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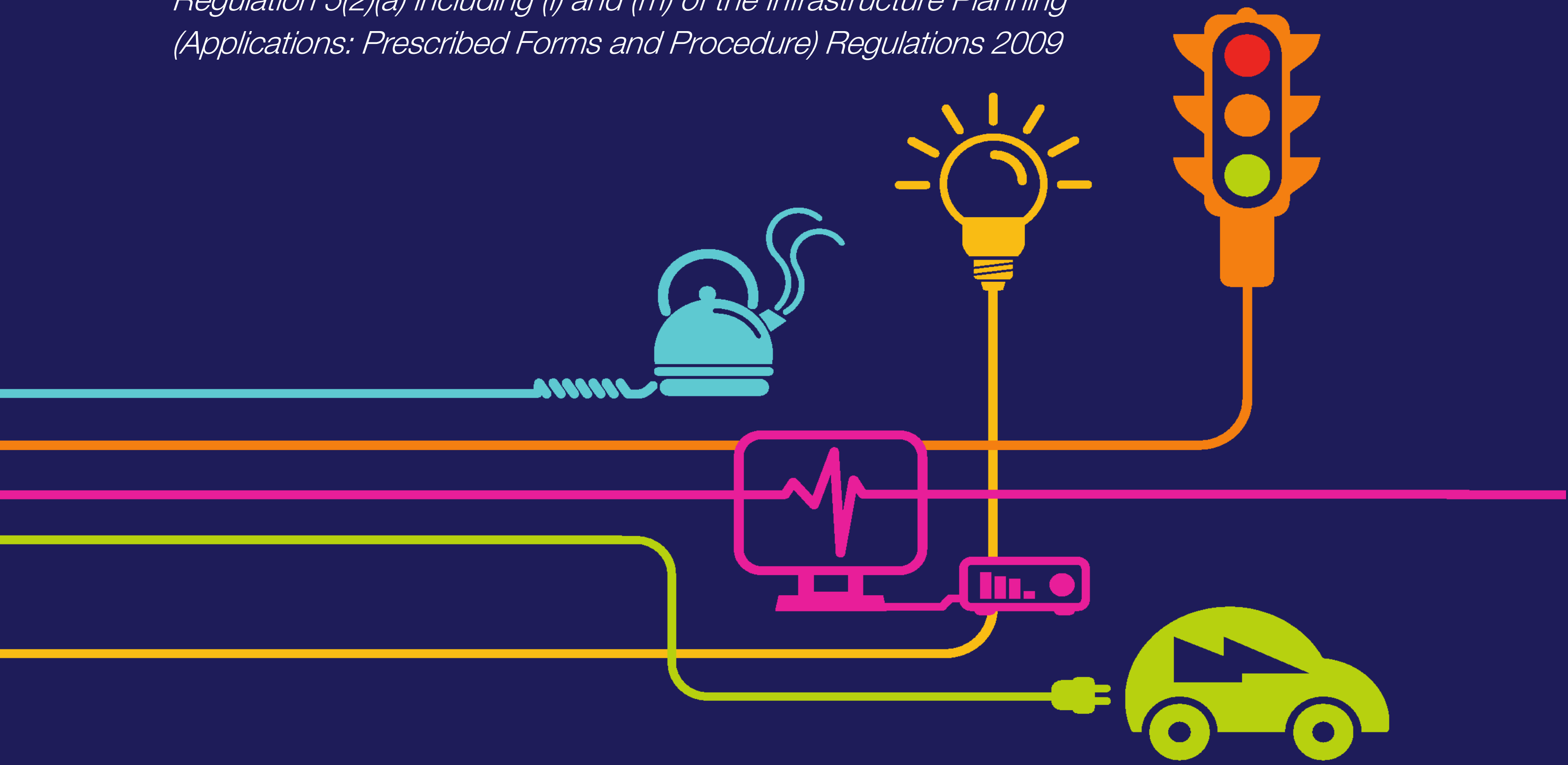
DOCUMENT 5.16.2.4

Taking into Account the Existing 400 kV OHL

Chapter 16 – Appendix 4

National Grid (North Wales Connection Project)

Regulation 5(2)(a) including (l) and (m) of the Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009



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North Wales Connection Project

Environmental Statement

Document 5.16.2.4 Appendix 16.4 Taking into Account the Existing 400 kV OHL

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Contents

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1 Taking into Account the Existing 400 kV OHL

1.1 INTRODUCTION

1.1.1 The Proposed Development being brought forward by National Grid is to develop a new 400 kV connection between the existing 400 kV Wylfa Substation on Anglesey and Pentir Substation in Gwynedd. This would facilitate the export of power from the proposed Wylfa Newydd power station. In Anglesey, for the majority of its route, the proposed new OHL would parallel the existing 400 kV Wylfa to Pentir OHL between Wylfa and near Gaerwen.

1.1.2 To address concerns raised by stakeholders and feedback received during the Stage 3 consultation, as detailed in the Consultation Report (**Document 6.1**), this appendix outlines how operational noise from the existing 400 kV OHL has been taken into account in the assessment of significance in Chapter 16, Operational Noise (**Document 5.16**) of the Environmental Statement (ES).

1.1.3 The purpose of this appendix is to describe the approach followed to identify receptors that may experience a combined effect from the two OHLs and to provide worked examples.

1.2 SUMMARY OF APPROACH

1.2.1 Section 9 of ES Chapter 16 Operational Noise (**Document 5.16**) takes the following approach with respect to the potential for a combined effect on receptors due to the existing and new OHL infrastructure[1]:

- Assessment of noise from new OHL infrastructure - All new or modified OHL infrastructure is assessed according to the operational noise

[1] With the exception of a short deviation near Capel Coch, the proposed OHL would run in parallel to the existing OHL infrastructure for the majority of its route between Wylfa and the point at which the lines diverge near Gaerwen. Existing OHL infrastructure refers to sections of OHL that would remain unchanged as a result of the Proposed Development. New OHL infrastructure refers to all new sections of OHL associated with the Proposed Development.

assessment methodology described in section 4 Methodology (**Document 5.16**) and Appendix 16.3 (**Document 5.16.2.3**). This assessment is carried out relative to a very low baseline that does not include a contribution from the existing OHL[2] and includes the sections (termed transposition points) where the new route would continue onto the existing pylons and vice-versa and where two new twin-conductored OHL would parallel one another.

- Identification of receptors potentially exposed to a combined effect from existing and new OHL - Receptors nearest the existing and new OHLs that may experience a combined effect from both are grouped into one of four categories (P1, P2, P3 and P4 – see below) depending on their location relative to the two OHLs.

- Consideration of combined effect - A qualitative approach, based on professional judgement, is followed to identify the factors (discussed below) that might determine whether the proximity of the identified receptors to the existing OHL justifies a higher level of significance of effect at that receptor than already identified from the assessment of the new OHL alone.

1.2.2 The aim of the approach is to identify those receptors where the significance of effect category (i.e. negligible, minor, moderate and major) may be judged to be higher due to its proximity to the existing OHL, and also to inform the judgment as to whether or not a moderate significance of effect may or may not be deemed to be significant in EIA terms (a major significance of effect is always considered to be significant).

[2] Data used for the determination of baseline sound levels exclude noise from the existing OHL for two reasons:

a) Measurement data obtained during poor weather conditions, i.e. high wind and periods of precipitation, is excluded from the calculation according to guidance in BS 4142:2014. However, it is under these conditions that OHL noise is also likely to occur and hence any noise from the existing OHL is also likely to be excluded.

b) The baseline sound levels used in the assessment are based on the lower quartile of the measured dataset. Consequently, the noisiest 75% of background LA90 sound levels (those which are more likely to contain OHL noise, if not already excluded in ‘a)’ above) have been filtered out of the baseline data.

1.2.3 The approach applies between Wylfa and near Gaerwen on Anglesey where the majority of the two OHL would be in parallel. The minimum separation between the two OHLs would be approximately 70 m and the maximum separation approximately 150 m.

1.2.4 This approach does not apply where the OHLs diverge between Gaerwen and Braint THH/CSEC in Anglesey, and between Tŷ Fodol THH/CSEC and Pentir Substation in Gwynedd. In these sections the new OHL does not parallel the existing OHL and the OHL study areas do not overlap at receptors. In these areas the operational noise assessment only takes account of the new OHL, although an in-combination assessment is undertaken to consider multiple Proposed Development sources including the operation of the Tunnel Head Houses and the new shunt reactor at Pentir Substation.

1.3 OHL DESIGN

1.3.1 The existing OHL is constructed of quad conductors on lattice pylons. The quad conductor system comprises a bundle of four ‘Zebra’ 28.6 mm diameter conductors in a box formation held 500 mm apart by square ‘spacers’. The quad conductor system is the largest and heaviest that National Grid uses and it can only be used on the largest and strongest pylons of the form used on the existing OHL and described in Chapter 3, Description of Proposed Development (**Document 5.3**). For the majority of its route, the existing OHL would remain unchanged.

1.3.2 The new OHL would be twin 41 mm diameter conductors on lattice pylons of a slightly different form from those on the existing OHL, as described in Chapter 3, Description of Proposed Development (**Document 5.3**). The twin conductor system comprises a bundle of two conductors side-by-side held 500 mm or 750 mm apart by straight spacers, or offset at an angle to each other, an arrangement which does not require spacers allowing each conductor to move independently of the other. The offset arrangement is the arrangement used on the existing twin-conductored OHLs in Gwynedd and is the most likely to be used on the new OHL. Some spans may not require spacers and others may require hoop spacers, as is the situation on twin OHLs in Gwynedd. The twin formation is lighter than the quad formation and is the largest, and hence quietest, conductor system that can be strung on the lighter, smaller lattice pylons proposed for the new OHL.

1.4 NOISE FROM HIGH VOLTAGE OHL

1.4.1 Although there are differences in the design of the two OHLs, overall the noise characteristics of the two OHLs will be similar. The following paragraphs set out similarities and differences and provide a rationale for the consideration of a combined effect.

1.4.2 The potential sources of noise from OHL fall into three principal categories:

- conductor noise (due to electrical stress);
- noise from insulators, fixtures and fittings (due to electrical stress); and
- noise induced by the wind.

1.4.3 As the detailed design of the two OHLs would be slightly different, the relative levels of these may also be slightly different.

1.4.4 Conductor noise can occur when corona occurs on the surface of the conductor due to the presence of surface contamination (e.g. dust, pollens, ash or bird droppings) or water droplets (due to rainfall). The conductor surface electrical gradient (electrical stress expressed as a maximum value, Emax) is a good indicator of likely conductor noise. Noise can occur from conductors when the corona inception level, commonly regarded to occur in the range 17 to 20 kV/cm in UK conditions, is exceeded. Many 400 kV OHLs across England and Wales operate at up to 18 kV/cm, and although they operate quietly for the majority of the time, the relatively high electric stress level means there is a relatively high probability of the corona inception level being exceeded under certain conditions. Because of the large geometrical arrangement of the conductor/pylon combinations on the existing and new OHLs, Emax is low or very low compared to the corona inception level (approximately 12.4 kV/cm on the existing OHL and 13.9 kV/cm on the new OHL). As both of these levels are significantly below the corona inception level for conductors, it means corona inception has a relatively low probability of occurring on either OHL.

1.4.5 Regarding the potential for noise from insulators, fixtures and fittings, all OHL lattice pylon designs utilise type-registered insulators, fixtures and fittings, which would be selected and sourced regardless of the specific OHL design for the Proposed Development. Insulators can be variants of glass, porcelain or polymeric designs. Fixtures and fittings include variants of spacers, arcing horns, vibration dampers, clamps, yoke plates, and identification plates.

1.4.6 Each of the noise source categories described above are likely to be present on both OHLs, with the same fundamental mechanisms potentially producing audible noise.

1.4.7 Due to the factors described above, overall noise from the two OHLs would be similar in terms of general character and occurrence. Because it is not possible to accurately quantify all noise types for the two OHLs, the basis of approach described in this appendix is that the two OHLs would exhibit similar noise characteristics which may be experienced by nearby receptors at the same time.

1.4.8 Table 16.2.4.1 below describes the noise characteristics for the existing and new OHL for each of these noise source categories. Noise from OHLs is described in more detail in section 16.8 (Potential Effects) of Chapter 16 Operational Noise (**Document 5.16**).

Table 16.2.4.1 Noise from OHL

Noise Source	Existing OHL	Proposed new OHL	Comparison
All OHL noise.	Considered on a qualitative basis as described in this document.	Included in the ES and considered on a quantitative and qualitative basis.	
Conductor Noise due to electrical stress	The TR(T)94 prediction model was developed for twin conductor systems where the electrical stress gradient is sufficiently high to produce noise. The model uses a ‘line of best fit’ and can be applied across a range of electrical stresses and twin conductor types. However, the quad conductor system on the existing OHL has a very low electrical stress level (12.4 kV/cm Emax), which falls outside the empirical data set used to derive the prediction model and hence it does not produce meaningful results if applied. Quad conductor systems do not produce noise of sufficient level to validate in the field, and are considered to be ‘practically quiet’.	Included in the ES and considered in the assessment on a quantitative basis. The TR(T)94 prediction model was developed for twin conductor systems where the electrical stress gradient is sufficiently high to produce noise. The model uses a ‘line of best fit’ and can be applied across a range of electrical stresses and twin conductor types. The twin conductor system proposed for the new OHL has a low electrical stress level (13.9 kV/cm Emax), the lowest of all twin conductor systems used by National Grid. This falls at the lowest end of the range to which the model can be applied.	Comparing the calculated Emax values provides a good indication of the likely noise performance of the two OHLs relative to each other. In terms of conductor noise, the existing OHL is likely to be quieter than the new OHL due to the lower electrical stress.

Table 16.2.4.1 Noise from OHL			
Noise Source	Existing OHL	Proposed new OHL	Comparison
Insulator, fixture and fitting noise due to electrical stress.	Although the mechanisms of noise production are well understood, there are no known reliable methods to model electrical noise from insulators, fixtures or fittings when in operation. Noise from insulators is likely to be the main source of noise from the existing OHL under certain conditions, principally due to salt deposition & moisture retention on the insulators (and, as noted above, the conductors are considered to be 'practically quiet'). Fixtures and fittings are not likely to be sources of noise. If required, insulators, fixtures and fittings can be cleaned or replaced to reduce noise levels.	Considered in the ES on a qualitative basis. Although the mechanisms of noise production are well understood, there are no known reliable methods to model electrical noise from insulators, fixtures and fittings from new OHLs. The likelihood of occurrence from the new OHL would be reduced through the selection of most appropriate types of insulator, fixtures and fittings. Fixtures and fittings would not be likely to be sources of noise. If required, insulators, fixtures and fittings could be cleaned or replaced to reduce noise levels.	The insulators, fixtures and fittings used on both OHLs must comply with 'type registration' requirements to be used on the transmission network. In terms of electrical noise from insulators, fixtures and fittings, the existing OHL is likely to be noisier than the new OHL.
Wind induced noise	Although the mechanisms of wind noise production are well understood, there are no known reliable methods to	Considered in the ES on a qualitative basis. Although the mechanisms of wind noise	All structures may produce noise when exposed to the wind. The insulators,

Table 16.2.4.1 Noise from OHL

Noise Source	Existing OHL	Proposed new OHL	Comparison
	model wind noise from conductors, pylon structure, insulators, fixtures and fittings when in operation. Wind induced noise is likely to occur from the existing OHL, especially in exposed locations. Tones may occur from the glass insulators under certain wind conditions. Wind induced noise may occur from the quad conductors and pylon structure under certain wind conditions. It is unlikely wind induced noise occurs from fixtures and fittings.	production are well understood, there are no known reliable methods to model wind noise from insulators, fixtures and fittings when in operation. Insulators, fixtures and fittings are designed and tested to reduce the occurrence of tonal noise due to the wind. Twin conductor systems are thought to be less prone to wind induced noise than quad systems. Noise from pylon structures is reduced through ensuring plates etc. are securely fixed and orifices closed with bolts or caps.	fixtures and fittings used on both OHLs must comply with type registration requirements to be used on the transmission network; this includes passing wind tunnel tests for insulators and some types of fittings. In terms of wind induced noise from conductors, insulators, fixtures and fittings the existing OHL would likely be noisier than the new OHL.

1.5 APPROACH TO ASSESSMENT

Assessment of noise from new OHL

1.5.1 Where all of the OHL infrastructure would be new or modified the assessment has been undertaken according to the method described in section 9 of the Operational Noise chapter and Appendix 16.3 (**Document 5.16.2.3**). This is carried out relative to a very low baseline that does not include a contribution from the existing OHL (as explained in paragraph 1.2.1 footnote 2). All receptors within the study area are attributed an initial significance of effect which could be major, moderate, minor or negligible.

1.5.2 Paragraph 4.6.11 in Chapter 16 Operational Noise (**Document 5.16**) states that:

'For operational noise, a major effect is considered to be significant, while a moderate effect may be significant, depending on the consideration of a number of factors. The factors may include the likely duration of the noise source (this is of relevance to both dry noise and wet noise from overhead lines, which do not occur all the time), taking into account the existing OHL and consideration of the context of the assessment (as referred to in BS 4142:2014). Professional judgement has been used when determining whether a potentially significant effect is significant or not, taking these factors into account.'

1.5.3 The assessment includes the transposition points where the new OHL transposes from one side of the existing OHL to the other. There are three transposition points where part of the existing OHL would be removed and two new OHLs, comprising twin conductors on lattice pylons, constructed. In these sections the two parallel OHLs of the Proposed Development have been modelled and assessed on a quantitative basis. As the existing OHL would be removed there would be no combined effect with the existing OHL in these sections. The assessment therefore takes full account of the likely effects of operational noise on receptors (categorised below as type 'P4' receptors) in these sections. The assessment for these receptors is worst case as the removal of the existing OHL is not considered.

Identification of receptors potentially exposed to a combined effect

1.5.4 Image 16.2.4.1 below shows the four scenarios that may occur in the parallel sections. In these sections where the existing OHL is not modified it would remain as quad conductors on lattice pylons. The new OHL and modified existing OHL would be twin conductors on lattice pylons. Receptor types P1, P2, P3 and P4 are all residential receptors within the 200 m study area.

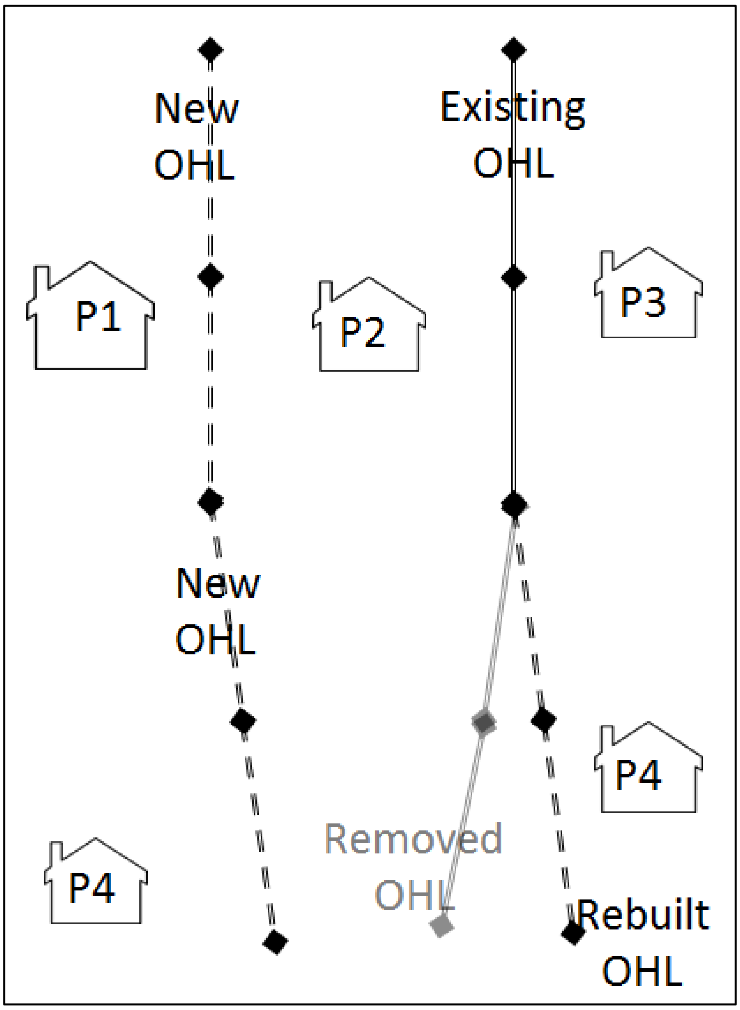


Image 16.2.4.1 Schematic of OHL Parallel Sections

1.5.5 This image shows a stylised example of two parallel OHLs and adjacent residential receptors categorised into types P1 to P4. The new OHL is on the left denoted by a dashed line. The existing OHL is on the right: in this example the top half remains unchanged (denoted by the solid line) while the bottom half represents part of a transposition point where the existing OHL is removed and replaced by a new section of OHL on a slightly different alignment (dashed line) and the old section of line is removed (greyed out). The minimum distance between the two OHLs would be approximately 70 m, the maximum distance approximately 150 m.

1.5.6 The first step of the assessment would consider the new OHL only. Receptors P1, P2 and P4 would be relatively more affected (potentially minor, moderate or major significance of effect) compared to P3 which would be relatively less affected (potentially minor or negligible significance of effect) due to its greater distance from the new OHL.

1.5.7 Each receptor type can be described as follows:

Receptor type P1

1.5.8 The new OHL would pass between a P1 receptor and the existing OHL. All P1 receptors are at least 100 m from the existing OHL, the closest the new OHL passes a P1 receptor would be approximately 35 m (Option A) or 29 m (Option B).

Receptor type P2

1.5.9 P2 receptors are residential properties that would be between the existing and new OHLs, and hence may be exposed to noise from more than one direction. The nearest P2 receptor is approximately 33 m from the existing OHL (Option A) or 28 m (Option B), and would be approximately 30 m from the new OHL (Options A and B).

Receptor type P3

1.5.10 The new OHL passes on the far side of the existing OHL to a P3 receptor which would be at least 110 m from this receptor type. The nearest P3 is approximately 40 m from the existing OHL.

Receptor type P4

1.5.11 P4 receptors are in the transposition areas where the existing OHL would be removed and two new OHLs would be constructed. In the transposition areas there are no receptors between the OHLs. As discussed above, there would be no combined effect due to the existing OHL on these receptors as the existing OHL would be removed. This receptor group is therefore not considered any further in this appendix.

Taking into account the existing OHL

1.5.12 This section presents worked examples for each receptor type, using actual receptors. All quoted distances are from the alignment centreline as shown on the Works Plans (**Document 4.4**) to the nearest façade of the relevant receptor.

1.5.13 The assessment of noise from the new OHL has assigned an initial magnitude and significance of effect to all receptors within the study area.

1.5.14 The assessment then considers the potential effect from the existing OHL. To do this, the existing OHL is assumed to have similar noise characteristics as the new OHL for the reasons set out above.

Worked example for receptor type P1

1.5.15 All P1 receptors are at least 100 m from the existing OHL. The new OHL would pass in between the receptor and the existing OHL. The closest P1 receptor is R4/01479 identified below, which would be approximately 35 m from the new OHL for Option A, or 29 m for Option B.

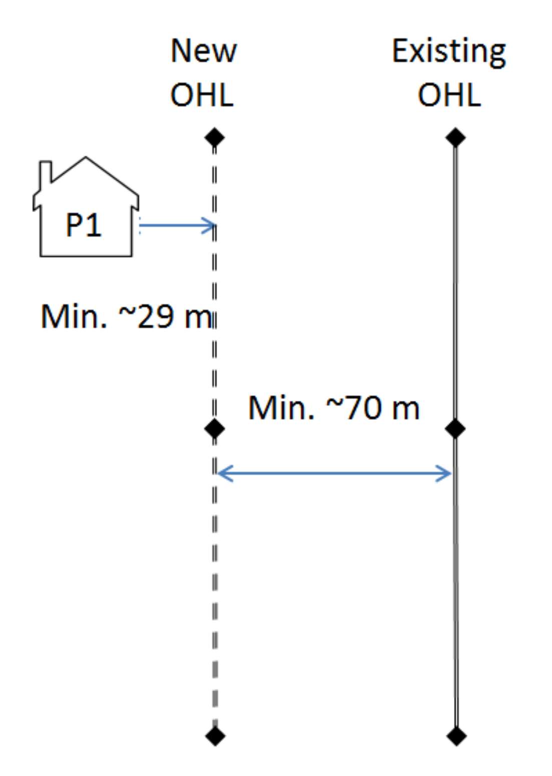
1.5.16 The assessment for the new OHL assesses the effect of the new OHL on P1 against a low or very low baseline that does not include a contribution from the existing OHL and a moderate, minor or negligible significance of effect may be reported.

1.5.17 The assessment then considers whether the presence of the existing OHL in combination with the predicted effect of the new OHL would result in a significant effect on a P1 receptor.

1.5.18 Considerations for P1 include:

- OHL noise would be incident from the same direction.
- The existing OHL would be further away from P1 than the new OHL.
- Due to distance attenuation, the existing OHL would have a relatively low contribution at P1 compared to the new OHL.
- The existing OHL is reasonably assumed to exhibit the same or similar noise characteristics as the new OHL.

Table 16.2.4.2 P1 Receptor Type.



The example above is receptor R4/01479. R4/01479 is approximately 100 m from the existng OHL, shown in green in the image on the right. Option A, shown in purple, would pass between R4/01479 and the exisitng OHL, passing 35 m from the receptor. For Option B (not shown) the new OHL would be closer, passing approximately 29 m from R4/01479.

1.5.19 P1 receptors closest to the existing OHL may be moderately affected by the new OHL. Due to distance attenuation, the existing OHL, which is further away, would likely have a negligible contribution at P1 compared to the new OHL. Due to the relatively low contribution from the existing OHL for that receptor, it is unlikely that when taking account of the existing OHL in the assessment it would conclude a greater significance of effect at the closest P1 receptors.

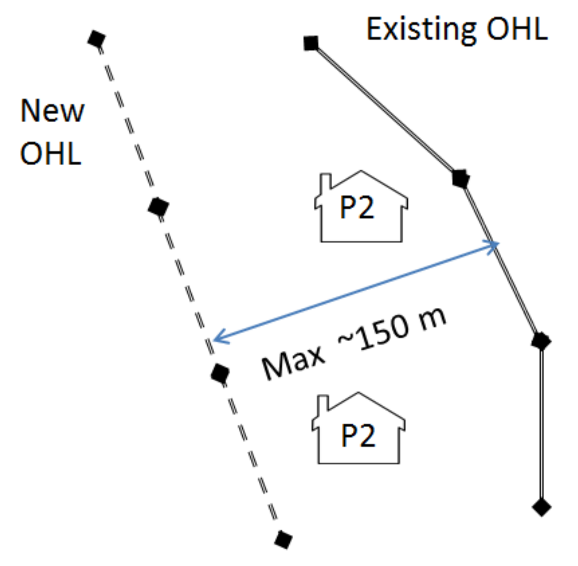
1.5.20 For P1 receptors further away from the existing OHL, or in an area with a higher baseline sound level, the significance of effect due to the new OHL would likely be negligible or minor. At greater distances the relative difference in noise contribution of each OHL reduces and the absolute contributions of both OHLs diminish. For P1 receptors, the likely magnitude of effect and therefore significance of effect would be lower due to the lower noise level and therefore when taking into account the existing OHL in the assessment it would not conclude a greater significance of effect at these receptors.

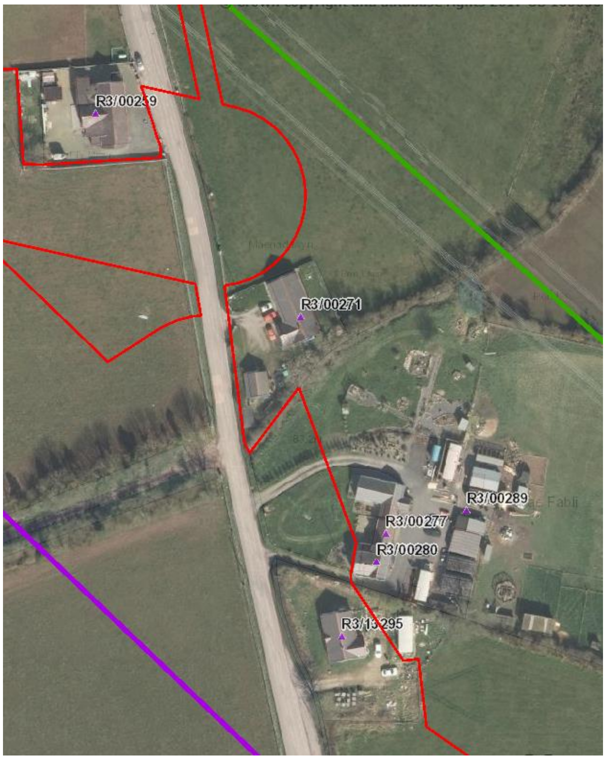
1.5.21 In conclusion, although it is possible that taking into account the existing OHL would result in a greater significance of effect being reported for the closest P1 receptor(s), this is unlikely for all but the very nearest of this receptor type.

Worked example for receptor type P2

1.5.22 P2 receptors are residential properties that would be between the existing and new OHLs. The closest P2 receptor would be approximately 30 m from the new OHL, the furthest approximately 90 m. The closest to the existing OHL is approximately 28 m (Option B) or 35 m (Option A), while the furthest P2 from the existing OHL is approximately 100 m. The maximum distance between the OHLs would be approximately 150 m.

Table 16.2.4.3 P2 Receptor Type.





The example above is for the receptors between the old and new OHLs. The southernmost property, R3/13295, would be approximately 30 m from the new OHL to the southwest (purple) and is 100 m from the exsitng OHL (to the northeast, green).

Table 16.2.4.3 P2 Receptor Type.
The other P2 receptors are different relative distances from the two OHLs.

1.5.23 The assessment considers the effects of the new OHL on P2 against a low or very low baseline that does not include a contribution from the existing OHL and a moderate or minor significance of effect may be reported.

1.5.24 Taking into account the existing OHL the assessor then considers whether the presence of the existing OHL in combination with the predicted effect of the new OHL would result in a higher significance of effect on a P2 receptor, and whether a moderate effect would be considered a significant effect in EIA terms.

1.5.25 Considerations for P2 include:

- OHL noise would be incident from two or more directions.
- The contributions of the two OHLs would be approximately equal, although this would vary depending on the relative distances to each OHL.
- The existing OHL is reasonably assumed to exhibit the same or similar noise characteristics as the new OHL.

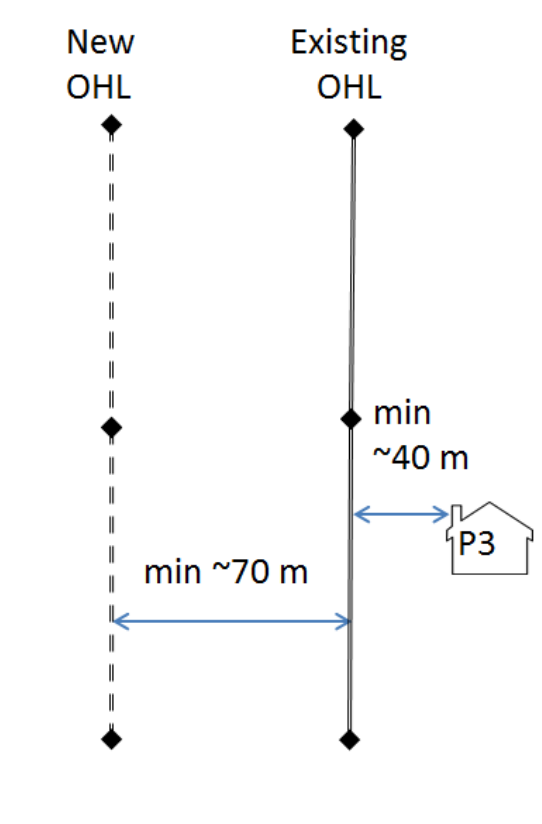
1.5.26 A P2 receptor may experience a moderate effect from the new OHL. The existing OHL would have a roughly equal effect at that receptor and the combined effect is likely to be incident from two or more directions.

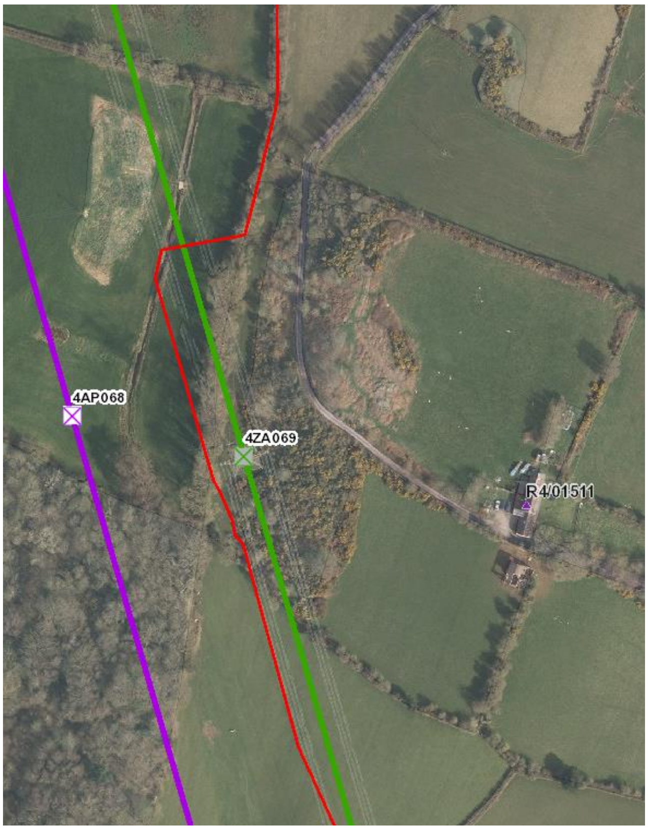
1.5.27 In conclusion, when taking into account the existing OHL on a P2 receptor it is likely that a greater significance of effect would be reported than for the new OHL in isolation and it is possible that effects would be deemed a significant effect in EIA terms. This is mainly due to the potential for the receptor to be affected by OHL noise from two or more directions and the approximately equal contributions from the existing and new OHLs.

Worked example for receptor type P3

1.5.28 All type P3 receptors are at least 40 m from the existing OHL. The new OHL would pass at least 150 m away on the far side of the existing OHL.

Table 16.2.4.4 P3 Receptor Type.





The example above is receptor R4/01511, which is approximately 95 m from the exsitng OHL, shown in green in the image. The new OHL, shown in purple, would pass on the far side of the exisitng OHL and would be approximatley 165 m from R4/01511.

1.5.29 The assessment considers the effect of the new OHL on a P3 receptor against a low or very low baseline that does not include a contribution from the existing OHL and a minor or negligible significance of effect may be reported.

1.5.30 Taking into account the existing OHL consideration is given to whether the presence of the existing OHL in combination with the predicted effect of the new OHL would result in a moderate significance of effect on a P3 receptor, and whether that moderate effect would be deemed significant.

1.5.31 Considerations for P3 include:

- OHL noise would be incident from the same direction.
- The existing OHL is nearer to P3 than the new OHL.
- Due to distance attenuation, the existing OHL would have a relatively high contribution at P3 compared to the new OHL, and this would not change as a result of the Proposed Development.
- The existing OHL is reasonably assumed to exhibit the same or similar noise characteristics as the new OHL.

1.5.32 For a P3 receptor closest to the two OHLs, the level of significance of effect due to the new OHL in isolation would be negligible or minor, due to the distance of the new OHL from the receptor.

1.5.33 Although it is possible that when taking into account the existing OHL a greater effect may be reported for a P3 receptor, due to the relatively low contribution from the new OHL, it is unlikely that this would be considered a significant effect in EIA terms even at the closest P3 receptors.

1.6 CONCLUSION

1.6.1 The assessment in Chapter 16 Operational Noise (**Document 5.16**) considers the potential for a greater significance of effect on receptors close to both the existing and new OHLs by taking into account the existing OHL where it remains unchanged by the Proposed Development.

1.6.2 Taking into account the existing OHL is likely to result in a greater significance of effect being reported for P2 receptors which would be located between the two OHLs. This is mainly due to the potential for P2 receptors to be affected by OHL noise from two or more directions and the approximately equal contributions from the two OHLs at these receptors.

1.6.3 It is possible that a greater significance of effect may be reported for the nearest P1 and P3 receptors; however the likelihood of this for the vast majority of receptors is decreased as they are located further away from the OHLs.

1.6.4 A greater significance of effect would not be reported for P4 receptors in the transposition areas as the existing OHL would be removed. The assessment includes both new and modified OHLs in these areas and is already a worst case assessment.