YG-DCO-043-5.3.14H

Yorkshire Green Energy Enablement (GREEN) Project

Volume 5

Document 5.3.14H ES Chapter 14 Appendix 14H - National Grid Technical Guidance Note TGN(E)322 (2021)

Final Issue A
November 2022

Planning Inspectorate Reference: EN020024

Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 Regulation 5(2)(a)

nationalgrid

OPERATIONAL AUDIBLE NOISE ASSESSMENT PROCESS FOR OVERHEAD LINES (NEW BUILD, RECONDUCTORING, DIVERSION AND UPRATING)

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PURPOSE AND SCOPE

The purpose of this technical guidance note (TGN) is to support the overhead line noise assessment process for new build, reconductoring, diversion and uprating projects at 275 and 400kV. The policy itself is set out in PS(T)134[1] and this TGN should be read in conjunction with the policy statement.

PART 1 – TECHNICAL GUIDANCE

1 CONSIDERATIONS

1.1 Background context

The highest noise levels generated by an overhead line (OHL) generally occur during rainfall. Noise generated under these circumstances is referred to as 'wet noise' and can be described as a crackle, which is sometimes accompanied by a tonal hum. Noise which occurs during dry weather conditions is referred to as ‘dry noise’ and can be described as a crackle. The tonal hum which sometimes occurs during wet weather conditions is typically more annoying than crackle alone. Consequently, wet noise is tolerated at lower sound pressure levels than dry noise.

Noise criteria have been set taking account of the UK Policy context and evidence from multiple sources, including the World Health Organisation, into noise and associated health impacts. Technical Report TR(E)564[2] explains the reasoning behind the noise criteria laid down in PS(T)134.

1.2 Policy overview

New build, reconductoring, diversion and uprating projects shall be assessed against the requirements of PS(T)134.

[1] Operational audible noise policy for overhead lines (new build, reconductoring, diversion and uprating).

[2] Development of method for assessing the impact of noise from overhead lines (new build, reconductoring, diversion and uprating).

The aim of the noise assessment is to determine the acceptability of the noise impact on Noise Sensitive Receptors (NSRs) and make any necessary recommendations for noise mitigation.

Where there is potential for an increase in noise impact[3] as a result of new build, reconductoring, diversion and uprating projects at 275kV and 400kV, the noise impact shall be assessed on a site by site and case-by-case basis and documented by Noise Specialists within the Environmental Engineering Team. The noise specialists shall:

- Follow the process outlined in Figure 1 when carrying out a noise assessment
- Determine whether noise mitigation measures are necessary
- Provide guidance on the level of any mitigation required.

2 NOISE ASSESSMENT PROCESS

The approach to assessing the noise impact of new build, reconductoring, diversion and uprating projects at 275kV and 400kV is outlined in Figure 1 and described below.

The OHL noise assessment process follows a three-tier approach. If predicted noise levels fail the Tier 1 test, a Tier 2 assessment shall be undertaken and if predicted noise levels fail the Tier 2 test, a Tier 3 assessment shall be undertaken.

The three-tier approach comprises the following steps, which are designed to screen out of further assessment, receptors where there would be no adverse impact:

Tier 1: A primary screening step based on 'worst-case' wet noise effects and the pre-determined assessment criteria in Table 1.

Tier 2: An assessment step based on combined wet noise and dry noise effects and recalculated assessment criteria in Table 2.

Tier 3: A further assessment step following the principles of BS 4142:2014 for both wet and dry noise.

For most projects, both the Tier 1 and Tier 2 assessment steps can be carried out at the same time using data already calculated in 'look up' tables for the most common OHL designs.

The noise criteria have been developed based on health impact data associated with the night time period[4]. The night time period is considered more sensitive than the daytime as background sound levels are lower and people are trying to sleep, therefore, lower noise levels have a greater impact on health.

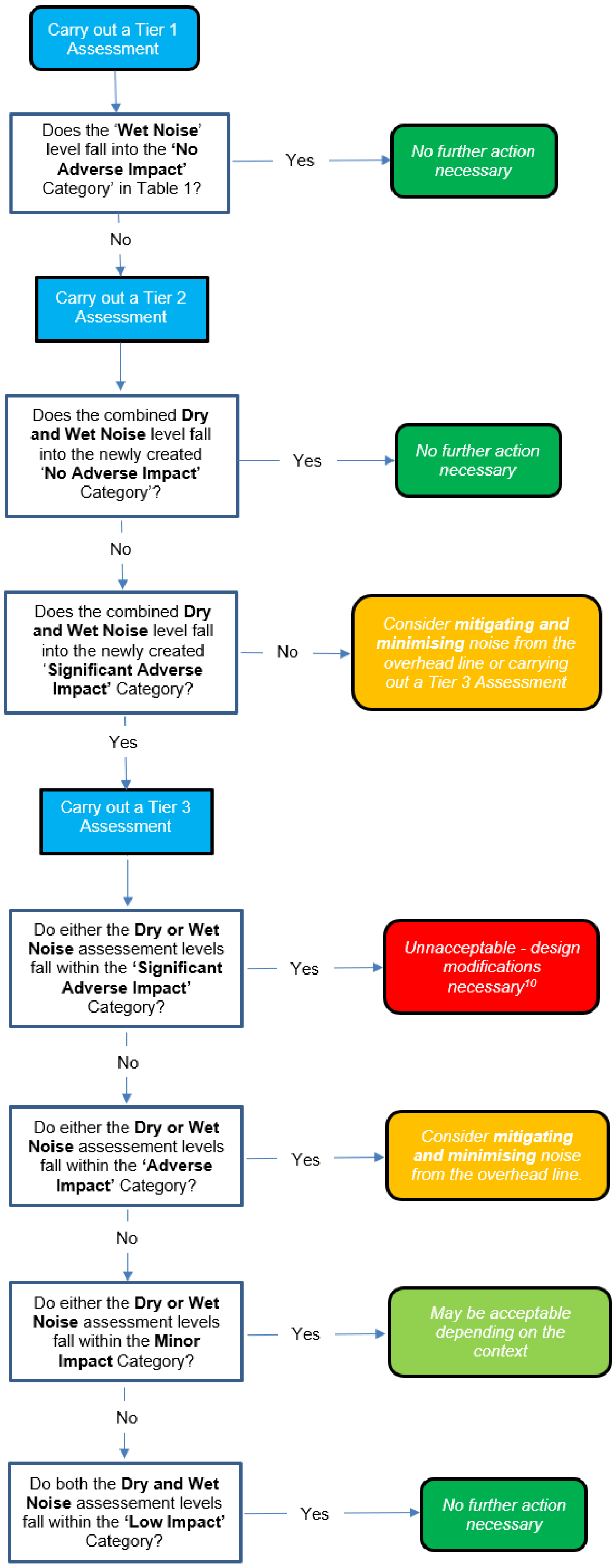
The time of day or night is not a factor in how noisy an OHL is at any particular time. Therefore, if the noise from the OHL meets the criteria presented in PS(T)134 and this TGN, which are based on the more sensitive night time period, then it will meet the criteria during both the day time and night time periods.

EFC400 is the preferred noise calculation software tool and the EPRI method is the preferred method of use within the EFC400 software. EFC400 produces an annual average sound pressure level equivalent to an L_{Aeq} for both wet and dry noise and thus allows subsequent calculations, which are required by this TGN to be undertaken. OHL noise 'look up' tables in support of PS(T)134 and this TGN have been produced using outputs from EFC400.

[3] Reconductoring projects under permitted development where noise impacts would reduce as a result of the new design do not require assessment under PS(T)134.

[4] Apart from non-residential schools which are the exception. They are not occupied during the night and so the noise criteria have been developed based on the daytime period and relevant effects.

Figure 1: OHL Noise Assessment Process



2.1 Tier 1 Assessment

The outcome of the Tier 1 assessment will determine whether the 'worst case' wet noise impact is predicted to be acceptable, or whether further assessment is required.

The Tier 1 noise criteria outlined in Table 1 relate to wet noise. Predicted free field wet noise levels at the external façade of the NSR should be compared against the Tier 1 noise criteria outlined in Table 1. There is no requirement to add a character penalty as a 6dB tonal penalty has already been applied to the Tier 1 noise criteria to account for tonal hum during wet weather conditions.

OHL noise is higher in wet weather conditions than in dry weather conditions, consequently, if the predicted wet noise levels meet the Tier 1 criteria in Table 1, dry noise levels will also meet the criteria.

Where the predicted wet noise levels fall into the 'No Adverse Impact' category in Table 1, the noise from the OHL is acceptable. Receptors falling into this category are screened out of further assessment and no further action or assessment is necessary.

A Tier 2 Assessment shall be carried out where predicted Wet Noise levels exceed the 'No Adverse Impact' Category in Table 1.

Table 1: Tier 1 Noise Criteria

Use	No Adverse Impact	Further Assessment Necessary
	Screened Out	Tier 2 Assessment Required
Vulnerable subgroups	< 29dBA	≥ 29 dBA
Residential	< 34dBA	≥ 34 dBA
Schools and Hotels	< 39dBA	≥ 39 dBA

2.2 Tier 2 Assessment

The outcome of the Tier 2 assessment will determine whether the combined wet and dry noise impact is acceptable, or whether further assessment is required.

The Tier 2 assessment requires:

1. A recalculation of the noise criteria (accounting for the duration of wet and dry weather) and;
2. A recalculation of the predicted noise level at the façade of the NSR (accounting for the duration of wet and dry weather)

The Tier 1 assessment assumes that wet noise occurs 100% of the time. In reality this is not the case. Wet weather conditions typically occur with lower frequency and duration than dry weather conditions. By taking into account the duration of wet and dry weather in the location of interest, the predicted noise levels at the façade of the NSR and the noise criteria can be recalculated. This will result in lower predicted noise levels at the NSR and higher decibel levels being reflected in the noise criteria (compared to the Tier 1 wet noise criteria) for the reasons outlined below.

OHL noise is lower in dry weather conditions than wet weather conditions. By recalculating the predicted noise levels, taking account of the duration of wet and dry weather, a lower noise level will be predicted at the NSR. How much lower will depend on the relative levels of wet and dry noise and the durations over which they are predicted to occur.

Wet noise is considered more annoying than dry noise due to tonal hum and therefore attracts a higher, 6dB penalty than dry noise, which attracts a 3dB penalty. This means a lower averaged sound pressure level due to the OHL can be tolerated in wet weather conditions. When the wet and dry noise criteria are combined, because wet noise is penalised to a greater extent than dry noise, the result is a combined figure for dry and wet noise, which is lower than the dry noise criteria, but higher than the wet noise criteria.

The combined criteria are more onerous than the dry noise criteria, because they take account of the effect of wet noise being more annoying than dry noise.

OHL noise ‘look up’ tables have been produced for the most common OHL designs. The ‘look up’ tables include the recalculated noise criteria, predicted wet and dry noise levels for numerous OHL designs and combined wet and dry noise levels based on differing rates of rainfall.

2.2.1 Determining the combined noise criteria

The dry and wet noise levels outlined in Appendix C have been combined through logarithmic calculation to determine new noise criteria for dry and wet noise combined. The combined noise criteria are presented in Table 2 in addition to the OHL noise ‘look up’ tables.

Through logarithmic calculation, the combined noise criteria take account of the percentage of time that dry and wet noise is likely to occur. The amount and duration of rainfall varies across the country and the combined noise criteria take account of this using historical Met Office rainfall data in Appendix A. This enables an assessment of the noise impact to be undertaken on a case-by-case basis based on the rate of rainfall in the project area. An example demonstrating how the combined noise criteria were determined can be found in Appendix D.

Table 2: Combined noise criteria for different rates of rainfall

Use	Rainfall (Annual Average Wet Hours)	No Adverse Impact (dBA)	Adverse Impact (dBA)	Significant Adverse Impact (dBA)
Vulnerable Subgroups	450	<31.9	31.9 - 41.9	>41.9
	600	<31.8	31.8 - 41.8	>41.8
	750	<31.8	31.8 - 41.8	>41.8
	900	<31.8	31.8 - 41.8	>41.8
	1050	<31.7	31.7 - 41.7	>41.7
	1200	<31.7	31.7 - 41.7	>41.7
Residential	450	<36.9	36.9 - 46.9	>46.9
	600	<36.8	36.8 - 46.8	>46.8
	750	<36.8	36.8 - 46.8	>46.8
	900	<36.8	36.8 - 46.8	>46.8
	1050	<36.7	36.7 - 46.7	>46.7
	1200	<36.7	36.7 - 46.7	>46.7
Schools & Hotels	450	<41.9	41.9 - 51.9	>51.9
	600	<41.8	41.8 - 51.8	>51.8
	750	<41.8	41.8 - 51.8	>51.8
	900	<41.8	41.8 - 51.8	>51.8
	1050	<41.7	41.7 - 51.7	>51.7
	1200	<41.7	41.7 - 51.7	>51.7

There is no requirement to add character correction penalties to the noise levels in Table 2, as penalties have already been applied. A 6dB tonal penalty has been applied to the wet noise levels and a 3dB character penalty has been applied to the dry noise levels.

2.2.2 Determining the predicted combined wet/dry noise level

The predicted combined wet/dry noise level at the facade of the NSR should be calculated. This should be determined through logarithmic calculation, taking account of the duration of wet and dry weather in the location of interest. As the amount and duration of rainfall varies across the country, the combined noise levels need to be calculated on a case-by-case basis using the Met Office rainfall data in Appendix A. These calculations have already been performed in the OHL noise 'look up' tables. The 'look up' tables outline the predicted wet and dry noise levels for numerous OHL designs and combined wet and dry noise levels based on differing rates of rainfall.

An example demonstrating how the predicted combined wet/dry noise levels were determined for the 'look up' tables is outlined in Appendix E.

2.2.3 Assessment against the combined noise criteria

Where the combined wet/dry noise level falls into the 'No Adverse Impact' category in Table 2, the noise from the OHL is acceptable and no further action or assessment is necessary.

Where the combined wet/dry noise level falls into the 'Adverse Impact' category in Table 2, consideration should be given to mitigating and minimising noise from the OHL. Alternatively, depending on the scale and cost of noise mitigation associated with mitigating and minimising noise for the specific scheme, it may be more appropriate to carry out a Tier 3 assessment. Liaising with the project team is highly recommended to understand implications for the project.

Where the predicted combined wet/dry noise level falls into the 'Significant Adverse Impact' category in Table 2, a Tier 3 assessment will be necessary.

2.3 Tier 3 Assessment

The outcome of the Tier 3 assessment will determine whether the noise impact is acceptable, whether the noise needs to be mitigated and minimized or whether the noise is unacceptable.

The Tier 3 assessment takes account of existing background sound levels in the area and noise levels due to rainfall.

The Tier 3 Assessment requires the impact of Dry Noise and Wet Noise to be assessed separately using two different methods which are based on the principles of BS4142[5]. The two methods differ in that the Dry Noise assessment requires the determination of the existing baseline sound level, whilst for the Wet Noise assessment, it is necessary to predict the increase in background sound levels due to rainfall.

2.3.1 Tier 3 Dry Noise Assessment

A BS4142 assessment shall be carried out to determine the impact of 'Dry Noise' at NSR's. A penalty of 3dB shall be added to the dry noise level at the NSR to give a rating level. The penalty accounts for the character of the noise being clearly identifiable. The difference between the rating level and the background sound level gives an assessment level, which should be compared against the Tier 3 Noise criteria in Table 3.

[5] BS 4142:2014+A1:2019 'Methods for rating and assessing industrial and commercial sound', British Standards Institution, June 2019

A difference in the rating level at the NSR compared to background sound levels of +10dB or more is likely to be an indication of a Significant Adverse Impact and therefore unacceptable.

A difference of +5dB to +9dB is likely to be an indication of an Adverse Impact and consideration should be given to mitigating and minimizing noise from the OHL.

The lower the rating level is relative to the measured background sound level, the less likely it is that noise from the OHL will have an adverse impact or a significant adverse impact.

A difference of 0 to +4dB is an indication of a Minor Impact and may be acceptable depending on the context in which the noise occurs.

Where the rating level of noise from the OHL does not exceed the background sound level, this is an indication of noise from the OHL having a Low Impact and is therefore acceptable.

2.3.2 Tier 3 Wet Noise Assessment

An assessment based on the principles of BS4142 shall be carried out to determine the impact of Wet Noise at NSR's.

The noise level due to rainfall shall be determined using the 'Miller Curves' in Appendix B. The relevant Miller Curve No. should be chosen to take account of the terrain/ground near the receptor being assessed, and the rate of rainfall shall be assumed to be 1mm/hr to produce a likely background sound level due to the effect of rainfall.

The measured background sound levels in dry weather must be added (through logarithmic addition) to the noise level due to rainfall, to produce a likely background sound level due to the effect of rainfall in the area of interest. A spreadsheet has been produced to enable this calculation to be completed with ease.

A penalty of 6dB shall be added to the predicted OHL wet noise level to account for the character of wet noise hum being tonal to give a rating level. This rating level shall be compared against the calculated background sound level due to the effect of rainfall in the area of interest. The difference between the two results in an assessment level. The assessment level should be compared against the Tier 3 Noise criteria in Table 3.

A difference in the rating level at the NSR compared to the calculated background sound level (accounting for noise due to rainfall) of +10dB or more is likely to be an indication of a Significant Adverse Impact and therefore unacceptable.

A difference of +5dB to +9dB is likely to be an indication of an Adverse Impact and consideration should be given to mitigating and minimizing noise from the OHL.

The lower the rating level is relative to the calculated background sound level (accounting for noise due to rainfall), the less likely it is that noise from the OHL will have an adverse impact or a significant adverse impact.

A difference of 0 to +4dB is an indication of a Minor Impact and may be acceptable depending on the context in which the noise occurs.

Where the rating level of noise from the OHL does not exceed the background sound level (accounting for noise due to rainfall), this is an indication of noise from the OHL having a Low Impact and is therefore acceptable.

Table 3: Tier 3 Noise Criteria

Assessment Level	Impact	Action
≥+10dB	Significant Adverse Impact	Unacceptable (Avoid)
+5 to +9dB	Adverse Impact	Mitigate and Minimise
0 to +4dB	Minor Impact	May be acceptable depending on the context in which the noise occurs.
≤0dB	Low Impact	Acceptable (No action necessary)

2.4 Prediction of OHL Noise Levels

Generic Outputs detailing annual average sound pressure levels equivalent to an L_{Aeq} have been calculated using EFC400 at varying distances in dry and wet weather and for both straight and curved sections of OHL. These generic outputs have been produced for different overhead line designs. The generic outputs are referred to as OHL noise 'look up' tables.

The EFC400 generic outputs should be consulted to determine the approximate sound pressure levels at the nearest or most affected NSR's. If the criteria are met at the nearest or most affected NSR (for each category of NSR), it can be assumed that the criteria will be met at all NSR's on the route and therefore further assessment of individual NSR's is not required.

Using the generic EFC400 outputs should be sufficient to enable a high-level assessment to be made without detailed modelling using individual OHL span data. Attention should be paid to applying the relevant set of generic EFC400 outputs depending on whether the relevant section of OHL is straight or curved.

Use of the curves relating to OHL bends gives a worse case assessment as noise levels are higher on the inside of a bend (and should ensure all receptors are captured). This is in part due to the OHL configuration and also due to the influence of noise from more than one span on receptors on the inside of a bend. The opposite is true for receptors on the outside of a bend and for these receptors, use of the straight OHL look up tables is appropriate.

Where some OHL spans fall into the Adverse or Significant Adverse Impact categories, detailed line design data can be obtained (co-ordinates, line schedule and clearance schedule) and a specific model run in EFC400 for that section of OHL to improve modelling accuracy if required. The assessment can then be validated using the detailed line design data.

Where a planning application or Development Consent Order (DCO) application is required, modelling of the OHL in EFC400 using detailed design data may be necessary. The Consents Team can offer advice.

For noise modelling purposes, Method F9 should be used in EFC400, ensuring the EPRI method is chosen (should be automatically selected). The rainfall rate for the purposes of modelling wet noise should be set to 1mm/hr as historical studies[6] identified that hum inception occurs at this rainfall rate, whilst background sound levels due to rainfall do not increase significantly and hence this is considered a worse case assessment.

[6] Studies at Bramley referenced in TR(T)94 'A method for assessing the community response to overhead line noise' (Withdrawn and superseded by PS(T)134, TGN(E)322 and TR(E)564).

2.5 DCO Applications/Environmental Impact Assessments (EIA's)

The principles of the Tier 1 to 3 approach described above shall be used for these types of applications, however the method of reporting the noise impact may require a different approach.

2.5.1 DCO/EIA Significance of Effect

These projects require the sensitivity of NSR's to be defined, along with the magnitude of the noise impact, to give an overall significance of effect.

Combined effects of other EIA disciplines and the level of significance for combined effects needs to be developed on a project specific basis.

Receptor sensitivities to be used in these types of applications are outlined in Table 4.

Table 4: Classification of receptor sensitivity

Sensitivity	Receptor
High	Vulnerable subgroups including hospitals and pre-schools, care homes and hospices
Medium	Residential and schools
Low	Area used primarily for leisure activities, including PRoW, sites of historic or cultural importance.
Negligible	All other areas such as those used primarily for industrial or agricultural purposes.

The magnitude of the noise impact is defined as either High, Medium, Low, Negligible or No Effect. A matrix combining the sensitivity of the receptor with the magnitude of the impact gives the overall significance of effect.

The significance of effect determines whether, in EIA terms, the effect is deemed to be significant or not significant. Major Effects correspond directly to 'Significant Adverse Impacts'. Moderate and Minor effects correspond to 'Adverse Impacts' and Negligible effects correspond to 'No Adverse Impact'. Only Major effects are deemed to be significant for the purposes of DCO/EIA noise assessments.

There are two significance of effect matrices. The first relates to absolute noise criteria and is therefore specific to Tier 1 and Tier 2 assessments and is presented in Table 5. The second relates to noise criteria relative to background sound levels and is therefore specific to Tier 3 assessments and is presented in Table 7. These matrices are proposed for use in DCO/EIA applications.

Table 5: Significance of Effect Matrix for Tier 1 and Tier 2 Assessments

Significance of Effect	Sensitivity of Receptor			
Magnitude	**High**	**Medium**[7]	**Low**	**Negligible**
High	Major	Major	Moderate	Minor
Medium	Major	Moderate	Minor	Negligible
Low	Moderate	Minor	Minor	Negligible
Negligible	Minor	Negligible	Negligible	Negligible
No Effect	Negligible	Negligible	Negligible	Negligible

[7] When assessing the impact of noise on non-residential schools (where people do not sleep), the noise criteria should be increased by 5dB, as the relevant criteria for this type of receptor relates to the day time period rather than the night time.

2.5.2 DCO/EIA Tier 1 Assessment

For Tier 1 and Tier 2 assessments, the magnitude of effect categories are based on resulting noise levels at the NSR for both dry and wet noise. The noise criteria have been developed based on health impact data associated with the night time period[8] and are shown in Table 6. The colours in the table represent the significance of effect in line with the matrix presented in Table 5.

When carrying out a Tier 1 assessment for a DCO/EIA, the Wet Noise Levels outlined in Table 6 for the relevant receptor category should be used as the basis for screening out receptors where there would be 'No Adverse Impact' (Green). Where receptors fall into the 'Adverse Impact' (Amber) or 'Significant Adverse Impact' category (Red), the duration of wet and dry weather must be considered in a Tier 2 Assessment.

Table 6: Noise criteria (Tier 1 and 2) and resulting significance of effect[9]

Significance of Effect	Weather Condition	Sensitivity of Receptor			
Magnitude		High	Medium	Low	Negligible
High	Wet	>44	>44	>44	>44
	Dry	>47	>47	>47	>47
Medium	Wet	39 - 44	39 - 44	39 - 44	39 - 44
	Dry	42 - 47	42 - 47	42 - 47	42 - 47
Low	Wet	34 - 39	34 - 39	34 - 39	34 - 39
	Dry	37 - 42	37 - 42	37 - 42	37 - 42
Negligible	Wet	29 - 34	29 - 34	29 - 34	29 - 34
	Dry	32 - 37	32 - 37	32 - 37	32 - 37
No Effect	Wet	<29	<29	<29	<29
	Dry	<32	<32	<32	<32

2.5.3 DCO/EIA Tier 2 Assessment

Where a Tier 2 assessment is required for a DCO/EIA, the combined predicted wet/dry noise levels should be calculated as described in Appendix D. New noise criteria must be calculated (using the noise levels from Table 6) for wet and dry noise combined for the relevant receptor category, as described in Appendix E. The newly predicted combined wet/dry noise levels must then be assessed against the combined noise criteria.

Where the combined wet/dry noise level falls into the newly calculated 'No Adverse Impact' category, the noise from the OHL is acceptable and no further action or assessment is necessary.

Where the combined wet/dry noise level falls into the newly calculated 'Adverse Impact' category, consideration should be given to mitigating and minimising noise from the OHL. Alternatively, depending on the scale and cost of noise mitigation associated with mitigating and minimising noise for the specific scheme, it may be more appropriate to carry out a Tier 3 assessment. Liaising with the project team is highly recommended to understand implications for the project.

Where the predicted combined wet/dry noise level falls into the newly calculated 'Significant Adverse Impact' category, a Tier 3 assessment will be necessary.

[9] For the purposes of a DCO/EIA application, whilst Table 6 suggests a moderate significance of effect for low sensitivity receptors with a high magnitude of effect (based on health data for exposure to noise over a full 16-hour period), the effect is likely to be lower. Lower sensitivity receptors are likely to be used by people for shorter durations than 16 hours and for lower durations than patients in hospitals, residential properties and schools. Additionally, these areas are less likely to be used during wet weather conditions when the highest noise levels from an OHL occur.

2.5.4 DCO/EIA Tier 3 Assessment

For Tier 3 assessments, the magnitude of effect categories are based on the difference between the OHL rating noise level and the background sound level in the area with or without the effect of noise from rainfall. For DCO/EIA's the significance of Effect Matrix for Tier 3 Assessments is presented in Table 7. The Tier 3 magnitude of effect categories are shown in Table 8. The colours in the table represent the significance of effect in line with the matrix presented in Table 7.

Table 7: Significance of Effect Matrix for Tier 3 Assessments

Significance of Effect	Sensitivity of Receptor			
Magnitude	High	Medium[8]	Low	Negligible
High	Major	Major	Moderate	Minor
Medium	Major	Moderate	Minor	Negligible
Low	Moderate	Minor	Minor	Negligible
Negligible	Minor	Negligible	Negligible	Negligible
No Effect	Negligible	Negligible	Negligible	Negligible

Table 8: Noise criteria (Tier 3) and resulting significance of effect

Significance of Effect	Sensitivity of Receptor			
Magnitude	High	Medium	Low	Negligible
High	≥+10dB	≥+10dB	≥+10dB	≥+10dB
Medium	+5 to +9dB	+5 to +9dB	+5 to +9dB	+5 to +9dB
Low	+0 to +4dB	+0 to +4dB	+0 to +4dB	+0 to +4dB
Negligible	≤0dB	≤0dB	≤0dB	≤0dB
No Effect	≤0dB	≤0dB	≤0dB	≤0dB

When carrying out a Tier 3 assessment, it is important to consider the context in which the noise occurs. For example, the wet noise assessment may suggest a 'Significant Adverse Impact', however, wet noise may only occur for 5% of the time and therefore may not be considered Significant. Additionally, whilst in this example wet noise occurs for 5% of the time, some of this will be during the day and some during the night time. The method may overestimate the impact during the daytime if the assessment is based on a night time background noise level. The context must therefore be carefully considered and discussed in the DCO/EIA and a judgement made on the overall significance of effect.

Only Major effects are deemed to be significant for the purposes of DCO/EIA noise assessments.

Where the outcome of the Tier 3 Assessment suggests a 'Significant Adverse Impact', and therefore a Major significance of effect, consideration should be given with the DCO project team to avoiding such effects, whilst balancing the impact on all other EIA disciplines and the project itself.

Where the outcome of the Tier 3 Assessment suggests an 'Adverse Impact' and therefore a Moderate significance of effect, consideration should be given with the DCO Project Team to mitigating and minimizing noise from the OHL, whilst also balancing the impacts on all other EIA disciplines and the project itself.

For Medium sensitivity receptors, where the outcome of the Tier 3 Assessment suggests a Minor significance of effect, the noise from the overhead line may be acceptable depending on the context in which the noise occurs. The context must therefore be carefully considered and discussed in the DCO/EIA and a judgement made on the overall significance of effect.

Where the outcome of the Tier 3 Assessment suggests there will be 'No Adverse Impact' and therefore a Negligible significance of effect, the noise from the OHL is acceptable.

3. RISKS

Adherence to this policy will reduce the adverse environmental impact of noise from overhead lines on our neighbours and other noise sensitive receptors. Consequently, the risk of future noise complaints and contact from our regulators and other stakeholders should reduce.

The perceived effect of noise from our overhead lines is subjective. As a result, there cannot be an absolute guarantee that complaints will not be received.

4. FORMS AND RECORDS

None.

PART 2 - DEFINITIONS AND DOCUMENT HISTORY

5. DEFINITIONS

Assessment Level

The predicted difference in the rating level compared to the background noise level (with or without noise due to rainfall).

Context

The context in which a sound occurs affects the acceptability of the noise. The context should be considered when carrying out an assessment and making a final recommendation. Factors that should be considered include for example, the absolute level and character of the sound, the duration of rainfall in the area and hence duration of wet noise, the existing background sound level and the sensitivity of the receptor.

Corona noise

An electrical breakdown of the air occurs around the conductor leading to a crackling noise.

Crackle

Noise caused by corona discharge which sounds like a crackle. Occurs in dry and wet weather conditions.

Dry Noise

Noise which occurs during dry weather conditions is referred to as 'Dry Noise' and can be described as a crackle.

Conductor system noise is caused by corona discharge activity. Corona discharge occurs when the conductor surface electric stress exceeds the inception level for corona discharge activity, a level of around 17 to 20 kV/cm. Most transmission line conductors are designed to operate below this threshold, and so usually operate quietly in dry weather conditions.

Small areas of surface contamination on conductors spoiling the otherwise smooth conductor surface are likely to cause a local enhancement of electric stress which may be sufficiently high to initiate localised discharge activity. At each discharge site a limited electrical breakdown of the air occurs. A portion of the energy associated with the corona process is released as acoustic energy which radiates into the air as sound pressure waves. After a prolonged spell of dry weather without heavy rain to wash the conductors, contamination may accumulate sufficiently to result in increased noise. Under these circumstances the noise is referred to as 'dry noise'.

Environmental Noise

Noise which has a negative adverse environmental impact.

Free-field

A region in space where sound may propagate free from any form of obstruction, this is typically assumed to be at least 3m from any reflecting surface.

Hum

Hum can occur in wet weather conditions and is caused by the oscillation of water droplets in the electric field. Under excitation at 50Hz the water droplets are extended and contracted twice during the full 50Hz cycle, leading to noise with a fundamental frequency at 100Hz. Harmonics may also occur, most commonly 200 Hz, 300 Hz and 400 Hz.

Noise

Any sound that is undesired by the recipient.

Noise Sensitive Receptors (NSRs)

Relates to buildings or places where our stakeholders may be exposed to noise from our overhead lines.

Buildings where people sleep are always considered to be sensitive. These are typically domestic residences but will also include, for example, hotels, residential nursing homes, hospitals and some schools. The most sensitive or most affected receptor is not always the nearest to a noise source.

Receptors such as amenity areas, public rights of way, places of worship and commercial premises (such as shops) are less sensitive, but may need to be considered on a case-by-case basis.

Rating Level

Sound pressure level of the sound source + a penalty for tonality (+3dB penalty for dry noise and +6dB penalty for wet noise).

Sound

An auditory sensation produced in the ear and brain by variations in the pressure of air.

Sound pressure level

Decibel level (dB) at a given location measured to the reference pressure of 20 μPa.

Wet Noise

Noise which occurs during wet weather conditions is referred to as ‘Wet Noise’ can be described as a crackle, which is sometimes accompanied by a tonal hum.

The highest noise levels generated by an overhead line generally occur during rainfall. Water droplets may accumulate on the surface of the conductor and initiate multiple corona discharges. The number of droplets, and hence the noise level, will depend primarily on the rate of rainfall. Fog may also give rise to increased noise levels, although these levels are less than those during rain. Noise generated under these circumstances is referred to as 'wet noise'.

6. AMENDMENTS RECORD

Issue	Date	Summary of Changes / Reasons	Author(s)	Approved By (Inc. Job Title)
1	February 2021	New document to support overhead line developments	Janine Dickinson Engineering Services	Jemma Spencer Environmental Engineering Manager
2	June 2021	Amendments to Table 1 and the Tier 2 assessment process, insertion of Table 2 and clarification of application to reconductoring projects.	Janine Dickinson Operational Compliance	Jemma Spencer Environmental Engineering Manager

7. IMPLEMENTATION

7.1. Audience Awareness

Audience	**Purpose** Compliance (C) / Awareness (A)	**Notification Method** Memo / letter / fax / email / team brief / other (specify)
Asset Operations	C	Team Brief
Customer Connections	C	Team Brief
New Infrastructure	C	Team Brief
Safety, Risk and Compliance	A	Email

7.2. Training Requirements

Training Needs N/A / Informal / Workshop / Formal Course	Training Target Date	Implementation Manager
Workshop with Environmental Engineering Team	30/03/2021	Jemma Spencer

7.3. Compliance

This document provides information to support PS(T)134, 'Operational audible noise policy for overhead lines (new build, reconductoring, diversion and uprating)', the policy document has compliance measures in place.

Policy Review Date

Following a change in legislation.

PART 3 - GUIDANCE NOTES AND APPENDICES

7. REFERENCES

This policy refers to and should be read in conjunction with the following documents.

7.1 NATIONAL GRID POLICIES, TRANSMISSION PROCEDURES AND TECHNICAL SPECIFICATIONS

PS(T) 003	TYPE REGISTRATION
PS(T)134	OPERATIONAL AUDIBLE NOISE POLICY FOR OVERHEAD LINES (NEW BUILD, RECONDUCTORING, DIVERSION AND UPRATING)
TP188	TRANSMISSION CAPITAL DELIVERY ELECTRICITY – DESIGN MANAGEMENT
TP215	ELECTRICITY INVESTMENT PROCESS – ENVIRONMENTAL COMPLIANCE AND SUSTAINABILITY
TP500	NETWORK DEVELOPMENT PROCESS MAP ENABLING DOCUMENT
TS 2.27	GENERIC DESIGN PRINCIPLES FOR A NEW OVERHEAD LINE
TS 2.4	GENERIC DESIGN PRINCIPLES FOR RE-UTILISATION OF OVERHEAD LINES
TS 3.04.17	INSULATOR SETS FOR OVERHEAD LINES
TS 3.04.35	COMPONENTS FOR OVERHEAD LINES
TS 3.04.37	CONDUCTORS AND CONDUCTOR SYSTEMS FOR OVERHEAD LINE

7.2 NATIONAL GRID TECHNICAL GUIDANCE NOTES

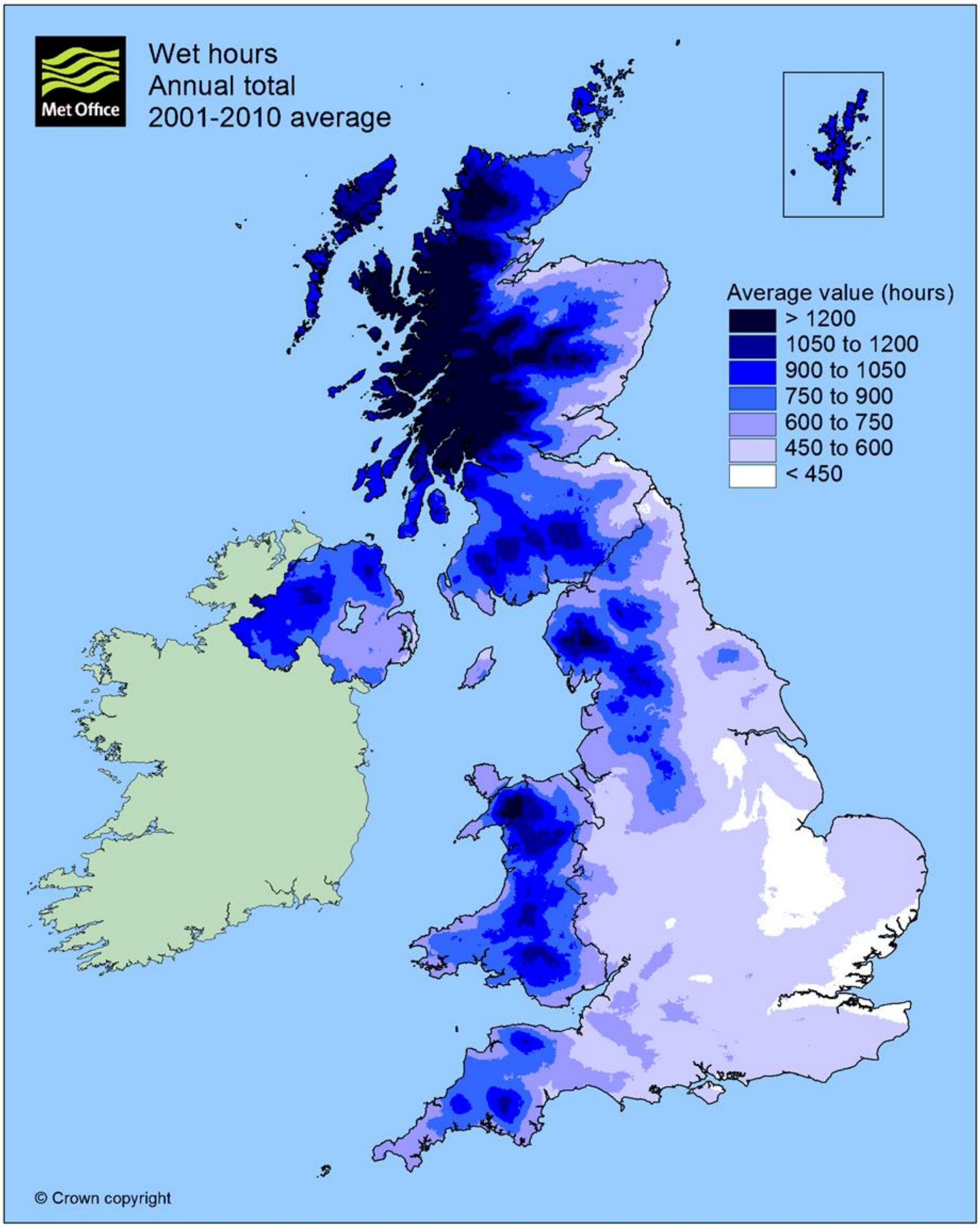
TGN(E) 259	TYPE REGISTRATION OF OVERHEAD LINES

APPENDIX A

Met office rainfall data

The Met Office reviewed its rainfall intensity and rainfall duration data for the period 2001 to 2010 on behalf of National Grid and has produced the chart presented in this Appendix. The data can also be accessed via a weather data layer in Geogrid.

Annual average wet hours (above 0.2mm/hr), 2001-2010



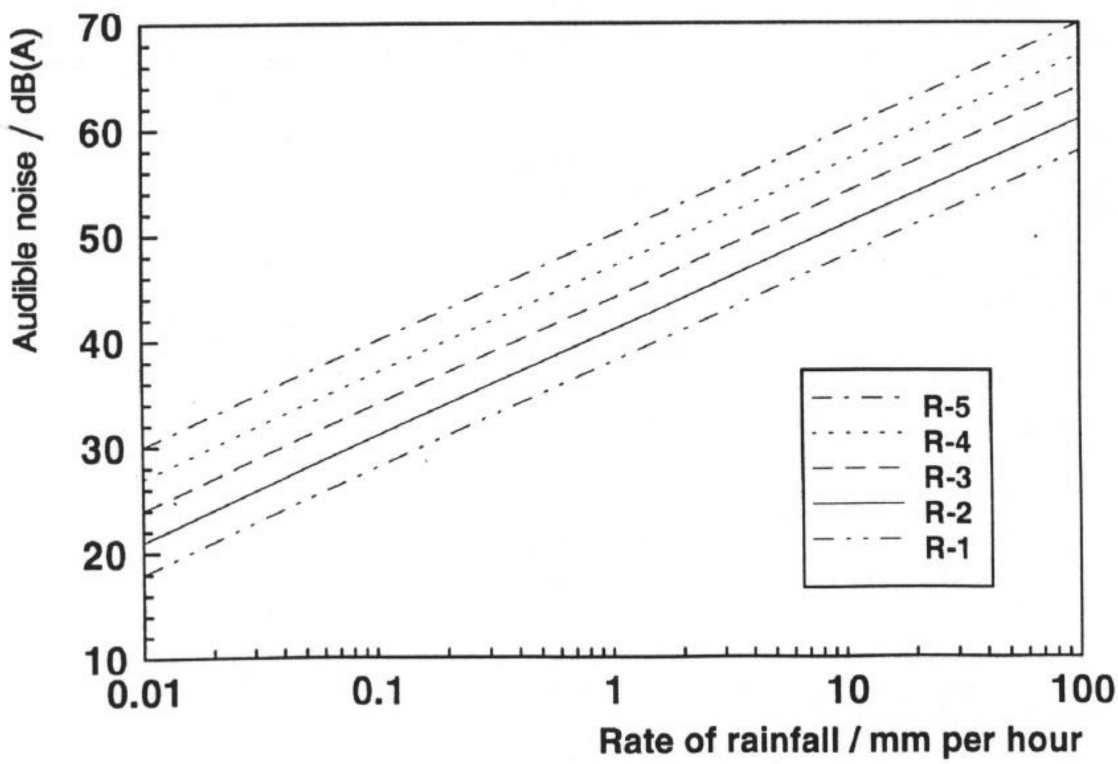
APPENDIX B

Miller table, curves and calculations

Curve number to be used for estimating a weighted sound levels due to rainfall

Curve no.	Condition of ground and vegetation
R-1	Essentially bare, porous ground (that is ploughed field or snow covered ground); no standing puddles of water. Relatively small-leafed ground cover vegetation, such as grass lawn, meadow, hay field shortly after mowing, field of small-leafed plants.
R-2	Non-porous, hard, bare ground or pavement; falling raindrops splash on thin layers or puddles of collected water; or in or beside wooded area of deciduous trees without leaves or with only small leaves; or in or beside wooded area of coniferous trees or evergreens having needles rather than leaves; or thin-leafed ground cover or crop, such as hay, clover or grain.
R-3	A few small, fully-leafed deciduous trees at 15 to 30 m or a few large, fully-leafed trees at 30 to 90 m.
R-4	Large area of fully-leafed trees or large-leafed crops or vegetation, such as corn, starting at 15 to 30 m distance.
R-5	Large area of fully-leafed trees or large-leafed crops or vegetation entirely surrounding the area of interest.

Miller curves for estimating sound levels due to rainfall



Miller equations for estimating sound levels due to rainfall

dBA = K + 10 LOG R

K = constant depending on the miller curve number

R = rate of rainfall in cm/hr

Based on a rainfall rate of 1mm/hr (hum inception point), noise levels due to rainfall for the different miller curves are:

Curve	Miller Equation	dBA
R1	48 + 10 Log 0.1	38
R2	51 + 10 Log 0.1	41
R3	54 + 10 Log 0.1	44
R4	57 + 10 Log 0.1	47
R5	60 + 10 Log 0.1	50

APPENDIX C

Dry and Wet Noise Levels for determination of combined noise criteria

Use	Weather condition	No Adverse Impact	Adverse Impact	Significant Adverse Impact
		Acceptable - No Action Necessary	**Mitigate and Minimise[10]**	**Unacceptable - Avoid**
Vulnerable subgroups	**Wet**	< 29dBA	29 to 39dBA	> 39dBA
	Dry	< 32dBA	32 to 42dBA	> 42dBA
Residential	**Wet**	< 34dBA	34 to 44dBA	> 44dBA
	Dry	< 37dBA	37 to 47dBA	> 47dBA
Schools & Hotels	**Wet**	< 39dBA	39 to 49dBA	> 49dBA
	Dry	< 42dBA	42 to 52dBA	> 52dBA

[10] e.g. move towers, re-route, use a different a conductor for specific spans. The Environmental Engineering Team can advise.

APPENDIX D

How to combine wet and dry noise levels in Appendix C to produce new noise criteria for Tier 2 assessments

Example

Using the 'Wet hours annual total (greater than 0.2mm/hr)' chart in Appendix A, determine the percentage of time that wet weather occurs in the project area.

To do this, look at the colour chart on the map of the UK in Appendix A. Divide the number of hours that wet weather occurs in the project area by the number of hours in a year using Equation 1. The number of hours in a year (24 x 365) = 8760. This tells you the percentage of time that wet weather occurs in the project area.

In this example, the nearest NSR is a residential property in an area where rain falls on average up to 600 hours in a year (a relatively low occurrence). We can assume that wet noise occurs for the same duration.

Equation 1:

Percentage wet weather = (hours of wet weather in area/hours in a year) x 100

(600/8760) x 100 = 6.8%

In this example, wet noise occurs for 6.8% of the time and dry noise for 93.2% of time.

To calculate the new combined noise criteria, take the wet and dry noise levels from Appendix C and carry out a logarithmic calculation to take account of the duration of wet and dry weather.

In this example, wet noise occurs for 6.8% of the time and dry noise for 93.2% of time. For a residential receptor, the significant adverse impact level for wet noise is >44dB i.e. 44.1dB and for dry noise is >47dB i.e. 47.1dB. Using the percentage data for wet and dry noise, the contribution of each to the combined criteria can be determined from Equation 2.

Equation 2:

Combined Wet/Dry Noise Criteria = 10Log($10^{\text{Wet Noise Criteria}/10}$ x percentage duration wet noise/100) + ($10^{\text{Dry Noise Criteria}/10}$ x percentage duration dry noise/100)

$$10\text{Log}(10^{4.41} \times 0.068) + (10^{4.71} \times 0.932) = 46.9\text{dB}$$

In this example, the new combined dry/wet noise criteria indicting a Significant Adverse Impact is 46.9dB.

APPENDIX E

How to determine the predicted combined wet/dry noise level at NSR façade

Example 1

Using the 'Wet hours annual total (greater than 0.2mm/hr)' chart in Appendix A, determine the percentage of time that wet weather occurs in the project area.

To do this, look at the colour chart on the map of the UK in Appendix A. Divide the number of hours that wet weather occurs in the project area by the number of hours in a year using Equation 1. The number of hours in a year (24 x 365) = 8760. This tells you the percentage of time that wet weather occurs in the project area.

In this example, the nearest NSR is a residential property in an area where rain falls on average up to 600 hours in a year (a relatively low occurrence). We can assume that wet noise occurs for the same duration.

Equation 1:

Percentage wet weather = (hours of wet weather in area/hours in a year) x 100

(600/8760) x 100 = 6.8%

In this example, wet noise occurs for 6.8% of the time and dry noise for 93.2% of time.

Using the predicted wet and dry noise levels from the EFC400 outputs or from detailed modelling in EFC400, the predicted wet and dry noise levels at the façade of the NSR can be substituted into Equation 2. Using the percentage data for wet and dry noise, the contribution of each to the combined level can be determined from Equation 2.

Equation 2:

Combined Wet/Dry Noise Level = 10Log($10^{\text{Wet Noise Level}/10}$ x percentage duration wet noise/100) + ($10^{\text{Dry Noise Level}/10}$ x percentage duration dry noise/100)

For example, where the wet noise level (occurring for 6.8% of the time) is predicted to be 49dB and the dry noise level (occurring for 93.2% of the time) is predicted to be 24dB at the façade of the NSR, the predicted combined noise level can be calculated from:

10Log($10^{4.9}$ x 0.068) + ($10^{2.4}$ x 0.932) = 37.5dB

The combined predicted noise level can then be compared against the combined noise criteria in Table 2. In this example, for a residential receptor, the combined predicted noise level of 37.5dB falls into the adverse impact category in Table 2.

Example 2

In this example, the duration of wet weather is significantly higher (1200 hours), this equates to 13.7% of the time. The wet noise level is predicted to be 49dB and the dry noise level is predicted to be 24dB at the façade of the NSR.

The predicted combined wet/dry noise level needs to be calculated using Equation 2:

10Log($10^{4.9}$ x 0.137) + ($10^{2.4}$ x 0.863) = 40.4dB

The combined predicted noise level can then be compared against the combined noise criteria in Table 2. In this example, for a residential receptor, the combined predicted noise level of 40.4dB falls into the adverse impact category in Table 2.

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

Registered in England and Wales
No. 4031152
[redacted]