BRYMBO SOLAR FARM

NOISE ASSESSMENT

Acoustics Report A2244 R01

7th February 2025

Report for:

Dulas Ltd
Unit 1 Dyfi Eco Park
Machynlleth
Powys
SY20 8AX

FAO Rachel Kennedy

Prepared by:
Gavin Irvine BSc(Hons) MIOA
Director

Checked by:
David O'Neill BSc MSc CEng MIOA
Director

Issue/Revision number:

A2244 R01

Date:

07/02/2025

Ion Acoustics Ltd
Georges House
9 – 10 Bath Street
BRISTOL
BS1 6HL

www.ionacoustics.co.uk

0117 911 3765
mail@ionacoustics.co.uk

Consultants in Acoustics Noise & Vibration
Registered in England & Wales No. 5920418

Contents

1 Introduction 1
2 Proposed Scheme Details 1
3 Planning Policy and Other Guidance on Noise 3
3.1 Local Authority Consultation Response 3
3.2 Technical Advice Note 11: Noise (1997) (TAN 11) 3
3.3 BS 4142:2014 +A1: 2019 – Assessment Principles 4
3.4 BS 8233: 2014 and WHO criteria 5
4 Noise Limits 5
5 Operational Noise Predictions 6
5.1 Noise Data 6
5.2 Noise Contours 6
5.3 Predicted Noise Levels at Receptors 7
5.4 Uncertainty and Context 8
6 Summary 9

Appendix A: Glossary of Acoustic Terms
Appendix B: Local Authority Consultation Response
Appendix C: Manufacturer's Data Sheets

1 Introduction

Ion Acoustics is appointed by Dulas Ltd. to carry out a noise assessment for a proposed solar farm on land off Brymbo Road in Brymbo, near Wrexham.

Solar farms are not normally considered noisy and often no noise is audible away from the site boundary. However, various electrical components, such as inverters and transformers, can emit low noise levels which can be audible over shorter distances. Following the submission of the planning application, the public protection officer at Wrexham County Borough Council (WCBC) commented that a noise assessment was required.

This report provides the noise assessment. Computer modelling has been used to calculate operational noise levels at the nearby sensitive residential receptors. Noise levels from the development are compared with absolute noise limits set to protect residential amenity. A glossary of acoustic terms is given in Appendix A.

In addition, some noise can occur during the construction phase from the construction of access tracks and hard standings, the installation of the panels themselves and from transport movements on the local roads. Any construction noise however will be temporary and will occur during daytime hours which will be limited by the local authority.

2 Proposed Scheme Details

The scheme is a small-scale community development for the Brymbo Heritage Trust located off Brymbo Road, to the south-west of the village and north-west of Wrexham. The development is approximately 200m north of the existing Brymbo Grid Substation.

A satellite image of the site is given in Figure 1 with the red line boundary and the assessment positions considered in this report. The assessment positions do not include every residential property. However, all the closest addresses are included.

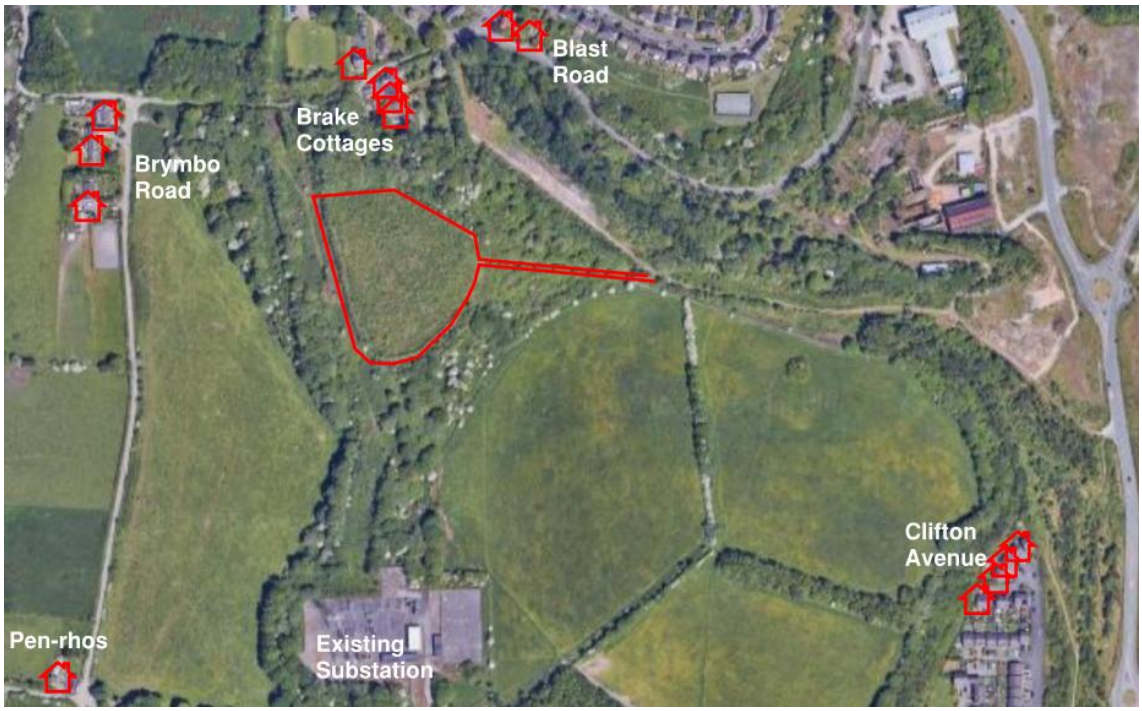


Figure 1 – Satellite image of the proposed location © Google

The assessment positions are also shown below in Table 1 including the approximate Ordnacne Survey grid coordinates and the distance to the main boundary of the site (note that this is not distance to the actual noise generating elements).

Table 1: Noise Assessment Positions

Assessment Position	Approximate OS Grid Coordinates		Distance to the Site Boundary (m)
	Easting	Northing	
Brake Cottages	329055	353610	58
Blast Road	329142	353668	150
Clifton Avenue	329509	353240	456
Pen-rhos	328789	353167	340
Brymbo Road	328823	353548	165

The proposed development includes the following noise-generating equipment:

- 5 No. String Inverters located on the underside of specific solar panels
- 1 No. 100kW Battery with a built-in PCS (Power Conversion System)

These items are the only operational noise sources of interest. The nature of solar farms is such that electricity is only generated during daylight hours. Note however that the battery unit may operate at any time (charging or discharging). The solar electricity generation may also extend in times considered part of the night during the summer, i.e. early mornings before 0700hrs, and also during the evening period after 1900hrs. Note that the early morning periods during spring and summer often coincide with the dawn chorus so there are elevated noise levels in any case.

A site layout plan is presented in Figure 2 below, with the battery location shown in green.

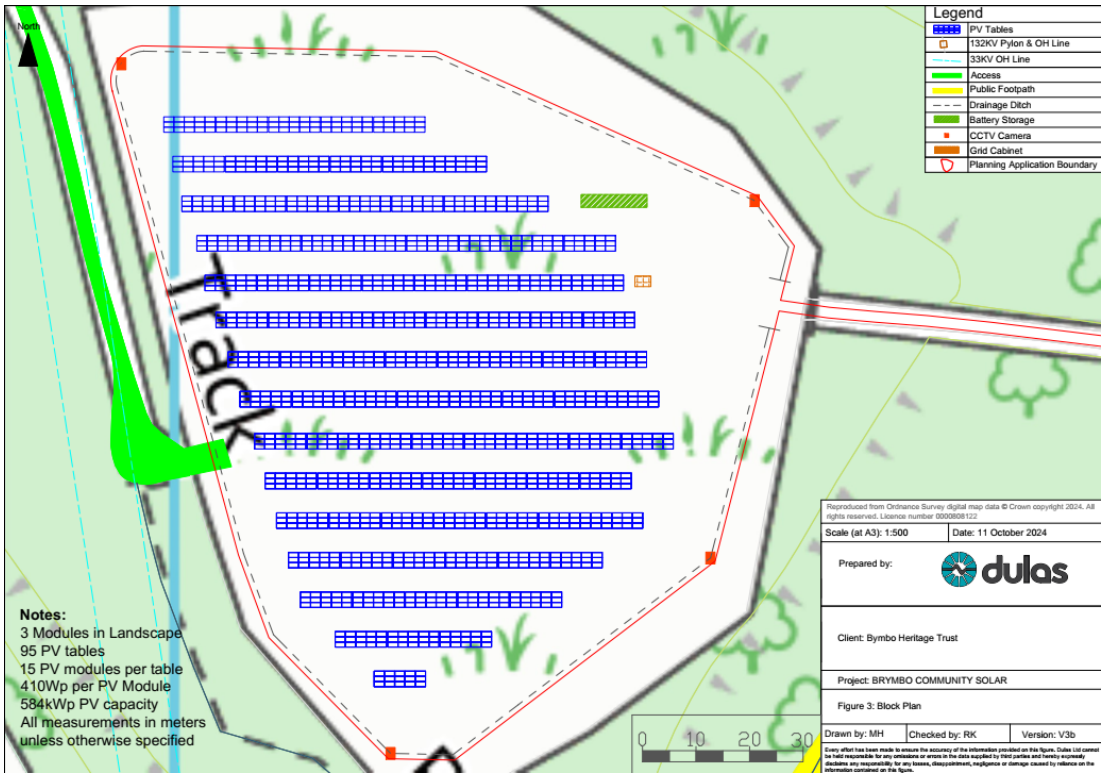


Figure 2 – Site Layout Plan (Dulas)

The string inverters are not shown above but they will be installed behind the solar panels at the end of the rows in the following locations:

1. 329067, 353414
2. 329084, 353455
3. 329088, 353469
4. 329084, 353485
5. 329058, 353506

Therefore, the panels would shield noise from the string inverters. The orientation of the panels ensures the most shielding to the south, whereas other directions are less shielded. The shielding effect of the panels is included in the computer model.

3 Planning Policy and Other Guidance on Noise

3.1 Local Authority Consultation Response

A fairly detailed consultation response was provided from Ian Jones, head of public protection for Wrexham. This included the statement:

> *Due to the presence of residential receptors near the proposal, this section requires a noise report so as to make informed comments. I recommend that this report be required predetermination.*

The full consultation response is provided in Appendix B. The response makes reference to "*large technical infrastructure applications*" and wind farm developments but note this is a small scale development with only a few low-level noise sources; it is not a large infrastructure application.

The consultation response also suggested a noise survey but in consideration of the low predicted noise levels and following a telephone conversation with Toby Zorn, Environmental Health Specialist Officer at WCBC, it was agreed that a desktop study (this report) could be submitted for consideration.

3.2 Technical Advice Note 11: Noise (1997) (TAN 11)

The current planning guidance in respect of planning and noise in Wales is TAN 11. This guidance document was referenced in WCBC's consultation response. In terms of "noise generating developments", the document states:

"Local planning authorities must ensure that noise generating development does not cause and unacceptable degree of disturbance. They should also bear in mind that if subsequent intensification of change of use results in greater intrusion, consideration should be given to the use of appropriate conditions."

Noise characteristics and levels can vary substantially according to their source and the type of activity involved. In the case of industrial development, for example, the character of the noise should be taken into account as well as its level. Sudden impulses, irregular noise or noise which contains a distinguishable continuous tone will require a special consideration."

The assessment requirements described above can be addressed by a BS 4142:2014 assessment, as this takes into account the level and character of a noise. The standard is most often used for development of this nature and is described below.

3.3 BS 4142:2014 +A1: 2019 – Assessment Principles

The standard method for assessing noise of an industrial nature affecting housing is British Standard BS 4142 "Method for rating and assessing industrial and commercial sound". A BS 4142 assessment is typically made by determining the difference between the industrial noise under consideration and the background sound level as represented by the L_{A90} parameter, determined in the absence of the industrial noise. The L_{A90} parameter is defined as the level exceeded for 90% of the measurement time, representing the underlying noise in the absence of short-duration noise events such as dog barks or individual cars passing.

The industrial noise under consideration is assessed in terms of the ambient noise level, L_{Aeq}. Still, a character correction penalty can be applied where the noise exhibits certain characteristics such as distinguishable tones, impulsiveness or if the noise is distinctively intermittent. The ambient noise level, $L_{Aeq,}$ is defined as the steady-state noise level with the same energy as the actual fluctuating sound over the same time period. It is effectively the average noise level during the period. The industrial noise level (L_{Aeq}) with the character correction (if necessary) is known as the rating level, L_{Ar}, and the difference between the background noise and the rating level is determined to make the BS 4142 assessment. The standard then states:

a) *"Typically, the greater the difference, the greater the magnitude of the impact.*

b) *A difference of around +10dB or more is likely to be an indication of a significant adverse impact, depending on the context.*

c) *A difference of around +5dB is likely to be an indication of an adverse impact, depending on the context.*

d) *The lower the rating level relative to the measured background sound level, the less likely it is that the specific sound will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context."*

The standard outlines several methods for defining appropriate 'character 'corrections' to determine the rating levels to account for tonal qualities, impulsive qualities, other sound characteristics and/or intermittency.

The standard also highlights the importance of considering the context in which a sound occurs. The standard indicates that factors including the absolute sound level, the character of the sound, the sensitivity of the receptor and the existing acoustic character of the area should be considered when assessing the context and the noise impact. The absolute sound level is of particular importance where the measured background sound levels are low, typically taken as L_{A90} 30dB and below. Regarding low sound levels, the standard states:

"Where background sound levels and rating levels are low, absolute levels might be as or more relevant than the margin by which the rating level exceeds the background. This is especially true at night."

Therefore an assessment against absolute noise limits can be carried out and is consistent with BS 4142 guidance.

3.4 BS 8233: 2014 and WHO criteria

British Standard BS 8233: 2014[1] and the World Health Organisation (WHO) also provide external noise criteria to protect residential amenity. The criteria are detailed in Table 2 below.

Table 2: WHO / BS 8233: 2014 Guideline Noise Levels

Location	Critical Health Effect	07:00 to 23:00	23:00 to 07:00
Outside Bedroom Windows	Sleep Disturbance (Windows Open)	--	45dB $L_{Aeq,\ 8hours}$ (1)
Amenity Spaces (Gardens / Patios)	Moderate Annoyance Serious Annoyance	50dB $L_{Aeq,\ 16\ hours}$ (2) 55dB $L_{Aeq,\ 16\ hours}$ (2)	--
Notes: (1) From WHO Community Noise Guidelines (1999) (2) BS 8233: 2014 and WHO Community Noise Guidelines			

The WHO guideline of 45 dB $L_{Aeq,\ 8hr}$ represents an 8-hour L_{Aeq} outside noise-sensitive rooms to prevent sleep disturbance. The WHO limit is a level of 1m from the façade. Therefore, the equivalent free field level would be approximately 3dB lower, 42 dB L_{Aeq}.

The daytime limits apply to relatively anonymous noises without character and are commonly applied to traffic noise.

4 Noise Limits

A baseline noise survey has not been conducted for this site, but it is thought that background noise levels are fairly low, as it is a semi-rural location, albeit on the outskirts of a larger urban area. In instances of low background noise levels, BS4142 indicates that assessment using absolute noise limits might be more appropriate than a relative assessment of the specific noise against the measured background sound level.

To ensure the proposed development is not a significant or prohibiting factor in achieving the relevant WHO guideline values at sensitive receptors, noise generated by the development would need to be approximately 10dB below the night-time guidance levels in Table 2. These levels would ensure that the proposed scheme would not contribute to any exceedance of the WHO night-time limits and would have low noise levels.

Therefore, a limit of 32 dB L_{Aeq} (free-field) is proposed for noise from the solar farm at residential receptors. This level is set for both day and night, although daytime background noise levels are expected to be higher than this. During the daytime, even in rural areas, it would be rare for the background noise to be less than 32 dB L_{Aeq}. A limit of 32 dB L_{Ar} in the daytime is also likely to be consistent with a low impact rating in accordance with BS 4142.

1 British Standards Institution (2014) BS 8233:2014: Guidance on sound insulation and noise reduction for buildings

5 Operational Noise Predictions

A noise model has been constructed using IMMI[2] noise modelling software to predict noise levels to the nearest noise-sensitive receptor locations. Within the modelling software, the propagation of noise has been calculated in accordance with BS ISO 9613-2[3] with the following input parameters:

- Downwind propagation (noise levels under crosswind and upwind conditions will be less),
- Soft ground between the noise source and the receiver locations (G = 1.0)
- Ambient air temperature of 10°C and 70% Relative Humidity; and,
- Receptor height at 4m to represent bedroom windows and to reduce the influence of screening
- Barriers and screening influence, including the effect of the solar panels calculated in accordance with ISO 9613-2.

5.1 Noise Data

The noise data used in calculations are provided below for all noise sources in the model. If different equipment is used, it will be necessary to check that noise levels can meet the same noise limit, but in any case any different plant would only be selected if it can meet the noise limits. Data sheets are provided in Appendix C.

String Inverters

The solar panels will require a total of five string inverters. These will be mounted on the underside of the solar panels. A typical model is the Fronius Tauro Eco 99/100-3-D/P unit with the manufacturer's sound power level of 64.1 dB L_{WA}. This broadband value has been used in the model.

Battery Cabinet

Noise data for a Lemax 100kW battery cabinet has been assumed. The manufacturer's data indicates a noise level of 75 dB (index not stated). Subsequent correspondence with Lemax has confirmed that this refers to a sound pressure level of 75 dB(A) at 1m from the cabinet. This has been converted to a sound power level of 83 dB L_{WA} assuming hemi-spherical radiation. The unit has a vent on the front side of the unit for the cooling fans. To minimize noise radiation the vent must be positioned facing south away from Brake Cottages.

5.2 Noise Contours

In the first instance, the predictions as a noise contour plot in Figure 3 below, showing the predicted specific noise levels (dB L_{Aeq}) and the nearest houses. The contours assume that all equipment is running at full capacity, which is only likely to occur in the middle of a sunny day when all plant is operating at 100% and the cooling fans for the battery cabinet are in operation.

2 IMMI noise mapping https://www.immi.eu/en/noise-mapping-with-immi.html
3 BS ISO 9613-2: 2024 Acoustics – Attenuation of sound during propagation outdoors

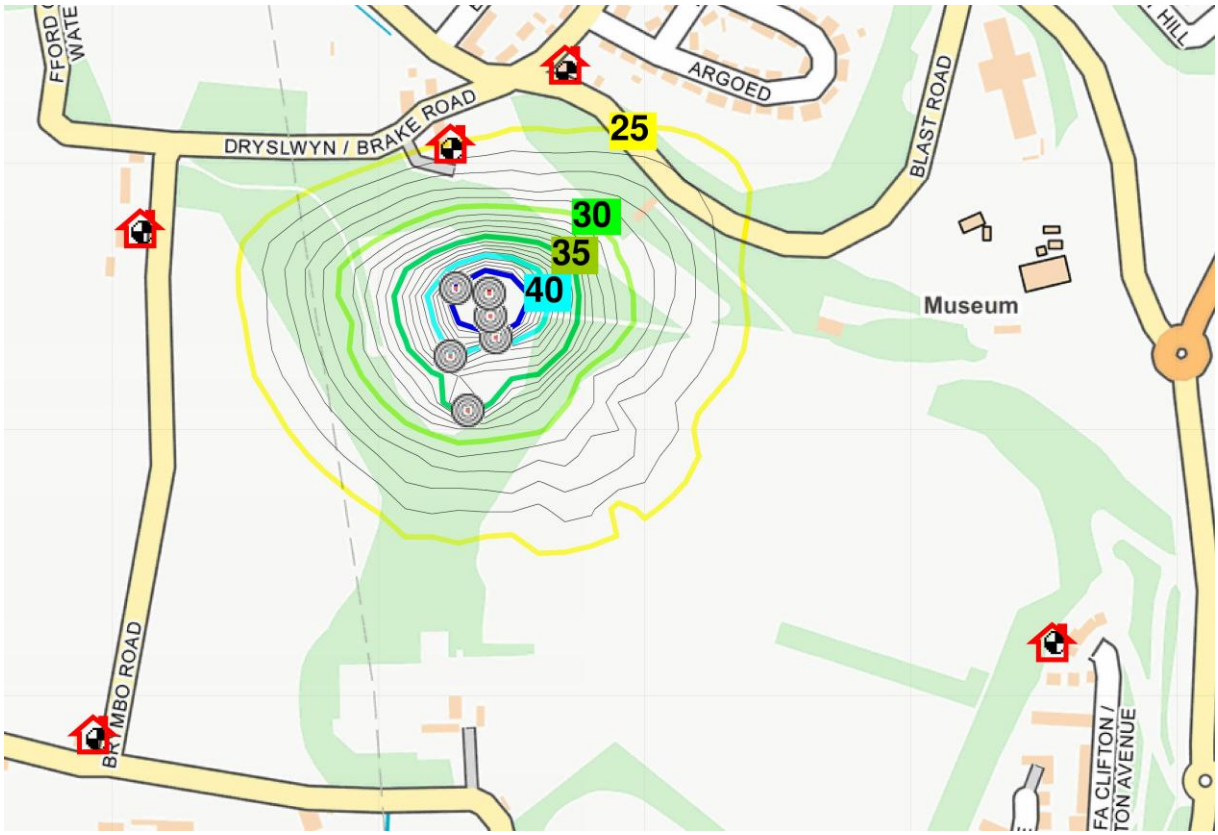


Figure 3: Indicative Daytime Noise Contour Plot, at 4m height dB L_{Aeq}

The major contour lines shown in Figure 3 range from 45dB(A) to 25dB(A). All receptors are predicted to have noise levels less than 25 dB(A) except for the nearest location, Brake Cottage on Brake Road which has noise levels at around 25 dB(A).

5.3 Predicted Noise Levels at Receptors

In addition to the noise contours, the model has been used to calculate specific noise levels at the third-party receptor locations shown with red house symbols above. These predicted levels have been used to evaluate the noise impact following the methodology detailed in BS 4142. The results are shown in Table 3 below.

As indicated above, the inverters may generate some tonal content and, therefore, could warrant a rating level correction in accordance with BS 4142. The predicted specific noise levels, presented in Figure 3, demonstrate low noise levels at the nearest receptors. Therefore, any tonal content will likely be masked by the prevailing ambient noise climate. In this instance, a +2dB correction has been applied in Tabel 3 in the assessment as a worst case, assuming that any tonal content could be 'just perceptible'.

In addition, the solar farm does not generate any other identifiable characteristics, i.e. intermittency, impulses and/or 'other' noise characteristics. To that end, no further character corrections have been applied in calculating the rating noise level.

Table 3: Noise Impact Assessment

Receptor Location	Predicted (Specific) Level, dB L_{Aeq}	Character Correction (dB)	Rating Level*, dB L_{Ar}	Noise Limit, dB L_{Ar}	Difference, dB
Brake Cottages	25.4	+2	27	32	-5
Blast Road	22.1		24		-8
Clifton Avenue	15.8		18		-14
Pen-rhos	17.1		19		-13
Brymbo Road	23.2		25		-7
**includes +2dB correction for potentially just audible tones*					

Table 3 above indicates that noise generated by the solar farm is of a low level in absolute terms for operation at maximum capacity. Noise levels are 5 dB below the proposed 32 dB L_{Ar} limit at the nearest property. So not only is the limit met, but the plant noise level is 23dB L_{Aeq}, which is a very low absolute noise level in itself. This would achieve noise levels inside properties below 15dBA which is exceptionally low.

It is reiterated that the daytime noise levels assume the site is running at 100% capacity. While the solar equipment might be operational early in the morning, it would not operate at full duty. Therefore, the operational scenario presented above is unlikely to occur during the normal night period (23.00 – 07.00 hours) and not when people are trying to sleep.

5.4 Uncertainty and Context

BS 4142 requires an assessment of uncertainty and context. The prediction methodology in BS ISO 9613-2 is considered accurate to ±3dB. However, conservative input assumptions are adopted, and downwind propagation is assumed. Noise levels for upwind and crosswind propagation will be lower.

Additional uncertainty may occur in the manufacturer's noise data obtained; however, conservative calculation and assessment principles have been included to minimise this, including:

- The proposed noise limit, 32dB L_{Ar} is set 10 dB below WHO guidance to protect sleep and is expected to be below daytime background noise levels.
- A 2dB rating correction has been applied for the potential tonal content associated with the inverter units, and,
- All plant is assumed to operate at full duty for 100% of the assessment period. In practice, this is unlikely and certainly not during the more sensitive periods (evenings and early mornings).

Given the above, uncertainty does not significantly impact the overall assessment outcome.

The context of the area is that the solar farm is situated in a semi-rural area and is reasonably small-scale in nature. There are a few isolated receptors around the site. Nevertheless, the area is on the outskirts for Wrexham and so there is likely to be a reasonable level of background noise in the daytime when most of the equipment will be operating. Noise levels will be lower at night but the proposed solar farm is assessed to an absolute limit of 32 dB L_{Ar}. This is low enough to protect amenity irrespective of the background noise.

6 Summary

A noise assessment has been carried out for the proposed Brymbo solar farm.

Operational noise has been assessed against an absolute noise limit of 32 dB L_{Ar} which is set to be low enough to protect amenity irrespective of the background noise. Operational noise levels have been calculated using manufacturer's data for typical equipment provided to provide robust calculations of the proposed facility operating at 100% which is representative of a sunny day during the summer. Most of the time, the facility is expected to operate below the calculated values.

Given the above, it is considered that there are no noise-related issues associated with Brymbo Solar Farm that would prevent the development being given planning permission.

Appendix A: Glossary of Acoustic Terms

Glossary of Acoustic Terms

Decibel (dB) – The bel is the logarithm of the ratio of two powers, and decibel is 1/10 bel. The human ear responds logarithmically, and it is there expedient to deal in logarithmic units for acoustic values such as sound intensity.

A Weighting – A frequency weighted applied to the measured sound spectrum which corrects the level to simulate the frequency response of the hearing system to sound levels of varying frequencies.

L_{eq}– This is a quasi-average noise level which includes all the sound energy during the measurement period averaged out across the period. It is typically used to describe the ambient noise level. The A weighted value is the L_{Aeq}.

L_{90} – This is the level exceeded for 90% of the measurement period and indicates the steady underlying background noise level. The A weighted Level is the L_{A90}.

L_{pA} – This is an A-weighted sound pressure level.

L_{WA} – This is an A-weighted sound power level, which is the theoretical sum of energy of a noise source. A sound power level cannot be directly measured, only derived through measurements of sound pressure level.

Appendix B: Initial Consultation Response

wrexham
COUNTY BOROUGH COUNCIL
CYNGOR BWRDEISTREF SIROL
wrecsam

MEMORANDUM

From: **Ian Jones** **To:** **Matthew Phillips**

Head of Service Public Protection **Head of Service Planning Development**

Our Ref: **Your Ref: P/2024/1578**

Date: 10-12-2024

Town and Country Planning Act 1990

Town and Country Planning (General Development Procedure) Order 1996

Re: P/2024/1578, LAND OFF, BRYMBO ROAD, BRYMBO, WREXHAM, LL11 5LY

GOSOD PANELI SOLAR AR Y TIR, STROFA BATRI A CHABINED GRID / INSTALLATION OF GROUND MOUNTED SOLAR PHOTOVOLTAIC (PV) SCHEME, BATTERY STORAGE AND GRID CABINET

RPT 2 - REPORT REQUIRED

Due to the presence of residential receptors near the proposal this section requires a noise report so as to make informed comments. I recomend tha this rpeort be required predetermination:

A noise survey shall be carried out, and a detailed report of the survey findings submitted to, and approved in writing by, the Local Planning Authority. The noise survey shall determine noise levels for both Day (07:00 – 23:00 hours) and Night (23:00 – 07:00 hours), having regard to Planning Policy Wales (PPW) Guidance, Technical Advice Note (TAN) 11 – Noise. The report of the noise survey findings shall include:

Appendix B: Initial Consultation Response

a)Noise levels arising from day / night time activities in the vicinity of the proposed development site and the impact upon the existing accommodation, and

b) A detailed scheme of noise insulation and / or attenuation measures so designed to safeguard the amenity of the existing accommodation.

The measures as are approved shall be fully implemented prior to the first occupation / use of the development.

It is common that large technical infrastructure applications are determined well ahead of the procurement and purchase of the plant and equipment required. A similar process occurs for Wind Turbine applications.

In that circumstance the applicant selects atypical wind turbine specification known as a 'candidate' turbine. The application details, decision and conditions are then determined based on the candidate plant.

Within the above noise assessment details should be provided of candidate plant that may contribute to environmental noise, or if this is not possible, the report shall establish maximum noise limits of plant so as to not exceed background levels at sensitive receptors. Details of any tonal and or impulsivity penalties under BS 4142; 2014 shall be provided or reasons for their non-inclusion.

Any report should also include a discussion on vibration from the proposed plant with details of any impact on existing residential receptors. If vibration cannot be ruled out as having a detrimental affect suitable attenuation should also be detailed in the report.

I recommend the following form the basis of a planning condition that follows the general approach for wind turbine developments, being the closest comparable relevant scheme, where:

1) The applicant specifies and agrees candidate plant and equipment as part of the application process. Or if this is not possible provides maximum noise limits for plant.

2) The noise impact of the candidate plant is assessed against national standards and determined to be acceptable (or not)for the location and circumstances.

3) Prior to the operation of the proposed development the operator submits for the written agreement of the planning authority a list of noise consultants who can undertake compliance measurements on behalf of the operator.

4) Within 21 days of receipt of a written request of the local planning authority, following complaint alleging noise disturbance at a dwelling from the operation of the development, the operator shall, at its own expense, employ a consultant (as approved by the local planning authority in para 3) to assess the level of noise emission and report back to the local planning authority findings regarding compliance with the planning conditions and the noise impact assessment accompanying the application. Such a report shall be submitted to the local planning authority

1. String Inverter Sound Power Levels

Wels, 01.06.2023

Noise Emission Fronius Tauro

Fronius International GmbH

confirms the following acoustic parameters:

	Sound power
Fronius Tauro 50-3-D/P	62,5 dB(A) (ref. 1pW)
Fronius Tauro Eco 50-3-D/P	63,6 dB(A) (ref. 1pW)
Fronius Tauro Eco 99/100-3-D/P	64,1 dB(A) (ref. 1pW)

Sound power is the sum of noise emitted over the whole surface of the device.

Fronius International GmbH
Business Unit Solar Energy
Froniusplatz 1
4600 Wels

Philipp Rechberger
Head of System Technology

2. Lemax 100kW Battery



PRODUCT PARAMETERS

Model	LM-ESS100KW215KWH
Total Energy	215kWh
Nominal Voltage	768V
Output Voltage Range	672~852V
Cell Type	LFP 3.2V280Ah
Nominal	140A(0.5C)
Battery Cluster Configuration	240S1P
Cycle Times	≥6000 cycles
Rated Power	100kW
THDI	<3%
Rated AC Voltage	400V/3W+N+PE
Rated Grid Frequency	50/60Hz
Grid Frequency Range	45-55Hz
IP Protection	IP55
Operation Temperature	-20℃~55℃
Operation Humidity	0~95%(Non-condensing)
Noise Level	≤75dB
Nominal Operation Altitude	≤3000m
Firefighting	Perfluorohexane
Cooling Method	Fan cooling