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11C Operational Noise Assessment

National Grid (Richborough Connection Project) Order

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Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 and
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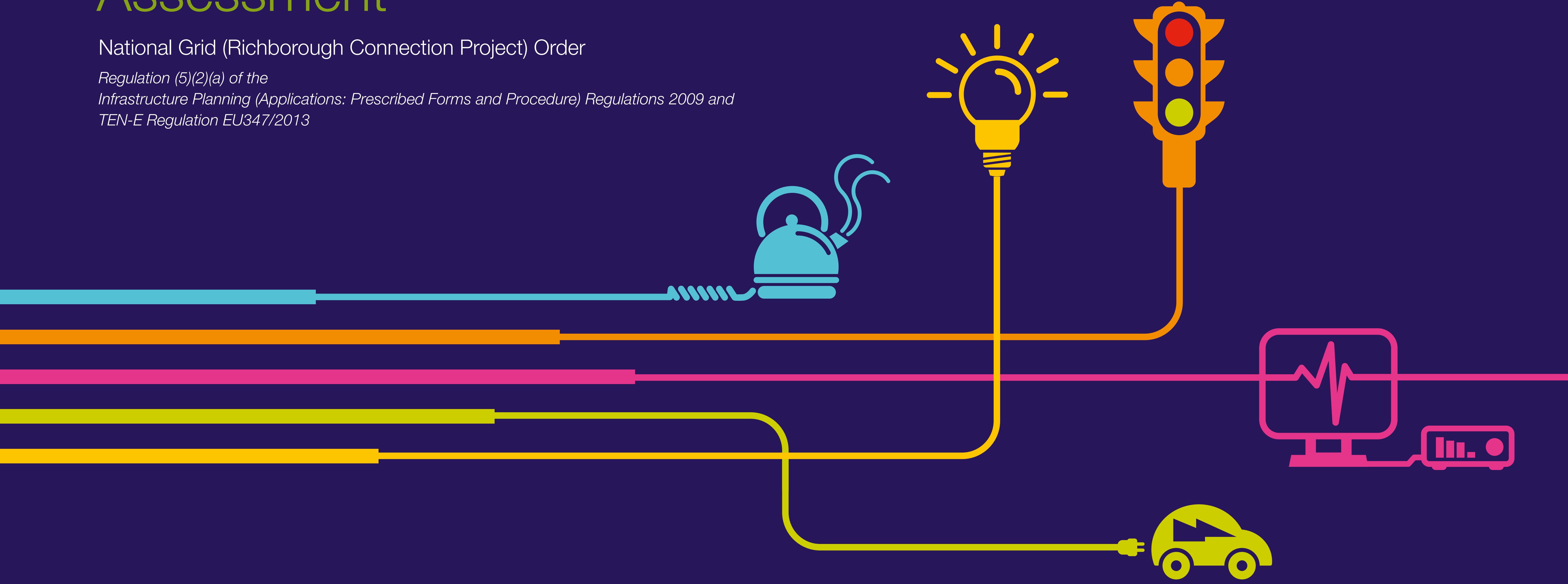

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Richborough Connection Project

Volume 5

5.4 Environmental Statement Appendices

5.4.11C Operational Noise Assessment

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1. OPERATIONAL NOISE ASSESSMENT

1.1 Introduction

1.1.1 Noise from overhead line conductors can be categorised into two types: noise in dry weather (dry noise) which is usually heard as an intermittent or continuous ‘crackle’ from specific points on the conductor, and noise in wet weather (wet noise), usually heard as semi-continuous or continuous ‘crackle’ or ‘fizz’, and under heavier rainfall conditions a low frequency ‘hum’. Noise is produced by “corona discharge” on the surface of the conductors. The effect of the audible noise reduces with distance from the overhead line, and the magnitude of effect will also depend upon the existing levels of background noise in the area. A summary of overhead line noise and the assessment of its impact and significance are described in **Volume 5, Document 5.2, Chapter 11: Noise and Vibration**.

1.1.2 The principal factor affecting conductor noise is conductor surface electrical stress, which itself is a function of operating voltage and physical line configuration. The level of noise can vary depending on weather (principally rainfall) and the surface condition of the conductors (surface contamination). The prediction of noise therefore requires a number of assumptions to be made in order for an assessment of potential noise effects to be made. National Grid uses an in-house method, described in internal report TR(T)94[1] and referenced in NPS EN-5[2], which follows the principles of BS4142 (1990)[3] for dry noise and describes a method for predicting and assessing wet noise. BS4142:1990 has been replaced by BS4142:2014[4], however NPS EN5 recommends using TR(T)94 as a suitable noise assessment method to deal with rain-induced noise. Other methods are available, but these have been developed for systems other than the UK transmission network, and are not thought to give as accurate a result for UK operating and weather conditions.

1.1.3 The National Grid method is based on empirical electrical stress data and measured noise data from selected twin-bundle 400kV overhead lines. The data produced is essentially a time-weighted average noise level for overhead line noise; lines will usually operate quietly under certain (usually dry) conditions and may be noisier under other conditions (usually heavy rainfall).

1.1.4 The model in TR(T)94 was developed with measured data from in service twin aluminium steel reinforced conductor (ACSR) (28.6mm diameter) and twin all aluminium alloy conductor (AAAC) (31.5mm diameter) systems on a range of lattice pylon types. These conductor systems are inherently noisier (due to much higher surface electrical stresses) than that proposed for Richborough. It is therefore necessary to assume extrapolation of the assessment method to other conductor

[1] Technical Report TR(T)94, Issue 1, October 1993. A Method for Assessing the Community Response to Overhead Line Noise, National Grid

[2] NPS EN-5, ‘National Policy Statement for Electricity Networks Infrastructure (EN-5), Department of Energy & Climate Change, 2011

[3] BS4142:1990 ‘Method for rating industrial noise affecting mixed residential and industrial areas’ British Standards Institution, 1990

[4] BS4142:2014 ‘Methods for rating and assessing industrial and commercial sound’. British Standards Institution, 2014.

systems with lower electrical stresses is valid and because of this, prudent modelling data has been selected to ensure the assessment is conservative.

1.1.5 The method does not predict how a particular individual may perceive noise from an overhead line, instead it produces rating levels which can then be compared to significance criteria to assess the effect on populations of people living within approximately 300m either side of the overhead line. In order to ensure that the predicted impact is conservative, the BS4142 (2014) dry noise assessment is carried out relative to measured night-time (i.e. lowest) background noise levels, while the wet noise assessment assumes a rate of rainfall sufficient to induce 'hum' on the overhead line and also a ground terrain that produces minimal masking due to the noise of rainfall on the ground. Both dry and wet noise assessments include a +6dB penalty to account for character in the noise in accordance with the principles of BS4142 (2014).

1.2 Richborough Connection project details

1.2.1 It is proposed to construct a new 400kV overhead line with a conductor system comprised of twin 33mm diameter AAAC, spaced 400mm apart. The conductor system geometry in this assessment is based on National Grid standard construction, updated with specific data for the Richborough Connection project provided by the project design team. The project design ground clearance of 14.7m average span height has been applied to the standard lattice pylons through Sections A, B and C[5], whilst the project design ground clearance of 13.6m average span height has been applied to the low height lattice pylons through Section D. These average ground clearances are considered a typical worst case for normal operating conditions.

1.2.2 For the wet noise assessment it is assumed that an average of 600mm of rain falls over <450 hours per year for the whole project area. This is based upon recent rainfall data provided to National Grid by the Met Office for the period 2001-2010 (see **section 1.4 within this document and Appendix 11D within Volume 5, Document 5.4.11D**). From this data it can be assumed that wet weather conditions will be present for approximately 5% of the year.

[5] The overhead line route is broken down into four geographical sections; A, B, C and D running west to east from Canterbury to Richborough.

1.3 Overhead line noise prediction method

1.3.1 The noise prediction methodology is carried out in three steps:

1.3.2 Step 1: Calculation of conductor surface electrical stress:

- Expressed in kV/cm, conductor surface electrical stress is the principal factor which determines the likelihood that the principal source of noise, corona discharge, can occur when contamination or rain drops impinge on the surface of the conductor. The lower the electrical stress, the quieter the overhead line is likely to be. Conductor surface electrical stress is determined by the line voltage (in this case 400kV), the size (diameter) of the conductors, the number of conductors per bundle and the geometry of the pylon .
- The input factors for the electrical stress calculation are: line voltage, pylon geometry (including height and arrangement of cross arms), conductor radius, bundle geometry and electrical phasing arrangement.

1.3.3 Step 2: Calculation of a sound pressure level at 1.5m from the conductor bundle surface:

- The National Grid model calculates an A-weighted sound pressure level [dB(A)] at 1.5 metres from the surface of each conductor bundle, corrected with a +5dB penalty for character of the noise source. This produces twelve values: six corrected sound pressures for dry noise and six for wet noise. These values have been used as inputs into the CadnaA model where an additional +1dB penalty has been added to account for the character of the noise, giving a full +6dB penalty in line with BS4142 (2014). The CadnaA noise contour plots are shown in **Appendix 11E within Volume 5, Document 5.4.11E**.
- The input factors for the calculation of the corrected sound pressure level are: conductor radius, the averaged maximum conductor surface electrical stress (Emax) for each bundle calculated in step 1, and a 'k factor' which describes the skew of the stress profile around the conductors.

1.3.4 Step 3: Calculation of dry noise and wet noise assessment levels at distances from the line.

- The National Grid model includes a basic noise propagation model which accounts for the attenuation of noise over distance and absorption in the air. The noise contour plots shown in **Appendix 11E within Volume 5, Document 5.4.11E** are produced with the propagation model used in CadnaA, which is compliant with ISO 961 3-2. The two propagation models produce consistent results.
- For dry noise, a free-field BS4142 (2014) type assessment level is calculated at various distances from the line. The assessment level can be positive or negative, depending on the noise level from the line compared to the prevailing background noise level without the line. It is possible to report the result as a rating level (dB $L_{Ar,Tr}$) by adding the assessment level to the background noise level.
- The input values for this are the output values of step 2, a selected background noise level (dB L_{A90}), and the distance in metres to the receiver being assessed.

- For wet noise, additional input information includes the typical annual rainfall rate (mm per year and number of hours of rainfall) and information on the ground terrain near the receiver, which provide an estimate of the increase in background noise due to the noise of rain falling on the ground. This information can be represented as "Miller curves"[6]. The calculated assessment value is the predicted difference in noise level in rain including the presence of the line compared to the noise level in the rain without the line and is always a positive figure.

1.3.5 The electrical stress values and corrected sound pressure values calculated in steps 1 and 2 for the two proposed overhead line configurations for the Richborough Connection project are summarised in Table 11C.1.1 below.

Table 11C.1.1 Conductor surface electrical stress and predicted source rating level (sound pressure level + 6dB character penalty)

Pylon Type	Maximum Conductor Surface Electrical Stress (AAAC 2 x 33mm diameter) (Emax) kV/cm	Dry Noise Rating Level at 1.5m from each Conductor Bundle (dBA)	Wet Noise Rating Level at 1.5m from each Conductor Bundle (dBA)
Standard lattice	16.3	Top: 34.8, 34.8 Middle: 36.5, 36.5 Bottom: 36.8, 36.8	Top: 50.4, 50.4 Middle: 52.1, 52.1 Bottom: 52.4, 52.4
Low height lattice	16.7	Top: 32.0, 32.0 Outer: 37.4, 37.4 Inner: 37.9, 37.9	Top: 47.6, 47.6 Outer: 53.0, 53.0 Inner: 53.5, 53.5

1.3.6 The sound level values calculated above can then be used in a sound propagation model to calculate the relevant assessment levels at various distances from the line.

1.3.7 The dry noise assessment levels are consistent with BS4142 (2014) and hence can be compared to the assessment method values presented in section 11 of BS4142 (2014). BS4142 (2014) describes a method for rating and assessing sounds of an industrial and/or commercial nature. BS4142 (2014) states that typically the greater the difference between the background sound level and rating level, the greater the magnitude of the impact, a difference of around +10dB or more is likely to be an indication of a significant adverse effect (depending on the context), a difference of

[6] Miller Curves 'Sound Levels of Rain and Wind in the Trees', Noise Control Engineering Vol 11, No 3, Miller L N. 1978

around +5dB is likely to be an indication of an adverse effect (depending on the context), the lower the rating level is relative to the background sound level, the less likely it is that the specific sound will have an adverse or significant adverse effect and 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.

1.3.8 The wet noise assessment levels represent the predicted time weighted change (increase) in noise levels near the overhead line in wet weather. (Wet weather noise will vary with rainfall rate and hence is not a single number.) The method assumes the rate of rainfall to be 1mm/hr, which represents a 'worst case' assessment, as at this intensity of rainfall the greatest difference exists between the background noise due to rain and noise due to the overhead line. The noise change can be used to calculate an equivalent rating level for wet noise.

1.3.9 It is important to understand that overhead line noise and background noise levels can vary hence the assessment describes typical conditions, time-weighted average noise levels and typical rainfall rates.

1.4 Wet weather data

1.4.1 The Met Office has recently reviewed its rainfall intensity and rainfall duration data for the period 2001 to 2010 on behalf of National Grid and has produced the charts shown in **Appendix 11D within Volume 5, Document 5.4.11D**. From these charts it can be seen that the typical rainfall rate in the project area falls in the range 500 to 600 mm over <450 hours. The selected rainfall rate for the wet noise modelling for the Richborough Project is 600mm falling over 450 hours.