order 2015 approved BS 5228-1:2009+A1:2014 and BS 5228-2:2009+A1:2014 for the purpose of giving guidance on appropriate methods for minimising noise from construction and open sites in exercise of the powers conferred on the Secretary of State by Sections 71(1)(b), (2) and (3) of the Control of Pollution Act 1974 .

1.1.3 There are no set standards for the definition of the significance of construction noise effects, however, for noise, example criteria are provided in BS 5228-1:2009+A1:2014 Annex E and for vibration, example criteria are provided in BS 5228-2:2009+A1:2014 Annex B. The assessment of whether changes in noise levels due to construction activity constitute significant effects will be dependent on the absolute levels of ambient and construction noise, as well as the magnitude, duration, time of occurrence and frequency of the noise change.

1.1.4 BS 5228-1:2009+A1:2014 provides basic information and recommendations for methods of noise control relating to construction and open sites where work activities/operations generate significant noise levels. It includes sections on: community relations; noise and persons on site, neighbourhood nuisance; project supervision; and control of noise. However, annexes include: information on legislative background; noise sources, remedies and their effectiveness (mitigation options); current and historic sound level data on site equipment and site activities; significance of noise effects; calculation procedures estimating sound emissions from sites and sound level monitoring; types of piling; and air overpressure.

1.1.5 BS 5228-2:2009+A1:2014 covers basic information and recommendations for basic methods of vibration control relating to construction and open sites where work activities/operations generate significant vibration levels. It includes sections on: community relations; vibration and persons on site; neighbourhood nuisance; project supervision; control of vibration and measurement. BS 5228-2:2009+A1:2014 refers to BS ISO 4866:2010 (BSI, 2010); BS 7385-2:1993 (BSI, 1993); BS 6472-1:2008 (BSI, 2008a) and BS 6472-2:2008 (BSI, 2008b) for further advice on the significance of vibration.

1.2 BS 5228-2:2009+A1:2014 'Code of practice for noise and vibration control on construction and open sites' - Vibration

1.2.1 Whilst not strictly applicable to an operational vibration assessment, BS 5228-2:2009+A1:2014 provides useful guidance and covers information and recommendations for basic methods of vibration control relating to construction and open sites where work activities/operations generate significant vibration levels. It includes sections on: community relations; vibration and persons on site; neighbourhood nuisance; project supervision; control of vibration and measurement.

1.2.2 Table B.1 of BS 5228-2:2009+A1:2014 provides guidance on effects of vibration levels, in terms of human perception and disturbance. These are given in Table 1.1 below.

Table 1.1: Guidance on effects of vibration levels.

Vibration Level (mm/s)	Effect
0.14	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	Vibration might be just perceptible in residential environments.
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	Vibration is likely to be intolerable for any more than a very brief exposure to this level.

1.3 BS 4142:2014+A1:2019 'methods for rating and assessing industrial and commercial sound'

1.3.1 The foreword to BS 4142:2014+A1:2019 'Methods for rating and assessing industrial and commercial sound' (BSI, 2014c) provides the following introduction for the assessment of human response to sound:

"Response to sound can be subjective and is affected by many factors, both acoustic and non-acoustic. The significance of its impact, for example, can depend on such factors as the margin by which a sound exceeds the background sound level, its absolute level, time of day and change in the acoustic environment, as well as local attitudes to the source of the sound and the character of the neighbourhood."

1.3.2 BS 4142:2014+A1:2019 primarily provides a numerical method by which to determine the significance of sound of an industrial nature (i.e. the 'specific sound' from the proposed development) at residential noise sensitive receptors (NSRs). The specific sound level may then be corrected for the character of the sound (e.g. perceptibility of tones and/or impulses), if appropriate, and it is then termed the 'rating level', whether or not a rating penalty is applied. The 'residual sound' is defined as the ambient sound remaining at the assessment location when the specific sound source is suppressed to such a degree that it does not contribute to the ambient sound.

1.3.3 An initial estimate of the impact of the specific sound is obtained by subtracting the measured background sound level from the rating level of the specific sound. In the context of the standard, adverse impacts include, but are not limited to, annoyance and sleep disturbance. Typically, the greater this difference, the greater is the magnitude of the impact:

1.3.4 A difference of around +10 decibel (dB) or more is likely to be an indication of a significant adverse impact, depending on the context.

1.3.5 A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.

1.3.6 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.

1.3.7 Whilst there is a relationship between the significance of impacts determined by the method contained within BS 4142:2014+A1:2019 and the significance of effects described in the National Planning Practice Guidance on Noise (NPPG) (Ministry of Housing, Communities & Local Government, 2019), there is not a direct link. It is not appropriate to ascribe numerical rating / background level differences to Lowest Observed Adverse Effect Level (LOAEL) and Significant Observed Adverse Effect Level (SOAEL) because this fails to consider the context of the sound, which is a key requirement of the Standard.

1.3.8 The significance of the effect of the noise in question (i.e. whether above or below SOAEL and LOAEL) should be determined on the basis of the initial estimate of impact significance from the BS 4142:2014+A1:2019 assessment with reference to the examples of outcomes described within the NPPG on Noise and after having considered the context of the sound. It is necessary to consider all pertinent factors, including:

- The absolute level of the sound;
- The character and level of the residual sound compared to the character and level of the specific sound; and
- The sensitivity of the receptor and whether dwellings or other premises used for residential purposes will already incorporate design measures that secure good internal and/or outdoor acoustic conditions.

1.4 Design Manual for Roads and Bridges, Volume 11, Section 3, Part 7: Noise and Vibration

1.4.1 The Design Manual for Roads and Bridges (DRMB), Volume 11, Section 3, Part 7 (Highways Agency et al., 2019), provides guidance on the appropriate level of assessment to be used when assessing the noise and vibration impacts arising from all road projects including new construction, improvements and maintenance. It can also be referred to when a non-road project results in changes in traffic flow on the existing road network.

1.4.2 Generally a project should be considered for assessment if it alters the alignment of any existing carriageways including new sections of road, additional junctions and slip roads or if there is a change in traffic volume, traffic speed, proportion of heavy vehicles or changes in infrastructure surrounding the road that could cause a change in noise level of more than 1 dB(A); and if there are any dwellings within two kilometres of the project that would be subject to a change in noise or vibration. DMRB states that an increase in traffic flow by at least 25% or a decrease by 20% is equivalent to a 1 dB(A) change in noise level.

1.4.3 DMRB defines a simple and detailed method for assessing the impacts of road traffic noise. The simple method is used as a preliminary assessment to determine if there will be any significant change in noise levels. It is based on a comparison between baseline conditions in the opening year of the development and conditions with the development in the future assessment year which is typically the 15th year after the opening of a project. Calculations are made of the increase or decrease in noise level between the two scenarios for dwellings and other sensitive receptors within 600 m either side of the centreline of the affected routes.

1.4.4 The detailed method is based upon two comparisons; one between baseline conditions within the opening year of the development and conditions with the development in the opening year; and one between conditions with the development in the opening year and conditions with the development in the future year. For this assessment calculations are made both of the increase or decrease in noise level and of the increase or decrease in nuisance level. The calculation of nuisance level draws upon a number of studies on perceived traffic noise nuisance which are referred to in Annex 3 of the DMRB document.

1.4.5 The classification of magnitude of impacts to be used for traffic noise from the base year is provided in Table 1.2 short term effects. The noise threshold criteria for short term effects are more stringent than those for long term effects. In order to ensure a robust assessment, it is considered appropriate to apply the threshold criteria in Table 1.2 to the assessment of construction traffic noise.

Table 1.2: Calculation of magnitude of noise impacts in the short term.

Noise Change, dB $L_{A10, 18hr}$	Magnitude of Impact
0	No Change
0.1 – 0.9	Negligible
1 – 2.9	Minor
3 – 4.9	Moderate
5+	Major

1.5 Calculation of Road Traffic Noise, 1988

1.5.1 The Department of Transport document, Calculation of Road Traffic Noise (CRTN) (Department of Transport Welsh Office, 1988), describes the procedures for measuring and calculating noise from road traffic. These procedures are necessary to enable entitlement under The Noise Insulation Regulations to be determined but they also provide guidance appropriate to the calculation of traffic noise for more general applications, e.g. environmental appraisal of road schemes, highway design and land use planning. The document can also be used to generate scaling factors for expected increases in road traffic and expected levels of attenuation from barriers.

1.6 Guidelines for Community Noise

1.6.1 The World Health Organisation (WHO) published guidance on the desirable levels of environmental noise in 2000. In this document, Guidelines for Community Noise (GCN) (Berglund et al., 1999), the authors consider that sleep disturbance criteria should be taken as an internal noise level of 30 dB $L_{Aeq,8hr}$ or an external level of 45 dB $L_{Aeq,8hr}$, measured at 1 m from the façade. It is also suggested that internal L_{Amax} levels of 45 dB and external L_{Amax} levels of 60 dB, should not be exceeded.

1.6.2 For daytime levels, it is considered that:

"To protect the majority of people from being seriously annoyed during the daytime, the outdoor sound level from steady, continuous noise should not exceed 55 dB LAeq on balconies, terraces, and outdoor living areas. To protect the majority of people from being moderately annoyed during the daytime, the outdoor sound level should not exceed 50 dB LAeq. Where it is practical and feasible, the lower outdoor sound level should be considered the maximum desirable sound level for new development."

1.6.3 However, a review of health effects based noise assessment methods undertaken for the Department for the Environment, Transport and the Regions (DETR) by Porter et al (1998), just before the issue of GCN, it is noted that:

'Perhaps the main weakness of both WHO-inspired documents is that they fail to consider the practicality of actually being able to achieve any of the stated guideline values.'

1.6.4 The report goes on to state that:

"around 56% of the population in England and Wales are exposed to daytime noise levels exceeding 55 dB LAeq and that around 65% are exposed to night-time noise levels exceeding 45 dB LAeq (as measured outside the house in each case). The

value of 45 dB LAeq night-time outdoors is equivalent to the 1995 WHO guideline value of 30 dB LAeq night-time indoors allowing 15 dB attenuation from outdoors to indoors for a partially open window (for free air ventilation to the bedroom). The percentages exposed above the WHO guideline values could not be significantly reduced without drastic action to virtually eliminate road traffic noise and other forms of transportation noise (including public transport) from the vicinity of houses. The social and economic consequences of such action would be likely to be far greater than any environmental advantages of reducing the proportion of the population annoyed by noise. In addition, there is no evidence that anything other than a small minority of the population exposed at such noise levels find them to be particularly onerous in the context of their daily lives."

1.6.5 Based on the most recent national survey of noise exposure carried out in England and Wales in 2000/2001, the percentage of the population exposed to day and night-time noise levels exceeding the WHO guidelines are 54% and 67%, respectively. The studies indicate that:

"the percentage of the UK population exposed to daytime levels of 55 dB LAeq16hr or greater, have decreased since 1990, whilst the percentage of the UK population exposed to night-time levels of 45 dB LAeq,8hr or greater, have increased since 1990, although this change is not considered statistically significant."

1.6.6 Therefore, the levels suggested in GCN may be considered more aspirational than immediately attainable.

1.7 The Night Noise Guidelines for Europe

1.7.1 WHO and the European Commission sponsored guidance on night-time noise levels based upon scientific evidence for health effects from exposure to varying levels of transportation (air, road and rail) noise. The results of the study were published as the Night Noise Guidelines (NNG) (WHO, 2009). The report provides a summary of the results of research into the mental and physical effects of environmental night-time noise to people. NNG provides observed effect thresholds, i.e. the level above which an effect starts to occur or shows itself to be dependent on the exposure level. In the context of the NNG, these levels are commensurate with the LOAEL. For waking up in the night and/or too early in the morning, NNG suggests the LOAEL is an internal sound level of 42 dB L_{Amax}.

1.7.2 The night-time noise indicator L_{night} is defined in the Environmental Noise Directive (END) as an annual average L_{Aeq} over a period of 8 hours between 23:00 and 07:00 hours. The authors of the NNG recommend a threshold of 40 dB $L_{night,outside}$ to protect the public including vulnerable groups such as children and a threshold of 55 dB $L_{night,outside}$ as an interim target for countries where 40 dB $L_{night,outside}$ cannot be achieved in the short term.

1.7.3 The role of the NNG, and other similar reports commissioned by organisations such as WHO and the European Commission, is to provide information to the governments and policy makers within each country and/or member state so that national policy and standards can be made that is commensurate and relevant to their national aspirations. For example, NPPG on Noise (Ministry of Housing, Communities & Local Government, 2019) provides the UK Government's policies on noise that are relevant to planning and includes references to sleep disturbance. BS 8233:2014 'Guidance on sound insulation and noise reduction for buildings' (BSI, 2014d) provides guideline values for internal ambient noise levels that are desirable within houses in the UK.

1.7.4 On the basis of the above, the information contained within the NNG is not directly applicable to planning and/or permit applications in the UK because national policy and standards set the terms of reference for the assessment of night-time noise.

1.8 ISO 9613:1996 'Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation

1.8.1 International Standard ISO 9613-2:1996 (International Organisation for Standardisation (ISO), 1996) provides a method for predicting acoustic propagation outdoors. The method is applicable in practice to a great variety of sources and environments. It is applicable, directly or indirectly, to most situations concerning road or rail traffic, industrial sources, construction activities, and many other ground-based sound sources.

1.8.2 The scope of the standards states that the method predicts the L_{Aeq} under meteorological conditions favourable to propagation from sources of known sound emission. These conditions are for downwind propagation or, equivalently, propagation under a well-developed moderate ground-based temperature inversion, such as commonly occurs at night. Inversion conditions over water surfaces are not covered and may result in higher sound pressure levels than predicted from this method.

1.8.3 Calculations are made for each individual octave band from 63 Hertz (Hz) to 8 kHz. The calculation is summarised by:

$LAT\ (DW) = \sum \sum [\ LW + DC - A_{div} - A_{atm} - A_{gr} - A_{bar} - A_{misc}\ ]$

(contributions are summed for each source and in each octave band)

Where:

LAT (DW) = average 'A'-weighted downwind sound pressure level at receptor

LW = sound power level of source*

DC = directivity of the source*

A_{div} = attenuation due to geometric divergence*

A_{atm} = attenuation due to atmospheric absorption*

A_{gr} = attenuation due to ground effect*

A_{bar} = attenuation due to a barrier*

A_{misc} = attenuation due to miscellaneous other effects (e.g. woodland)*

*(per source and octave band)

1.8.4 The estimated accuracy for values of LAT (DW) is stated as ±3 dB for a mean source / receptor height of up to 5 m and source / propagation separation distance of up to 1 km.

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