

NOISE ASSESSMENT

STONESHOLLOW SOLAR FARM

ETHICAL POWER LTD

APRIL 2024

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NOISE ASSESSMENT

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Revision	Prepared By	Date
1.0	L Jephson BEng (Hons) MIOA	28/4/24

This report has been prepared using all reasonable skill and care within the resources and brief agreed with the client. LF Acoustics Ltd accept no responsibility for matters outside the terms of the brief or for use of this report, wholly or in part, by third parties.

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1. Introduction

LF Acoustics Ltd have been appointed by Ethical Power Ltd to prepare an updated operational noise assessment for the proposed Stoneshollow Solar Farm.

Planning Permission for the solar farm has been granted by Hinkley & Bosworth Borough Council (Ref. 21/01395/FUL). No noise conditions were attached to the planning permission.

RPS prepared a noise assessment on behalf of JBM Solar Projects 26 Ltd to accompany the planning application [1]. The assessment included a baseline noise monitoring exercise to establish the prevailing noise levels upon which the assessment was based, calculations of the operational noise levels based upon the plant proposed at the time and an assessment, which sought to demonstrate that, the operation of the solar farm would not result in adverse noise impacts at surrounding noise sensitive properties. Reference has been made to the RPS report within this report with regards to the baseline noise conditions.

This report presents an updated noise assessment, based upon the plant to be installed on site, to ensure that the proposed plant would generate acceptable noise levels, which would not result in adverse noise impacts when assessed against relevant standards.

Section 2 of this report presents an overview of the relevant standards and guidelines applicable when assessing noise from this type of facility. Section 3 provides a description of the site, its surroundings and proposed operation, with an assessment of the existing noise environment provided in Section 4. The calculation and assessment of noise levels associated with the operation of the solar farm is provided in Section 5. Finally, Section 6 provides a summary of the assessment.

This report has been prepared by L Jephson BEng(Hons) MIOA, Director of LF Acoustics Ltd. A summary of his experience is provided in Appendix A.

2. Standards and Guidelines

A description of the noise units referred to in this report is provided in Appendix B.

2.1. National Planning Policy Framework

The National Planning Policy Framework (NPPF) revised in December 2023 [2], sets out the Government's planning policies for England and how these should be applied. It provides a framework upon which locally prepared plans for housing and other development can be produced.

The purpose of the planning system is to contribute to the achievement of sustainable development and at the heart of the Framework is a presumption in favour of sustainable development.

With regards noise, local planning policies and decisions should contribute to and enhance the natural and local environment by:

- preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of noise pollution.
- mitigate and reduce to a minimum, potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life;
- identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.

Reference is made within the NPPF to the Noise Policy Statement for England (NPSE) within Footnote 65, which sets out the long-term vision of the Government noise policy. Further information has been provided on the assessment of noise within recent Planning Practice Guidance, updated in July 2019 and available on the Government planning web site (<https://www.gov.uk/guidance/noise--2>). Whilst this guidance does not provide any objective criteria upon which to base noise assessments, the guidance provides a description of the relevant Effects Levels identified within the NPPF and NPSE and this is reproduced in Table 2.1.

Perception	Examples of Outcomes	Increasing Effect Level	Action
Not noticeable	No Effect	No Observed Effect Level (NOEL)	No specific measures required
Noticeable and not intrusive	Noise can be heard, but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect	No specific measures required
		Lowest Observed Adverse Effect Level (LOAEL)	
Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
		Significant Observed Adverse Effect Level (SOAEL)	
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	Prevent

Table 2.1 Significance Criteria

The NPPF advises that development should seek to ensure that noise from proposed developments does not give rise to significant impacts, i.e. a level identified as a Significant Observed Adverse Effect (SOAEL), equivalent to a level where the noise would cause a material change in behaviour.

2.2. British Standard BS 4142:2014+A1:2019

BS 4142 [3] is the British Standard for rating and assessing noise of a commercial or industrial nature and is relevant to the noise associated with the operation of the proposed plant.

BS 4142 is a comparative standard in which the estimated noise levels from the proposed development are compared to the representative / typical background noise level from existing uses.

The initial assessment relates the likelihood of adverse impact to the difference between the Rating Level of the noise being assessed and the background noise level. This assessment can be modified to take account of the context.

The background noise level is the L_{A90} noise level, usually measured in the absence of noise from the source being assessed, but may include other existing industrial or commercial sounds. The background noise levels should generally be obtained from a series of measurements each of not less than 15-minute duration.

The Rating Level of the noise being assessed is defined as its L_{Aeq} noise level (the 'specific noise level'), with the addition of appropriate corrections should the noise exhibit a marked impulsive and/or tonal component or should the noise be irregular enough in character to attract attention. The extent of the correction is dependent upon the degree of tonality or character in the noise and is determined either by subjective professional judgement, where the plant is not operational at present, or by measurements.

Where the noise is tonal in nature, the standard imposes the following character corrections when assessing the rating level based on a subjective assessment:

- 2 dB for a tone which is just perceptible;
- 4 dB where the tone is clearly perceptible; and
- 6 dB where the tone is highly perceptible.

Methods for identifying whether noise is tonal in nature are provided within BS 4142 Section 9.2, Annex C or Annex D.

Where noise exhibits other sound characteristics, the Standard advises a character correction of 3 dB should be applied.

During the daytime, the specified noise levels are determined over a reference time interval of 1 hour, with a 15 minute reference period adopted when assessing night-time noise.

If the Rating Level of the noise being assessed exceeds the background level by 10 dB or more BS 4142 advises that there is likely to be an indication of a significant adverse impact, depending upon context. A difference between background level and Rating Level of around 5 dB is likely to be an indication of an adverse impact, depending upon context. The lower the Rating Level is, relative to the background noise level, the less likely the specific source will have an adverse or significant adverse impact. Where the Rating Level does not exceed the background noise level is an indication of a low impact, depending upon context.

The assessment method outlined above is intended for the assessment of external noise levels and is not intended to assess the extent of impact at internal locations.

Where the initial assessment of impact, based upon and assessment of the external noise levels, needs to be modified due to the context, all pertinent factors should be taken into account, including:

- The absolute level of sound;
- 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; and
- The sensitivity of the receptor and whether the premises will already incorporate measures to ensure good internal and/or external acoustic conditions.

The current revision of BS 4142 (BS 4142:2014+A1:2019) does not define low background or rating levels. The previous revisions of the Standard (e.g. BS 4142:1997) described very low background sounds as being less than 30 dB L_{A90} and low rating levels as being less than 35 dB $L_{Aeq,T}$. The Association of Noise Consultants have prepared a technical note to accompany the current revision of BS 4142 [4]. The document advises that it would not be unreasonable to adopt similar lower limits when assessing noise levels against the current revision of the Standard.

2.3. British Standard BS 8233

British Standard BS 8233 [5] principally provides design guidance for new buildings. For residential premises, the guidance advises for steady external noise sources, levels of noise internally not exceeding 30 dB $L_{Aeq, 8 \text{ hour}}$ within bedrooms at night are desirable, with a level of 35 dB $L_{Aeq, 16 \text{ hour}}$ representing a desirable standard of noise within living rooms and bedrooms for resting purposes during daytime periods.

Externally within gardens and amenity spaces, the guidance recommends a general limit of 50 dB $L_{Aeq, T}$.

2.4. World Health Organisation Guidelines

The World Health Organisation guidance [6] provides additional guidance upon potential effects in relation to noise.

The guidance advises:

- few people are moderately annoyed by noise levels of below 50 dB L_{Aeq} during the daytime;
- to minimise sleep disturbance, noise levels within bedrooms should not exceed 30 dB L_{Aeq} , with individual noise events not exceeding 45 dB L_{Amax} ; and
- special attention should be given to noise sources in an environment with low background noise levels and to noise sources with low frequency components.

Assuming an open window provides a reduction in noise levels of between 10 – 15 dB(A), during the night-time the WHO guidance indicates that external noise levels should remain below 40 – 45 dB L_{Aeq} to maintain the restorative processes of sleep.

The WHO produced additional noise guidance in relation specifically to night-time noise in 2009 [7], which is generally considered to be the most noise sensitive period. This report provides a description of the no observed adverse effect level (which is equivalent to a No Observed Effects Level, NOEL) and advises for night-time noise (which is considered to be the most sensitive period of the day) that this concept is less useful, as the adversity of effects are less clear. Instead, it advises the use of the observed effects thresholds, above which an effect starts to occur or shows itself to be dependent upon the exposure level.

The guidance is presented in terms of external and internal recommendations to minimise any potential adverse effects. Externally, the guidance advises that an average night-time noise level L_{night} of 40 dB is equivalent to the Lowest Observed Adverse Effect Level (LOAEL) and advises this guideline value is recommended for the protection of public health from night-noise. However, below this level there was no change in the small number of awakenings identified and hence a reason for considering that the NOEL was not an appropriate descriptor in noise terms for identifying adverse effects and hence recommend the use of the observed effects threshold as an appropriate descriptor to identify the potential for the onset of adverse effects.

The guidance, however, advises that an external night-time noise level of 30 $L_{\text{Aeq, 8 hour}}$ would be equivalent to the NOEL, as their research indicated that there were no detectable effects on sleep observed below this level.

The potential for Significant Observed Adverse Effects (SOAEL) were identified to occur at levels considerably above 40 dB $L_{\text{Aeq, 8 hour}}$.

3. Site Description and Identification of Potentially Affected Dwellings

The location of the proposed solar farm is as indicated on Figure 1, with the proposed layout shown on Figure 2.

The previous noise assessment considered the plant proposed for the solar farm at the time, which included a number of battery stations and separate solar inverters, distributed around the site.

The layout of the site has since been amended to incorporate alternative plant, which has recently become available and is of higher capacity and would generate lower noise levels than the plant considered previously.

Thirteen battery stations (incorporating a central inverter) and one separate central inverter are proposed to be positioned around the site, as indicated on Figure 2.

The batteries within the battery stations would be charged whilst the panels were generating during the daytime period and typically discharge during the peak morning and evening periods. They would also potentially recharge at other times of the day, particularly overnight, when the cost of electricity is low, thus the plant has the potential to operate over a 24-hour period. The principal sources of noise within the battery stations would be associated with the central inverter and DC-DC converters, which would be located adjacent to the battery containers.

A customer substation would be constructed within the north-eastern corner of the site, to enable the generated electricity to be supplied to the grid. The main source of noise within the substation would be associated with the operation of the power transformer. Whilst the transformer would typically generate low levels of noise, particularly overnight, it would be fan cooled, with the fans potentially operating during periods of high temperatures.

There are a number of noise sensitive properties surrounding the proposed solar farm, which have the potential to be affected by noise attributable to the operation. Those identified and considered within this assessment are indicated on Figure 1.

4. Baseline Noise Assessment

4.1. Identification of Noise Sensitive Receptors

Noise sensitive properties surrounding the solar farm were identified previously and considered within the noise assessment prepared to accompany the planning application. The properties identified are as follows:

- 1 Church Farm, Barlestone, located to the south;
- 2 Properties along Bagworth Road, Barlestone, to the south-east of the site;
- 3 Lodge Farm, located to the north-east;
- 4 Properties along Littlemill Close, Barlestone, located to the south;
- 5 Properties on Church Road, Nailstone, located to the north of the site;
- 6 The Bungalow, Nailstone to the north-west of the site;
- 7 Properties on Hinkley Road to the south-west of the site; and
- 8 Crown Farm to the north of the site.

The noise sensitive locations are indicated on Figure 1.

4.2. Noise Surveys

Unattended noise monitoring was carried by RPS in 2021 to support the noise assessment prepared to accompany the planning application.

The results of the noise surveys are considered to remain applicable for the basis of the current assessment.

A series of unattended and short term attended measurements were made at positions representative of the noise sensitive properties identified above, with the details of the noise monitoring exercise presented within the RPS report.

The typical background noise levels established from the noise surveys are provided below.

Noise Sensitive Receptor	Typical Background Noise Levels [dB L _{A90}]	
	Daytime	Night-time
1 – Church Farm 2 – Bagworth Road 3 – Lodge Farm 4 – Littlemill 9 – Heath Lodge Farm (Day)	37	26
5 – Church Road 6 – The Bungalow 9 – Heath Lodge Farm (Night)	38	25
7 – Hinkley Road 8 – Crown Farm	40	29

Table 4.1 Typical Background Noise Levels

5. Calculation and Assessment of Noise from the Operation of the Solar Farm

5.1. Proposed Plant and Equipment

The plant requirements have been updated since the previous assessment.

The battery stations would contain the majority of the plant, with each station incorporating two EnerC Battery Containers, four Power Electronics DC-DC Gen3 Converters, one Power Electronics HEMK/PCSK Gen3 Inverter and a small transformer.

A 132kV substation would be located within the south-eastern area of the site to which the inverters and battery stations would be connected.

The locations of the substation, inverters and battery stations are indicated on Figure 2.

Specifications for the proposed plant, which have been provided by Ethical Power or sourced from other RWE projects are provided in Appendix C. The noise specifications provided within the data provided have been used as the source data within the noise modelling software.

5.2. Calculation of Noise Levels

As indicated above, the main noise generating elements of the proposed development would be attributable to the operation of the inverters, battery stations and substation.

Calculations of the noise levels attributable to the operation of the site have been made using the SoundPlan computer modelling package, which implements the calculation methodology from ISO 9613-2.

The calculations have taken account of the land formation around the site based upon Lidar mapping.

The modelling has assumed the following parameters:

- ground absorption across the surrounding fields assumed to be soft;
- temperature 20°C
- all plant fully operational (100%);
- pressure 1013 mbar;
- meteorological conditions (Cmet) = 0;
- inclusion of the solar panels as reflective noise barriers, placed 1 metre off the ground and 2m in height.

Calculations have been prepared on the basis of all plant operating during the day and night-time periods to provide likely worst-case conditions.

Noise levels have been calculated on the basis of the site layout indicated on Figure 2.

Figure 3 presents the calculated operational noise levels in graphical format and additionally provides the day and night-time calculated façade noise levels in numerical form at the properties potentially most likely to be affected by the operation of the site.

The calculated noise levels at the potentially most affected properties are summarised in Table 5.1 below.

The table additionally provides a comparison with the noise levels modelled for the development previously.

Location	Calculated Noise Level at First Floor Level [dB L _{Aeq,T}]	
	Proposed Plant Day / Night	Previous Scheme Day / Night
1 – Church Farm	22 / 22	24 / 21
2 – Bagworth Road	23 / 23	24 / 22
3 – Lodge Farm	31 / 31	29 / 28
4 – Littlemill Close	25 / 25	30 / 27
5 – Church Road	25 / 25	32 / 28
6 – The Bungalow	24 / 24	33 / 30
7 – Hinkley Road	24 / 24	27 / 24
8 – Crown Farm	28 / 28	27 / 24
9 – Heath Lodge Farm	11 / 11	13 / 11

Table 5.1 Noise Levels Generated by Operation of Proposed Solar Farm

5.3. Assessment Criteria

For the purposes of the current assessment, the assessment approach adopted previously within the RPS report has been used within this assessment for consistency.

The assessment has been made in accordance with the requirements of BS 4142 to ensure the operation of the site would not result in the potential for adverse noise impacts.

5.4. Assessment

The assessment has been prepared on the basis that the plant could potentially operate on a 24-hour basis.

With the exception of areas very close to the inverter cabins, battery stations and substation (typically, within 25 metres), where high frequency noise from the operation of the inverters / converters is likely to be clearly audible, the noise generated by the inverters / transformers would be principally associated with the operation of the cooling fans, which generates broadband noise. At the large distances between the inverters and neighbouring properties, any high frequency components of the noise would be effectively mitigated, as the higher frequencies attenuate at a higher rate over distance compared to lower frequencies.

To ensure consistency with the previous assessment no acoustic feature correction has been applied for the initial BS 4142 assessment.

Uncertainties in the calculations have been considered and have been minimised on the basis of all plant and equipment operational.

The calculated noise levels have been assessed against the guidance within BS 4142. The initial assessment against the prevailing background noise levels is provided in Tables 5.2 and 5.3 below for the day and night-time periods respectively.

Noise Sensitive Receptor	Specific Sound Level [dB L _{Aeq,T}]	Acoustic Feature Correction [dB]	Rating Level [dB L _{Aeq,T}]	Background Level [dB L _{A90}]	Rating Level – Background Level [dB]
1 – Church Farm	22	0	22	37	-15
2 – Bagworth Road	23	0	23	37	-14
3 – Lodge Farm	31	0	31	37	-6
4 – Littlemill Close	25	0	25	37	-12
5 – Church Road	25	0	25	38	-13
6 – The Bungalow	24	0	24	38	-14
7 – Hinkley Road	24	0	24	40	-16
8 – Crown Farm	28	0	28	40	-12
9 – Heath Lodge Farm	11	0	11	37	-25

Table 5.2 Initial BS 4142 Assessment Daytime

Noise Sensitive Receptor	Specific Sound Level [dB L _{Aeq,T}]	Acoustic Feature Correction [dB]	Rating Level [dB L _{Aeq,T}]	Background Level [dB L _{A90}]	Rating Level – Background Level [dB]
1 – Church Farm	22	0	22	26	-4
2 – Bagworth Road	23	0	23	26	-3
3 – Lodge Farm	31	0	31	26	+5
4 – Littlemill Close	25	0	25	26	-1
5 – Church Road	25	0	25	25	0
6 – The Bungalow	24	0	24	25	-1
7 – Hinkley Road	24	0	24	29	-5
8 – Crown Farm	28	0	28	29	-1
9 – Heath Lodge Farm	11	0	11	25	-14

Table 5.3 Initial BS 4142 Assessment Night-time

The initial assessment for the daytime operations indicates that the operation of the solar farm would not result in adverse noise impacts at the surrounding noise sensitive receptors. The predicted noise levels would be substantially below the prevailing background noise levels and thus the operation is not anticipated to be generally audible at the properties during the day.

The night-time assessment indicates a general increase in noise levels attributable to the operation of the plant, as the current modelling has assumed the potential for all the plant to operate overnight. Previously it had been assumed that the separate central solar inverters would only operate during the daytime period, with only the BESS plant operational overnight.

Generally, the noise levels overnight would remain very low, with the operational noise levels remaining below the prevailing background noise levels at the surrounding properties and the BS 4142 indicating a low potential for adverse noise impacts.

Higher noise levels are anticipated at Lodge Farm overnight than previously predicted, with the initial assessment indicating a potential for an adverse noise impact. The increase in noise levels at this property is attributable to the fact that the BESS plant areas have been moved closer to the property than assumed previously. The current layout indicates that there would be a line of sight between one of the BESS plant areas located along the eastern site boundary and the property.

The overall noise level attributable to the operation of the plant at this location would remain low and below a level specified in the technical guidance accompanying BS 4142 as representing a low level of noise, which would indicate a low potential for adverse noise impact. Furthermore, the noise levels predicted would remain commensurate with a No Observed Effects Level when assessed against the WHO night noise guidance. Taking the context of the noise into account, the operation of the site overnight would not result in adverse noise impacts.

However, should it be considered appropriate to reduce noise levels at the property, such that the night-time noise levels were equivalent to those previously assessed, mitigation could be provided for the plant located in TX5, TX8 and TX9, which are closest to the property. For these plant areas, consideration could be given to utilising sound reduction kits on the inverters or providing acoustic fences to screen the plant from the property.

6. Summary

LF Acoustics Ltd were appointed by Ethical Power Ltd to prepare an updated operational noise assessment for the proposed Stoneshollow Solar Farm.

Planning Permission for the solar farm has been granted by Hinkley & Bosworth Borough Council (Ref. 21/01395/FUL). No noise conditions were attached to the planning permission.

RPS prepared a noise assessment on behalf of JBM Solar Projects 26 Ltd to accompany the planning application. The assessment included a baseline noise monitoring exercise to establish the prevailing noise levels upon which the assessment was based, calculations of the operational noise levels based upon the plant proposed at the time and an assessment, which sought to demonstrate that, the operation of the solar farm would not result in adverse noise impacts at surrounding noise sensitive properties. Reference has been made to the RPS report within this report with regards to the baseline noise conditions.

This report has presented an updated noise assessment, based upon the plant to be installed on site, to ensure that the proposed plant would generate acceptable noise levels, which would not result in adverse noise impacts when assessed against relevant standards.

The calculated noise levels have been assessed against relevant standards and guidance, to ensure that the operation of the plant does not result in occupants of nearby properties being unacceptably affected by levels of noise.

The assessment concluded that, with the revised plant proposed to be installed on the site, the operation of the solar farm would generate low noise levels at surrounding properties both during the day and night-time periods. An assessment of the noise levels against the requirements of BS 4142 and World Health Organisation guidelines concluded that the operation would result in a low potential for adverse impact. Furthermore, an assessment of the overall noise levels during the night-time and early morning periods indicated the operation of the plant would result in noise levels achieving a No Observed Effects Level, thus ensuring that the operation did not result in the potential for adverse noise impacts.

An increase in noise levels at Lodge Farm has been identified compared to the previous assessment, attributable to the repositioning of the plant closer to the property. Whilst the assessment indicates a low potential for adverse impact, if considered appropriate, mitigation could be provided for the closest plant to reduce noise levels to those predicted previously.

References

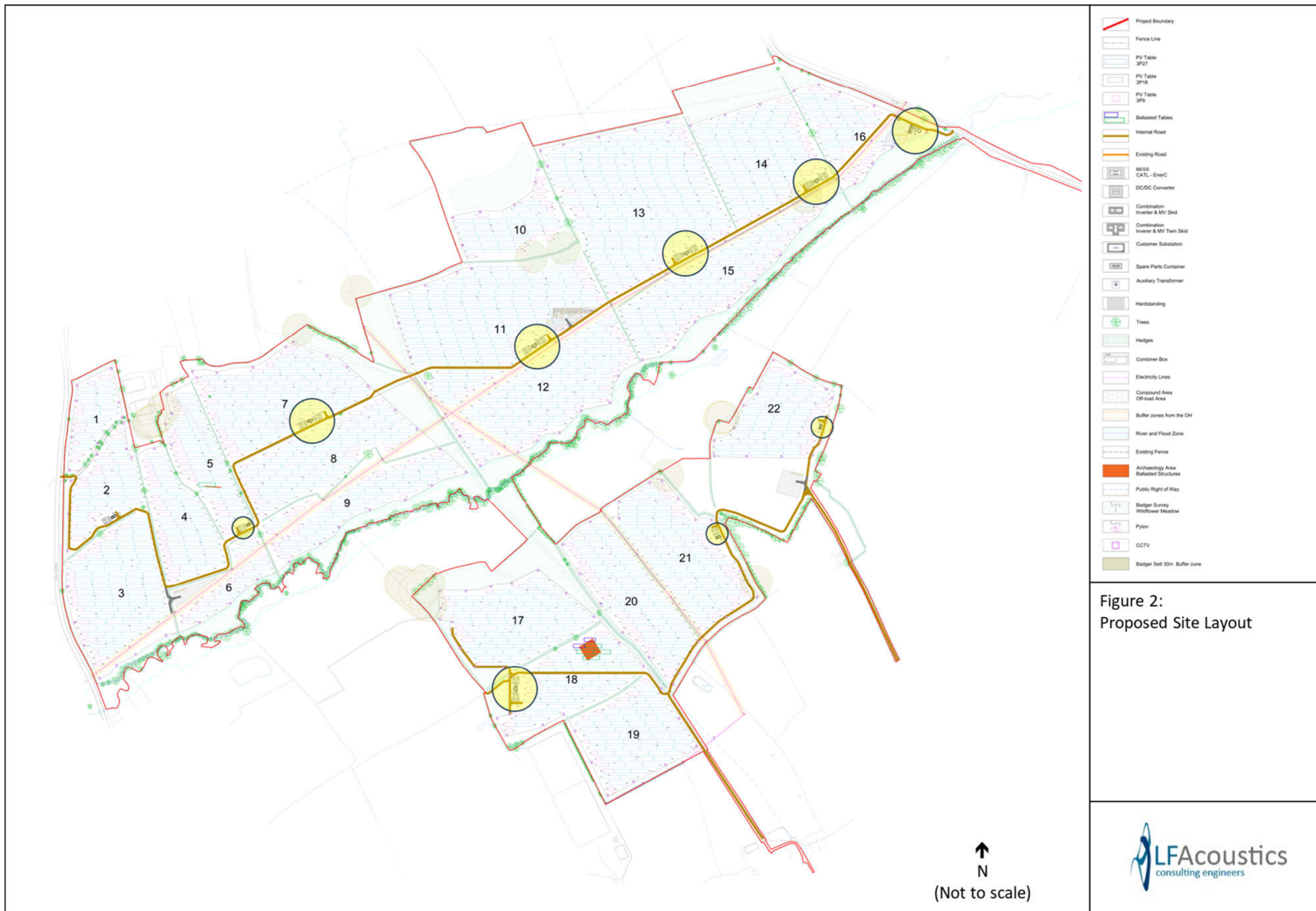
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Figures




 Noise Sensitive Receptors

Figure 1:
Site Location



Noise Level LAeq,T in dB(A)

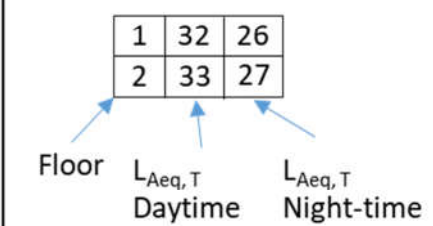
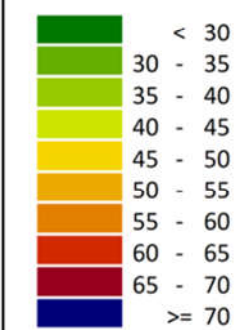


Figure 3:
Calculated Noise Levels –
Daytime



Appendix A L Jephson CV

Full Name	Leslie Peter Jephson
Qualifications	BEng (Hons) in Electroacoustics (1993) University of Salford
Professional Bodies	Member of Institute of Acoustics
Nationality	British

Career History

2013 to Present	Director, LF Acoustics Limited
1998 - 2013	Principal, Acoustics Noise and Vibration (ANV) & Director Acoustics Noise and Vibration Ltd (instrumentation supplier)
1997 – 1998	Acoustic Consultant, Arup Acoustics, Ove Arup Partnership
1996 - 1997	Research Assistant at the Institute of Sound and Vibration Research, University of Southampton
1993 - 1996	Acoustic and Senior Acoustic Consultant, Ashdown Environmental Ltd
1991 - 1992	Assistant Consultant, Ashdown Environmental Ltd

Key Experience

- Over 30 years experience in environmental acoustic consultancy;
- extensive experience in the assessment of noise from solar farms;
- expert witness, providing evidence in support of a variety of projects including solar farms, minerals and residential developments;
- management of noise and vibration from major construction sites;
- proven expertise and experience in providing practical noise and vibration advice to engineering teams working on major transportation and construction projects;
- measurement, evaluation, assessment and mitigation of operational noise and vibration impacts;
- negotiation and liaison with local authority officers in respect of planning applications, mitigation measures and monitoring regimes;
- assessment of noise and vibration impacts from construction activities and development of mitigation measures.

Appendix B

Noise Units

Decibels (dB)

Noise can be defined as unwanted sound. Sound in air can be considered as the propagation of energy through the air in the form of oscillatory changes in pressure. The size of the pressure changes in acoustic waves is quantified on a logarithmic decibel (dB) scale firstly because the range of audible sound pressures is very great, and secondly because the loudness function of the human auditory system is approximately logarithmic.

The dynamic range of the auditory system is generally taken to be 0 dB to 140 dB. Generally, the addition of noise from two sources producing the same sound pressure level, will lead to an increase in sound pressure level of 3 dB. A 3 dB noise change is generally considered to be just noticeable and a 10 dB change is generally accepted as leading to the subjective impression of a doubling or halving of loudness. A 5 dB change is generally considered to be clearly discernible.

A-weighting

The bandwidth of the frequency response of the ear is usually taken to be from about 18 Hz to 18,000 Hz. The auditory system is not equally sensitive throughout this frequency range. This is taken into account when making acoustic measurements by the use of A-weighting, a filter circuit which has a frequency response similar to the human auditory system.

Units Used to Describe Noises Which Change Their Level with Time

The Equivalent Continuous A-Weighted Sound Pressure Level ($L_{Aeq,T}$) is the principal measurement index for environmental noise. The $L_{Aeq,T}$ is defined as the A-weighted sound pressure level of the steady sound which contains the same acoustic energy as the noise being assessed over a specific time period, T.

The L_{A90} is the noise level exceeded for 90% of the measurement period. It is generally used to quantify the background noise level, the underlying level of noise which is present even during the quieter parts of the measurement period.

The L_{Amax} is the single maximum value that the A-weighted sound pressure level reaches during a measurement period. $L_{Amax F}$, or Fast, is averaged over 0.125 of a second and $L_{Amax S}$, or Slow, is averaged over 1 second. The measured L_{Amax} noise levels in this assessment are Fast.

Appendix C

Plant Specifications

TECHNICAL REPORT

ACOUSTIC CHARACTERISATION
POWER ELECTRONICS
HEMK/PCSK GEN3 INVERTER

+Technical

+Technical

C/ Luis Bolinches 18 esc 2, 1º A
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Telephone: 96.320.21.11
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www.tecnival.com



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INDUSTRIALES
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Illustration 5. Views of the PCSK Gen3 inverter without acoustic attenuation kit



Illustration 6. Views of the PCSK Gen3 inverter without acoustic attenuation kit

MEAN TIME-AVERAGED SOUND PRESSURE LEVEL FROM THE ARRAY OF MICROPHONE
POSITIONS OVER THE MEASUREMENT SURFACE
(ISO 3744, sections 8.2.2.1, 8.2.3 & 8.2.4)

		$\overline{L_p'(ST)}$	$\overline{L_p(B)}$	ΔL_p	K_1	K_2
	12.5	50,1	42,8	7,4	0,8782	
	16	51,2	43,7	7,6	0,8372	
	20	51,9	43,7	8,2	0,7113	
	25	55,2	46,2	9,0	0,5813	
	31.5	57,7	45,4	12,2	0,2687	
	40	59,0	53,0	6,0	1,3000	
	50	59,5	47,4	12,1	0,2768	3,1635
	63	57,6	46,4	11,2	0,3422	2,0243
	80	55,1	45,0	10,1	0,4481	1,4982
	100	55,4	39,5	15,9		0,1095
	125	61,3	39,1	22,2		1,0525
	160	56,8	36,3	20,5		0,4731
	200	60,4	35,3	25,2		0,1490
	250	65,4	35,6	29,9		0,2933
	315	60,1	35,4	24,7		0,5997
	400	55,7	35,1	20,6		0,6836
	500	54,4	34,7	19,8		0,7335
	630	52,6	34,8	17,7		0,8044
	800	52,6	33,2	19,4		0,6687
	1k	52,3	33,9	18,4		0,2141
	1.25k	52,5	31,7	20,8		0,1106
	1.6k	51,4	29,5	21,8		0,3938
	2k	50,2	26,1	24,1		0,7997
	2.5k	50,3	22,5	27,8		0,6858
	3.15k	49,2	19,9	29,3		0,6429
	4k	48,2	15,1	33,1		0,1194
	5k	48,4	11,8	36,6		-0,6347
	6.3k	47,5	10,4	37,1		-0,9664
	8k	44,2	9,5	34,7		-1,9054
	10k	42,8	9,3	33,5		-2,8112
	12.5k	40,1	9,5	30,6		-4,2102
	16k	36,5	10,7	25,8		-6,0448

	$\overline{L_p'(ST)}$	$\overline{L_p(B)}$	ΔL_p	K_1	K_2
A-weighted	64,0	41,7	22,3		0,31

SOUND POWER LEVEL FROM THE SOUND PRESSURE LEVEL, IN dB(A)
(ISO 3744, section 8.2.5)

$$\overline{L_p} = \overline{L_p'(ST)} - K_1 - K_2 \quad L_W = \overline{L_p} + 10 \lg \frac{S}{S_0}$$

Area of measurement surface [S]: 628,32 m² $S_0 = 1 \text{ m}^2$ $S_0 = 1 \text{ m}^2$

$L_W = 91,7 \text{ dB(A)}$

A-WEIGHTED SOUND POWER LEVEL FROM MID-BAND FREQUENCIES OF
ONE-THIRD OCTAVE BANDS
(ISO 3744, Annex E)

Coef. C_k	$\overline{L_{pk}}$	L_{Wk}	Aux: $10^{0,1(L_{Wk}+C_k)}$
-30,2	56,0832	84,0650	243.499
-26,2	55,2033	83,1851	499.471
-22,5	53,1493	81,1312	729.651
-19,1	55,2933	83,2751	2.615.222
-16,1	60,2107	88,1925	16.190.000
-13,4	56,3425	84,3243	12.371.673
-10,9	60,2953	88,2771	54.664.998
-8,6	65,1445	93,1263	283.552.671
-6,6	59,4934	87,4752	122.325.279
-4,8	54,9919	82,9737	65.671.149
-3,2	53,7061	81,6879	70.597.568
-1,9	51,7804	79,7622	61.124.821
0,8	51,9587	79,9405	118.590.378
	52,1052	80,0870	102.024.472
0,6	52,3424	80,3242	123.715.269
1	50,9635	78,9453	98.748.382
1,2	49,4259	77,4077	72.572.637
1,3	49,5986	77,5804	77.274.713
1,2	48,5786	76,5604	59.708.983
1	48,0369	76,0187	50.334.611
0,5	49,0388	77,0206	56.501.706
-0,1	48,4728	76,4546	43.197.580
-1,1	46,0712	74,0530	19.737.786
-2,5	45,5930	73,5748	12.807.898

$$\overline{L_{pk}} = \overline{L_p'(ST)} - K_1 - K_2$$

$$L_{Wk} = \overline{L_{pk}} + 10 \lg \frac{S}{S_0}$$

$$L_{WA} = 10 \lg \sum_{k=k_{min}}^{k_{max}} 10^{0,1(L_{Wk}+C_k)}$$

$L_{WA} = 91,8 \text{ dB(A)}$

Table 13. A-weighted sound power from one-third octave bands. 80% operating instructions, without kit

CATL EnerC Battery Specs

No.	Fan PWM %	SPL dB (A)																		SML dB (A)
		Point 1	Point 2	Point 3	Point 4	Point 5	Point 6	Point 7	Point 8	Point 9	Point 10	Point 11	Point 12	Point 13	Point 14	Point 15	Point 16	Point 17		
1	20%	68.6	66.9	62.8	68.1	67.7	66.9	64.4	64.3	68.9	67.1	68.3	60.8	61.7	65.9	63.7	61.3	60.6	82.7	
2	25%	70.0	68.2	62.6	68.7	68.9	68.4	65.9	64.9	69.8	69.1	69.0	60.3	61.9	66.7	65.2	61.4	61.0	83.7	
3	30%	73.8	72.1	67.6	72.6	73.4	73.0	68.4	68.9	72.9	73.3	73.1	65.3	65.2	69.9	70.0	65.8	63.7	87.7	
4	40%	76.2	73.0	66.5	72.6	74.5	74.4	69.8	69.5	73.6	76.6	73.5	64.8	65.6	71.6	71.3	65.9	66.3	89.0	
5	50%	79.7	73.9	66.6	74.0	77.5	77.5	70.9	70.7	75.2	80.3	74.8	66.1	67.4	75.0	74.1	67.3	69.7	91.6	
6	60%	83.1	76.8	69.8	76.4	80.8	80.8	73.6	73.8	77.7	84.1	77.1	68.9	70.5	78.0	77.5	70.5	73.1	94.9	
7	70%	86.0	79.2	71.2	78.8	83.8	83.8	76.3	76.5	80.0	87.3	79.5	70.9	73.0	80.9	80.5	73.1	75.9	97.8	
8	80%	88.9	81.7	73.5	81.1	86.4	86.7	79.0	79.0	82.3	90.0	82.2	73.4	75.4	83.4	83.5	75.8	78.3	100.5	
9	90%	90.9	83.7	75.3	83.4	88.7	88.9	81.1	81.2	83.9	92.3	84.3	75.1	77.6	85.8	85.9	78.1	80.6	102.7	

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Email Received 27/2/24

For noise assessment use the PWM 25% fan speed noise test results. The total 83.7 dB (A) is for 1 chiller and as per the noise experts, when you put two of the same sources together the total noise power increase is 3 dB (A). The EnerC product has 2 x chillers and therefore, for Noise assessment you should use noise power level of 87 dB(A) per EnerC container.

Power Electronics Freemaq DC-DC Converter GEN3

**Provided to LFA for Other RWE Project
Received from PE on 11/4/24**

Advised by PE to assume 80% Operating Speed for UK

Correction on my email below, we have received noise measurements for the DCDC:

% Ventilation	Sound power Lwa (dBa)
80	76.9
100	83.2

Best regards,

Elisa Blasco Muñoz
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Specification for BESS Transformer

 Transformatör Sanayi ve Ticaret A.Ş. Seri No / Serial Number: YT-22-12185	ELTAŞ TRANSFORMATÖR SANAYİ VE TİCARET A.Ş. TEST LABORATUVARLARI / TEST LABORATORIES		AB-0347-T
			22.YDT.0846
			05-22

GÜRÜLTÜ SEVİYESİNİN ÖLÇÜLMESİ <i>Determination Of Sound Level</i> <i>Test Standardı / Test Standard</i> <i>TS EN 60076-1:2016 / IEC 60076-10:2016</i>			
Test Cihazı / Test Device BRÜEL&KJAE, 2239, Seri No/Serial Number: 2679872 Kalibratör / Calibrator BRÜEL&KJAE, 4231, Seri No/Serial Number: 2524658			

Çevre Hattının Uzunluğu (L_m)	: 14	m	Transformatör Tank Yüksekliği (h)	: 1.6	m
Prescribed Contours			Height of Transformer Tank		
Test Odası Toplam Yüzey Alanı (S_v)	: 2728	m ²	Ölçüm Uzaklığı (x)	: 0.3	m
Total Surface Area Of Test Room			Measurement Distance		
Akustik Yutma Katsayısı (a)	: 0.2		Uyarma Gerilimi	: 690	V
Acoustic Absorption Coefficient			Applied Voltage		
Ses Yutma Yüzeyi (A)	: 545.6	m ²	Uyarma Frekansı	: 50	Hz
Noise Absorption Surface			Excitation Frequency		
Ölçme Yüzey Alanı (S)	: 28	m ²	Kademe Pozisyonu	: 3	
Surface Area			Tap Changer Position		

Mikrofon Yeri	Deney Başı Arkaplan gürültüsü L_{bgA} (dB)	Deney Sonu Arkaplan gürültüsü L_{bgA} (dB)	Ölçülen Ses Basınç Seviyesi L_{pA} (dB)	
Microphone Position	Initial Background Noise	Final Background Noise	Measured Sound Pressure Level	
1	34.2 dB	34.9 dB	50.1 dB	dB
2	35.2 dB	35.3 dB	52.6 dB	dB
3	34.9 dB	36.2 dB	48.9 dB	dB
4	35.3 dB	35.4 dB	52.3 dB	dB
5	35.8 dB	34.8 dB	51.9 dB	dB
6	dB	dB	50.4 dB	dB
7	dB	dB	49.9 dB	dB
8	dB	dB	50.8 dB	dB
9	dB	dB	53.1 dB	dB
10	dB	dB	52.7 dB	dB
11	dB	dB	50.8 dB	dB
12	dB	dB	49.6 dB	dB
13	dB	dB	51.1 dB	dB
14	dB	dB	53.4 dB	dB
15	dB	dB	dB	dB
16	dB	dB	dB	dB
17	dB	dB	dB	dB
18	dB	dB	dB	dB
19	dB	dB	dB	dB
20	dB	dB	dB	dB
Ortalama / Average	35.1 dB	35.3 dB	51.1 dB	dB

Çevre Düzeltme Faktörü, K (≤ 7 dB olmalıdır.)	: 0.8	
Environment Correction Factor (must be ≤ 7 dB)		
Deney Başı L_{bgA} - Deney Sonu L_{bgA} (≤ 3 dB olmalıdır.)	: -0.2	dB
Initial L_{bgA} - Final L_{bgA} (must be ≤ 3 dB)		
L_{pA0} - En yüksek L_{bgA} (≥ 3 dB olmalıdır.)	: 14.9	dB
L_{pA0} - Higher L_{bgA} (must be ≥ 3 dB)		
Garanti Edilen Ses Basınç Seviyesi L_{pA}	: ---	dB
Guaranteed Values of Sound Pressure Level		
Ölçülen Ses Basınç Seviyesi L_{pA}	: 50.7	dB
Measured Sound Pressure Level		
Garanti Edilen Ses Güç Seviyesi L_{wA}	: ---	dB
Guaranteed Values of Sound Power Level		
Hesaplanan Ses Güç Seviyesi L_{wA}	: 65.1	dB
Calculated Sound Power Level		

DOKÜMAN NO: EL-F-3.1	YAYINLANMA TARİHİ: 21.08.2013	REVİZYON NO: 10	REVİZYON TARİHİ: 26.08.2019	SAYFA NO: 10/14
Document Number: EL-F-3.1	Publication Date: 21.08.2013	Revision Number: 10	Revision Date: 26.08.2019	Page: 10/14

Specification for Substation Transformer Provided by RWE



ITEM 1	Three phase oil immersed power transformer with conservator	kV		V
		132	±9x1,67%	33000

ELECTRICAL DATA				
Rating Power:	40000 / 60000	kVA		
Service:	Distribution			
N° of Phases:	3			
N° of Windings per phase:	2			
Cooling:	ONAN / ONAF			
Fn:	50	Hz		
No load primary voltage:	132	kV		
Type of Tap changer on primary:	OLTC			
Primary Voltage Regulation:	±9x1,67%			
No-load secondary voltage:	33000	V		
Vector group:	YNd11			
Insulating level at I°:	145 / 230 / 550	kV		
Insulation level at neutral:	52 / 95 / 250	kV		
Insulating level at II°:	36 / 70 / 170	kV		
Insulating class I°/II°:	A / A			
Primary/Secondary winding conductors:	Cu / Cu			
Primary bushings protection degree:	3 x O/A condenser OIP bushings with porcelain case - ABB GOB650/1250 kV or equivalent + 1x GOB250/800 for neutral			
Secondary bushings protection degree:	IP55 - oil/air solid porcelain EN50180 - 12 kV / 3150 A protected by air filled cable box designed for cables from the bottom, with undrilled gland plate			
Ambient temperature [MIN / MAX]:	-25 / +40	°C		
Overtemp. prim./sec. windings:	60/65	°C		
Altitude of installation:	<1000	mt		
Installation:	Outdoor			
Po at 1 Vn:	31000	W		
Pcc at 75°C and Sn:	108500	W		
Vcc at 75°C and Sn:	10	%		
PEI:	≥99.706	%		
Io at 1 Vn:	0.3	%		
Lp(A) at 1mt:	70 dB(A) at 1 m with ONAN cooling - 75 dB(A) at 2 m ONAF	dB(A)		
Painting / Colour:	C4-H / RAL7031 - Fittings and accessories (valves, fans, OLTC, kiosk, relays etc) will remain with original painting shade			
Tank execution:	Radiators tank			
Oil type:	Not inhibited LIBRA			
Transformer overall dimensions (LxWxH)	6500 x 4000 x 5300	mm		
Transformer weight:	75000	kg		
Oil Weight:	18000	kg		
Untanking weight:	41000	kg		

Technical Remarks: Tolerances and tests according to IEC 60076 (if not otherwise indicated)
Dimensions and weight to be confirmed after PO
Warranty referred at nominal power rating and nominal voltage ratio (the highest in case of double primary voltages)