

East Anglia One North and East Anglia Two
SASES (Substation Action Save East Suffolk)
Submission on the Topic of Noise

30 October 2020

1. SUMMARY

Operation

- 1.1 An important feature of these two applications is that two similar substations will be operated near to each other, and the principal sources of noise in each will be transformers and associated equipment in which the acoustic source is the second harmonic of the line frequency. Noise from transformers and many of the other items associated with them is concentrated at the frequency of 100 Hz, and when two sounds of predominantly single frequency are combined, constructive interference occurs in locations where two or more sources are in phase. In such circumstances it is the sound pressures, not the sound intensities that have to be added which results in an increase in noise level of several dB above the result of applying conventional methods for sound sources that are not predominantly single-frequency. The pressure sum of two similar sources results in an increase of 6dB as opposed to 3dB for sources with a random phase relationship which is the commonly used assumption in noise prediction methods.
- 1.2 The ES conclusions, from which the noise limit in the draft DCO has been derived, are based on a background sound level of 29 dBA. It is shown in the Baseline Noise Survey Report that the night-time background is in the low 20s on many occasions and was measured at less than 17 dBA. and on those occasions the tonal noise emitted by transformers will be clearly perceptible, attracting a penalty for tonality of +6dB. The ES also shows, using the same statistical methodology, a background noise level of 25 dBA at one of the closest receptors in the Friston area.
- 1.3 The combined rating level at the specified locations, predicted in the ES for EA1N and EA2 as 30.1 dB(A), will be in excess of the DCO limit of 34 dB(A) with the inclusion of a 6 dB tonal character correction. Where the background is 25 dB(A) there will be a difference between the rating level and the background sound level

of more than +10 dB. The effect of constructive interference would result in a further increase in actual sound level.

- 1.4 The ES predictions make the assumption that mitigation will be included in the form of noise enclosures, particularly for the main transformers, which assumes that they have very high sound insulation performance. Further mitigation, for example enclosure of other sources which predominate over the enclosed transformers, may be difficult to achieve.
- 1.5 Even if the excess above background is reduced by even further mitigation, to achieve compliance with the DCO limit of 34 dB(A), then in locations where the background level is 25 dB(A) or less, the difference between the rating level and the background sound level +9 dB or more.
- 1.6 A difference between the rating level and the background sound level of around +10 dB or more is "an indication of a significant adverse impact" according to BS 4142. EN-1 at 5.11.9 states that significant adverse impacts on health or quality of life should be avoided.
- 1.7 The proposals would be in contravention of the requirements of EN-1.

Construction

- 1.8 The outline Code of Construction Practice (CoCP) is deficient, and this is of great importance since Requirement 22 states that the full CoCP for which approval must be obtained from the local authority must accord with the outline code of construction practice. Consequently it is necessary that matters which are essential for inclusion in the final CoCP should be foreseen in the outline CoCP.
- 1.9 The applicant has stated that the main objectives of the CoCP with regard to managing construction noise are to "Minimise noise and vibration impacts on nearby residents and other sensitive receptors to acceptable levels; and Comply with relevant legislation, requirements, standards and best practice relating to construction noise". As explained below the applicant's stated position, in the Environmental Statement (ES), on what are acceptable levels is based on an erroneous application of the principal standard for construction noise. There is no commitment in the CoCP to employ the best practicable means (BPM) to minimise noise and no commitment to apply for consents under the provision of Section 61 of the Control of Pollution Act 1974 (CoPA). Because of the effective disapplication of Section 82(1) of the Environmental Protection Act 1990(c) (summary proceedings by person aggrieved by statutory nuisance) by 3(7) of each DCO, a person affected by construction noise, in the absence of the use of S60 of CoPA by the local authority, or action by the LA for breach of a CoCP approved pursuant to a requirement of the DCO, has no recourse other than action in Common Law in the High Court. The draft CoCP is seriously deficient as set out below. The Construction noise assessment in the Environmental Statement (ES) contains errors and misstatements which are explained below. Consequently there is no

adequate means of achieving mitigation of the effects of construction noise on people.

2. QUALIFICATIONS EXPERIENCE AND EXPERTISE

- 2.1 This document has been prepared by Rupert Thornely-Taylor of Rupert Taylor Ltd, consultants in acoustics, noise and vibration.
- 2.2 He is a Fellow of, and was a founder member of, the Institute of Acoustics (who in 2016 awarded him the Rayleigh Medal for outstanding contributions to Acoustics), a Fellow of the International Institute of Acoustics and Vibration and a Member of the Institute of Noise Control Engineering of the USA. He has specialised exclusively in the subjects of noise, vibration and acoustics for 56 years. He has been an independent consultant in these subjects for the past 52 years, and heads the Rupert Taylor Ltd consultancy practice.
- 2.3 He is a past President and Honorary Member of the Association of Noise Consultants (who in 2013 awarded him their Outstanding Contribution award).
- 2.4 He has carried out many studies of noise from major infrastructure developments including infrastructure in the electricity supply industry, and been expert witness in well over 100 public inquiries, parliamentary select committees, courts of law, DCO hearings and other tribunals.
- 2.5 He was appointed by SASES in May 2019 to review the application by Scottish Power Renewables and associated environmental information. He has studied noise-sensitive locations in the Friston area which are close to the proposed installations, carried out noise surveys, visited a relevant existing installation and attended a meeting with the planning authority and its noise consultants.

3. SCOPE OF THIS SUBMISSION

- 3.1 This submission concentrates on the effects of noise from the development as it would affect dwellings in the village of Friston. There are dwellings in Friston, such as the noise sensitive receiver location labelled "SSR5 NEW" in the ES, as little as 360m from the southern edge of the indicative boundary of the East Anglia One substation, next to which are the East Anglia TWO and National Grid substations. The receiver location SSR2 is a slightly shorter distance from the eastern edge of both substation sites.

4. THE APPLICANT'S ASSESSMENT

- 4.1 The ES finding for SSR5 NEW (East Anglia ONE North Offshore Windfarm Appendix 25.5 Operational Phase Assessment Environmental Statement Volume 3, 6.3.25.5 Page 10) is that "The assessment indicates a potential for an adverse impact depending on the context". This result is based on the requirement of the draft DCO for EA1N, sections 26 and 27, that stipulates an operational rating noise limit (in accordance with BS4142:2014+A1:2019) of 34dBA at two specified sensitive

receptors close to SSR2 and SSR5. It is to be seen in the context of a calculated rating level for noise from EA1N, assuming zero acoustic feature correction, of 29.4 dBA.

- 4.2 The cumulative assessment for EA1N and EA2 shows that at SSR5 NEW the combined predicted specific sound level (equal to the rating level with zero acoustic feature correction) is 30.1.

5. THE NOISE LIMIT IN THE DCO

- 5.1 The noise limits in Schedule 1 Part 3 sections 26 and 27 of the draft DCO for the East Anglia One North are identical to those in the equivalent sections of the East Anglia TWO draft DCO. They are based on the "statistically repeatable" background noise level reported as having been measured at SSR2 and SSR5 of 29 dBA, plus 5 dBA. It is explained in the ES Chapter 25 paragraph 120 that BS4142:2014+A1:2019 states that "a difference of around +5dB is likely to be an indication of an adverse impact, depending on the context". Paragraph 120 states "Using this principle, a difference in sound level of between +3dBA to +5dBA is detailed as a minor adverse impact." And "The allowance for up to +5dBA above the background level was derived from consideration of the context of the existing environment and the proposed onshore infrastructure in accordance with BS4142:2014+A1:2019." Paragraph 124 explains "For example, although the plant noise may be considered as somewhat different in character to the existing acoustic environment (rural), the operational rating noise limit of 34dBA (post mitigation and compliance with the requirement of the draft DCO) is low and will have little impact on residents using their amenity space during the night time (most sensitive period)."
- 5.2 In the event that the noise from EA1N and EA2 substations on commissioning is found to be at the limit permitted by each DCO, the rating level *at the specified locations* will be 34 dBA. No cumulative assessment including the National Grid Substation has been provided, or been included in the DCO requirements. There is no limit on noise levels at other locations.

6. POLICY REQUIREMENTS

National Noise Policy in England is set out in the Noise Policy Statement for England (NPSE), which is referred to in the National Planning Policy Framework, and further guidance is to be found in the online Planning Practice Guidance. The principles of the NPSE are the basis of the policy on noise contained in the Overarching National Policy Statement for Energy (EN-1), which requires in 5.11.6 and footnote 137 that operational noise, with respect to human receptors, should be assessed using the principles of the relevant British Standards and other guidance for example BS 4142, BS 6472 and BS 8233.

- 6.1 With regard to other guidance, the ES Chapter 25 at paragraph 125 states "The 2018 World Health Organization guidance establishes a 45dB L_{Aeq} external noise

level as desirable.” However, the WHO Environmental Noise Guidelines for the European Region 2018 makes this recommendation with express reference to noise from wind turbines, not from onshore substations.

6.2 The ES makes reference to BS 8233 and in Chapter 25 paragraph 127 states “The proposed draft DCO requirement is considered appropriate as it is considerably below the external recommendation of 45dBA L_{Aeq} detailed in BS8233:2014, in order to achieve a night time internal level of 30dBA, even when relying on openable windows as a means of rapid ventilation.” This is a reference to paragraph 7.7.2 of the Standard. BS 8233 also says in 7.7.1 “This subclause applies to external noise as it affects the internal acoustic environment from sources without a specific character, previously termed ‘anonymous noise’. Occupants are usually more tolerant of noise without a specific character than, for example, that from neighbours which can trigger complex emotional reactions. For simplicity, only noise without character is considered in Table 4. For dwellings, the main considerations are:

- a) for bedrooms, the acoustic effect on sleep; and
- b) for other rooms, the acoustic effect on resting, listening and communicating.

NOTE Noise has a specific character if it contains features such as a distinguishable, discrete and continuous tone, is irregular enough to attract attention, or has strong low-frequency content, in which case lower noise limits might be appropriate.” In the context of noise emitted by factories, BS 8233 states at 7.7.7.3 “Extensive noise control measures might be required, especially if the noise is impulsive, has a strong tonal character, or is otherwise of a distinguishable nature.”

It should be noted that the BS8233 recommendation applied to overall noise levels, i.e. with the background included, and not specific source levels as in BS 4142.

6.3 Under the heading “IPC Decision Making” EN-1 states

“5.11.9 The IPC should not grant development consent unless it is satisfied that the proposals will meet the following aims:

- avoid significant adverse impacts on health and quality of life from noise;
- mitigate and minimise other adverse impacts on health and quality of life from noise; and
- where possible, contribute to improvements to health and quality of life through the effective management and control of noise.

When preparing the development consent order, the IPC should consider including measurable requirements or specifying the mitigation measures to be put in place

to ensure that noise levels do not exceed any limits specified in the development consent.”

7. CRITIQUE OF THE APPLICANT’S ASSESSMENT

Operation

- 7.1 The applicant’s noise prediction is stated as a single number for each location, 30.1 dBA cumulative for EA1N and EA2 for the nearest location in Friston, SSR5 NEW. Table 25.30 of Chapter 25 of each ES shows that it has been assumed that the main transformers will have noise enclosures, and comparison of the sound power levels in Table 25.30 with the spectra in Table 25.32 shows that the assumed performance of the main transformer enclosures is a reduction of 35.5 dB(A). This is a substantial requirement for a low frequency source. Further mitigation, for example enclosure of other sources which predominate over the enclosed transformers, may be difficult to achieve.
- 7.2 After including the benefit of the main transformer (and shunt reactor) enclosures, Table 25.32 shows that the predominant sources are the STATCOM Air Core Reactor, the STATCOM Filter Capacitor Bank and the Harmonic filter. Their spectra are notable for the fact that their A-weighted sound power levels are 78-79 dB at 125Hz and only 42-44 dB in the adjacent frequency bands of 63Hz and 250Hz as a result of the prominence of sound at 100Hz. When the number of units is taken into account the Air Coolers and Main Transformer Forced Cooling Systems are also sources with high sound power levels, and while these do not have peaks in the 125Hz band, they have peaks at higher frequencies which will be reduced more by ground attenuation than will the 100Hz sources, so that they will not have the effect of masking the 100Hz tone at the distance of the relevant receptors.
- 7.3 The predictions are arrived at by combining predictions for each of the two substations, using a standard noise mapping software package which will have produced a power sum of the individual predictions, namely 29.4 dBA for EA1N and 21.8 dB(A) for EA2. This is appropriate when combining two randomly related, incoherent sound sources.
- 7.4 An important feature of these two applications is that two similar substations will be operated near to each other, and the principal source of noise in each will be transformers and other equipment which emit noise containing strong components at the frequency of 100 Hz.
- 7.5 This phenomenon is associated with electrical power installation and is not normally present in other kinds of industrial noise installation. It results in a special case with regard to the combination of noise from more than one source, because depending on exact location, the contributions of separate sources will be in-phase, and this has an important effect on the process of mathematically combining noise levels from different sources. In the normal case, the phase relationship between several sources is random, and combination of sources is

carried out by adding the sound intensities of the individual sources. When two or more sources are in-phase, the sound pressures must be added, and whereas adding the sound intensities of two randomly-related sources results in an increase in sound level in decibels of 3 dB, adding two sound pressure results in an increase in sound level of 6 dB. In locations where this occurs constructive interference is taking place. There will also be locations where the sound waves from each source are in anti-phase, the result of combing their sound pressures is a large reduction due to destructive interference.

- 7.6 A related issue arises with regard to the effect of buildings and rooms, both at the source with regard to transformer enclosures and at the receiver. In rooms with dimensions that are multiples of a half wavelength (approximately 1.68m) standing waves occur which enhance the level of internal noise and both reduce the performance of enclosures and the outside-in-side noise reduction at dwellings. This issue is highlighted in transformer design codes such as Northern Powergrid's document "NSP/007/020 - Guidance on Substation Design: Transformer Noise".
- 7.7 The result of such sound pressure addition will be dependent on location. If the noise sources listed in Table 25.32 of Chapter 25 of the ES are used to predict received sound levels at a distance of 360m, depending on the assumptions about atmospheric conditions the effect of calculating a pressure sum instead of a power sum is an increase of approximately 4 dB(A).
- 7.8 Over a distance of 360m the phase relationships between multiple 100Hz sound waves will depend on the propagation conditions along each source-receiver line. These are not known in sufficient detail to make it possible to predict exactly where the regions of constructive and destructive interference will be. This effect applies to instantaneous sound level and the DCO limit is specified in terms of equivalent continuous sound level, L_{Aeq} , over a period of five minutes. As atmospheric conditions can vary with time, over a long enough period, the degree of interference will vary at each location, and combined sound levels will rise and fall. Over a long enough period, the power sum as used in the ES will result, but it is most unlikely that atmospheric conditions will vary sufficiently over a 5-minute measurement period for prevent interference having its full effect.
- 7.9 The potentially large variation in received sound level with location is of importance given the application of the Requirements 26 and 27 to two fixed locations at specific points. This may have two consequences – firstly one or other of those points may be in a location where constructive interference is occurring so that predicted sound levels are exceeded and the requirement breached, or secondly both locations may be in areas of destructive interference such that compliance is achieved while higher noise levels are affecting people in dwellings at other locations not covered by the Requirements.
- 7.10 Uncertainty in general is only considered with regard to the background measurements "The measurements were taken under repeatable conditions and

the uncertainty in the result will be low" with no consideration of uncertainty in the prediction. According to paragraph 110 of Chapter 25 of Volume 1, the conclusion that there is no acoustic feature correction required is because the separation distance affects perceptibility. For the tonality correction to be zero, the noise has to be imperceptible according to BS 4142. The perceptibility conclusion reached in the ES is a result of the background sound level being measured at 29 dBA. However, the figure of 29 dBA has been selected from a range of background sound levels and is described as "statistically repeatable". BS4142 provides, in Note 4 to 8.1.4, a method of plotting the statistical distribution of background sound levels, from which the mode can be taken. In Note 1 the Standard says "A representative level should account for the range of background sound levels and should not automatically be assumed to be either the maximum or modal value." It is shown in Appendix 25.1 Baseline Noise Survey Report that the night-time L_{A90} is in the low 20s on many occasions and was measured at less than 17 dBA. What is not reported is the fact that, other than laboratory equipment, no sound level meter can validly measure levels as low as 17 dBA. What will have been measured is the internal noise "floor" of the instrument, and inspection of the log of the meter would show an indication that it is "under range". Consequently, on many occasions the background noise level will be well below 29 dBA down to less than 17 dBA, and on those occasions the tonal noise emitted by transformers will be clearly perceptible, attracting a penalty for tonality of +6dB. Thus to achieve the noise limits in sections 26 and 27 of the draft DCO the specific noise level would have to be lower than the predicted value of 29 dBA for EA1N alone.

- 7.11 At SSR2 the Baseline Noise Survey Report modal value of the background measurements is 25 dBA according to the EA2 report and $\geq 26.5 < 27.5$ in the EA1N report.
- 7.12 It should be noted that the source spectra given in Table 25.32 of the ES which at source show heavy concentration in the 125Hz Octave band (in which the frequency of 100Hz lies) will change with propagation over distance due to the effect of ground absorption, to enhance the prominence of the 100Hz tone at the receptor still further.
- 7.13 The cumulative assessment of 30.1 dBA with a +6dB tonality penalty would exceed the DCO limits for EA1N alone by 2.1 dBA. As explained in 6.2 above, in regions of constructive interference, which may cover one or other (or both) of the specified locations, the combined sound level will be several dBA higher and tonality will be very clear so that the DCO limit is significantly exceeded. As also explained above, it is possible that, when commissioning occurs, measured noise levels at the two specified locations will be compliant thanks to their being in regions of destructive interference, but at other locations where there is

constructive interference the combined noise level may be well above the limits specified for the DCO locations.

- 7.14 No cumulative assessment is provided that includes the adjacent National Grid Substation on the grounds that (ES Chapter 25 25.3.2.1 page 8) "29. The National Grid infrastructure does not contain plant such as high voltage transformers or shunt reactors, or rotating plant such as transformer coolers, that would usually be the dominant noise sources from a substation during operation. 30. Any noise during the operational phase from National Grid infrastructure would be due to switchgear (circuit breakers & isolators), and if present, auxiliary plant such as control systems or an emergency generator.
- 7.15 However, the subsequent paragraph draws attention to "noise from switchgear which is impulsive in character" but makes no numerical assessment of it on the grounds that "these items of plant are designed to be inherently quiet in operation, and do not make operational noise or vibration at a level that would be perceptible at NSRs." Impulsivity attracts an additional penalty of from +3 to +9 dBA in BS4142 depending on its perceptibility.
- 7.16 The noise predictions benefit significantly from the presence of ground absorption (ES Chapter 25 178, page 52). No assessment is made for times when there is a temperature inversion, which over the distances involved can partially or completely negate the attenuation provided by absorptive ground in a homogeneous atmosphere. Likewise, no assessment is made for the case of a light wind from source to receiver which has a similar effect. The draft DCO limit applies in all weather conditions.

Construction

The Outline Code of Construction Practice

- 7.17 The outline code of construction practice contains a section "Noise and Vibration Management" which consists of seven paragraphs. The main objective is to minimise noise and vibration impacts to acceptable levels, with no statement as to what those levels are, and to comply with relevant legislation, requirements, standard and best practice relating to construction sites.
- 7.18 As explained below, the section of the ES which deals with "acceptable levels" misstates the content of BS 5228 and fails to take account of best practice in a recent document issued by the Highways Agency (LA 111) or to follow best practice as for example followed by other major projects such as HS2 or Thames Tideway Tunnel.
- 7.19 Best practice, as evidenced by the draft HS2 CoCP and the Thames Tideway Tunnel draft CoCP prepared at the DCO application stage, both include a commitment the contractors will be required to seek consents from the relevant local authority under Section 61 of the Control of Pollution Act 1974 for the proposed construction

works. BS 5228-1:2009+A1:2014 provides information on the application of the Section 61 process.

7.20 Current best practice is to require that the contractor shall ensure BPM, as defined under Section 72 of the CoPA, at all times for all activities in order to minimise noise and vibration from the works.

7.21 In the absence of a S61 consent, enforcing a failure to follow the CoCP will be a long drawn out process, possibility necessitating proceedings for a breach of a DCO requirement, whereas breach of a S61 consent is an offence.

The construction noise assessment in the Environmental Statement

7.22 The ES (page 22 paragraph 74 and page 47 Table 25.26) relies on the "ABC method" described in BS5228-1:2009+A1:2014. Contrary to the statement made in the ES this method does not establish that there is no impact below the three thresholds presented. The "ABC" method appears in the Standard as one of several examples to illustrate ways of assessing significance, The examples are offered as guidance which "might be useful in the implementation of discretionary powers for the provision of off-site mitigation of construction noise arising from major highways and railway developments". The Standard offers significance assessment based on fixed noise limits and an alternative based on noise change. Two noise change methods are offered, the first being the ABC method, and this has been widely used on many major projects. It offers a decision matrix for potential significant effects at dwellings. If the case in which the ABC method is applied leads to an outcome that does not exceed the significant effect threshold, this does not mean there is no impact and there is no statement to that effect in the Standard.

7.23 The Design Manual for Roads and Bridges document LA111 Revision 2 May 2020, Table 3.12, takes BS5228 further into the setting of LOAEL (Lowest Observed Adverse Effect Level) and SOAEL (Significant Observed Adverse Effect Level) values and says that LOAEL is the baseline and SOAEL is the ABC threshold. This is in sharp contrast to the ES which falsely says the ABC threshold is the boundary between no impact and negligible impact

7.24 Although LA111 is about highway construction and not substation construction, it would be wholly inconsistent to apply one interpretation to the same kind of noise when it was for road construction and then switch to another interpretation when entering the substation site.

7.25 National Policy Statement EN-1 states

"5.11.9 The IPC should not grant development consent unless it is satisfied that the proposals will meet the following aims:

- avoid significant adverse impacts on health and quality of life from noise;

- mitigate and minimise other adverse impacts on health and quality of life from noise; and
- where possible, contribute to improvements to health and quality of life through the effective management and control of noise.

When preparing the development consent order, the IPC should consider including measurable requirements or specifying the mitigation measures to be put in place to ensure that noise levels do not exceed any limits specified in the development consent.”

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8. CONCLUSIONS

Operation

- 8.1 The cumulative noise from EA1N and AE2 at the specified locations, in neutral atmospheric conditions, is predicted to be 30.1. This is based on a power sum of the individual contributions of noise sources in each of the two substations. Over the 5-minute measuring period of the DCO requirement, due to the fact that the most significant sources contain prominent components at the single frequency of 100Hz, there will be cases where constructive interference will occur and a pressure sum and not a power sum will be required giving a result several dB higher than the ES prediction. The choice of background noise level is the ES is 29 dB(A), but the ES also shows, using the same statistical methodology, a background noise level of 25 dBA at one of the closest receptors in the Friston area. The DCOs require a cumulative rating level not exceeding 34 dBA from EA1N and EA2 to be determined at the same two specified locations. The ES prediction is 36.2 dBA once a tonality correction has been applied, and higher in meteorological conditions such as temperature inversions or light winds. In the event, higher levels may occur in locations other than those specified in Requirements 26 and 27.

Subtracting a background of 29 dBA from 36.2 dB(A) gives a difference of +7, and the difference will be several dB higher in the weather conditions favourable to propagation, and further increased as a result of constructive interference. The BS 4142 conclusion, derived as required by the Overarching National Policy Statement for Energy (EN-1), when the difference between the rating level and the background sound level is around +10 dB or more is “an indication of a significant adverse impact”. EN-1 at 5.11.9 states that significant adverse impacts on health or quality of life should be avoided.

Construction

- 1.10 The outline Code of Construction Practice (CoCP) is deficient, and this is of great importance since Requirement 22 states that the full CoCP for which approval must be obtained from the local authority must accord with the outline code of

construction practice. Consequently it is necessary that matters which are essential for inclusion in the final CoCP should be foreseen in the outline CoCP.

- 1.11 The construction noise assessment uses incorrect criteria due to a mis-interpretation of current standards and guidance.

Overall

The proposals would be in contravention of the requirements of EN-1.

Signed

A handwritten signature in black ink, appearing to read 'Rupert Thornely-Taylor', with a long horizontal flourish extending to the right.

Rupert Thornely-Taylor
30 October 2020