Clune Wind Farm

Technical Appendix 11.3

BESS Acoustic Assessment

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Contents

1 Introduction

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 The guidance refers to a since superseded version of BS 4142 in terms of assessing the impact of new noise generating development on neighbouring residences (the latest and previous version of which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 sound 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 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-minutes 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 11.3.1** provides a summary of expected impacts when comparing background and rating levels.

Table 11.3.1: 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

Existing background and ambient sound levels have been taken from the Glen Kyllachy Wind Farm Environmental Assessment [9]. This assessment references the baseline noise survey data measured at properties in the vicinity of the (now operational) Glen Kyllachy Wind Farm that was obtained by RWE npower in 2005 in support of the Farr Wind Farm development. Two of the survey locations are in the vicinity of the proposed Clune BESS development and are concordant with the properties identified for this assessment. The relevant survey locations are Asgard and Easter Woodend and are identified in **Figure 11.2**.

These baseline measurements were taken prior to the construction of the Farr and Glen Kyllachy Wind Farms and the use of this data ensures that the measured baseline noise levels are not affected by noise from existing turbines.

The assessment states that the noise environment in the surrounding area is generally characterised by 'natural' sources, such as wind disturbed vegetation, birds etc. It was noted that noise from water flowing in water courses was also noted at several locations, particularly at Asgard, where noise from the River Findhorn was noted as being audible. Road traffic noise on the A9, B851, B9154 and / or other local roads were also noted at the majority of the monitoring locations. Other sources of noise noted include intermittent local road and farming activities in the area.

Therefore, for the purposes of this assessment it would be prudent to take the results of the baseline survey at Easter Woodend instead of Asgard as these baseline measurements were not as impacted by the watercourses in the area.

Details of the survey including the methodology, results and equipment used are provided within the assessment.

The background sound levels adopted for the BS 4142 assessment provided herein are taken from the background sound levels detailed as part of the Farr and Glen Kyllachy Wind Farms assessments for standardised 10 m height wind speeds below 3ms^{-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 11.3.2** and in **Figure 11.2**.

Table 11.3.2: Adopted Background Noise Levels at the nearest receptors, dB L_{A90}

Location	Daytime	Night-time
H21	25	22
H22	25	22
H23	25	22
H24	25	22
H26	25	22
H41	25	22

The determined background noise levels are presented for the six nearest residential receptors (H21, H22, H23, H24, H26 & H41) as these represent the locations of residences closest to the proposed 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 [10] 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 2m 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 1.5m;
- Atmospheric attenuation corresponding to a temperature and relative humidity of 10 °C and 70 % respectively, as defined within ISO 9613-1 [11] 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

[1] www.datakustik.com

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 64 BESS containers, 32 attached power conversion system (PCS) units, 16 associated transformers and two substation transformers.

The relevant assumed sound power data for the equipment to be installed at the BESS facility are provided at **Table 11.3.3**. The overall levels correspond to the maximum expected sound output for each of the respective plant, 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 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 in **Section 5**.

Table 11.3.3: Overall Sound Power Levels, dB L_{WA}

Equipment & ID	Sound Power Level, dB L_{WA}
Battery Energy Storage System (BESS)	68
Power Conversion System (PCS)	80
PCS Transformer (TRA)	76
Substation Transformer (SUB)	93

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 in the assessment 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 11.3.5** for day and night-time periods respectively. A penalty of 2dB for distinctive tonal character has been added to the specific sound level in order to determine the rating level. 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 low for daytime and night-time periods.

In all instances, the predicted specific, rating and background noise levels are especially low, at least 5 dB lower than the point at which the 1997 version of BS4142 considered the standard was not appropriate for use (see **Section 2.3**). 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 11.3.5: 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					
H21	9	11	25	-14	Low
H22	16	18	25	-7	Low
H23	15	17	25	-8	Low
H24	15	17	25	-8	Low
H26	14	16	25	-9	Low
H41	12	14	25	-11	Low
Night-time					
H21	9	11	22	-11	Low
H22	16	18	22	-4	Low
H23	15	17	22	-5	Low
H24	15	17	22	-5	Low
H26	14	16	22	-6	Low

House ID	Specific Level, dB L_{Aeq}	Rating Level, dB L_{Ar}	Background Level, dB L_{A90}	L_{Ar} - L_{A90}, dB	Potential Impact*
H41	12	14	22	-8	Low

* Based on BS 4142 Assessment Criteria

An illustrative sound footprint for the Proposed Development showing the predicted specific sound level for daytime and night-time periods is provided in **Figure 11.2**.

Additionally, 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 6 dB L_{Aeq} within the closest residential location. This is nearly 24 dB lower than the suggested WHO/BS8233 values to minimise the potential for sleep disturbance internally.

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.

Further to the above, the Environmental Health Officer (EHO) dealing with the development requested that sound levels associated with the BESS facility, in the 100 Hz 1/3 octave band, should not be higher than 30 dB(Z)[2]. This level is equivalent to approximately 11 dB(A) in the 100 Hz 1/3 octave band, which is close to the average threshold of perception for human hearing. Designing to achieve such a low level externally to a residence can be particularly challenging and is an atypical requirement in

[2] dB(A) is the A weighting frequency and is representative of what humans are capable of hearing. dB(Z) is the Z weighting frequency and is the flat frequency response of 8Hz to 20kHz, this is the actual noise that is made with no weighting at all for the human ear.

planning terms for a development of this kind. Furthermore, existing ambient/background sound levels in this frequency band will often exceed this threshold as a result of pre-existing sources, including that from wind induced sound.

Nevertheless, the assessment indicates that a level of 22 dB(Z) in the 100 Hz 1/3 octave band at the nearest neighbouring residence, H22 – Iarr Tigh as a result of the introduction of the BESS facility, is well below the suggested 30 dB(Z) level and even further below more commonly applied criteria, such as that provided within NANR45 - Procedure for the Assessment of Low Frequency Noise Complaints [12].

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 impact of the BESS, as part of the Proposed Development, would not be considered significant in terms of current planning policy due to the particularly low levels of predicted sound at neighbouring properties potentially generated by the facilities. The predicted noise levels will easily meet absolute limiting values referenced within WHO guidance and BS 8233. Moreover, the sound levels associated with the BESS facility in the 100 Hz 1/3 octave band would not be higher than 30 dB(Z), as requested by the Environmental Health Officer (EHO) dealing with the development.

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] Glen Kyllachy Wind Farm, Environmental Assessment – Noise & Vibration, 13_02441_FUL-VOL_4__CHAPTER_14_14A_NOISE___VIBRATION_REPORT-53304, Hoare Lea Acoustics, 28 May 2013

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

[11] 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

[12] University of Salford (February 2005) NANR45 - Procedure for the Assessment of Low Frequency Noise Complaints