Torfichen Wind Farm

Technical Appendix 12.3

BESS Acoustic Assessment

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Date	6th October 2023
Ref	04726-6563848

Contents

1 Introduction

Torfichen Wind Farm (hereafter the Proposed Development) will incorporate a battery energy storage system (BESS) which is to be located within the developable area of the site. An assessment of the noise generated by these facilities has been undertaken in accordance with BS 4142:2014 + A1:2019 'BS 4142 Methods for Rating and Assessing Industrial & Commercial Sound'.

2 Planning Guidance & Standards

2.1 Planning Advice Note 1/2011: Planning and Noise

Within Scotland, the treatment of noise is defined in the planning context by 'Planning Advice Note (PAN) 1/2011: Planning and Noise' [1]. This details the Government's planning policies and how these are expected to be applied. The PAN provides advice on the role of the planning system in helping to prevent and limit the adverse effects of noise, stating that planning policies and decisions should aim to avoid noise giving rise to significant adverse impacts, whilst at the same time mitigating and reducing other adverse impacts on health and quality of life to a minimum.

2.2 Technical Advice Note: Assessment of Noise

The online documentation 'Technical Advice Note (TAN): Assessment of Noise' [2] provides guidance to assist in the technical evaluation of noise assessments and aims to assist in assessing the significance of impacts associated with various development. The guidance refers to a since superseded version of BS 4142 in terms of assessing the impact of new noise generating development on neighbouring residences (the latest and previous version of which are discussed herein) and provides various matrices as to the significance and sensitivity of residences resulting from the introduction of certain facilities. The document states, at Paragraph 3.20, that '*… the Scottish Government consider impacts are normally not significant (in a quantitative sense only) [if] the difference between the Rating and background noise levels is less than 5 dB(A), and that usually the threshold of minor significant impacts is when the difference between the rating and background noise levels is at least 5 dB(A); and commonly*

do not become sufficiently significant to warrant mitigation until the difference between the Rating and background noise levels is more than 10 dB(A)'. The documentation also refers to publications released by the World Health Organisation (WHO) in terms of general internal and external absolute noise criteria for the protection of health, amenity and sleep disturbance (see **Section 2.4**).

2.3 BS 4142 Methods for Rating and Assessing Industrial & Commercial Sound

BS 4142 [3] describes methods for rating and assessing sound of an industrial or commercial nature. Outdoor sound levels are used to assess the likely effects on people who might be inside or outside a residential property via the comparison of the pre-existing background noise levels with the predicted/modelled noise associated with the introduction of noise generating development, known as the 'rating' level, which also accounts for any distinguishing characteristics of the emitted sound.

To determine a value for the background noise level at a specific assessment point, a series of measurements are made at a location at, or representative of, a dwelling or receptor of interest. The standard requires that that the background noise measurements (dB $L_{A90,\,T}$ – the noise level exceeded for 90% of the time, or the lowest 10 % of noise, for the reference time period, T) should be measured during times when the noise source in question could or will be operating and that the individual measurement intervals should not normally be less than 15-minuites in length. The objective is then to determine a justifiable representative background noise level for time periods of interest via statistical analysis and/or observations of the data set collected. The standard states that the representative background noise level *'… should not automatically be assumed to be either the minimum or modal value'*.

The 'rating' (dB L_{Ar}) level is defined as the 'specific' sound level (dB L_{Aeq} – the average sound level) plus any corrections for the presence tones (i.e. whines, whistles or hums) or other impulsive character (i.e. banging, crashing or tapping) in the sound generated by the source in question. In instances where the source is unlikely to have a specific character at the assessment location then the 'rating' level can be assumed to equal to the 'specific' sound level. Where tones are present a correction of 2 to 6 dB

can be added to the 'specific' sound level to determine the 'rating' level and a further addition of up to 9 dB maybe added where the source is highly impulsive.

The defined representative background sound level(s) and rating level(s) are then compared to determine the possible impact but with consideration of the context in which the industrial or commercial sound source to be introduced presents itself in respect of other noise sources and the existing character of the area. **Table 12.3.1** provides a summary of expected impacts when comparing background and rating levels.

Table 12.3.1: BS 4142 Assessment Criteria

Rating Level	BS 4142 Assessment Criteria
Equal to or below background	'…an indication of the specific sound source having a low impact, depending on the context'.
Approximately +5 dB greater than the background noise level	'…an indication of an adverse impact, depending on the context'.
Approximately +10 dB or more greater than the background noise level	'…an indication of a significant adverse impact, depending on the context'.

Further to the above, it may not be appropriate or proportionate to undertake a full assessment in accordance with the BS 4142 standard, particularly when the sound level associated with the new source is particularly low at neighbouring receptors and/or is expected to be much lower than the existing background sound levels. The previous version of BS 4142 [4] stated that this version of the standard is not appropriate for use in instances where background and rating noise levels are very low and that '*… background noise levels below about 30 dB and rating levels below about 35 dB are considered to be very low*'.

2.4 World Health Organisation (WHO)

The WHO document Guidelines for Community Noise [5] provides guideline values on overall desirable internal and external noise levels for a variety of situations which are intended to minimise health impacts for certain environments. The guidance informs much of the standards and guidance relating to the protection of external and internal amenity in relation to the impacts of sound on residences such as BS 8233 [6].

The guidelines state that overall internal night-time sound levels should not be above 30 dB L_{Aeq} within bedrooms such that people may sleep with

minimal disturbance while the windows are open and it is stated that this corresponds to an external night-time noise level of 45 dB L_{Aeq}, when assuming a 15 dB attenuation in noise levels externally to internally. However, it is typically assumed that attenuation of sound through and open window is 10 – 15 dB and the application of the lower range of attenuation corresponds with an external night-time noise level of 40 dB L_{Aeq}. Furthermore, the guidance recommends that daytime external noise levels should not exceed 50 dB L_{Aeq} to protect the majority of people from being moderately annoyed and that levels '*…during the evening and night should be 5-10 dB lower than during the day*'.

The Night Noise Guidelines for Europe [7] are described as complementary to the Guidelines for Community Noise and recommend a limit of 40 dB L_{night}, outside. This is a yearly average night-time sound level which could potentially be exceeded on some nights of the year such that it is not necessarily inconsistent with the Guidelines for Community Noise if the sound levels do not exceed 45 dB L_{Aeq} on those nights.

The WHO Environmental Noise Guidelines for the European Region [8] was published in 2018 and provides '… recommendations for protecting human health from exposure to environmental noise originating from various sources: transportation (road traffic, railway and aircraft) noise, wind turbine noise and leisure noise' and make a series of strong or conditional noise exposure recommendations for each based on the weight of evidence available at the time the report was being drafted. The document does not consider noise from industrial sources as the specific features of these sources are usually very localised and vary between different kinds of development.

3 Background Noise Levels

A discussion of the existing sound environment is provided within Environmental Impact Assessment (EIA) Report **Chapter 12: Acoustic Assessment**.

The background noise levels adopted for the BS 4142 assessment provided herein are taken from the background noise levels detailed as part of the chapter for standardised 10 m height wind speeds below 3 $m.s^{-1}$. In the experience of RES these levels tend to closely correlate with that

determined as part of the BS4142 methodology. These are shown in **Table 12.3.2** and marked in **Section 5 - Figure 12.3.1**.

Table 12.3.2: Adopted Background Noise Levels, dB L_{A90}

Location	Daytime	Night-time
H20	27	23
H29	25	20

The determined background noise levels are only presented for H20 and H29 as these represent the locations of surveyed residences closest to the proposed BESS facilities.

The H20 background noise levels have been used to represent this specific location and the lower H29 background noise values have been used to represent the remaining locations considered most sensitive to noise resulting from the operation of the BESS facilities.

4 Predictions

A noise model of the proposed BESS facilities and the surroundings has been developed using CadnaA[1] noise modelling software. The ISO 9613-2 [9] noise propagation/prediction methodology has been employed to determine the noise levels resulting from the development at nearby residential properties, incorporating various assumptions which are considered appropriate for use here:

- The various plant to be installed as part of the development has been modelled as point sources with a height of 2 m and these sources are assumed to be operating at their maximum potential output for all time periods as a conservative basis of assessment;
- Semi-soft mixed ground conditions have been assumed (i.e. G=0.5). The ISO 9613-2 standard allows for a range of ground conditions to be applied, from porous ground conditions (G=1), which includes surfaces suitable for the growth of vegetation (i.e. farmland), to hard ground (G=0), such as paving, water and concrete. The area surrounding the site mainly consists of fields and farmland. As a result, the G=0.5 assumption is considered to provide a conservative basis for modelling purposes;
- The receptors have been assigned a height of 1.5 m;

[1] www.datakustik.com

- Atmospheric attenuation corresponding to a temperature and relative humidity of 10 ˚C and 70 % respectively, as defined within ISO 9613-1 [10] which represents relatively low levels of sound absorption in the atmosphere;
- The topography of the site and surroundings has been included within the noise model; and,
- The structures to be introduced as part of the BESS, which could potentially shield noise associated with the operation of the facility, have not been included within the prediction model.

Furthermore, ISO 9613-2 is a downwind propagation model. Where conditions less favourable to sound propagation occur, such as when the assessment locations are upwind of the Proposed Development, the sound levels would be expected to be less and the downwind predictions presented as part of this report would be regarded as conservative, i.e. greater than those likely to be experienced in practice.

The predominant sources of sound to be introduced as part of the Proposed Development are the cooling systems associated with the 32 BESS containers, 16 attached power conversion system (PCS) units and 8 associated transformers.

The assumed sound power data for the noisy equipment to be installed at the BESS facility are provided at **Table 12.3.3**. The overall levels correspond to the maximum expected sound output for each of the respective equipment, as advised by a candidate manufacturer. The propagation modelling therefore represents a conservative scenario and the actual sound levels would be expected to be less when the site is not operating at maximum capacity. The source noise data is further supplemented by the level of noise in octave bands, as provided at **Table 12.3.4**.

The combination of assumptions detailed above are considered to provide a conservative prediction/modelling basis overall. The various equipment has been located at the proposed BESS facility location and the results of the predictions at the various residences surrounding the site(s) are shown at **Section 5**.

Table 12.3.3: Overall Sound Power Levels, dB L_{WA}

Equipment & ID	Sound Power Level, dB L_{WA}
Battery Energy Storage System (BESS)	80
Power Conversion System (PCS)	96
Transformer (TRA)	79

Table 12.3.4: Octave Band Sound Power Levels

ID	Overall, dB L_{WA}	Centre of Octave Band (A-Weighted), Hz							
		63	125	250	500	1k	2k	4k	8k
BESS	80	68	72	73	73	75	70	60	53
PCS	96	70	80	91	88	89	88	85	79
TRA	79	56	68	70	76	73	69	64	55

The sound emitted by the various equipment to be introduced as part of the battery storage facilities can have distinctive tonal character (i.e. a whine, whistle or hum). Under the subjective method described in BS 4142, a correction of 2 dB has been applied to account for this feature. However, the assessed specific and rating noise levels detailed in **Section 5** below are particularly low and potential tonal noise in the sound emitted from the various plant may well be masked by existing sources of sound in the area.

5 Assessment

The predicted specific sound levels and the corresponding rating level at the most sensitive properties located nearest to the BESS facilities are shown in **Table 12.3.5** for day and night-time periods respectively. The rating level is compared to the background sound levels detailed at **Section 3** in order to provide the associated impact at each location.

The assessment indicates that the predicted noise impact from the proposed BESS facility at the nearest neighbouring residences is generally low for daytime periods and low-to-moderate for night-time periods, with the exception of H19, where the impacts are expected to be moderate and major for daytime and night-time periods respectively.

In almost all instances, the predicted specific, rating and background noise levels are especially low, nearly 10 dB or more lower than the point at which the 1997 version of BS1412 considered the standard was not appropriate for use (see **Section 2.3**). Furthermore, H19 will be financially

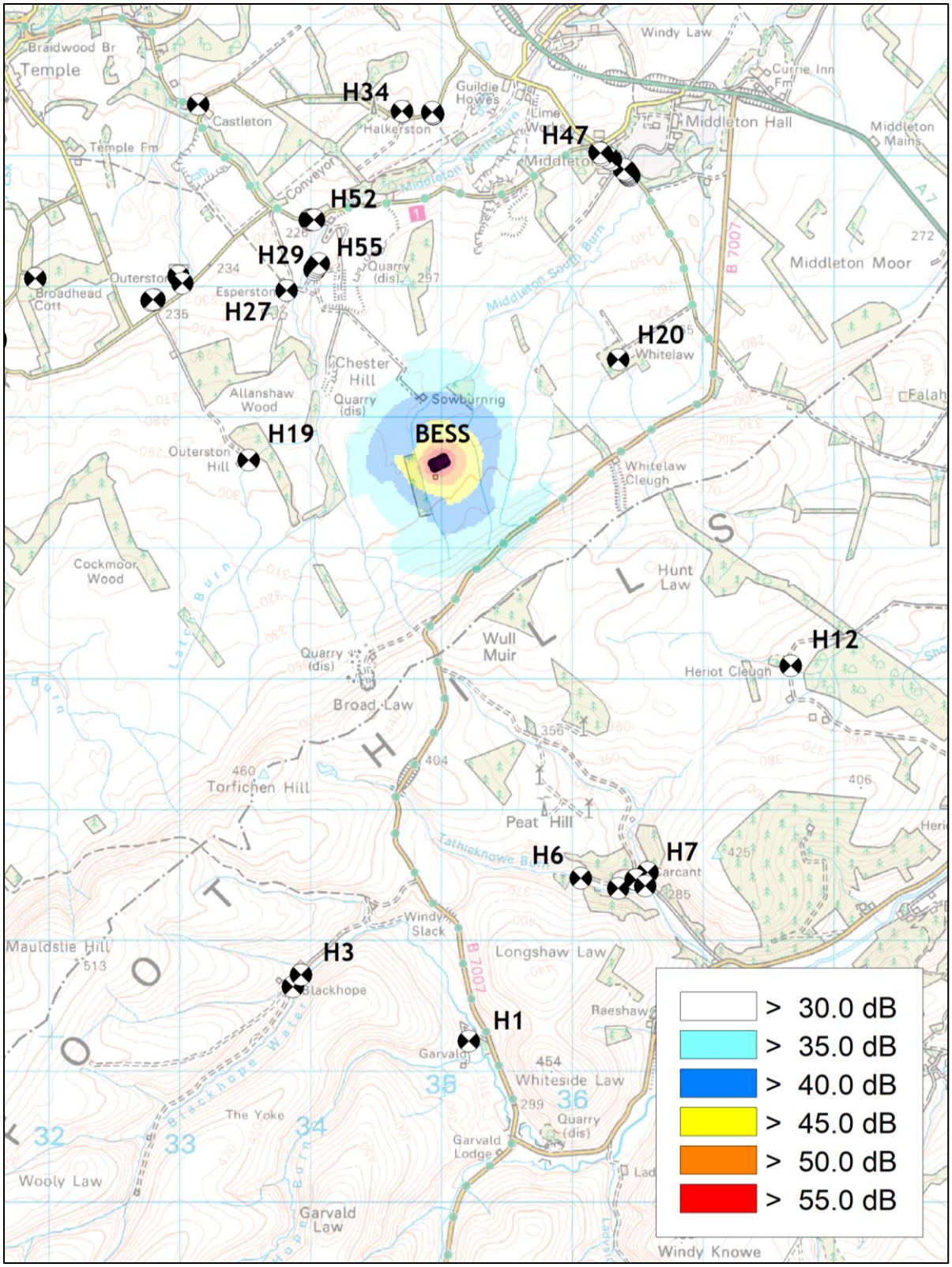
involved with the Proposed Development and it is considered that the respective moderate to major impacts predicted at this property can be considered acceptable in this context. As a result of these factors, the overall noise impact associated with the BESS facilities is considered acceptable in terms of overall maximum levels predicted and should not be refused planning permission on grounds of noise.

Table 12.3.5: BS 4142 Assessment

House ID	Specific Level, dB L_{Aeq}	Rating Level, dB L_{Ar}	Background Level, dB L_{A90}	L_{Ar} - L_{A90}, dB	Potential Impact
Daytime					
H19	29	31	25	6	Moderate
H20	24	26	27	-1	Low
H27	23	25	25	0	Low
H12	12	14	25	-11	Negligible
H47	18	20	25	-5	Low
H55	23	25	25	0	Low
H52	21	23	25	-2	Low
H34	18	20	25	-5	Low
H29	23	25	25	0	Low
Night-time					
H19	29	31	20	11	Major
H20	24	26	23	3	Minor
H27	23	25	20	5	Moderate
H12	12	14	20	-6	Low
H47	18	20	20	0	Low
H55	23	25	20	5	Moderate
H52	21	23	20	3	Minor
H34	18	20	20	0	Low
H29	23	25	20	5	Moderate

An illustrative sound footprint for the Proposed Development showing the predicted specific sound level for daytime and night-time periods is provided in **Figure 12.3.1**.

Figure 12.3.1: Specific Noise Level Contour Plot, dB L_{Aeq}



Additionally to the above, the general requirements of WHO guidelines and BS 8233 for internal and external levels (see **Section 2.4**), whilst not strictly applicable as assessment criteria for the site, are met by a substantial margin.

An open window typically provides 10 – 15 dB of sound attenuation externally to internally and the resultant predicted internal noise levels due to the battery storage facilities would therefore be calculated to be a maximum of 21 dB L_{Aeq} within the closest residential location. This is nearly 10 dB lower than the suggested WHO/BS8233 values to minimise the potential for sleep disturbance internally.

Furthermore, the sound associated with the introduction of the BESS facilities will be very different in nature to that generated by the turbines forming the main part of the site and for which different assessment criteria and methodologies apply respectively. As a result, a comparative cumulative noise assessment is not strictly possible or appropriate. Nevertheless, predicted noise levels from the BESS facilities will be 10 dB or more lower than the maximum sound levels generated by the wind turbines which is a positive indication that significant cumulative impacts would be avoided in any case.

6 Conclusions

An acoustic impact assessment of the battery energy storage system (BESS) facilities, to be installed as ancillary to the Proposed Development, has been undertaken with reference to BS 4142:2014 + A1:2019 'BS 4142 Methods for Rating and Assessing Industrial & Commercial Sound'.

The assessment demonstrates that the development would not be considered significant in terms of current planning policy due the particularly low levels of predicted sound potentially generated by the facilities at neighbouring properties. The predicted noise levels will easily meet absolute limiting values alluded to within a previous version of BS 4142 and the guideline limiting requirements referenced within WHO guidance and BS 8233.

7 References

[1] Scottish Government (March 2011) Planning Advice Notice 1/2011: Planning and Noise

[2] Scottish Government (March 2011) Technical Advice Note: Assessment of Noise

[3] The British Standards Institution (2019) BS 4142:2014 + A1:2019 Methods for Rating and Assessing Industrial and Commercial Sound

[4] The British Standards Institution (1997) BS 4142:1997 Rating Industrial Noise Affecting Mixed Residential and Industrial Areas

[5] World Health Organisation (2000) Guidelines for Community Noise

[6] The British Standards Institution (2014) BS 8233:2014 Guidance on sound insulation and noise reduction for buildings

[7] World Health Organisation (2009) Night Noise Guidelines for Europe

[8] World Health Organisation (2018) Environmental Noise Guidelines for the European Region

[9] International Organisation for Standardisation (December 1996) ISO 9613-2:1996 Acoustics - Attenuation of Sound During Propagation Outdoors - Part 2: General Method of Calculation

[10] International Organisation for Standardisation (June 1993) ISO 9613-1:1993 Acoustics - Attenuation of Sound During Propagation Outdoors - Part 1: Calculation of the Absorption of Sound by the Atmosphere