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nationalgrid

Contents

14. Operational Noise from Overhead Line (Informative)

14.1 Introduction

14.1.1 This appendix has been produced to support Chapter 14: Noise and Vibration (document reference 6.14) of the Environmental Statement (ES) (Volume 6 of the Development Consent Order (DCO) application) for Norwich to Tilbury (the 'Project'). It provides evidence to support scoping out operational noise from the overhead lines from the Environmental Impact Assessment (EIA) and provides information to demonstrate that any noise that may occur during the operation of the overhead transmission line would be not significant.

14.1.2 Operational noise from the overhead lines was scoped out of the assessment in the EIA Scoping Report (document reference 6.19) as the proposed overhead line system would use 'triple Araucaria' conductors or alternative technology that performs to the same or better standard in relation to noise on standard and low height lattice pylons for reducing operational noise (as reported in Chapter 4: Project Description (document reference 6.4). This would be regarded as practically quiet. In addition, pylon fittings, such as insulators, dampers, spacers and clamps, are designed and procured in accordance with a series of National Grid Technical Specifications and must be type registered. These processes reduce the potential for audible noise and tones to occur from all types of fittings, including insulators.

14.1.3 Where modifications for existing transmission overhead lines are required, like for like conductors are proposed. No change in noise is therefore expected in these situations and no further assessment has been undertaken.

14.1.4 The EIA Scoping Report (document reference 6.19) concluded that operational noise from the overhead line was therefore not likely to be significant at nearby noise sensitive receptors (NSR) under any weather conditions. The Planning Inspectorate confirmed in the EIA Scoping Opinion (document reference 6.20) in response ID 3.12.4, that they agreed with scoping out operational noise from the overhead lines as there was unlikely to be a significant effect, on the basis of the embedded measures set out in the EIA Scoping Report (document reference 6.19).

14.1.5 National Grid committed to include a technical note within the application for development consent to support scoping out noise associated with overhead lines. This appendix provides this evidence.

14.1.6 This appendix relates only to the overhead line sections of the Project. The underground cable sections are scoped out of the operational noise assessment on the basis that cables do not make noise. This was supported by the Planning Inspectorate in ID 3.12.7 in the EIA Scoping Opinion (document reference 6.20).

14.2 Background

Noise from Overhead Lines

14.2.1 Noise from high voltage overhead lines is primarily due to a phenomenon called corona discharge. Line noise is generated when the conductor surface voltage gradient (electric stress, or Emax expressed in kilovolts per centimetre (kV/cm)) exceeds the inception level for corona discharge activity which is released as acoustic energy and radiates into the air as sound. In UK conditions, the corona inception level is regarded to occur when electric stress is in the range 17 to 20 kV/cm. Whilst most high voltage overhead lines are designed to operate below this level, those that operate close to this may produce audible noise when enhancement of conductor surface electric stress occurs due to rainfall (wet noise) or the presence of conductor surface contamination (dry noise). Overhead lines that operate significantly below the corona inception level are much less likely to produce audible noise.

14.2.2 When it occurs, overhead line noise can be described as a ‘crackle’, which is sometimes accompanied by a tonal ‘hum’ in wet conditions. The highest noise levels generated by an overhead line generally occur during rainfall. Hum, if it occurs, is typically more annoying than crackle alone and therefore the occurrence of wet noise is considered worst-case.

Embedded Measures

14.2.3 National Grid has committed to embedded mitigation in the form of a triple Araucaria conductor system or alternative technology that performs to the same or better standard in relation to noise on standard lattice pylons for reducing operational noise (EM-P03). This would be a similar design to the existing 400 kV overhead line. Due to its geometrical configuration the triple Araucaria design is the least electrically stressed conductor system that National Grid uses. The maximum conductor surface electrical stress level of triple Araucaria on a lattice pylon is approximately 12 kV/cm when operated at 400 kV. This is significantly below the corona inception level and is the best design available for reducing the effects of dry and wet noise from the proposed 400 kV overhead line during operation.

National Grid Technical Guidance

14.2.1 National Grid has a suite of documents relating to the management of audible noise from its overhead lines. These documents are described in Table A14.5.1.

Table A14.5.1 National Grid Technical Guidance Documents

Document	Description
Policy Statement PS(T)134 - Operational Audible Noise Policy for Overhead Lines (National Grid, 2021)	Applies to environmental noise due to the operation of new overhead lines, reconductoring, diversion and uprating projects for overhead lines operated at 275 kV and 400 kV.
Technical Report TR(E)564 - Development of Method for Assessing the Impact of Noise from	The policy describes a three-tier assessment process and sets noise impact criteria against

Document	Description
Overhead Lines (New Build, Reconductoring, Diversion and Uprating) (National Grid, 2021a)	which predicted levels of noise from operational overhead lines can be assessed.
Technical Guidance Note TGN(E)322 - Operational Audible Noise Assessment Process for Overhead Lines (New Build, Reconductoring, Diversion and Uprating) (National Grid, 2021b)	Explains how the noise criteria presented in PS(T)134 were developed, taking into account the UK noise policy context and UK national and international guidance, including World Health Organisation guidelines and evidence for health effects.

14.2.2 PS(T)134 describes a method for predicting the environmental impact due to audible noise caused by new, reconductored, diverted or uprated overhead transmission lines. The method uses internationally recognised line noise prediction methodology to calculate noise emission levels based on operating voltage, conductor design and pylon geometry. PS(T)134 also sets out noise criteria against which predicted levels of noise from operational overhead lines can be assessed.

14.2.3 The PS(T)134 criteria applies a +6 decibel (dB) character correction to wet noise effects to account for the additional 'hum' generated during worst-case wet weather conditions and a +3 dB correction to dry noise effects to account for the 'crackle'. This means that the assessment method is consistent with guidance contained in Section 9 of British Standard 4142:2014+ A1:2019 'Methods for rating and assessing industrial and commercial sound' (BS 4142) (BSI, 2019), which takes account of acoustic features by applying a character correction to the specific sound level to calculate a BS 4142 rating level.

14.2.4 The overhead line noise assessment process set out in PS(T)134 follows a three-tier 'screening' approach based on predicted source noise level and the distance to NSR. If predicted worst case wet-noise levels fail the Tier 1 test, a Tier 2 assessment would be undertaken and if predicted noise levels fail the Tier 2 test, a Tier 3 assessment would be undertaken. The three-tier approach comprises the following steps which are designed to screen out of further assessment where there would be no adverse impact:

- **Tier 1**: A primary screening step based on 'worst-case' absolute wet noise effects and the pre-determined assessment criteria set out in PS(T)134
- **Tier 2**: A further screening step based on combined absolute wet noise and dry noise effects and recalculated assessment criteria. This step takes account of the fact that wet noise occurs only during periods of wet weather and therefore does not occur all the time
- **Tier 3**: Full assessment following the principles of BS 4142 for both wet noise and dry noise.

14.2.5 Noise criteria have been set taking account of the UK policy context and evidence from multiple sources, including the World Health Organisation and BS 4142, for noise and associated health impacts. The criteria have been developed by National Grid based on health impact data associated with the night-time period. The night-time period is considered more sensitive than the daytime, as background sound levels are normally lower and people are trying to sleep. National Grid Technical Report TR(E)564 explains the reasoning behind the noise criteria set out in PS(T)134.

14.3 Assessment

Tier Assessment for Proposed 400kV Overhead Lines

Tier 1 Assessment Criteria

14.3.1 The Tier 1 Assessment criteria set out in PS(T)134 are shown in Table A14.5.2. The 'No Adverse Impact' criteria applicable to residential NSR for worst-case wet weather noise is 34 dBA. In the case of the Tier 1 assessment, this is a rating level which includes a +6 dB character correction to account for the occurrence of transmission line 'hum' in wet weather. The criteria for NSR that may be regarded as highly sensitive to noise (for example vulnerable subgroups as defined by the World Health Organisation) is 5 dB lower, while the criteria for NSR that may be regarded as less sensitive to noise (for example those not used at night and those used for commercial purposes) is 5 dB higher.

Table A14.5.2 Tier 1 Noise Impact Criteria (Wet Noise), from PS(T)134

NSR Group	No Adverse Impact (Screened Out)	Further Assessment Necessary (Tier 2 Assessment Required)
Vulnerable subgroups	< 29 dBA	≥ 29 dBA
Residential	< 34 dBA	≥ 34 dBA
Schools and hotels	< 39 dBA	≥ 39 dBA

14.3.2 For the purposes of the Tier 1 assessment, 34 dBA is considered to be the Lowest Observed Adverse Effect Level (LOAEL) for residential NSR used for sleeping at night. These levels are free-field and apply at the façade of an NSR. Where vulnerable subgroups are present, the LOAEL is 29 dBA.

Tier 1 Wet Noise Prediction

14.3.3 Worst-case wet noise levels for the proposed triple Araucaria conductor system have been predicted using the proprietary line noise prediction software EFC-400. This software is widely used across the electricity industry to calculate conductor surface electrical stress, to assess compliance with electric and magnetic field guidelines and to predict transmission line noise levels under a range of weather conditions.

14.3.4 Overhead line noise source prediction is calculated by EFC 400 using the internationally recognised Electrical Power Research Institute method. Propagation either side of a modelled line is calculated according to International Organisation for Standardisation (ISO) ISO 9613-2:2024 Acoustics – Attenuation of sound during propagation outdoors – Part 2: Engineering method for the prediction of sound pressure levels outdoors (ISO, 2024). Modelling assumptions include:

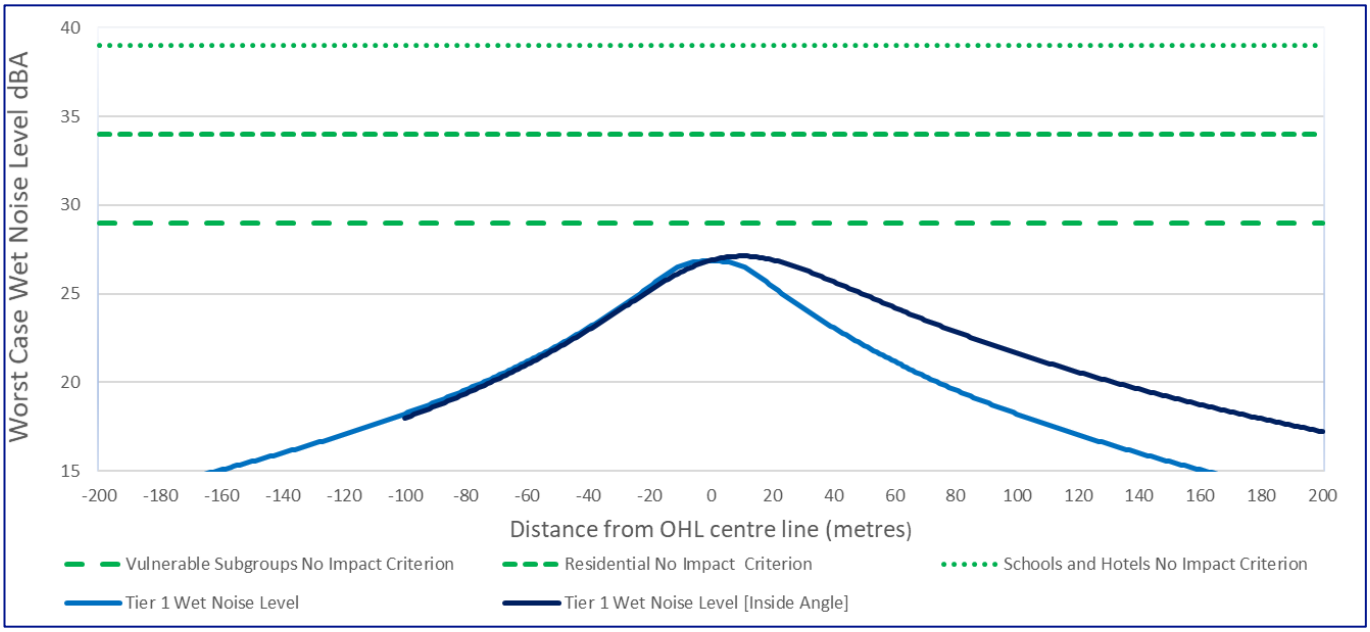
- A normalised wet noise third octave spectrum which contains 'hum' at 100 Hertz (Hz) and 200 Hz, harmonics of the electricity supply frequency of 50 Hz
- Air temperature = 10˚C
- Relative humidity = 90%

- Downwind propagation
- Porous ground = 1.0.

14.3.5 Image A14.5.1 shows the predicted worst-case wet noise levels at distances up to 200 m either side of the proposed overhead line alignment. Two scenarios are considered: a straight section of line (blue curve) and an angled section of line (dark blue curve). For the angled section, the inside of the angle is shown on the right of the chart. The consideration of an inside angle accounts for a NSR that may receive a greater combined effect from adjacent overhead line spans due to the overhead line deviating around the NSR.

14.3.6 Image A14.5.1 also shows the Tier 1 No Adverse Impact assessment criteria for each of the three NSR groups (green dashed lines).

Image A14.5.1 EFC-400 Wet Noise Prediction for Proposed Overhead Line (Tier 1 Screening)



14.3.7 The predicted noise levels are significantly below the No Adverse Impact Criteria for all three NSR groups.

14.3.8 This assessment is worst case as it assumes wet noise and hence hum would occur 100% of the time. In reality, these worst-case conditions are predicted to occur for only 5% of the year in the region.

14.3.9 The Tier 1 assessment therefore concludes that the predicted worst-case noise rating level for operational noise at all NSR due to the proposed 400 kV overhead line would be significantly below the 'No Adverse Impact' assessment criteria set out in PS(T)134.

14.3.10 As the worst-case wet noise from the triple Araucaria conductor design on lattice pylons is below the Tier 1 No Adverse Impact criteria for all NSR groups, there is no requirement to undertake a Tier 2 or Tier 3 assessment.

14.3.11 Operational noise from the proposed 400 kV overhead line would therefore be not significant. It is therefore justified that operational noise from the proposed overhead line remains scoped out of the assessment in accordance with the EIA Scoping Opinion (document reference 6.20).

Overhead Line Fixtures and Fittings

14.3.12 To be approved for use on the National Grid high voltage electricity transmission network, each fitting design must be 'Type Registered'. Type registration comprises a series of tests on the fitting in question to provide compliance with the relevant technical specification. These tests include performance requirements for corona inception and audible noise on all fittings along with wind tunnel testing of insulators for audible tones generated by Aeolian mechanisms.

14.3.13 Once the fitting has been Type Registered and approved for use, a number of further tests are also carried out post-manufacture in the form of sample testing. This demonstrates that the fitting design conforms to the specification in the Type Registration document.

14.3.14 The Technical Specification and Type Registration processes reduce the potential for audible noise and tones to occur from all types of fittings, including insulators. Where noise does occur, it is likely to be localised and of short duration. If due to a fault, actions can be taken to rectify it. Where noise from fittings does occur, which results in a complaint, appropriate actions can be taken to seek to remedy the cause of the noise, usually through cleaning or replacement of the relevant fitting. Therefore, noise from fixtures and fittings remains scoped out in accordance with the EIA Scoping Opinion (document reference 6.20).

14.4 Conclusions

14.4.1 This appendix presents the technical background to demonstrate that operational audible noise from the proposed 400 kV overhead line would be below the LOAEL for all NSR groups and therefore not significant due to the very low predicted noise levels even under worst-case wet noise conditions.

14.4.2 National Policy Statement for Electricity Networks Infrastructure (EN-5) includes the requirement for the applicant to consider noise from overhead lines. Paragraphs 2.9.40 to 2.9.43 and 2.11.7 provide guidelines on what needs to be considered during the application and decision-making process. The evidence presented within this Appendix satisfies the requirements of the relevant paragraphs in EN-5 and provides sufficient information to demonstrate that the residual noise impacts of the proposed overhead line would be not significant. This note considers:

- Worst-case wet noise during rainfall
- An appropriate method as set out in PS(T)134 and the internationally recognised prediction tool EFC-400 to predict overhead line source noise levels
- Embedded mitigation in the form of the proposed triple Araucaria conductor system, or alternative technology that performs to the same or better standard in relation to noise, for reducing dry and wet noise from the operation of the overhead line
- Use of tested and type-registered fixtures and fittings.

Abbreviations

Abbreviation	Full Reference
BS	British Standard
BSI	British Standards Institution
dB	Decibels
DCO	Development Consent Order
EIA	Environmental Impact Assessment
ES	Environmental Statement
kV	Kilovolt
kV/cm	kilovolt per centimetre
ISO	International Organization for Standardization
LOAEL	Lowest Observed Adverse Effect Level
NSR	Noise and Vibration Sensitive Receptor
UK	United Kingdom

Glossary

Term	Definition
A-Weighted	The A Weighting corrects the variation in the ear's ability to hear different frequencies and provides a good representation of how sound is perceived by the human ear.
Conductor	The overhead wire that carries electricity from one place to another. For example, the line between two pylons.
Corona Discharge	An electrical discharge caused by the ionisation of fluid such as air surrounding a conductor carrying a high voltage. It represents a local region where the air (or other fluid) has undergone electrical breakdown and become conductive. A corona occurs at locations where the strength of the electric field (potential gradient) around a conductor exceeds the dielectric strength of the air.
Decibel (dB)	Unit for measuring sound levels.
Environmental Statement (ES)	The main output from the EIA process, an ES is the report required to accompany an application for development consent (under the Infrastructure Planning (EIA) Regulations 2017) to inform public and stakeholder consultation and the decision on whether a project should be allowed to proceed. The EIA Regulations set out specific requirements for the contents of an ES for Nationally Significant Infrastructure Projects.
Equivalent Continuous Sound Level (Leq)	Equivalent continuous sound level is a notional steady sound level that causes the same A-weighted sound energy to be received as that due to the actual and possibly fluctuating sound over a period of time T. It can also be used to relate periods of exposure and noise level. For example, halving or doubling the period of exposure is equivalent in sound energy to a decrease or increase of 3dB(A) in the sound level for the original period.
Frequency Weighting Networks	Frequency weighting networks, which are generally built into sound level meters, attenuate the signal at some frequencies and amplify it at others. The A-weighting network approximately corresponds to human frequency response to sound. Sound levels measured with the Aweighting network are expressed in dB(A). Other weighting networks also exist, such as C-weighting which is nearly linear (i.e. unweighted) and other more specialised weighting networks. Variables such as Lp and Leq that can be measured using such weightings are expressed as LpA / LpC, LAeq / LCeq etc.
Insulator	Used to attach the conductors to the pylons preventing electrical discharge to the steelwork.
$L_{Aeq,T}$	The A-weighted L_{eq} sound level measured over a specified period of time, T.

Term	Definition
Lowest Observed Adverse Effect Level	This is the level of noise above which adverse effects on health and quality of life can be detected.
No Observed Effect Level	This is the noise level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.
Noise	Unwanted sound.
Noise and vibration sensitive receptor (NSR)	A location that is sensitive to noise and/or vibration. The sensitivity of a receptor to noise and vibration varies depending on the receptor type.
Overhead Line	Conductor (wire) carrying electric current, strung from pylon to pylon.
Overhead line refurbishment	Repair and renewal of conductors, earthwire, fittings and insulators and, where necessary, remedial works to the pylon and foundations.
Pylons	Structures that support the overhead line (conductors). There are two types of pylons; suspension (line), where the conductors are simply suspended from the tower and tension (angle).
Rating Level	The A-weighted, L_{eq}, sound pressure level of the sound in question at the assessment location over time period T, adjusted for any tonal character and impulsiveness.
Receptor	The physical resource or user group that would respond to an effect e.g. somebody or something adversely affected by a pollutant.
Sensitivity	A term applied to specific receptors, combing judgements of the susceptibility of the receptors to the specific type of change or development proposed and the value related to that receptor.
Significance	A measure of the importance or gravity of the environmental effect, defined by significance criteria specific to the environmental topic.
Significant observed adverse effect level (SOAEL)	This is the level of noise above which significant adverse effects on health and quality of life occur.
Sound	Sound is vibrations travelling through a medium (usually air) that the can be perceived by the hearing organs.

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British Standard Institution (2014) *BS 8233:2014 Guidance on sound insulation and noise reduction for buildings*

Department for Energy & Climate Change (2023) *National Policy Statement for Electrical Networks Infrastructure (EN-5).*

National Grid (2021) *National Grid Policy Statement PS(T)134 - Operational Audible Noise Policy for Overhead Lines*

National Grid (2021a) *National Grid Technical Report TR(E)564 - Development of Method for Assessing the Impact of Noise from Overhead Lines (New Build, Reconductoring, Diversion and Uprating)*

National Grid (2021b) *National Grid Technical Guidance Note TGN(E)322 - Operational Audible Noise Assessment Process for Overhead Lines (New Build, Reconductoring, Diversion and Uprating)*

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