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Bramford to Twinstead Reinforcement

Volume 6: Environmental Information

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nationalgrid

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1. Introduction

1.1 Overview

1.1.1 National Grid Electricity Transmission plc (here on referred to as National Grid) is making an application for development consent to reinforce the transmission network between Bramford Substation in Suffolk, and Twinstead Tee in Essex. The Bramford to Twinstead Reinforcement ('the project') would be achieved by the construction and operation of a new electricity transmission line over a distance of approximately 29km (18 miles), the majority of which would follow the general alignment of the existing overhead line network.

1.1.2 The reinforcement would include approximately 18km of overhead line (consisting of approximately 50 new pylons, and conductors). It is assumed that this reinforcement would operate at least 400kV in a similar way to the majority of the rest of the transmission network. For the purposes of this report, the new overhead line is referenced as 'proposed 400kV overhead line' to differentiate it from the existing 400kV overhead line and the UK Power Networks (UKPN) owned 132kV overhead line.

1.1.3 This Environmental Statement (ES) appendix 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.

1.1.4 Operational noise from the overhead lines was scoped out of the assessment at the scoping stage 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 lattice pylons for reducing operational noise (embedded measure EM-P03). 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.

1.1.5 The Scoping Report (**application document 6.5.1**) 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 Scoping Opinion (**application document 6.6**) in ID 4.9.2, 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 Scoping Report (**application document 6.5.1**).

1.1.6 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.

1.1.7 This appendix relates only to the overhead line sections of the proposed reinforcement. 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 4.9.2 in the Scoping Opinion (**application document 6.6**). ES Appendix 14.4: Grid Supply Point Substation Noise Assessment (**application document 6.3.14.4**) provides the evidence to support scoping out operational noise from the proposed grid supply point substation.

1.2 Structure of this Appendix

1.2.1 This Appendix presents the results of the assessment to demonstrate that the overhead lines would not result in significant noise levels. Chapter 2 of this appendix presents background assumptions and the existing policy and guidance that applies to designs of overhead lines. Chapter 3 presents the assessment and Chapter 4 presents the conclusions of the assessment.

2. Background

2.1 Noise from Overhead Line

2.1.1 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 20kV/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.

2.1.2 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.

2.2 Embedded Measures

2.2.1 National Grid has embedded 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 400kV 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 12kV/cm when operated at 400kV. 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 400kV overhead line during operation.

2.3 National Grid Technical Guidance

2.3.1 National Grid has a suite of documents relating to the management of audible noise from its overhead lines. These documents are described in Table 22.1.

Table 22.1 – National Grid Technical Guidance Documents

Document	Description
Policy Statement PS(T)134 - Operational Audible Noise Policy for Overhead Lines (National Grid, 2021e)	Applies to environmental noise due to the operation of new overhead lines, reconductoring, diversion and uprating projects for overhead lines operated at 275kV and 400kV. The policy describes a three-tier assessment process and sets noise impact criteria against which predicted levels of noise from operational overhead lines can be assessed.
Technical Report TR(E)564 - Development of Method for Assessing the Impact of Noise from	Explains how the noise criteria presented in PS(T)134 were developed, taking into account the UK noise policy context and

Document	Description
Overhead Lines (New Build, Reconductoring, Diversion and Uprating) (National Grid, 2021f)	UK national and international guidance, including World Health Organisation guidelines and evidence for health effects.
Technical Guidance Note TGN(E)322 - Operational Audible Noise Assessment Process for Overhead Lines (New Build, Reconductoring, Diversion and Uprating) (National Grid, 2021g)	Provides guidance on the practical implementation of PS(T)134 and on noise impact and significance of effect for EIA submitted as part of development consent order applications.

2.3.2 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.

2.3.3 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 +3dB 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' (here on referenced as 'BS 4142:2014'), which takes account of acoustic features by applying a character correction to the specific sound level to calculate a BS 4142 rating level.

2.3.4 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; and
- **Tier 3**: Full assessment following the principles of BS 4142:2014 for both wet noise and dry noise.

2.3.5 Noise criteria have been set taking account of the UK policy context and evidence from multiple sources, including the World Health Organisation and BS 4142:2014, 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.

3. Assessment

3.1 Tier 1 Assessment for Proposed 400kV Overhead Lines

Tier 1 Assessment Criteria

3.1.1 The Tier 1 Assessment criteria set out in PS(T)134 are shown in Table 3.1. The 'No Adverse Impact' criteria applicable to residential NSR for worst-case wet weather noise is 34dBA. In the case of the Tier 1 assessment, this is a rating level which includes a +6dB 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 5dB 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 5dB higher.

Table 3.1 – Tier 1 Noise Impact Criteria (Wet Noise), from PS(T)134

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

3.1.2 For the purposes of the Tier 1 assessment, 34dBA 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 29dBA.

Tier 1 Wet Noise Prediction

3.1.3 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.

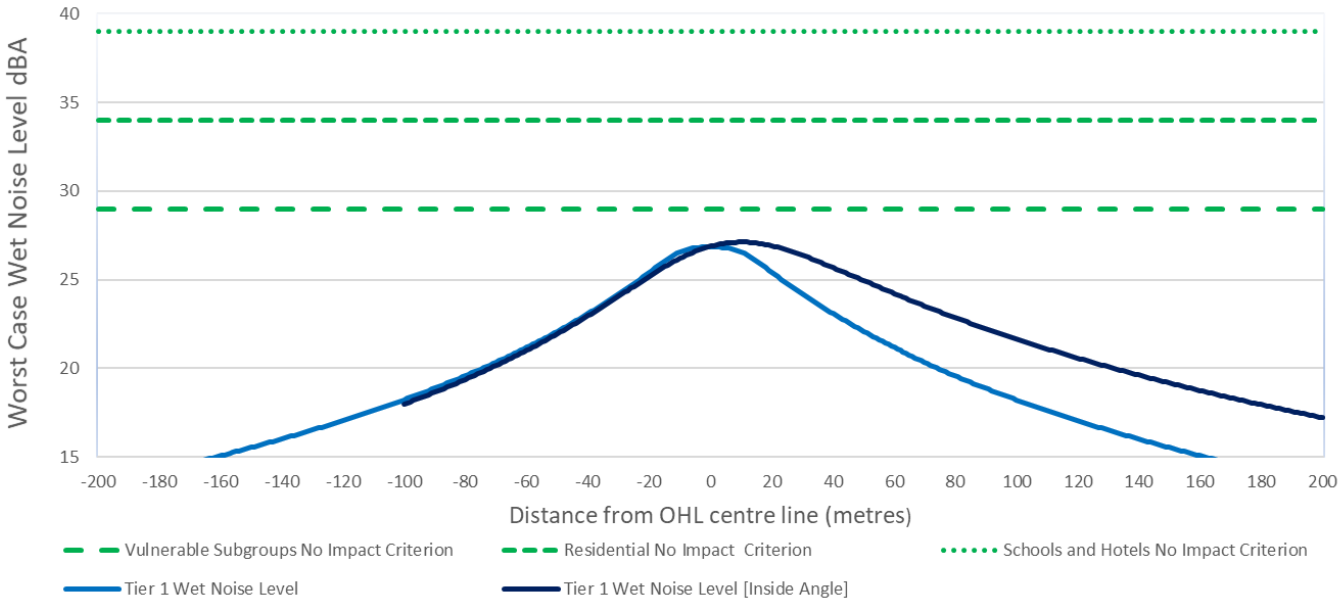
3.1.4 Overhead line noise source prediction is calculated by EFC 400 using the internationally recognised Electrical Power Research Institute method. Propagation either side of a modelled line is calculated according to ISO 9613-2 'Acoustics – Attenuation of sound during propagation outdoors'. Modelling assumptions include:

- A normalised wet noise third octave spectrum which contains 'hum' at 100Hz and 200Hz, harmonics of the electricity supply frequency of 50Hz
- Air temperature = 10˚C
- Relative humidity = 90%
- Downwind propagation
- Porous ground = 1.0

3.1.5 Illustration 3.1 shows the predicted worst-case wet noise levels at distances up to 200m either side of the proposed overhead line centreline. 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.

3.1.6 Illustration 3.1 also shows the Tier 1 No Adverse Impact assessment criteria for each of the three NSR groups (green dashed lines).

Illustration 3.1 – EFC-400 Wet Noise Prediction for Proposed Overhead Line (Tier 1 Screening)



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

3.1.8 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.

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

3.1.10 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.

3.1.11 Operational noise from the proposed 400kV 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.

3.2 Overhead Line Fixtures and Fittings

3.2.1 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.

3.2.2 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.

3.2.3 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.

4. Conclusion

4.1.1 This appendix presents the technical background to demonstrate that operational audible noise from the proposed 400kV 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.

4.1.2 National Policy Statement for Electricity Networks Infrastructure (EN-5) includes Section 2.9, which deals with noise and vibration. Paragraphs 2.9.8 to 2.9.13 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 measure (EM-P03) 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; and
- Use of tested and type-registered fixtures and fittings.

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