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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 This appendix, detailing construction noise and vibration data, has been produced to support the application for development consent and the accompanying Environmental Statement (ES) under the Planning Act 2008.

2. Construction Noise and Vibration Data

2.1 Construction Noise

- 2.1.1 The construction noise assessment has been undertaken with reference to the methods and empirical data outlined in British Standard (BS) 5228:2009+A1:2014 Part 1 (British Standards Institution, 2009), here on referred to as 'BS 5228-1'.
- 2.1.2 Indicative construction plant and data associated with each proposed construction activity is provided in Table 2.1. The table provides the average expected sound power level for each activity and includes likely attenuation provided by best practicable means (BPM) to reduce noise with the exception of screening, which is considered on a case by case basis in ES Chapter 14: Noise and Vibration (**application document 6.2.14**).
- 2.1.3 Table 2.1 provides indicative construction noise levels over a range of distances and Table 2.2 shows how noise levels reduce with distance. Indicative distances within which Significant Observed Adverse Effect Levels (SOAEL) may be exceeded during daytime, evenings and weekends, and night-time periods are provided in Table 2.3. Indicative distances within which Lowest Observed Adverse Effect Levels (LOAEL) may be exceeded during daytime and night-time periods are provided in Table 2.4.

Table 2.1 – Construction Activity Plant and Noise Data

| Activity | Plant Item | Number of Plant Items | BS 5228-1 Ref | % On-time | A-weighted Sound Pressure Level at 10m, dBA | Assumed Attenuation due to Embedded BPM, dB | Average Activity Sound Power Level, dBA |
|---|------------------------|-----------------------|---------------|-----------|---|---|---|
| General Works | | | | | | | |
| Site preparation | Tracked excavator | 2 | C2.7 | 70 | 70 | 0 | 107 |
| | Dozer | 3 | C2.1 | 70 | 75 | 0 | |
| Top soil strip | Tracked excavator | 2 | C2.7 | 70 | 70 | 0 | 107 |
| | Dozer | 3 | C2.1 | 70 | 75 | 0 | |
| Temporary access route | Wheeled backhoe loader | 1 | C2.8 | 70 | 68 | 0 | 107 |
| | Dumper | 2 | C4.4 | 70 | 76 | 0 | |
| | Vibratory roller | 1 | C2.40 | 70 | 73 | 0 | |
| Temporary Construction Compounds | | | | | | | |
| Site preparation | Tracked excavator | 2 | C2.7 | 70 | 70 | 0 | 107 |
| | Dozer | 3 | C2.1 | 70 | 75 | 0 | |
| Road construction | Dumper | 3 | C4.4 | 70 | 76 | 0 | 110 |
| | Road Roller | 1 | C5.19 | 70 | 80 | 0 | |
| Compound buildings | Telehandler | 2 | C4.55 | 50 | 70 | 0 | 98 |
| | Generator | 2 | C3.33 | 100 | 57 | 10 | |
| Compound operation | Lorry | 1 | C2.34 | 25 | 80 | 0 | 104 |

| Activity | Plant Item | Number of Plant Items | BS 5228-1 Ref | % On-time | A-weighted Sound Pressure Level at 10m, dBA | Assumed Attenuation due to Embedded BPM, dB | Average Activity Sound Power Level, dBA |
|---------------------------------------|------------------------------|-----------------------|----------------|-----------|---|---|---|
| | Telehandler | 2 | C4.55 | 50 | 70 | 0 | |
| | Generator | 2 | C3.33 | 100 | 57 | 10 | |
| Overhead Line Removal | | | | | | | |
| Site preparation | Tracked excavator | 1 | C2.7 | 90 | 70 | 0 | 98 |
| Breaking up concrete | Excavator mounted pulveriser | 2 | C1.5 | 50 | 72 | 0 | 100 |
| Dumping brick rubble | Tracked excavator | 1 | C1.10 | 10 | 85 | 0 | 103 |
| Breaking up/ cutting steel | tracked excavator | 1 | C1.16 | 25 | 82 | 0 | 104 |
| Overhead Line Construction | | | | | | | |
| Pylon construction | Tracked excavator | 1 | C2.7 | 70 | 70 | 0 | 111 |
| | Steel tube piling rig | 1 | C3.8 | 25 | 88 | 0 | |
| | Concrete pump | 1 | C3.26 | 50 | 75 | 0 | |
| Pylon Assembly | Telehandler | 1 | C4.55 | 50 | 70 | 0 | 95 |
| Pylon installation | Crane lifting pylon | 1 | C4.46 | 10 | 67 | 0 | 85 |
| Cable tensioning | Winder | 1 | Suppliers data | 60 | 77 | 0 | 106 |
| | Rear Winder | 1 | Suppliers data | 60 | 77 | 0 | |
| Underground Cable Construction | | | | | | | |
| Trenching | Tracked excavator | 1 | C2.7 | 70 | 70 | 0 | 97 |

| Activity | Plant Item | Number of Plant Items | BS 5228-1 Ref | % On-time | A-weighted Sound Pressure Level at 10m, dBA | Assumed Attenuation due to Embedded BPM, dB | Average Activity Sound Power Level, dBA |
|----------------------|----------------------------------|-----------------------|---------------|-----------|---|---|---|
| | Tracked mobile crane | 1 | C3.28 | 25 | 67 | 0 | |
| | Sheet piling (hydraulic jacking) | 1 | C3.11 | 25 | 59 | 0 | |
| | Power pack | 1 | C3.12 | 100 | 63 | 10 | |
| Lower and lay | Side boom | 3 | C3.28 | 25 | 67 | 0 | 95 |
| | Water pump | 1 | C2.46 | 100 | 62 | 10 | |
| | Wheeled backhoe loader | 1 | C2.8 | 25 | 68 | 0 | |
| Backfill trench | Wheeled backhoe loader | 1 | C2.8 | 70 | 68 | 0 | 104 |
| | Tracked excavator | 1 | C2.7 | 70 | 70 | 0 | |
| | Dumper | 2 | C4.4 | 25 | 76 | 0 | |
| | Vibratory roller | 2 | C2.40 | 10 | 73 | 0 | |
| Reinstatement | Wheeled backhoe loader | 1 | C2.8 | 70 | 68 | 0 | 100 |
| | Dumper | 1 | C4.4 | 25 | 76 | 0 | |
| Transition joint pit | Generator | 3 | C3.33 | 100 | 57 | 10 | 104 |
| | Welder | 3 | C3.31 | 25 | 73 | 0 | |
| | Grinder | 2 | C4.93 | 10 | 80 | 0 | |
| | Side boom | 1 | C3.28 | 25 | 67 | 0 | |
| Cable pulling | Conveyor drive unit | 1 | C10.21 | 50 | 76 | 0 | 101 |

| Activity | Plant Item | Number of Plant Items | BS 5228-1 Ref | % On-time | A-weighted Sound Pressure Level at 10m, dBA | Assumed Attenuation due to Embedded BPM, dB | Average Activity Sound Power Level, dBA |
|--|----------------------|-----------------------|---------------|-----------|---|---|---|
| | Field Conveyor | 2 | C10.23 | 50 | 53 | 0 | |
| Horizontal directional drilling | Directional drilling | 1 | C2.44 | 70 | 77 | 0 | 104 |
| | Tracked excavator | 1 | C2.7 | 50 | 70 | 0 | |
| | Water pump | 2 | C2.46 | 100 | 62 | 10 | |
| Cable Sealing End (CSE) Compound Construction | | | | | | | |
| Site preparation | Tracked excavator | 2 | C2.7 | 70 | 70 | 0 | 107 |
| | Dozer | 3 | C2.1 | 70 | 75 | 0 | |
| CSE assembly | Telehandler | 2 | C4.55 | 70 | 70 | 0 | 100 |
| | Generator | 2 | C3.33 | 100 | 57 | 10 | |
| Grid Supply Point (GSP) Substation Construction | | | | | | | |
| Site preparation | Tracked excavator | 2 | C2.7 | 70 | 70 | 0 | 107 |
| | Dozer | 3 | C2.1 | 70 | 75 | 0 | |
| Substation assembly | Telehandler | 2 | C4.55 | 50 | 70 | 0 | 110 |
| | Generator | 2 | C3.33 | 100 | 57 | 10 | |
| | Vibratory piling rig | 1 | C3.8 | 25 | 88 | 0 | |

Table 2.2 – Construction Activity Noise Levels Over Distance

| Activity | Average Activity Sound Power Level, dBA | Sound Pressure Level, dBA, at Distance, m | | | | | | |
|---|---|---|----|----|-----|-----|-----|--|
| | | 10 | 25 | 50 | 100 | 200 | 300 | |
| General Works | | | | | | | | |
| Site preparation | 107 | 82 | 74 | 68 | 62 | 56 | 53 | |
| Top soil strip | 107 | 79 | 71 | 65 | 59 | 53 | 50 | |
| Temporary access routes | 107 | 79 | 71 | 65 | 59 | 53 | 49 | |
| Temporary Construction Compounds | | | | | | | | |
| Site preparation | 107 | 82 | 74 | 68 | 62 | 56 | 53 | |
| Road construction | 110 | 85 | 77 | 71 | 65 | 59 | 55 | |
| Compound buildings | 98 | 73 | 65 | 59 | 53 | 47 | 43 | |
| Compound operation | 103 | 78 | 70 | 64 | 58 | 52 | 49 | |
| Overhead Line Removal | | | | | | | | |
| Site preparation | 98 | 73 | 65 | 59 | 53 | 47 | 43 | |
| Breaking up concrete | 100 | 75 | 67 | 61 | 55 | 49 | 45 | |
| Dumping brick rubble | 103 | 78 | 70 | 64 | 58 | 52 | 48 | |
| Breaking up/cutting steel | 104 | 79 | 71 | 65 | 59 | 53 | 49 | |
| Overhead Line Construction | | | | | | | | |
| Pylon construction | 111 | 86 | 78 | 72 | 66 | 60 | 56 | |

| Activity | Average Activity Sound Power Level, dBA | Sound Pressure Level, dBA, at Distance, m | | | | | |
|---------------------------------------|---|---|----|----|-----|-----|-----|
| | | 10 | 25 | 50 | 100 | 200 | 300 |
| Pylon assembly | 95 | 70 | 62 | 56 | 50 | 44 | 40 |
| Pylon installation | 85 | 60 | 52 | 46 | 40 | 34 | 30 |
| Cable tensioning | 106 | 81 | 73 | 67 | 61 | 55 | 51 |
| Underground Cable Construction | | | | | | | |
| Trenching | 97 | 72 | 64 | 58 | 52 | 46 | 43 |
| Lower and lay | 95 | 70 | 62 | 56 | 50 | 44 | 41 |
| Backfill trench | 103 | 78 | 71 | 64 | 58 | 52 | 49 |
| Reinstatement | 100 | 75 | 67 | 61 | 55 | 49 | 45 |
| Transition joint pit | 104 | 79 | 71 | 65 | 59 | 53 | 49 |
| Cable pulling | 101 | 76 | 68 | 62 | 56 | 50 | 46 |
| Horizontal directional drilling | 104 | 79 | 71 | 65 | 59 | 53 | 50 |
| CSE Compound Construction | | | | | | | |
| Site preparation | 107 | 82 | 74 | 68 | 62 | 56 | 53 |
| CSE assembly | 99 | 74 | 67 | 61 | 54 | 48 | 45 |
| GSP Substation Construction | | | | | | | |
| Site preparation | 107 | 82 | 74 | 68 | 62 | 56 | 53 |
| Substation assembly | 110 | 85 | 77 | 71 | 65 | 59 | 56 |

Table 2.3 – Construction Activity Noise SOAEL Distances

| Activity | Average Activity Sound Power Level, dBA | Distance Within Which SOAEL May Be Exceeded, m | | |
|---|---|--|-------------------------------|---------------------|
| | | Daytime (65dBA) | Evenings and Weekends (55dBA) | Night-time (45 dBA) |
| General Works | | | | |
| Site preparation | 107 | 71 | 225 | 712 |
| Top soil strip | 107 | 71 | 225 | 712 |
| Temporary access routes | 107 | 68 | 216 | 684 |
| Temporary Construction Compounds | | | | |
| Site preparation | 107 | 71 | 225 | 712 |
| Road construction | 110 | 98 | 311 | 984 |
| Compound buildings | 98 | 25 | 80 | 252 |
| Compound operation | 103 | 47 | 149 | 471 |
| Overhead Line Removal | | | | |
| Site preparation | 98 | 24 | 75 | 238 |
| Breaking up concrete | 100 | 32 | 100 | 316 |
| Dumping brick rubble | 103 | 45 | 141 | 447 |
| Breaking up/cutting steel | 104 | 50 | 158 | 500 |
| Overhead Line Construction | | | | |
| Pylon construction | 111 | 107 | 338 | 1067 |

| Activity | Average Activity Sound Power Level, dBA | Distance Within Which SOAEL May Be Exceeded, m | | |
|---------------------------------------|---|--|-------------------------------|---------------------|
| | | Daytime (65dBA) | Evenings and Weekends (55dBA) | Night-time (45 dBA) |
| Pylon assembly | 95 | 18 | 56 | 178 |
| Pylon installation | 85 | 6 | 18 | 56 |
| Cable tensioning | 106 | 62 | 195 | 616 |
| Underground Cable Construction | | | | |
| Trenching | 97 | 23 | 73 | 232 |
| Lower and lay | 95 | 19 | 59 | 186 |
| Backfill trench | 103 | 47 | 149 | 472 |
| Reinstatement | 100 | 30 | 95 | 301 |
| Transition joint pit | 104 | 48 | 151 | 479 |
| Cable pulling | 101 | 36 | 113 | 356 |
| Horizontal directional drilling | 104 | 50 | 160 | 505 |
| CSE Compound Construction | | | | |
| Site preparation | 107 | 71 | 225 | 712 |
| CSE assembly | 99 | 30 | 94 | 298 |
| GSP Substation Construction | | | | |
| Site preparation | 107 | 71 | 225 | 712 |
| Substation assembly | 110 | 103 | 325 | 1029 |

Table 2.4 – Construction Activity Noise LOAEL Distances

| Activity | Average Activity Sound Power Level, dBA | Distance Within Which LOAEL May Be Exceeded, m | |
|---|---|--|--------------------|
| | | Daytime (50dBA) | Night-time (40dBA) |
| General Works | | | |
| Site preparation | 107 | 401 | 1267 |
| Top soil strip | 107 | 401 | 1267 |
| Temporary access route | 107 | 385 | 1216 |
| Temporary Construction Compounds | | | |
| Site preparation | 107 | 401 | 1267 |
| Road construction | 110 | 554 | 1751 |
| Compound buildings | 98 | 142 | 449 |
| Compound operation | 103 | 265 | 837 |
| Overhead Line Removal | | | |
| Site Preparation | 98 | 134 | 424 |
| Breaking up concrete | 100 | 178 | 562 |
| Dumping brick rubble | 103 | 251 | 794 |
| Breaking up/cutting steel | 104 | 281 | 889 |
| Overhead Line Construction | | | |
| Pylon construction | 111 | 600 | 1898 |

| Activity | Average Activity Sound Power Level, dBA | Distance Within Which LOAEL May Be Exceeded, m | |
|---------------------------------------|---|--|--------------------|
| | | Daytime (50dBA) | Night-time (40dBA) |
| Pylon assembly | 95 | 100 | 316 |
| Pylon installation | 85 | 32 | 100 |
| Cable tensioning | 106 | 346 | 1095 |
| Underground Cable Construction | | | |
| Trenching | 97 | 130 | 412 |
| Lower and lay | 95 | 105 | 331 |
| Backfill trench | 103 | 265 | 839 |
| Reinstatement | 100 | 169 | 535 |
| Transition joint pit | 104 | 269 | 852 |
| Cable pulling | 101 | 200 | 633 |
| Horizontal directional drilling | 104 | 284 | 897 |
| CSE Compound Construction | | | |
| Site preparation | 107 | 401 | 1267 |
| CSE assembly | 99 | 168 | 530 |
| GSP Substation Construction | | | |
| Site preparation | 107 | 401 | 1267 |
| Substation assembly | 110 | 579 | 1830 |

2.2 Construction Vibration

2.2.1 The construction vibration assessment has been undertaken with reference to the methods and empirical data outlined in BS 5228:2009+A1:2014 Part 2 (British Standards Institution, 2009).

2.2.2 The main significant sources of vibration during construction activities are expected to be ground compaction, and percussive or vibratory piling. These processes may be required during the following activities:

- Ground compaction with vibratory roller:
 - Setup of site compounds;
 - Site preparation;
 - Temporary access route construction; and
 - Cable laying.
- Piling:
 - Pylon foundations;
 - CSE compounds and
 - GSP substation construction.

Prediction of Construction Vibration

2.2.3 Peak particle velocity (PPV) vibration levels in mm/s generated by ground compaction and piling activities can be predicted using the guidance and empirical formulae in Table E1 of BS 5228-2. The formulae are shown below.

Vibratory Roller Calculation Formula

$$v_{res} = k_s \sqrt{n_d} \left[\frac{A}{x+L_d} \right]^{1.5} \quad (\text{Equation 1})$$

Where:

V_{res} = Resultant PPV, in millimetres per second (mm/s)

k_s = Scaling factor (and probability of predicted value being exceeded)

n_d = Number of vibrating drums

A = Maximum amplitude of drum vibration, in millimetres (mm)

x = Distance measured along the ground surface, in metres (m)

L_d = vibrating roller drum width, in metres (m)

Percussive Piling Calculation Formula

$$v_{res} \leq k_p \left[\frac{\sqrt{W}}{r^{1.3}} \right] \quad (\text{Equation 2})$$

Where:

V_{res} = Resultant PPV, in millimetres per second (mm/s)

K_p = Scaling factor (depending on soil conditions)

W = Nominal hammer energy, in joules (J)

r = Slope distance from the pile toe, in metres (m)

Assumptions

2.2.4 The following conservative assumptions have been made to predict vibration levels to assess a reasonable worst-case:

Vibratory Roller assumptions:

Scaling factor of 75, representative of average conditions.

Vibratory roller data based on worst case Bomag BW 213, 1 drum of 2.13m width and maximum amplitude of 1.1mm.

Percussive piling assumptions:

Typical value of nominal hammer energy of 25kJ.

Scaling factor of 1.5 representative of typical soil conditions

Vibration Prediction Results

2.2.5 Equations 1 and 2 have been used to predict the minimum distances within which the vibration threshold values human comfort impacts from vibration in terms of SOAEL and potential cosmetic building damage may be exceeded (1.0mm/s, and 12.5mm/s PPV respectively). The calculated distances in Table 2.5 are used in the preliminary assessment to identify areas where receptors are potentially affected by construction vibration.

Table 2.5 – Indicative Construction Vibration Threshold Distances

| Activity | Distance Within Which LOAEL May Be Exceeded (m) | Distance Within Which SOAEL May Be Exceeded (m) | Distance Within Which Cosmetic Building May Occur (m) |
|-------------------|---|---|---|
| Ground compaction | 45 | 18 | <2 |
| Percussive piling | 170 | 70 | <10 |

National Grid plc
National Grid House,
Warwick Technology Park,
Gallows Hill, Warwick.
CV34 6DA United Kingdom

Registered in England and Wales
No. 4031152
nationalgrid.com