tnei

A specialist energy consultancy

Environmental Noise Impact Assessment

Hazlehead Energy Storage Development

Banks Group

13755-001
11 February 2020

COMMERCIAL IN CONFIDENCE

BANKSRenewables
development with care

tneigroup.com

Quality Assurance

TNEI Services Ltd and TNEI Africa (Pty) Ltd. ("TNEI") operates an Integrated Management System and is registered with Ocean Certification Limited as being compliant with ISO 9001(Quality), ISO 14001 (Environmental) and OHSAS 18001 (Health and Safety).

Disclaimer

This document is issued for the sole use of the Customer as detailed on the front page of this document to whom the document is addressed and who entered into a written agreement with TNEI. All other use of this document is strictly prohibited and no other person or entity is permitted to use this report unless it has otherwise been agreed in writing by TNEI. This document must be read in its entirety and statements made within may be based on assumptions or the best information available at the time of producing the document and these may be subject to material change with either actual amounts differing substantially from those used in this document or other assumptions changing significantly. TNEI hereby expressly disclaims any and all liability for the consequences of any such changes. TNEI also accept no liability or responsibility for the consequences of this document being relied upon or being used for anything other than the specific purpose for which it is intended, or containing any error or omission which is due to an error or omission in data used in the document that has been provided by a third party.

This document is protected by copyright and may only be reproduced and circulated in accordance with the Document Classification and associated conditions stipulated or referred to in this document and/or in TNEI's written agreement with the Customer. No part of this document may be disclosed in any public offering memorandum, prospectus or stock exchange listing, circular or announcement without the express and prior written consent of TNEI. A Document Classification permitting the Customer to redistribute this document shall not thereby imply that TNEI has any liability to any recipient other than the Customer.

Any information provided by third parties that is included in this report has not been independently verified by TNEI and as such TNEI accept no responsibility for its accuracy and completeness. The Customer should take appropriate steps to verify this information before placing any reliance on it.

Document Control

Revision	Status	Prepared by	Checked by	Approved by	Date
R1	FIRST ISSUE	EW	JS	JS	11/02/2020

TNEI Services Ltd

Company Registration Number: 03891836 **VAT Registration Number: 239 0146 20**

Registered Address	7th Floor	
Bainbridge House	West One	Queens House
86-90 London Road	Forth Banks	19 St. Vincent Place
Manchester	Newcastle upon Tyne	Glasgow
M1 2PW	NE1 3PA	G1 2DT
Tel:+44 (0)161 233 4800	Tel:+44 (0)191 211 1400	Tel:+44 (0)141 428 3180
Fax:+44 (0)161 233 4801		

TNEI Africa (Pty) Ltd

Registered: Mazars House, Rialto Rd, Grand Moorings Precinct, 7441 Century City, South Africa

Company Number: 2016/088929/07

1st Floor
Willowbridge Centre
39 Carl Cronje Drive
Cape Town
South Africa, 7530
Tel: +27 (0)21 974 6181

Contents

Document Control 1
Contents 2
1 Introduction 4
1.1 Overview 4
1.2 Nomenclature 4
2 Project Description 6
2.1 Proposed Development Description 6
2.2 Study Area 6
3 Assessment Methodology 7
3.1 Legislation and Policy Context 7
3.1.1 National Planning Policy Framework (NPPF) 7
3.1.2 Noise Policy Statement for England (NPSE) 7
3.1.3 National Policy Statement for Energy Infrastructure (EN-1) 7
3.2 Assessment Method 7
3.2.1 'Context' Based Limits (BS4142:2014 +A1:2019) 8
3.2.2 Fixed Guideline Levels (BS 8233:2014) 8
3.2.3 Assessment Criteria 9
3.3 Calculation Method 9
3.3.1 Noise Propagation Model (ISO 9613-2:2996) 9
3.3.2 Uncertainties and Limitations 9
4 Baseline Sound Level Monitoring 11
4.1 Project History 11
5 Operational Noise Impacts 13
5.1 Modelling of Individual Noise Sources 13
5.1.1 Containerised BESS Unit with HVAC 13
5.1.2 1260 kVA ONAN Transformer 13
5.1.3 Battery Inverter/Power Management Unit (PMU) 13
5.2 Calculated Sound Immission Level 14
6 Noise Impact Assessment 15
6.1 Quantitative Assessment 15
6.2 Qualitative Assessment 15
6.2.1 Tonality 16
6.2.2 Impulsivity 16

6.2.3 Intermittency 16
6.2.4 Other Sound Characteristics 16
6.2.5 Calculation of the Rating Level 16
6.2.6 Assessment of the Impacts 17
7 Discussion 19
7.1 Draft Planning Condition 19
8 Summary 20
9 References 21

TABLES

Table 3.1: Indoor Ambient Noise Levels for Dwellings (BS8233:2014 Table 4) 8
Table 4.1: 2012 Survey Baseline Noise Monitoring Locations 11
Table 4.2: Representative Background Sound level, dB $L_{A90,}$ Derived Through Statistical Analysis 12
Table 4.3: Measured Residual Sound level, dB $L_{Aeq\ (1\ hour)}$ 12
Table 5.1: Source Sound Level Data; 1260 kVA ONAN Transformer, SWL dBA 13
Table 5.2: Source Sound Level Data; SMA Sunny Central 2200 Inverter, SWL dBA 14
Table 5.3: Calculated sound immission levels at NALs, dB $L_{Aeq(t)}$ 14
Table 6.1: Derived Fixed Level Limits, dB LAeq(t) 15
Table 6.2: Quantitative Assessment 15
Table 6.3: Margin Above / Below (+/-) Background Sound Level, dB 17

APPENDICES

Appendix A – Glossary of Terms
Appendix B – Development Information
Appendix C – Baseline Survey Data
Appendix D – Noise Modelling Data
Appendix E – Figures

1 Introduction

1.1 Overview

TNEI has been commissioned by Banks Renewables Ltd to undertake an environmental Noise Impact Assessment (NIA) to support the planning application for the operation of the proposed Hazlehead Energy Storage Development (the Proposed Development).

The Proposed Development is to be located within an area of currently undeveloped land adjacent to the electrical substation of the Hazlehead Wind Farm. The site is just off Flint Lane, Hepworth, Holmfirth, at approximate Ordnance Survey coordinates 417619, 404103 and is located within the existing Banks Renewables windfarm site.

The local area around the site is made up of predominantly grassland and trees, though a large area of industrial development is located to the north east. The residential receptors are located to the south east and west.

The aims of the NIA are to:

- Identify the potential noise sensitive receptors in the vicinity of the Proposed Development;
- Identify the dominant sound sources associated with the operation of the Proposed Development;
- Calculate the likely levels of operational noise at the identified receptors to determine the noise impacts associated with the Proposed Development; and
- Indicate any requirements for mitigation measures, if required, in order to provide sufficient levels of protection for all noise sensitive receptors.

All work undertaken to produce this report has been carried out by members of the TNEI Site Services Team, all of whom are affiliated with the Institute of Acoustics (IOA). Specifically, the following members of staff have been involved in the project;

- James Mackay, MIOA, BSc (Hons), IOA Postgraduate Diploma in Acoustics and Noise Control, Certificate of Competence in Environmental Noise Management: Oversaw baseline sound level survey (Undertaken in 2012 as part of Hazlehead Wind Farm Noise Compliance Assessment);
- Ewan Watson, Tech IOA, BEng (Hons): Noise propagation modelling, reporting and production of figures;
- Jim Singleton, MIOA, BSc (Hons), IOA Postgraduate Diploma in Acoustics and Noise Control: Quality Assurance.

1.2 Nomenclature

Please note the following terms and definitions, which are used throughout this report;

- **Emission** refers to the noise level emitted from a noise source, expressed as either a sound power level or a sound pressure level;
- **Immission** refers to the sound pressure level received at a specific location from a noise source;
- **SWL** indicates the sound power level in decibels (dB);
- **SPL** indicates the sound pressure level in decibels (dB);
- **NML** (Noise Monitoring Location) refers to any location where baseline or specific noise levels have been measured;
- **NSRs** (Noise Sensitive Receptors) are all identified receptors which are sensitive to noise; and

- **NAL** (Noise Assessment Location) refers to any location where the noise immission levels are calculated and assessed.

A Glossary of Terms is also provided as Appendix A of this report.

All figures referenced within the report can be found in Appendix E.

Unless otherwise stated, all noise levels refer to free field levels i.e. noise levels without influence from any nearby reflective surfaces.

All grid coordinates refer to the Ordnance Survey grid using Eastings and Northings.

2 Project Description

2.1 Proposed Development Description

The Proposed Development consists of a single high capacity Battery Energy Storage System (BESS) unit, housed within a container; a battery inverter/PMU (Power Management Unit), and a 0.4 kV/11 kV transformer. An indicative layout plan and elevation drawings provide an overview of the proposed layout and are included in Appendix B.

The Proposed Development would introduce new sound sources to the local area in the form of externally located fixed plant. Specifically, the dominant sound sources considered within the assessment are:

- Containerised BESS Unit with HVAC;
- Battery Inverter/PMU; and,
- 1260 kVA ONAN Transformer

The sound level output of auxiliary items of plant and infrastructure will be insignificant in comparison to the primary sound sources detailed above. Accordingly, other items of plant that may be installed have not been considered within the assessment.

2.2 Study Area

Noise Sensitive Receptors (NSRs) are properties which are sensitive to noise and, therefore, require protection from nearby noise sources. The Study Area for the assessment of environmental noise is usually defined through the identification of the closest NSRs to the development.

The assessment of noise attributable to the Proposed Development considers the nearest NSRs only, with the assumption that if sound levels at the closest receptors are within the defined limits, then sound levels at NSRs at greater distances from the Proposed Development should also be within acceptable levels.

The nearest identified NSRs, which have a high level of sensitivity, are two residential properties located approximately 400 m to the south and 450 m to the west respectively. Figure 1 details the closest identified NSRs considered within the assessment.

3 Assessment Methodology

3.1 Legislation and Policy Context

The overarching European legislation in respect of environmental noise is the 'Environmental Noise Directive' (END) (1). The END aims to limit people's exposure to noise and requires each EU member state to provide data on noise exposure and to adopt action plans to prevent or reduce noise exposure and preserve environmental noise quality where it is already good. The END is still current legislation in the UK.

3.1.1 National Planning Policy Framework (NPPF)

At a national level the relevant policy is the National Planning Policy Framework (NPPF) (2), which states that planning policies and decisions should:

"…mitigate and reduce to a minimum potential adverse impact resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life" (Paragraph 180).

The NPPF refers to the NPSE for further explanation.

3.1.2 Noise Policy Statement for England (NPSE)

The Noise Policy Statement for England (NPSE) (3) sets out the long-term vision of Government noise policy and should apply to all forms of noise including environmental noise, neighbour and neighbourhood noise. The NPSE refers to 'environmental noise' with the key aims being to:

- *"Avoid significant adverse impacts on health and quality of life while taking into account the guiding principles of sustainable development;*
- *Mitigate and minimise adverse impacts on health and quality of life; and*
- *Where possible, contribute to the improvement of health and quality of life through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development."*

3.1.3 National Policy Statement for Energy Infrastructure (EN-1)

The overarching National Policy Statement for Energy Infrastructure (EN-1) (4) sets out the Government's policy for delivery of energy infrastructure. EN-1 advises that where noise impacts are likely to arise from a development the applicant should undertake a noise assessment with the extent of the assessment proportionate to the likely noise impact. The development should also demonstrate good design to minimise noise emissions and permission should not be granted unless the proposal will avoid significant adverse impact and mitigate or minimise other adverse impacts on health and quality of life from noise.

3.2 Assessment Method

A number of standards and guidelines are available for the assessment of environmental noise from proposed new developments or activities. Typically, assessments are based on a comparison of likely noise levels against either 'context' based limits or a set of fixed limits.

Context based limits are set relative to the existing noise environment and may also consider the characteristics of the noise source(s), whilst fixed limits are usually set regardless of the existing noise environment or type of noise source(s).

3.2.1 'Context' Based Limits (BS4142:2014 +A1:2019)

BS 4142:2014 *'Methods for Rating and Assessing Industrial and Commercial Sound'* (5) is commonly used to assess the potential impacts of new sound sources on nearby residential receptors. In June 2019 the standard was amended and reissued as BS 4142:2014 + A1:2019, therefore, this assessment is undertaken in accordance with the newly revised version (hereafter referred to simply as BS4142). It should be noted that no material changes have been made to the assessment process detailed within the Standard, rather the amendments are simply to provide clarifications to the text.

The BS 4142 form of assessment is based on the predicted or measured levels of an assessed source sound compared to the measured background sound levels without the specific sound source present and uses, *"outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident".*

Specifically, the assessment is made by subtracting the measured background sound level from a calculated or measured 'Rating Level'.

BS4142 uses the following definitions;

Ambient Sound: Totally encompassing sound in a given situation at a given time, usually composed of sound from many sources, both near and far. Described using the sound metric, $L_{Aeq\ (t)}$.

Specific Sound Level: Equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval, *Tr*. Described using the sound metric $L_{Aeq\ (t)}$. Also referred to in this report as the *Immission Level*.

Residual Sound Level: Equivalent continuous A-weighted sound pressure level of the residual sound without the specific sound source(s) present at the assessment location over a given time interval, *T*. Described using the sound metric $L_{Aeq\ (t)}$.

Background Sound Level: A-weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval, *T*, measured using time weighting *F* and quoted to the nearest whole number of decibels. Described using the sound metric $L_{A90\ (t)}$.

Rating Level: The Specific Sound Level adjusted for the characteristics of the sound. The Rating Level is calculated by adding a character correction or corrections (if required) to the Specific Sound Level when the sound source contains audible characteristics such as tonal, impulsive or intermittent components. Described using the sound metric, $L_{Aeq\ (t)}$.

3.2.2 Fixed Guideline Levels (BS 8233:2014)

BS 8233 '*Guidance on sound insulation and noise reduction for buildings*' (6) presents guideline noise levels for daytime and night-time periods for a number of different building types; for residential developments these are based on guidelines issued by the World Health Organisation (WHO). Specifically, the Standard states; *"it is desirable that the internal ambient noise level does not exceed the guideline values in Table 4."* Table 4 is reproduced here as Table 3.1.

Table 3.1: Indoor Ambient Noise Levels for Dwellings (BS8233:2014 Table 4)

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living room	35 dB $L_{Aeq(16hour)}$	-
Dining	Dining room/area	40 dB $L_{Aeq(16hour)}$	-

Activity	Location	07:00 to 23:00	23:00 to 07:00
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq(16hour)}$	30 dB $L_{Aeq(8hour)}$

BS 8223 suggests that an allowance of 15 dBA for the attenuation of a partially open window is reasonable in order to convert between internal and external sound levels and limits. Therefore, an assessment of external noise levels can assume an external noise level limit of 15 dB above those values detailed within Table 3.1 i.e. to achieve an internal night-time level of 30 dB $L_{Aeq(8hour)}$ with windows open the external sound level must not exceed 45dB $L_{Aeq(8hour)}$.

3.2.3 Assessment Criteria

Considering all of the above, the assessment is made as follows:

- A quantitative assessment is made against the fixed noise guideline levels defined in BS 8233:2014 for both residential receptors and the nearby temple; and
- A qualitative assessment is undertaken in accordance with BS 4142:2014 for residential receptors only, taking into consideration the context of the development and the outcome of the quantitative assessment.

3.3 Calculation Method

3.3.1 Noise Propagation Model (ISO 9613-2:2996)

In order to predict the noise immission levels attributable to the Proposed Development a noise propagation model was created using the propriety noise modelling software CadnaA. Within the software, complex models can be produced in order to simulate the propagation of noise according to a range of international calculation standards.

For this assessment noise propagation was calculated in accordance with ISO9613 '*Acoustics – Attenuation of sound during propagation outdoors*' (7) (8) using the following input parameters;

- Temperature is assumed to be 10°C and relative humidity as 70%;
- A ground attenuation factor of 1 (soft ground) has been used, with specific areas of developed ground (including the proposed development area) modelled with a ground attenuation factor of 0 (hard ground); and
- Receiver heights are set to 1.5 m.

3.3.2 Uncertainties and Limitations

The noise propagation model is designed to give a good approximation of the specific sound level and the contribution of each individual sound source; however, it is expected that measured levels are unlikely to be matched exactly with modelled values and the following limitations in the model should be considered:

- In accordance with ISO 9613, all assessment locations are modelled as downwind of all sound sources and propagation calculations are based on a moderate ground-based temperature inversion, such as commonly occurs at night. These conditions are favourable to noise propagation;
- Table 5 of ISO 9613 estimates overall accuracy for broadband noise predictions of ± 3 dB, with average source to receiver heights <5 m, at distances of up to 1,000 m;

- The predicted barrier attenuation provided by local topography, embankments, walls, buildings and other structures in the intervening ground between source and receiver can only be approximated and not all barrier attenuation will have been accounted for;
- The model assumes all noise sources are operating continuously, simultaneously and at maximum noise output, estimating a worst-case source noise level; and,
- Modelled sound sources represent candidate plant only and may change during final plant specification.

4 Baseline Sound Level Monitoring

4.1 Project History

In 2012, TNEI were commissioned by Banks Renewables to undertake a noise compliance assessment of the operational Hazlehead Wind Farm. As part of the study, TNEI undertook background noise monitoring over a period of at least 3 months at five properties neighbouring the wind farm. The turbines were shut down a number of times during the survey, in specific wind conditions, to facilitate noise data collection when the turbines were not operating.

A desktop study of up to date aerial imagery confirms that the infrastructure surrounding the proposed development has not significantly changed since 2012, therefore, the 2012 background noise data is still considered representative of the surrounding area and is appropriate for use within this assessment. Table 4.1 details the Noise Monitoring Locations (NMLs), which are also shown on Figure 1 (Appended). It should be noted that only NML03 and NML04 have been used within this assessment as these monitoring locations are representative of background sound levels of the closest receptors.

Table 4.1: 2012 Survey Baseline Noise Monitoring Locations

NML		Coordinates		Comments
NML03	Carlecotes	417734	403689	Property to South of Hazlehead Wind Farm
NML04	Riddle Pit Farm	417106	404166	Property to West of Hazlehead Wind Farm

At each NML unattended monitoring was carried out during the day-time, evening and night-time. All measurements were made with the sound level meter (SLM) mounted approximately 1.2 metres above the ground and away from nearby reflective surfaces i.e. building façades, fences etc.

The noise monitoring equipment consisted of three RION NL-31's and two RION NL-32's, all of which were fitted with environmental wind shields. All noise monitoring equipment (calibrator, SLM and microphones) used for the study can be categorised as Class 1, as specified in IEC 61672-1 *'Electroacoustics. Sound level meters. Specifications'* (IEC, 2002). The equipment was calibrated on site at the beginning and end of each measurement period with no significant deviations noted. Appendix C contains the equipment and laboratory calibration details for the SLMs and microphones.

The measurement data was obtained as a part of an ETSU-R-97 wind farm noise assessment and was measured alongside wind speed data measurements obtained with an on-site 10 m met mast.

For ETSU-R-97 assessments, measured noise data is not excluded for high wind speeds, rather the data is organised into wind speed 'bins' in order to help inform wind-speed specific noise limits. In contrast, BS4142 states, *"Monitor wind speed at the measurement location, using an anemometer, and record the wind speed together with the wind direction. Exercise caution when making measurements in poor weather conditions such as wind speeds greater than 5 m/s."* Accordingly, the noise data has been filtered to remove any data points captured during high wind speeds. As a large number of data points were recorded over a 3-month period, it has been possible to undertake a

conservative filtering of the data whilst still retaining a robust data set. Specifically, all data has been excluded for 1.5 m high wind speeds of 3 m/s and above at a height of 1.5 m

Table 4.2 details the typical background sound levels $L_{A90\ (10mins)}$, which have been determined after considering the distribution of data for each measurement period. The 10-minute measurement period has been used as the data obtained during the 2012 survey was logged in 10-minute periods as required by ETSU-R-97. Detailed measurement data, including statistical analysis charts, can be found in Appendix C.

Table 4.2: Representative Background Sound level, dB L_{A90}, Derived Through Statistical Analysis

NML ID	Daytime LA90(10mins)	Night-time LA90(10mins)
NML03	39	33
NML04	31	27

Table 4.3 details the measured residual sound levels $L_{Aeq\ (1hr)}$, which have been determined by analysing a 1-hour representative sample of data for both the daytime period (18:00 – 19:00 of the 27th of August 2012) and night-time period (00:00 – 01:00 of the 28th of August 2012) at both NMLs.

Table 4.3: Measured Residual Sound level, dB $L_{Aeq\ (1\ hour)}$

NML ID	Daytime LAeq (1 hour)	Night-time LAeq (1 hour)
NML03	52	41
NML04	43	40

5 Operational Noise Impacts

5.1 Modelling of Individual Noise Sources

The noise model considers all of the noise sources detailed within Section 2.1. All relevant noise source data sheets and calculation sheets are displayed in Appendix C.

5.1.1 Containerised BESS Unit with HVAC

Noise data for a candidate BESS Container Unit system has been provided by Banks. The candidate system consists of 8 battery cabinets and 2 PCS cabinets housed within a single air-conditioned container. A broadband Sound Pressure Level (SPL) of 72 dBA @ 1m from each façade of the container is quoted. No spectral data has been provided; therefore, the broadband SPL is assumed to be within the 500 Hz octave band frequency, in accordance with ISO9613-2:1996, which states; *"If only A-weighted sound power levels of the sources are known, the attenuation terms for 500 Hz may be used to estimate the resulting attenuation."*

5.1.2 1260 kVA ONAN Transformer

The BESS will be connected to a transformer of up to 1260 kVA. Final specification of this unit has not yet been determined, however, recognised methods for the calculation of transformer noise are available and have been used to predict a typical SWL for a unit of this rating. Specifically, two methods have been considered; Method 1 is described within the J&P Transformer Book (9) and is based on typical transformer average surface noise levels measured in accordance with BS EN 60551 'Determination of transformer and reactor sound levels' (10). Method 2 is described in Engineering Noise Control (Bies & Hansen) (11) and is based on typical NEMA (National Electrical Manufacturers Association) sound level ratings and spectral data measured by Army, Airforce and Navy, USA. Both methods consider the overall surface area of the transformers and allow for corrections to be made for a variety of cooling types. Noise levels for the proposed transformer power rating, derived through the use of calculation Method 2 (which is displayed in Appendix D), are presented in Table 5.1.

Table 5.1: Source Sound Level Data; 1260 kVA ONAN Transformer, SWL dBA

Descriptor	L_{wA}	31.5Hz	63Hz	125Hz	250Hz	500Hz	1KHz	2KHz	4KHz
Aux. Tx SWL	75	32	51	64	66	71	69	65	60

5.1.3 Battery Inverter/Power Management Unit (PMU)

The power transformer will be fed by a single Battery Inverter/PMU, which will generate noise through the use of fans for mechanical cooling.

TNEI have in-house data available for an inverter unit of the class proposed for this development and have used a SMA Sunny Central 2200 Inverter for the noise model. The spectral noise data for this inverter is displayed in Table 5.2. It should be noted that the noise levels displayed in Table 5.2 are representative of the inverter unit working at maximum capacity which, in reality, would only happen rarely during periods of high ambient temperatures. Therefore, standard operational noise levels are likely to be lower than those quoted below.

Table 5.2: Source Sound Level Data; SMA Sunny Central 2200 Inverter, SWL dBA

Descriptor	L_{wA}	31.5Hz	63Hz	125Hz	250Hz	500Hz	1KHz	2KHz	4KHz	8KHz
SMA Inverter	94	51	66	74	84	88	87	85	90	78

5.2 Calculated Sound Immission Level

The broadband noise immission levels have been calculated at two Noise Assessment Locations (NALs), which have been selected to represent the closest NSRs to the Proposed Development. Each NAL has been set at the closest boundary of the NSRs facing the Proposed Development. The NALs are detailed in Table 5.3 and shown on Figure 2. The noise immission levels have been calculated assuming all plant is operating continuously, concurrently and at maximum noise output during both the daytime and night-time.

Two NALs have been selected, which are the closest NSRs to the development on the assumption that if noise immission levels are acceptable at the closest receptors, they will be acceptable at receptors that are located further away.

Predictions of specific sound levels for the NALs are detailed in Table 5.3. In addition, Figure 2 in presented in Appendix E presents an isopleth noise contour plot for a height of 1.5 m overlaid on digital mapping data.

Table 5.3: Calculated sound immission levels at NALs, dB $L_{Aeq(t)}$

Noise Assessment Location		Co-ordinates		Immission Level
NAL ID	NAL Descriptor			dB $L_{Aeq(t)}$
NAL01	Property on Brookhill Lane (Carlecotes)	417740	403720	26
NAL02	Riddle Pit Farm	417148	404159	29

6 Noise Impact Assessment

6.1 Quantitative Assessment

The assessment against fixed noise levels is made against the most stringent of the guideline levels presented in BS8233:2014 (detailed in Table 6.1). To determine a set of limits, 15 dB has been added to the BS 8233 internal levels to allow for the attenuation that is provided by a partially open window, as detailed in Table 6.1.

Table 6.1: Derived Fixed Level Limits, dB LAeq(t)

Assessment parameter	BS8233 internal guideline level	Allowance for open window attenuation	Equivalent external level
Daytime 07:00 – 23:00	35	15	50 dB $L_{Aeq\ (16\ hours)}$
Night-time 23:00 – 07:00	30	15	45 dB $L_{Aeq\ (8\ hours)}$

Table 6.2 compares the predicted immission levels at the residential receptors with the derived noise level limits.

Table 6.2: Quantitative Assessment

Noise Assessment Location		Daytime		Night-time	
NAL ID	NAL Descriptor	Immission Level, dBA	Margin, dB	Immission Level, dBA	Margin, dB
NAL01	Property on Brookhill Lane (Carlecotes)	26	-24	26	-19
NAL02	Riddle Pit Farm	29	-21	29	-16

The predicted levels remain below the fixed guideline levels for both daytime and night-time assessment periods for all of the identified NSRs.

6.2 Qualitative Assessment

The qualitative assessment, which is undertaken following the guidance presented in BS 4142, considers the predicted immission levels, the character of the sound, the existing sound environment and the context of the development.

In order to assess the immission levels in accordance with BS4142, the Specific Sound Levels must be converted into Rating Levels. The Rating Level allows for character corrections to be added to the Specific Sound Level in order to account for particular characteristics of the sound which may be perceived as more annoying. In particular the Rating Level considers the tonality, impulsivity and intermittency of the sound, as well any other sound characteristics that are neither tonal, impulsive, or intermittent, but are otherwise readily distinctive against the residual acoustic environment.

6.2.1 Tonality

With regards to tonality, BS4142:2014 states:

"For sound ranging from not tonal to prominently tonal the Joint Nordic Method gives a correction of between 0 dB and +6 dB for tonality. Subjectively, this can be converted to a penalty of 2 dB for a tone which is just perceptible at the noise receptor, 4 dB where it is clearly perceptible and 6 dB where it is highly perceptible."

The noise data used for the SMA inverter does indicate the possibility of tonal elements at higher frequencies, more specifically at 3.15 kHz and 6.3 kHz. Even though the inverter will be tonal at source, predicted noise levels at the assessment locations in these frequency ranges are particularly low (approximately 10 dBA) and as such tonality is unlikely to be audible. Therefore, no tonal penalty has been added.

6.2.2 Impulsivity

With regards to impulsivity, BS4142:2014 states:

"A correction of up to +9dB can be applied for sound that is highly impulsive, considering both the rapidity of the change in sound level and the overall change in sound level. Subjectively this can be converted to a penalty of 3dB for impulsivity which is just perceptible at the noise receptor, 6dB where it is clearly perceptible, and 9dB where it is highly perceptible."

Impulsivity is not considered to be a relevant sound characteristic of a BESS development given that once they are operational, the noise is predictable and consistent.

6.2.3 Intermittency

The intermittency of the sound source needs to be considered when it has identifiable on/off conditions with regards to intermittency, BS4142:2014 states:

"If the intermittency is readily distinctive against the residual acoustic environment, a penalty of 3 dB can be applied."

As with impulsivity, intermittency is not considered to be a relevant sound characteristic in this case. Once operational, the BESS development will be operational for extended durations and will only likely shut down for maintenance purposes. Therefore, the noise is predictable and consistent. This is not considered to be intermittency.

6.2.4 Other Sound Characteristics

With regards to other sound characteristics, BS4142:2014(+A1-2019) states:

"Where the specific sound features characteristics that are neither tonal nor impulsive, nor intermittent, though otherwise are readily distinctive against the residual acoustic environment, a penalty of 3 dB can be applied."

The predicted immission levels are all below the measured Residual Sound Levels displayed in Table 4.3. As such, the immission levels are not anticipated to be '*readily distinctive against the residual acoustic environment'.*

6.2.5 Calculation of the Rating Level

With due regard to the above no character corrections are required. Therefore, the Rating Level is equal to the Specific Sound Level.

6.2.6 Assessment of the Impacts

BS4142, Section 11, requires that the assessment considers the context in which the sound occurs, and as such there is no definitive pass/fail element to the standard. However, as a starting point the standard states:

"Obtain an initial estimate of the impact of the specific sound by subtracting the measured background sound level from the rating level, and consider the following…

a) Typically, the greater this difference, the greater the magnitude of the impact.

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

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

d) The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source 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."

Table 6.3 presents a comparison of the Rating Levels to the daytime and night-time background sound levels. Background Sound Levels used for assessment at NAL01 and NAL02 are from NML03 and NML04 respectively.

Table 6.3: Margin Above / Below (+/-) Background Sound Level, dB

Noise Assessment Location		Daytime		Night-time	
NAL ID	**NAL Descriptor**	**Rating Level, dBA**	**Margin, dB**	**Immission Level, dBA**	**Margin, dB**
NAL01	Property on Brookhill Lane (Carlecotes)	26	-13	26	-7
NAL02	Riddle Pit Farm	29	-2	29	+2

At NAL02 during the night-time, the Rating level exceeds the background sound level by 2 dB but remains below the '*indication of an adverse impact, depending on the context.'*

At NAL01 for both daytime and night-time the Rating Level does not exceed the background sound level, which is *'an indication of the specific sound source having a low impact, depending on the context.'*

The context in which this assessment is made is as follows;

- The assessment considers candidate plant and the typical sound level output for this type of plant and assumes that all plant is operating constantly, concurrently and at full output, which in reality is unlikely;
- Noise levels from the site will be consistent and predictable i.e. little variation in noise level output will occur;
- Noise immission levels will be below the fixed guideline values as detailed in BS 8233 and the existing Residual Sound Levels; and,

Considering the context, therefore, does not change the assessment outcome and the specific sound source is still expected to have a low impact subject to appropriate selection of plant during the final specification/procurement stage.

7 Discussion

The assessment considers the likely noise level output of the proposed development based on candidate plant only and source noise levels will vary as the final plant is specified. As such, the source noise levels presented in this report should not be used to determine any particular noise level limits for the development.

Rather, it is more appropriate to set noise level limits based on the existing sound levels in the area, whilst considering the context of the development as discussed in the qualitative assessment. This allows appropriate levels of protection to be allocated to the nearest NSRs, giving comfort to residents and the Local Planning Authority (LPA), whilst providing the developer with sufficient flexibility in the design and specification of plant during the tendering process.

With this in mind, the following draft planning condition is put forward for consideration by the LPA, should they be minded to give consent to the development. With regards to the proposed noise level limits, the values detailed in Table 1 are based on the measured background sound level plus 4 dB. This would keep the Rating Levels below the indication of an adverse impact and also below the measured residual sound levels.

7.1 Draft Planning Condition

The Rating Level of noise immissions resulting from the operation of the proposed development, when determined in accordance with BS 4142:2014 +A1:2019 (BS 4142), shall not exceed the relevant values detailed in Table 1. The geographical coordinates referenced in Table 1 are provided for the purpose of identifying a location to which a given set of noise limits applies. Where there is more than one dwelling close to the location specified in Table 1, the noise limits shall apply to all dwellings in the vicinity of that location. Where a dwelling is not identified by name or location, the limits shall be equal to those set at the nearest location included in Table 1 unless otherwise agreed in writing with the Local Planning Authority.

For the purposes of this condition, a “dwelling” is a building within Use Classes C1, C2, C3 or C4 of the Town and Country Planning (Use Classes) Order 1987, which lawfully exists or had planning permission at the date of this permission.

Table 1: ***Rating Level Limits, dB LAeq(t)***

Location			07:00 – 23:00	23:00 – 07:00
Descriptor	**Easting**	**Northing**	**dB $L_{Aeq(1\ hour)}$**	**dB $L_{Aeq(15\ mins)}$**
Carlecotes	417734	403689	43	37
Riddle Pit Farm	417101	404175	35	31

8 Summary

In order to assess the impact of noise emissions from the Proposed Development, TNEI has produced a noise propagation model in accordance with ISO 9613 that predicts the noise immission levels at the nearest identified NSRs based on candidate plant typical for this type of development.

Two assessments considering the nearest residential NSRs have been carried out; firstly, a quantitative assessment concluded that levels would remain below the fixed guideline levels detailed in BS 8233 for both the daytime and night-time assessment periods.

Secondly, a quantitative assessment was undertaken in accordance with BS 4142. The assessment concludes that for all of the nearest receptors during the daytime "*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 same conclusion is reached for all residential receptors during the night-time, except for NSRs close to NAL02, where the Rating Level exceeds the background sound level but remains below the '*indication of an adverse impact, depending on the context.'*

Taking into context the proposed development and the anticipated noise effects, it is considered that the Proposed Development will not have an adverse noise impact on the local area, however, it will be necessary in the final design and tendering process to finalise appropriate plant specification. To this end, a draft planning condition has been put forward, which details BS 4142 Rating Level noise level limits. These limits should provide appropriate levels of protection for the nearest sensitive receptors.

9 References

1. **The European Parliament and the Council of the European Union.** *Relating to the Assessment and Management of Environmental Noise.* s.l. : European Parliament, 2002. DIRECTIVE 2002/49/EC.

2. **Department for Communities and Local Government.** *National Planning Policy Framework.* UK : The Crown, February 2019 (updated July 2019).

3. **Department for Environment, Food and Rural Affairs.** *Noise Policy Statement for England.* London : The Crown, 2010.

4. **Department of Energy and Climate Change.** *Overarching National Policy Statement for Energy (EN-1).* London : The Crown, 2011.

5. **British Standards Institute.** *Methods for Rating and Assessing Industrial and Commercial Sound.* UK : BSI, 2014. BS4142:2014 + A1:2019.

6. —. *Guidance on Sound Insulation and Noise Reduction for Buildings.* UK : BSI, 2014. BS8233:2014.

7. **(ISO), International Organization for Standardization.** *Acoustics – Attenuation of Sound during Propagation Outdoors: Part 1 – Method of Calculation of the Attenuation of Sound by Atmospheric Absorption.* Geneva : ISO, 1996. ISO9613-1:1996.

8. —. *Acoustics – Attenuation of Sound During Propagation Outdoors: Part 2 – General Method of Calculation.* Geneva : (ISO), International Organization for Standardization, 1996. ISO 9613-2:1996.

9. **Heathcote, Martin.** *J & P Transformer Book: A Practical Technology of the Power Transformer.* s.l. : Newnes, 2007.

10. **Commission, International Electrotechnical.** *IEC 60076-10, Power transformers – Part 10: Determination of sound levels, Edition 2.0.* 2016.

11. **David A. Bies, Colin H. Hansen.** *Engineering Noise Control: Theory and Practice.* s.l. : CRC Press, 2017.

Appendix A – Glossary of Terms

Attenuation: the reduction in level of a sound between the source and a receiver due to any combination of effects including: distance, atmospheric absorption, acoustic screening, the presence of a building façade, etc.

Background Sound Level: the sound level rarely fallen below in any given location over any given time period, often classed according to daytime, evening or night-time periods. The LA90 indices (see below) are typically used to represent the background sound level.

Broadband Noise: noise with components over a wide range of frequencies.

Decibel (dB): the ratio between the quietest audible sound and the loudest tolerable sound is a million to one in terms of the change in sound pressure. A logarithmic scale is used in sound level measurements because of this wide range. The scale used is the decibel (dB) scale which extends from 0 to 140 decibels (dB) corresponding to the intensity of the sound level.

dB(A): the ear has the ability to recognise a particular sound depending on its pitch or frequency. Microphones cannot differentiate sound in the same way as the ear, and to counter this weakness the sound measuring instrument applies a correction to correspond more closely to the frequency response of the human ear. The correction factor is called 'A Weighting' and the resulting measurements are written as dB(A). The dB(A) weighting is internationally accepted and has been found to correspond well with people's subjective reaction to sound levels and noise. Some typical subjective changes in sound levels are:

- a change of 3dB(A) is just perceptible;
- a change of 5dB(A) is clearly perceptible;
- a change of 10dB(A) is twice (or half) as loud.

Directivity: the property of a sound source that causes more sound to be radiated in one direction than another.

Emission: the sound energy emitted by a sound source (e.g. a wind turbine).

Frequency: the pitch of a sound in Hz or kHz. See Hertz.

Ground Effects: the modification of sound at a receiver location due to the interaction of the sound waves with the ground along its propagation path from source to receiver. Described using the term 'G', and ranges between 0 (hard ground), 0.5 (mixed ground) and 1 (soft ground).

Hertz (Hz): sound frequency refers to how quickly the air vibrates, or how close the sound waves are to each other (in cycles per second, or Hertz (Hz)).

Immission: the sound pressure level detected at a given location (e.g. the nearest dwelling).

Isopleth: a line on a map connecting points of equal value, for example air pressure, noise level etc.

Noise: unwanted sound

Lw: is the sound power level. It is a measure of the total sound energy radiated by a sound source and is used to calculate sound levels at a distant location. The *LWA* is the A-weighted sound power level.

Leq: is the equivalent continuous sound level, and is the sound level of a steady sound with the same energy as a fluctuating sound over the same period. It is possible to consider this level as the

ambient noise encompassing all noise at a given time. The LAeq, T is the A-weighted equivalent continuous sound level over a given time period (T).

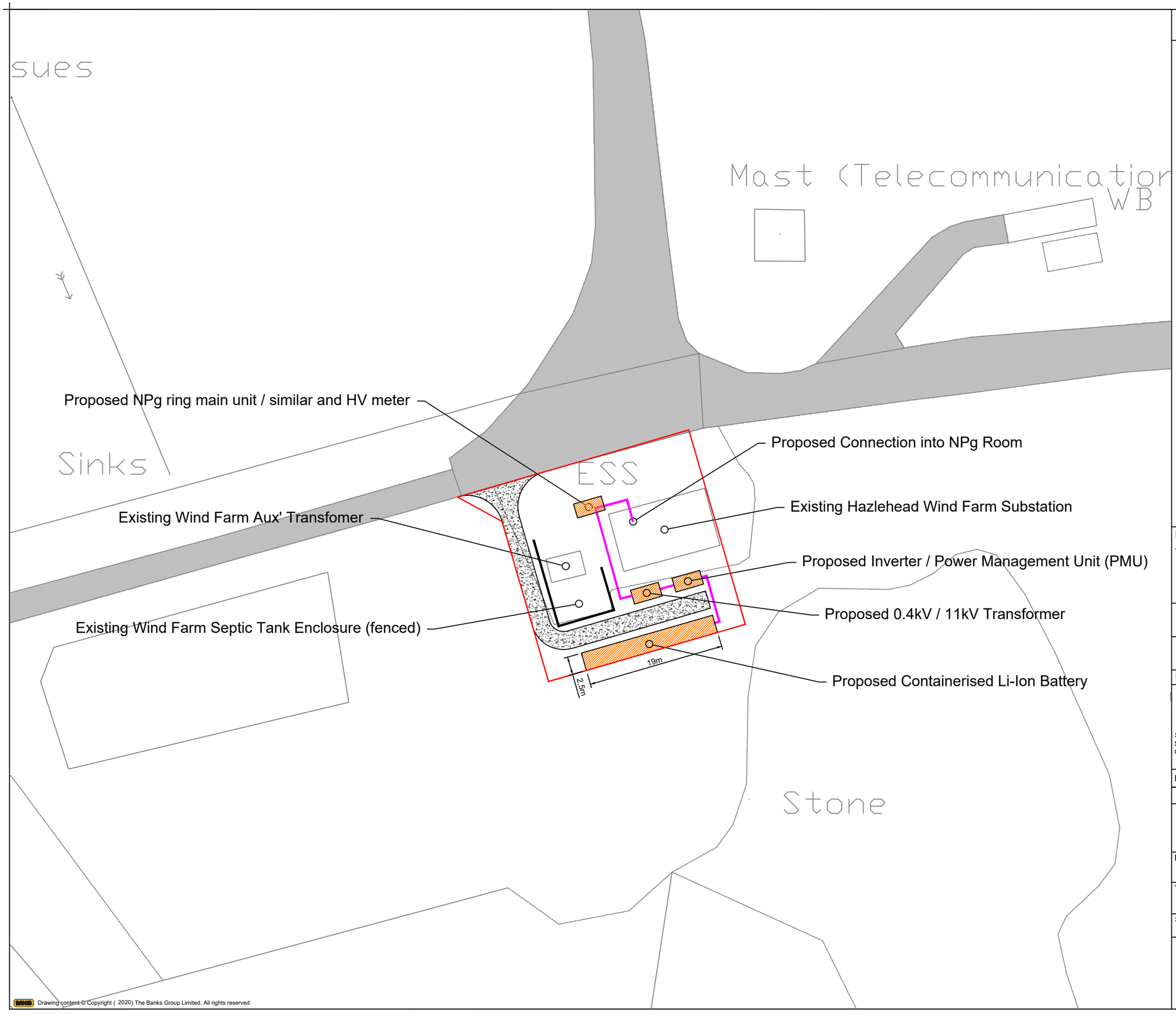
L90: index represents the sound level exceeded for 90 percent of the measurement period and is used to indicate quieter times during the measurement period. It is often used to measure the background sound level. The LA90,10min is the A-weighted background sound level over a ten-minute measurement sample.

Sound Level Meter: an instrument for measuring sound pressure level.

Sound Pressure Level: a measure of the sound pressure at a point, in decibels.

Tonal Noise: noise which covers a very restricted range of frequencies (e.g. a range of ≤20 Hz). This noise is subjectively more annoying than broadband noise.

Appendix B – Development Information



Key

- Site Boundary
- Existing Wind Farm Track
- New Track for battery
- New Infrastructure
- Approximate cable route

Notes:
-

Revision:	Description:	Drn:	Chkd:	Date:

Scale: 0m 5m 10m 15m 20m 25m

Source information:
Site Layout GA - 15-15-2019.dwg
OS MasterMap

Drawn:DB	Orig':EM	Checked:EM	App':11/02/2020

© Crown copyright and database rights (2019). Ordnance Survey 0100031673

Planning Application January 2020
Drawing PA02

Project: HAZLEHEAD BATTERY

Title: Site Layout

Scale:	Ref:	Sheet:
1:500@A3	HJB / 4090 / 7	1/1

BANKSRenewables
development with care
Inkerman House, St John's Road, Meadowfield, Durham. DH7 8XL
T: 0844 209 1515 F: 0844 209 1565 W: www.banksgroup.co.uk

Drawing content © Copyright (2020) The Banks Group Limited. All rights reserved.

07/08/2018 V5.3

Key

- Site Boundary
- Other land within applicant's control

Notes:
.

Revision:	Description:	Drn:	Chkd:	Date:

Scale: 0m 25m 75m 125m / 50m 100m

Source information:
OS MasterMap
HMLR_National_Polygons_Dataset_588114_780717.dwg

Drawn:DB	Orig':EM	Checked:EM	App':11/02/2020

© Crown copyright and database rights (2018). Ordnance Survey 0100031673

Planning Application January 2020
Drawing PA01

Project: HAZLEHEAD BATTERY

Title: Site Location

Scale:	Ref:	Sheet:
1:2500@A1	HJB / 4090 / 6	1/1

BANKS Renewables
development with care
Inkerman House, St John's Road, Meadowfield, Durham, DH7 8XL
T: 0844 209 1515 F: 0844 209 1565 W: www.banksgroup.co.uk

Drawing content © Copyright (2020) The Banks Group Limited. All rights reserved.

07/06/2018 V5.0

Appendix C – Baseline Survey Data

*Noise Monitoring Field Data Sheet

Project Title	Hazlehead	Project Number	7584
Client	Banks Renewables (Hazlehead Wind Farm) Ltd	Surveyor	JM/ SA/ MC/ MCL/ PG/ NS

MONITORING LOCATION DETAILS

Location Name	Noise monitoring location – Brookhill Lane
Description	The noise kit was initially sited at a location almost identical to the 2006 location, in a field used to grow christmas trees. After a few weeks, the land owner required the equipment to be removed and as such the kit had to be relocated. The new locations was approximately 40 meters away and located within the nearest residential property to the wind turbines so was judged representative. The equipments remained in this new location (the one shown on the pictures below) from 15th of June to the end of the survey and data only from this new location is used.
Approximate Grid Reference	Easting: 417773; Northing: 403679 (initial location) Easting: 417734; Northing: 403689 (location from 15/ 06 as used) The equipment moved during the survey but remained in the final location from 15/ 06 to the end of the survey as described above.
Dominant noise sources noted during installation, weekly inspection and removal	Wind in trees (dominant), road traffic noise, audible wind turbine noise, poultry in the garden, birdsongs.

MONITORING LOCATION PHOTOGRAPHS (location from 15/06/12 to 10/12/12)



North West



North East



South East



South West

MONITORING EQUIPMENT

		Kit Number	Model	Serial Number	Last Calibrated
16/03/12 to 18/05/12	Sound Level Meter	SLM 014	NL-31	01273102	01/06/2011
	Pre Amplifier	SLM 014	NH-21	26021	01/06/2011
	Microphone	SLM 014	UC-53A	313359	01/06/2011
18/05/12 to 10/12/12	Sound Level Meter	SLM 018	NL-31	01283554	11/10/2011
	Pre Amplifier	SLM 018	NH-21	29311	11/10/2011
	Microphone	SLM 018	UC-53A	315581	11/10/2011
Calibrator		CAL 02	NC-74	34973250	11/11/2011

EQUIPMENT SETTINGS

	Required	Selected
Noise Weighting	'A' Weighting	Yes
Measurement Interval	10 Minutes	Yes
Time Weighting	FAST	Yes
Measurement Range	20-110 dB	Yes

DATA

File Name	Start Time	End Time	Calibration at Start	Calibration at End	Drift	Observations
03-01 (SLM 014)	15:20 16/03/12	14:40 23/03/12	94.0	93.9	-0.1	Data unused due to erroneous wind data.
03-02 (SLM 014)	14:50 23/03/12	12:20 29/03/12	94.0	94.0	0.0	Data unused due to erroneous wind data.
03-03 (SLM 014)	12:30 29/03/12	10:30 05/04/12	94.0	94.1	0.1	Data unused due to erroneous wind data.
03-04 (SLM 014)	10:50 05/04/12	12:50 19/04/12	94.0	93.9	-0.1	Data unused due to erroneous wind data.
03-05 (SLM 014)	13:00 19/04/12	10:50 02/05/12	94.0	94.0	0.0	Data unused due to erroneous wind data.
03-06 (SLM 014)	11:00 02/05/12	11:20 18/05/12	94.0	94.1	0.1	Data unused due to erroneous wind data. SLM 014 removed from field at request of land owner.
08-07 (SLM 018)	11:50 18/05/12	12:10 31/05/12	94.0	94.0	0.0	SLM018 installed on 18/08 in garden of resident. Data unused due to erroneous wind data.
08-08 (SLM 018)	11:30 31/05/12	11:00 15/06/12	94.0	94.0	0.0	Data unused due to erroneous wind data.
08-09 (SLM 018)	11:20 15/06/12	13:00 29/06/12	94.0	94.2	0.2	Kit moved slightly within the garden on 15/06. Data used from 22/06, date of installation of a new 10m mast2.
08-10 (SLM 018)	13:10 29/06/12	12:00 13/07/12	94.0	94.0	0.0	None
08-11 (SLM 018)	12:10 13/07/12	11:10 27/07/12	94.0	93.8	-0.2	None
08-12 (SLM 018)	11:20 27/07/12	11:40 13/08/12	94.0	94.2	+0.2	None
08-13 (SLM 018)	11:50 13/08/12	11:40 16/09/12	94.0	93.9	-0.1	Out of battery on 16/09. Site visit on 28/09.
08-14 (SLM 018)	11:10 28/09/12	12:10 24/10/12	94.0	93.9	-0.1	None
08-15 (SLM 018)	12:20 24/10/12	13:40 (BST) 12/11/12	94.0	93.7	-0.3	Data from 28/10 02:00 to 12/11 13:40 are post-processed, adjusting -1h to correct for the change from BST to GMT time.
08-16 (SLM 018)	13:10 (GMT) 12/11/12	15:20 10/12/12	94.0	93.8	-0.2	Logger timestamp adjusted on site to be in GMT on 12/11. Survey end and equipment removed on 10/12/12.

Noise Monitoring Field Data Sheet

Project Title	Hazlehead	Project Number	7584
Client	Banks Renewables (Hazlehead Wind Farm) Ltd	Surveyor	JM/ SA/ MC/ MCL/ PG/ NS

MONITORING LOCATION DETAILS

Location Name	Noise monitoring location – Riddlepit Farm
Description	The noise kit was sited at a location almost identical to the 2006 location, in the garden to the east of the property.
Approximate Grid Reference	Easting: 417106; Northing: 404166. The equipment remained in the same location during the entire length of the survey.
Dominant noise sources noted during installation, weekly inspection and removal	Road traffic noise, audible wind turbine noise, dogs barking, wind in trees.

MONITORING LOCATION PHOTOGRAPHS



North



East



South



West

MONITORING EQUIPMENT

		Kit Number	Model	Serial Number	Last Calibrated
13/03/12 to 23/03/12	Sound Level Meter	SLM 024	NL-32	00703294	15/11/2011
	Pre Amplifier	SLM 024	NH-21	33385	15/11/2011
	Microphone	SLM 024	UC-53A	317046	15/11/2011
23/03/12 to 19/04/12	Sound Level Meter	SLM 015	NA-28	00680882	13/07/2011
	Pre Amplifier	SLM 015	NH-23	80933	13/07/2011
	Microphone	SLM 015	UC-59	01056	13/07/2011
19/04/12 to 13/08/12	Sound Level Meter	SLM 016	NL-31	00593593	12/10/2011
	Pre Amplifier	SLM 016	NH-21	30355	12/10/2011
	Microphone	SLM 016	UC-53A	316118	12/10/2011
	Calibrator	CAL 02	NC-74	34973250	14/11/2011

EQUIPMENT SETTINGS

	Required	Selected
Noise Weighting	'A' Weighting	Yes
Measurement Interval	10 Minutes	Yes
Time Weighting	FAST	Yes
Measurement Range	20-110 dB	Yes

DATA

File Name	Start Time	End Time	Calibration at Start	Calibration at End	Drift	Observations
04-01 (SLM 024)	11:40 16/03/12	12:10 23/03/12	94.0	94.0	0.0	Data unused due to erroneous wind data.
04-02 (SLM 015)	12:20 23/03/12	14:00 29/03/12	94.0	93.9	-0.1	Data unused due to erroneous wind data.
04-03 (SLM 015)	14:30 29/03/12	11:20 05/04/12	94.0	94.0	0.0	Data unused due to erroneous wind data.
04-04 (SLM 015)	11:30 05/04/12	11:50 19/04/12	94.0	94.1	0.1	Data unused due to erroneous wind data.
04-05 (SLM 016)	12:00 19/04/12	10:00 02/05/12	94.0	94.1	0.1	Data unused due to erroneous wind data.
04-06 (SLM 016)	10:20 02/05/12	12:00 18/05/12	94.0	94.1	0.1	Data unused due to erroneous wind data.
04-07 (SLM 016)	12:10 18/05/12	12:30 31/05/12	94.0	94.1	0.1	Data unused due to erroneous wind data.
04-08 (SLM 016)	12:50 31/05/12	11:50 15/06/12	94.0	93.9	-0.1	Data unused due to erroneous wind data.
04-09 (SLM 016)	12:00 15/06/12	14:20 29/06/12	94.0	94.1	0.1	Data unused due to erroneous wind data.
04-10 (SLM 016)	14:30 29/06/12	12:10 13/07/12	94.0	93.9	-0.1	Data used from 22/06, date of installation of a new 10m mast2.
04-11 (SLM 016)	12:30 13/07/12	11:30 27/07/12	94.0	93.9	-0.1	None
04-12 (SLM 016)	11:40 27/07/12	12:00 13/08/12	94.0	94.1	0.1	None
04-12 (SLM 016)	12:10 13/08/12	12:10 11/09/12	94.0	93.9	-0.1	Out of battery on 11/09, date of the last time stamp. Kit removed on 28/09.

MEASUREMENT SYSTEMS

CERTIFICATE OF CALIBRATION

Certificate Number	**CAL061102**
Date of Issue	**01/06/2011**
Customer	**TNEI Services Ltd**
	Description of Instrument
Sound Level Meter	Rion NL-31 Sound Level Meter [Serial No. 01273102] with Rion UC-53A Microphone [Serial No. 313359] and Rion NH-21 Preamplifier [Serial No. 26021] Fitted with a WS-10 foam windshield. The instrument successfully completed the Class 1 Periodic Tests of BS EN 61672.
Associated Calibrator	B & K 4226 S/N 2590976.
Date of Calibration	01/06/2011.
Test Procedure	..\..\..\Calibration Results Sheets\Current Approved Results Sheets\NL-31 Master 61672-3 Approved Issue 6 (BK 2590976).xls Test procedures in accordance with BS EN 61672-3:2006. NOTE: Test 10.1 (Self Generated Noise with Microphone Installed) omitted.
Test Engineer	Amrat Patel

APPROVED SIGNATORY .....

Les Jephson ☐ / Mike Breslin ☑

BEAUFORT COURT, 17 ROEBUCK WAY, MILTON KEYNES, MK5 8HL

☎ 01908 642846 🖹 01908 642814

✉ info@noise-and-vibration.co.uk 💻 www.noise-and-vibration.co.uk

ACOUSTICS NOISE AND VIBRATION LIMITED. REGISTERED IN ENGLAND NO. 3549028. REGISTERED OFFICE AS ABOVE.

CERTIFICATE OF CALIBRATION

CERTIFICATE NO. **CAL061102.**
DATE OF ISSUE **01/06/2011.**

Information relating to the operation and adjustment of the sound level meter were obtained from the data contained in the Rion Instruction Manual 32005 and associated Technical Notes 32042. Additional information relating to measurement uncertainties required by clause 11.3 has been provided by the Rion European Office and is available for inspection upon request.

Results

Tests on the Sound Level Meter were principally performed on the Main Channel. Limited tests were also performed using the Sub-Channel.

No Acoustic Calibrator was supplied with the instrument. When ANV Measurement Systems' B&K 4226 s/n 2590976 was initially applied the Sound Level Meter read 94.2dB (A).
The meter was adjusted to read 94.0 dB (A) derived from the current calibration certificate for the calibrator at the indicated frequency of 1000 Hz.

The environmental conditions at the start and end of the calibration were within the specified range for calibration and were noted to be as follows:

Conditions	Measured Value at Start	Measured Value at End
Temperature	23.8 °C	24.1 °C
Relative Humidity	34.1 %	33.9 %
Atmospheric Pressure	102.0 kPa	102.0 kPa

The self generated noise levels of the instrument with the microphone replaced by the electrical input device were:

09.9 dB (A);
16.6 dB (C); and
22.4 dB (Z).

These measured levels were within the specified limits defined within the instruction manual.

The Sound Level Meter submitted for testing has successfully completed the Class 1 Periodic Tests of BS EN 61672, for the environmental conditions under which the tests were performed. However, no general statement or conclusion can be made about the conformance of the Sound Level Meter to the full requirements of BS EN 61672-1:2003 because evidence was not publically available, from an independent testing organisation responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the requirements of BS EN 61672-1:2003 and because the periodic tests of BS EN 61672-3:2006 only cover a limited subset of the specifications in BS EN 61672-1:2003.

The calibration incorporated the windshield corrections supplied by the manufacturer and the results are therefore applicable to the instrument with the microphone and pre-amplifier attached with the windscreen fitted.

CERTIFICATE OF CALIBRATION

CERTIFICATE NO. **CAL061102.**
DATE OF ISSUE **01/06/2011.**

No information on the uncertainty of measurement, required by 11.7 of IEC 61672-3:2006, of the adjustment data given in the instruction manual or obtained from the manufacturer of the Sound Level Meter, or the manufacturer of the Microphone, or the manufacturer of the multi-frequency Sound Calibrator was published in the instruction manual or made available by the manufacturer or supplier. The uncertainty of measurement of the adjustment data has therefore been assumed to be numerically zero for the purpose of this periodic test. If these uncertainties are not actually zero, there is a possibility that the frequency response of the Sound Level Meter may not conform to the requirements of IEC 61672-1:2002.

The total expanded measurement uncertainties associated with the calibration equipment and procedures is based on a standard uncertainty multiplied by a coverage factor k=2 to provide a confidence of approximately 95% in the results. The assessment of uncertainty has been carried out in accordance with national and international guidance upon the calculation of uncertainties in metrology.

Notes

1. The tests were conducted principally on the main channel, with a limited number of tests conducted for the sub channel. The Peak C sound level measurements were carried out for the sub channel as they are only available on this channel.

2. The instrument was running firmware version 1.050.

015

MEASUREMENT SYSTEMS

CERTIFICATE OF CALIBRATION

Certificate Number	**CAL071113**
Date of Issue	**13/07/2011**
Customer	**TNEI Services Ltd**
	Description of Instrument Including Manufacturer / Supplier
Sound Level Meter	Rion NA-28 Sound Level Analyser [Serial No. 00680882] with Rion UC-59 Microphone [Serial No. 01056] and Rion NH-23 preamplier [Serial No. 80933] Fitted with a WS-10 foam windshield. The instrument conforms to Class 1 of BS EN 61672-1:2003 The instrument was running Version 1.8 Firmware
Associated Calibrator	B & K 4226 S/N 2590976.
Date of Calibration	13/07/2011
Test Procedure	..\..\..\Calibration Results Sheets\Current Approved Results Sheets\NA-28 Master 61672-Approved Issue 3 (BK 2590976).xls Test procedures in accordance with BS EN 61672-3:2006 NOTE: Test 10.1 (Self Generated Noise with Microphone Installed) omitted.
Test Engineer	Amrat Patel

APPROVED SIGNATORY .....

Les Jephson ☐ / Mike Breslin ☑

BEAUFORT COURT, 17 ROEBUCK WAY, MILTON KEYNES, MK5 8HL

☎ 01908 642846 🖹 01908 642814

✉ info@noise-and-vibration.co.uk 🖳 www.noise-and-vibration.co.uk

ACOUSTICS NOISE AND VIBRATION LIMITED. REGISTERED IN ENGLAND NO. 3549028. REGISTERED OFFICE AS ABOVE.

CERTIFICATE OF CALIBRATION

CERTIFICATE NO. **CAL071113**
DATE OF ISSUE **13/07/2011**

Information relating to the operation and adjustment of the sound level meter were obtained from the data contained in the Rion Instruction Manual 50490 and associated Technical Notes 50860. Additional information relating to measurement uncertainties required by clause 11.3 has been provided by the Rion European Office and is available for inspection upon request.

Results

No Acoustic Calibrator was supplied with the instrument. When ANV Measurement Systems' B&K 4226 s/n 2590976 was initially applied the Sound Level Meter read 9x.xdB (A).
The meter was adjusted to read 94.0 dB (A) derived from the current calibration certificate for the calibrator at the indicated frequency of 1000 Hz.
[No adjustment was made to the meter.]

The environmental conditions at the start and end of the calibration were within the specified range for calibration and were noted to be as follows:

Conditions	Measured Value at Start	Measured Value at End
Temperature	24.0 °C	24.6 °C
Relative Humidity	38.4 %	38.9 %
Atmospheric Pressure	101.0 kPa	101.0 kPa

The self generated noise levels of the instrument with the microphone replaced by the electrical input device were as follows:

09.5 dB (A);
14.7 dB (C); and
21.0 dB (Z).

These measured levels were within the specified limits defined within the instruction manual.

The evidence was available to the public, from an independent testing organisation responsible for pattern approvals, to demonstrate that the model of sound level meter submitted for periodic testing successfully completed the applicable pattern evaluation tests of BS EN 61672-2:2003.

CERTIFICATE OF CALIBRATION

CERTIFICATE NO. **CAL071113**
DATE OF ISSUE **13/07/2011**

The sound level meter submitted for testing has successfully completed the Class 1 Periodic tests of BS EN 61672-3:2006, for the environmental conditions under which the tests were performed. As public evidence was available, from an independent testing organisation responsible for approving the results of pattern evaluation tests performed in accordance with BS EN 61672-2:2003, to demonstrate that the model of sound level meter fully conformed to the requirements in BS EN 61672-1:2003, the sound level meter submitted for testing conforms to the Class 1 requirements of BS EN 61672-1:2003.

No information on the uncertainty of measurement, required by 11.7 of BS EN 61672-3:2006, of the adjustment data given in the instruction manual or obtained from the manufacturer of the Sound Level Meter, or the manufacturer of the Microphone, or the manufacturer of the multi-frequency Sound Calibrator was published in the instruction manual or made available by the manufacturer or supplier. The uncertainty of measurement of the adjustment data has therefore been assumed to be numerically zero for the purpose of this periodic test. If these uncertainties are not actually zero, there is a possibility that the frequency response of the Sound Level Meter may not conform to the requirements of BS EN 61672-1:2003.

The total expanded measurement uncertainties associated with the calibration equipment and procedures is based on a standard uncertainty multiplied by a coverage factor k=2 to provide a confidence of approximately 95% in the results. The assessment of uncertainty has been carried out in accordance with national and international guidance upon the calculation of uncertainties in metrology.

Notes

1. The wind screen correction on the instrument was set to *on* and the diffuse field correction set to *off* for the duration of the calibration.

2. The tests were conducted principally on the main channel, with a limited number of tests conducted for the sub channel. The Peak C sound level measurements were carried out for the sub channel as they are only available on this channel.

SLM016

MEASUREMENT SYSTEMS

CERTIFICATE OF CALIBRATION

Certificate Number	**CAL101110**
Date of Issue	**12/10/2011**
Customer	**TNEI Services Ltd**
	Description of Instrument
Sound Level Meter	Rion NL-31 Sound Level Meter [Serial No. 00593593] with Rion UC-53A Microphone [Serial No. 316118] and Rion NH-21 Preamplifier [Serial No. 30355] Fitted with a WS-10 foam windshield. The instrument successfully completed the Class 1 Periodic Tests of BS EN 61672.
Associated Calibrator	B & K 4226 S/N 2590976.
Date of Calibration	12/10/2011.
Test Procedure	..\..\..\Calibration Results Sheets\Current Approved Results Sheets\NL-31 Master 61672-3 Approved Issue 6 (BK 2590976).xls Test procedures in accordance with BS EN 61672-3:2006. NOTE: Test 10.1 (Self Generated Noise with Microphone Installed) omitted.
Test Engineer	Amrat Patel

APPROVED SIGNATORY .....

Les Jephson ☐ / Mike Breslin ☑

BEAUFORT COURT, 17 ROEBUCK WAY, MILTON KEYNES, MK5 8HL

☎ 01908 642846 🖹 01908 642814

✉ info@noise-and-vibration.co.uk 💻 www.noise-and-vibration.co.uk

ACOUSTICS NOISE AND VIBRATION LIMITED. REGISTERED IN ENGLAND NO. 3549028. REGISTERED OFFICE AS ABOVE.

CERTIFICATE OF CALIBRATION

CERTIFICATE NO. **CAL101110.**
DATE OF ISSUE **12/10/2011.**

Information relating to the operation and adjustment of the sound level meter were obtained from the data contained in the Rion Instruction Manual 32005 and associated Technical Notes 32042. Additional information relating to measurement uncertainties required by clause 11.3 has been provided by the Rion European Office and is available for inspection upon request.

Results

Tests on the Sound Level Meter were principally performed on the Main Channel. Limited tests were also performed using the Sub-Channel.

No Acoustic Calibrator was supplied with the instrument. When ANV Measurement Systems' B&K 4226 s/n 2590976 was initially applied the Sound Level Meter read 94.2dB (A).
The meter was adjusted to read 94.0 dB (A) derived from the current calibration certificate for the calibrator at the indicated frequency of 1000 Hz.

The environmental conditions at the start and end of the calibration were within the specified range for calibration and were noted to be as follows:

Conditions	Measured Value at Start	Measured Value at End
Temperature	22.8 °C	23.8 °C
Relative Humidity	51.2 %	49.9 %
Atmospheric Pressure	101.0 kPa	101.0 kPa

The self generated noise levels of the instrument with the microphone replaced by the electrical input device were:

11.2 dB (A);
19.1 dB (C); and
23.7 dB (Z).

These measured levels were within the specified limits defined within the instruction manual.

The Sound Level Meter submitted for testing has successfully completed the Class 1 Periodic Tests of BS EN 61672, for the environmental conditions under which the tests were performed. However, no general statement or conclusion can be made about the conformance of the Sound Level Meter to the full requirements of BS EN 61672-1:2003 because evidence was not publically available, from an independent testing organisation responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the requirements of BS EN 61672-1:2003 and because the periodic tests of BS EN 61672-3:2006 only cover a limited subset of the specifications in BS EN 61672-1:2003.

The calibration incorporated the windshield corrections supplied by the manufacturer and the results are therefore applicable to the instrument with the microphone and pre-amplifier attached with the windscreen fitted.

CERTIFICATE OF CALIBRATION

CERTIFICATE NO. **CAL101110.**
DATE OF ISSUE **12/10/2011.**

No information on the uncertainty of measurement, required by 11.7 of IEC 61672-3:2006, of the adjustment data given in the instruction manual or obtained from the manufacturer of the Sound Level Meter, or the manufacturer of the Microphone, or the manufacturer of the multi-frequency Sound Calibrator was published in the instruction manual or made available by the manufacturer or supplier. The uncertainty of measurement of the adjustment data has therefore been assumed to be numerically zero for the purpose of this periodic test. If these uncertainties are not actually zero, there is a possibility that the frequency response of the Sound Level Meter may not conform to the requirements of IEC 61672-1:2002.

The total expanded measurement uncertainties associated with the calibration equipment and procedures is based on a standard uncertainty multiplied by a coverage factor k=2 to provide a confidence of approximately 95% in the results. The assessment of uncertainty has been carried out in accordance with national and international guidance upon the calculation of uncertainties in metrology.

Notes

1. The tests were conducted principally on the main channel, with a limited number of tests conducted for the sub channel. The Peak C sound level measurements were carried out for the sub channel as they are only available on this channel.

2. The instrument was running firmware version 1.400.

SLM018

MEASUREMENT SYSTEMS

CERTIFICATE OF CALIBRATION

Certificate Number	**CAL101108**
Date of Issue	**11/10/2011**
Customer	**TNEI Services Ltd**
	Description of Instrument
Sound Level Meter	Rion NL-31 Sound Level Meter [Serial No. 01283554] with Rion UC-53A Microphone [Serial No. 315581] and Rion NH-21 Preamplifier [Serial No. 29311] Fitted with a WS-10 foam windshield. The instrument successfully completed the Class 1 Periodic Tests of BS EN 61672.
Associated Calibrator	B & K 4226 S/N 2590976.
Date of Calibration	11/10/2011
Test Procedure	..\..\..\Calibration Results Sheets\Current Approved Results Sheets\NL-31 Master 61672-3 Approved Issue 6 (BK 2590976).xls Test procedures in accordance with BS EN 61672-3:2006. NOTE: Test 10.1 (Self Generated Noise with Microphone Installed) omitted.
Test Engineer	Amrat Patel

APPROVED SIGNATORY .....

Les Jephson ☐ / Mike Breslin ☑

BEAUFORT COURT, 17 ROEBUCK WAY, MILTON KEYNES, MK5 8HL

☎ 01908 642846 🖹 01908 642814

✉ info@noise-and-vibration.co.uk 💻 www.noise-and-vibration.co.uk

ACOUSTICS NOISE AND VIBRATION LIMITED. REGISTERED IN ENGLAND NO. 3549028. REGISTERED OFFICE AS ABOVE.

CERTIFICATE OF CALIBRATION

CERTIFICATE NO. **CAL101108.**
DATE OF ISSUE **11/10/2011.**

Information relating to the operation and adjustment of the sound level meter were obtained from the data contained in the Rion Instruction Manual 32005 and associated Technical Notes 32042. Additional information relating to measurement uncertainties required by clause 11.3 has been provided by the Rion European Office and is available for inspection upon request.

Results

Tests on the Sound Level Meter were principally performed on the Main Channel. Limited tests were also performed using the Sub-Channel.

No Acoustic Calibrator was supplied with the instrument. When ANV Measurement Systems' B&K 4226 s/n 2590976 was initially applied the Sound Level Meter read 94.1dB (A).
The meter was adjusted to read 93.9 dB (A) derived from the current calibration certificate for the calibrator at the indicated frequency of 1000 Hz.

The environmental conditions at the start and end of the calibration were within the specified range for calibration and were noted to be as follows:

Conditions	Measured Value at Start	Measured Value at End
Temperature	23.4 °C	24.2 °C
Relative Humidity	46.6 %	48.0 %
Atmospheric Pressure	100.7 kPa	100.7 kPa

The self generated noise levels of the instrument with the microphone replaced by the electrical input device were:

10.2 dB (A);
17.3 dB (C); and
22.5 dB (Z).

These measured levels were within the specified limits defined within the instruction manual.

The Sound Level Meter submitted for testing has successfully completed the Class 1 Periodic Tests of BS EN 61672, for the environmental conditions under which the tests were performed. However, no general statement or conclusion can be made about the conformance of the Sound Level Meter to the full requirements of BS EN 61672-1:2003 because evidence was not publically available, from an independent testing organisation responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the requirements of BS EN 61672-1:2003 and because the periodic tests of BS EN 61672-3:2006 only cover a limited subset of the specifications in BS EN 61672-1:2003.

The calibration incorporated the windshield corrections supplied by the manufacturer and the results are therefore applicable to the instrument with the microphone and pre-amplifier attached with the windscreen fitted.

CERTIFICATE OF CALIBRATION

CERTIFICATE NO. **CAL101108.**
DATE OF ISSUE **11/10/2011.**

No information on the uncertainty of measurement, required by 11.7 of IEC 61672-3:2006, of the adjustment data given in the instruction manual or obtained from the manufacturer of the Sound Level Meter, or the manufacturer of the Microphone, or the manufacturer of the multi-frequency Sound Calibrator was published in the instruction manual or made available by the manufacturer or supplier. The uncertainty of measurement of the adjustment data has therefore been assumed to be numerically zero for the purpose of this periodic test. If these uncertainties are not actually zero, there is a possibility that the frequency response of the Sound Level Meter may not conform to the requirements of IEC 61672-1:2002.

The total expanded measurement uncertainties associated with the calibration equipment and procedures is based on a standard uncertainty multiplied by a coverage factor k=2 to provide a confidence of approximately 95% in the results. The assessment of uncertainty has been carried out in accordance with national and international guidance upon the calculation of uncertainties in metrology.

Notes

1. The tests were conducted principally on the main channel, with a limited number of tests conducted for the sub channel. The Peak C sound level measurements were carried out for the sub channel as they are only available on this channel.

2. The instrument was running firmware version 1.400.

MEASUREMENT SYSTEMS

CERTIFICATE OF CALIBRATION

Certificate Number	**CAL111126**
Date of Issue	**15/11/2011**
Customer	**TNEI Services Ltd**
	Description of Instrument
Sound Level Meter	Rion NL-32 Sound Level Meter [Serial No. 00703294] with Rion UC-53A Microphone [Serial No. 317046] and Rion NH-21 Preamplifier [Serial No. 33385] Fitted with a WS-10 foam windshield. The instrument successfully completed the Class 1 Periodic Tests of BS EN 61672.
Associated Calibrator	B & K 4226 S/N 2590976.
Date of Calibration	15/11/2011.
Test Procedure	..\..\..\Calibration Results Sheets\Current Approved Results Sheets\NL-31 Master 61672-3 Approved Issue 6 (BK 2590976).xls Test procedures in accordance with BS EN 61672-3:2006. NOTE: Test 10.1 (Self Generated Noise with Microphone Installed) omitted.
Test Engineer	Amrat Patel

APPROVED SIGNATORY .....
Les Jephson ☐ / Mike Breslin ☐

BEAUFORT COURT, 17 ROEBUCK WAY, MILTON KEYNES, MK5 8HL
☎ 01908 642846 🖹 01908 642814
✉ info@noise-and-vibration.co.uk 💻 www.noise-and-vibration.co.uk

ACOUSTICS NOISE AND VIBRATION LIMITED. REGISTERED IN ENGLAND NO. 3549028. REGISTERED OFFICE AS ABOVE.

CERTIFICATE OF CALIBRATION

CERTIFICATE NO. **CAL111126.**
DATE OF ISSUE **15/11/2011.**

Information relating to the operation and adjustment of the sound level meter were obtained from the data contained in the Rion Instruction Manual 32005 and associated Technical Notes 32042. Additional information relating to measurement uncertainties required by clause 11.3 has been provided by the Rion European Office and is available for inspection upon request.

Results

Tests on the Sound Level Meter were principally performed on the Main Channel. Limited tests were also performed using the Sub-Channel.

No Acoustic Calibrator was supplied with the instrument. When ANV Measurement Systems' B&K 4226 s/n 2590976 was initially applied the Sound Level Meter read 94.2 dB (A).
The meter was adjusted to read 94.0 dB (A) derived from the current calibration certificate for the calibrator at the indicated frequency of 1000 Hz.

The environmental conditions at the start and end of the calibration were within the specified range for calibration and were noted to be as follows:

Conditions	Measured Value at Start	Measured Value at End
Temperature	22.7 °C	23.0 °C
Relative Humidity	44.6 %	38.6 %
Atmospheric Pressure	101.0 kPa	101.0 kPa

The self generated noise levels of the instrument with the microphone replaced by the electrical input device were:

10.0 dB (A);
17.3 dB (C); and
22.2 dB (Z).

These measured levels were within the specified limits defined within the instruction manual.

The Sound Level Meter submitted for testing has successfully completed the Class 1 Periodic Tests of BS EN 61672, for the environmental conditions under which the tests were performed. However, no general statement or conclusion can be made about the conformance of the Sound Level Meter to the full requirements of BS EN 61672-1:2003 because evidence was not publically available, from an independent testing organisation responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the requirements of BS EN 61672-1:2003 and because the periodic tests of BS EN 61672-3:2006 only cover a limited subset of the specifications in BS EN 61672-1:2003.

The calibration incorporated the windshield corrections supplied by the manufacturer and the results are therefore applicable to the instrument with the microphone and pre-amplifier attached with the windscreen fitted.

CERTIFICATE OF CALIBRATION

CERTIFICATE NO. **CAL111126.**
DATE OF ISSUE **15/11/2011.**

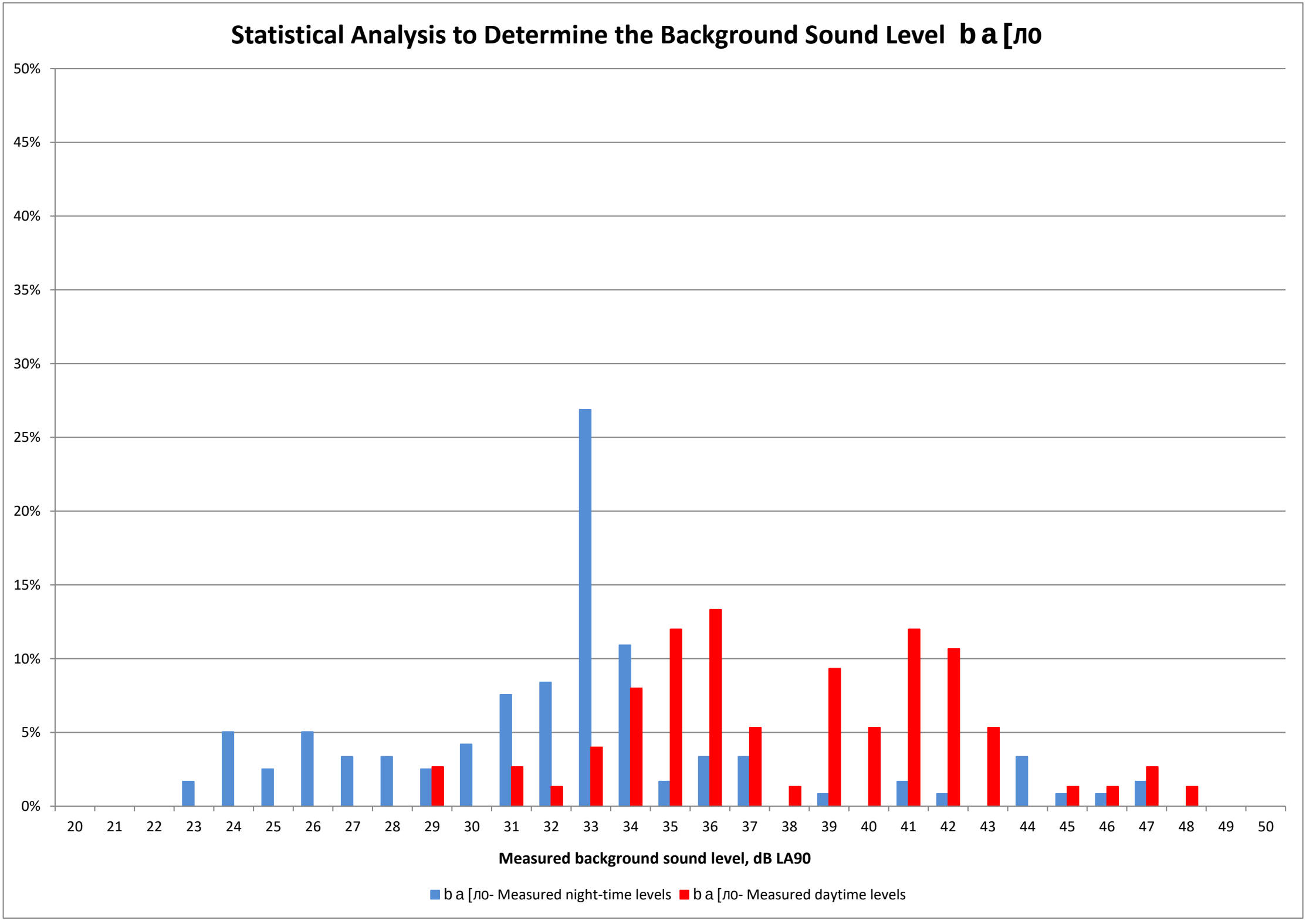
No information on the uncertainty of measurement, required by 11.7 of IEC 61672-3:2006, of the adjustment data given in the instruction manual or obtained from the manufacturer of the Sound Level Meter, or the manufacturer of the Microphone, or the manufacturer of the multi-frequency Sound Calibrator was published in the instruction manual or made available by the manufacturer or supplier. The uncertainty of measurement of the adjustment data has therefore been assumed to be numerically zero for the purpose of this periodic test. If these uncertainties are not actually zero, there is a possibility that the frequency response of the Sound Level Meter may not conform to the requirements of IEC 61672-1:2002.

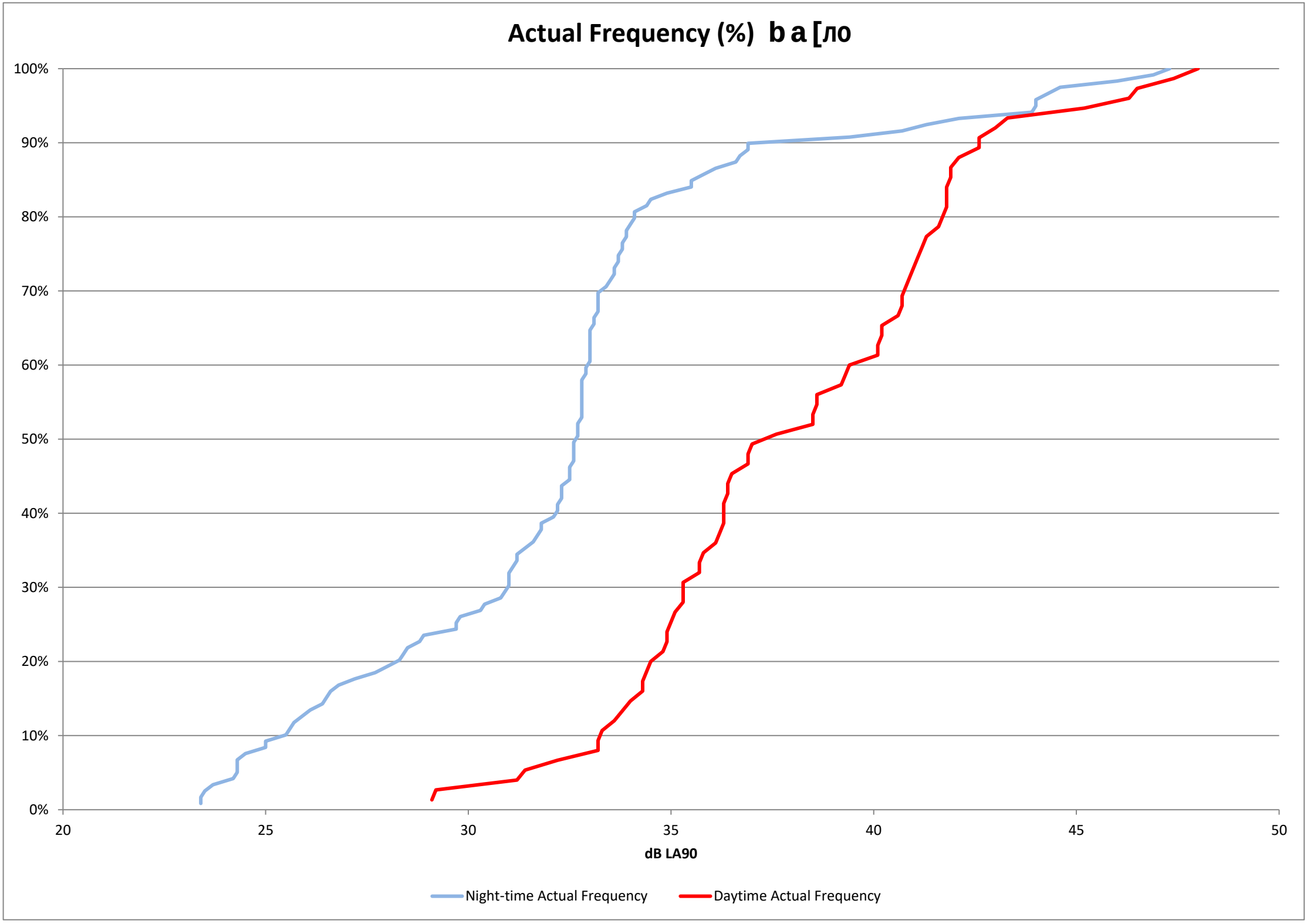
The total expanded measurement uncertainties associated with the calibration equipment and procedures is based on a standard uncertainty multiplied by a coverage factor k=2 to provide a confidence of approximately 95% in the results. The assessment of uncertainty has been carried out in accordance with national and international guidance upon the calculation of uncertainties in metrology.

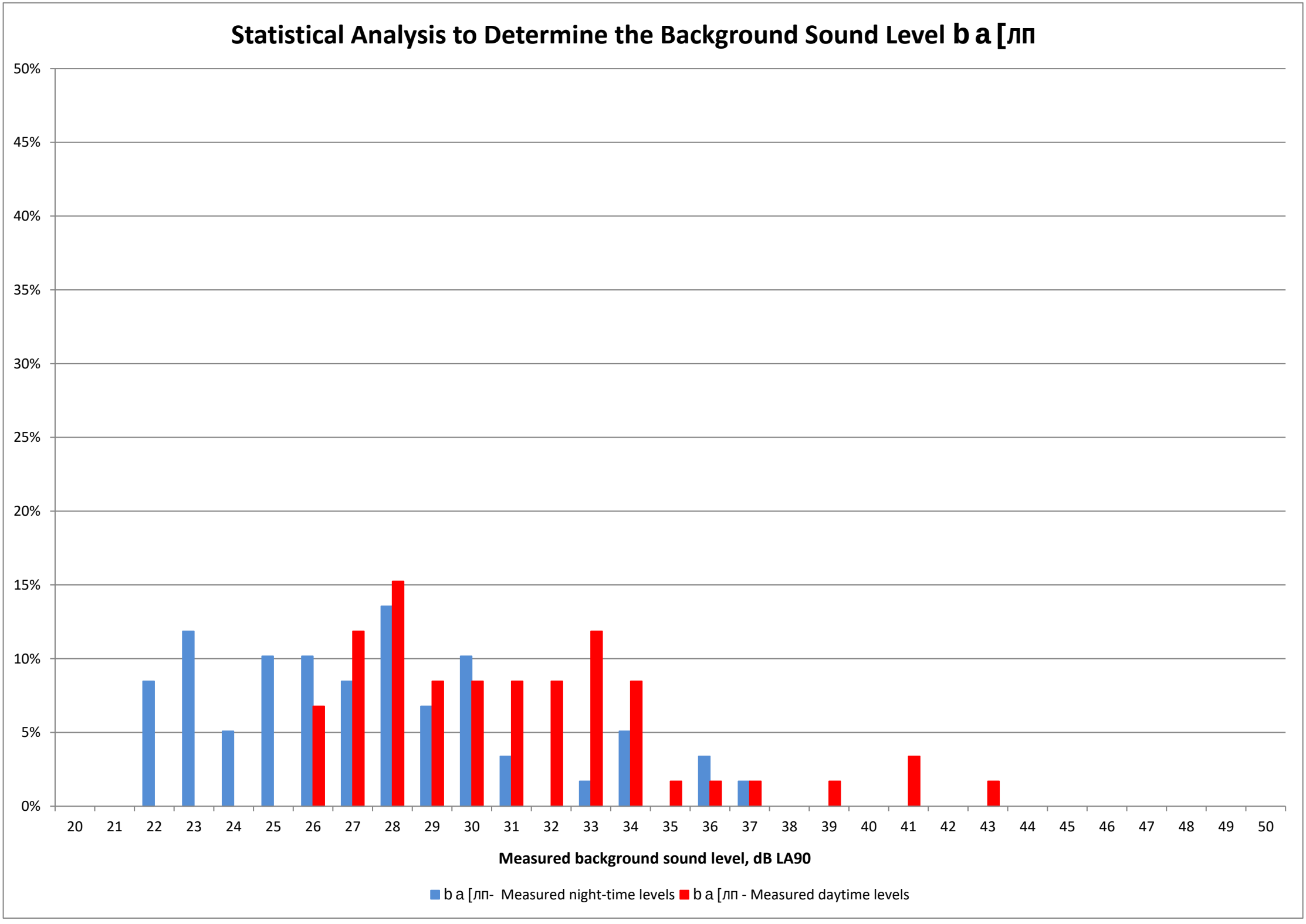
Notes

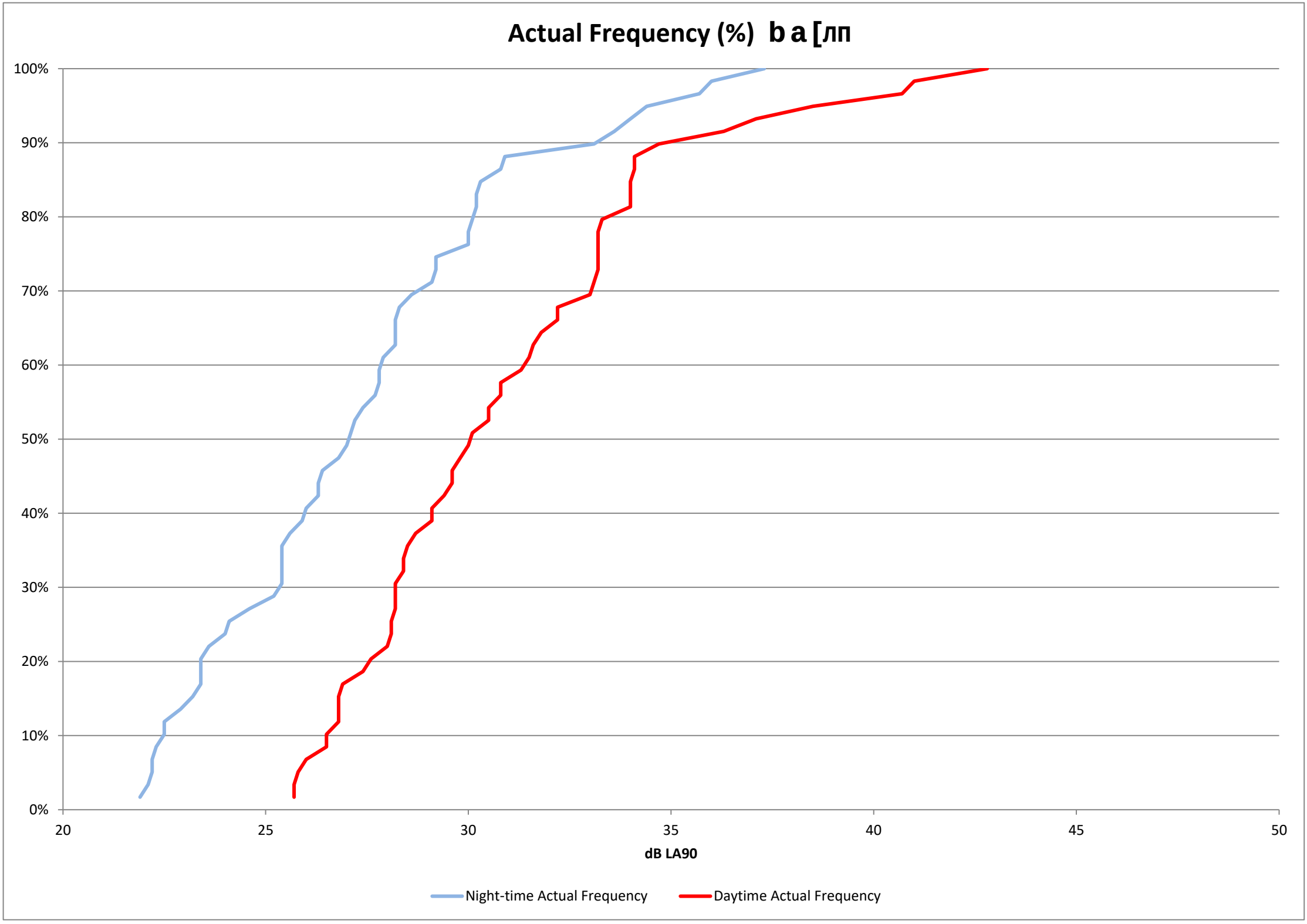
1. The tests were conducted principally on the main channel, with a limited number of tests conducted for the sub channel. The Peak C sound level measurements were carried out for the sub channel as they are only available on this channel.

2. The instrument was running firmware version 1.400.


Statistical Analysis to Determine the Background Sound Level b a [ло
50%
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50
Measured background sound level, dB LA90
b a [ло- Measured night-time levels
b a [ло- Measured daytime levels


Actual Frequency (%) b a [ло
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
20
25
30
35
40
45
50
dB LA90
Night-time Actual Frequency
Daytime Actual Frequency


Statistical Analysis to Determine the Background Sound Level b a [лп
50%
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50
Measured background sound level, dB LA90
b a [лп- Measured night-time levels
b a [лп - Measured daytime levels


Actual Frequency (%) b a [лп
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
20
25
30
35
40
45
50
dB LA90
Night-time Actual Frequency
Daytime Actual Frequency

Appendix D – Noise Modelling Data

Product Technical Specification Summary

(CS40HN-P1260B1900-E-R1& CS40HN-P1260B1900-E-R1M01)

Prepared By



1 Application

The commercial containerized Energy Storage System (ESS) is a modular fully integrated AC coupled system consisting of rechargeable lithium-ion (LFP) battery, PCS and other auxiliary system. The smallest modular grid-connected system is 1260kVA-1900kWh. The system can be scaled to create multi-MW sites. This specification also shortly introduces the basic unit of 1260kVA-1900kWh system construction.

2 Schematic diagram

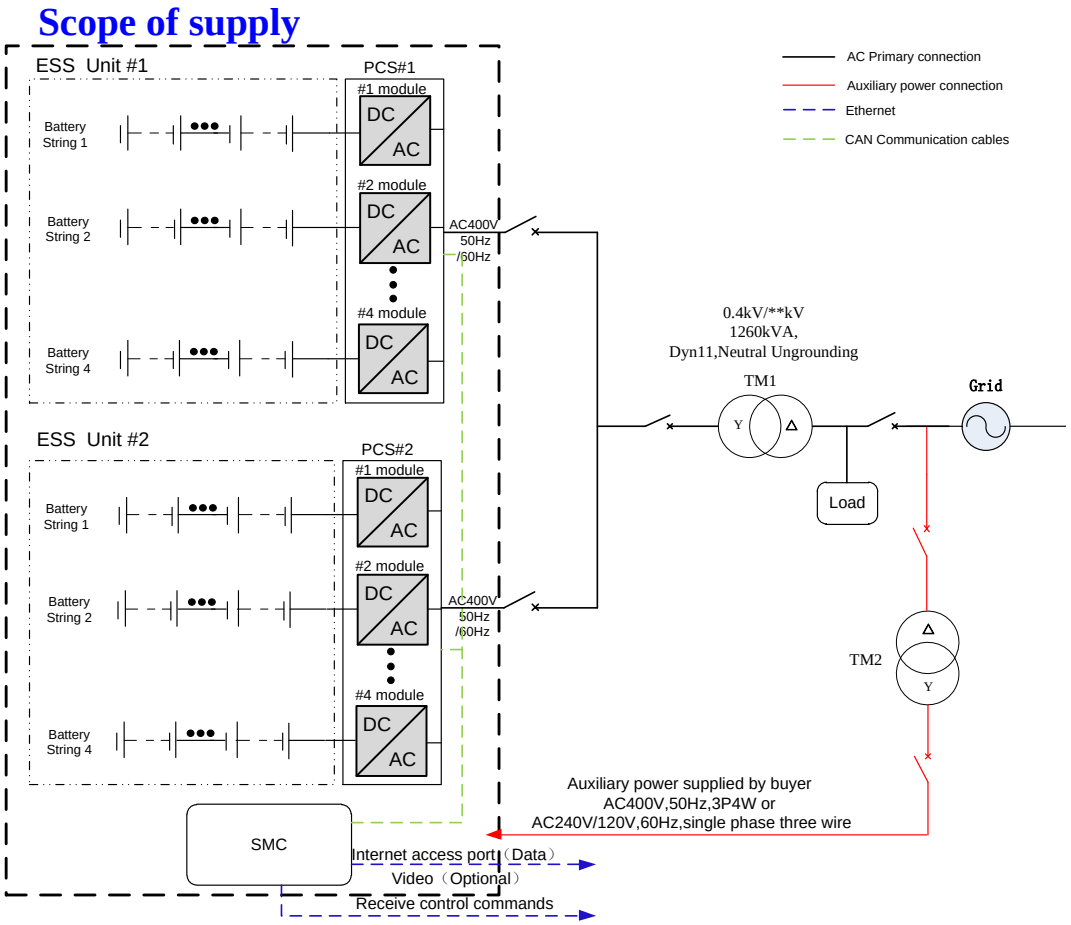


Figure 1 System topology diagram

3 System configuration

Table 1 Scope of supply by supplier

No.	Item	Number	Remark
1	Battery cabinet	8 pcs	BTS225-300-9P-R1
2	PCS cabinet	2 pcs	BEM630KTL-E-R1
3	container	1 pcs	Including air conditioning system, fire protection system, lighting system, power supply system, etc.

4 System parameter

Table 2 System parameter

No.	Item	Parameter	Remark
System parameter			
1	Charging and discharging power(MVA)	0.315	@AC400V,Frequency Regulation condition, about 283 days in a year
2	Charging power(MVA)	0.315	@AC400V, ESS charging once a day when electricity price are low, about 82 days in a year
	Discharging power(MVA)	1.26	@AC400V, ESS discharging once a day when electricity price are high in a day, about 82 days
3	Charging and discharging power(MVA)	1.26	@Testing condition ,only once a year, following **STC in Technical Specification**
4	Battery system total cell energy(kWh)	1900	
5	PCS AC side nominal energy(kWh)	1575	@SAT(The duration time from FAT to SAT is 3 calendar months)
6	Nominal output voltage(V)	400	
7	Output Voltage range(V)	360～440	
8	Nominal output frequency(Hz)	50/60	
9	Output frequency range(Hz)	47～52/58～60.5	47～52(complying with G59/3)
10	Max. output current	910A×2	@AC400V
11	Power factor	1(lagging)~1(leading)	
12	THD	＜5%	@Nominal Power
Working condition			
13	Ambient temperature range	-15℃～+45℃	Derating when exceeding 45℃
14	Permissible Ambient Humidity	5%～95%	Non-condensing
15	Permissible Altitude	＜2000m	

No.	Item		Parameter	Remark
Other parameter				
16	Enclosure Protection Grade		IP54	Battery room
			IP34	PCS room
17	Sound Pressure		Sound pressure level as measured at 1m shall not exceed 72dBA when background noise measures 58-60dBA.	@At any point 1m from outer surface of container or HVAC units when operating at 75% Rated Power and 30 ℃.
18	Round Trip efficiency @ BOL		≥88%	@Testing condition ,only once a year, following **STC in Technical Specification**
19	Round Trip efficiency over 10 years		≥86.5%	@Testing condition ,only once a year, following **STC in Technical Specification**
20	Communication Interface		Ethernet	
21	Dimension（W×D×H）		12192×2438×2896mm	
22	Weight		About 29t	
23	External interface	Power interface	2 pcs	Three phases three lines
		Auxiliary power supply interface	1 pcs	3P4W 400V,50Hz or AC240/120V,60Hz,single phase three wire power≥35kVA
		Communication interface	2 pcs	Ethernet
		Grounding interface	2 pcs	

5 Communication topology

In this ESS container, the system provides communication interface for buyer side SCADA system. The communication protocol of the communication interface is Modbus TCP/IP.

The ESS system reserves the communication interface and receives the instructions from the buyer SCADA to charge and discharge.

The buyer should set up the Internet at the site of the project so that the supplier can obtain the ESS running data remotely and facilitate the after-sales maintenance.

The buyer can connect the video monitoring system to monitor the inside of the container for remotely. This monitoring function is optional.

The project communication topology is shown as below for reference.

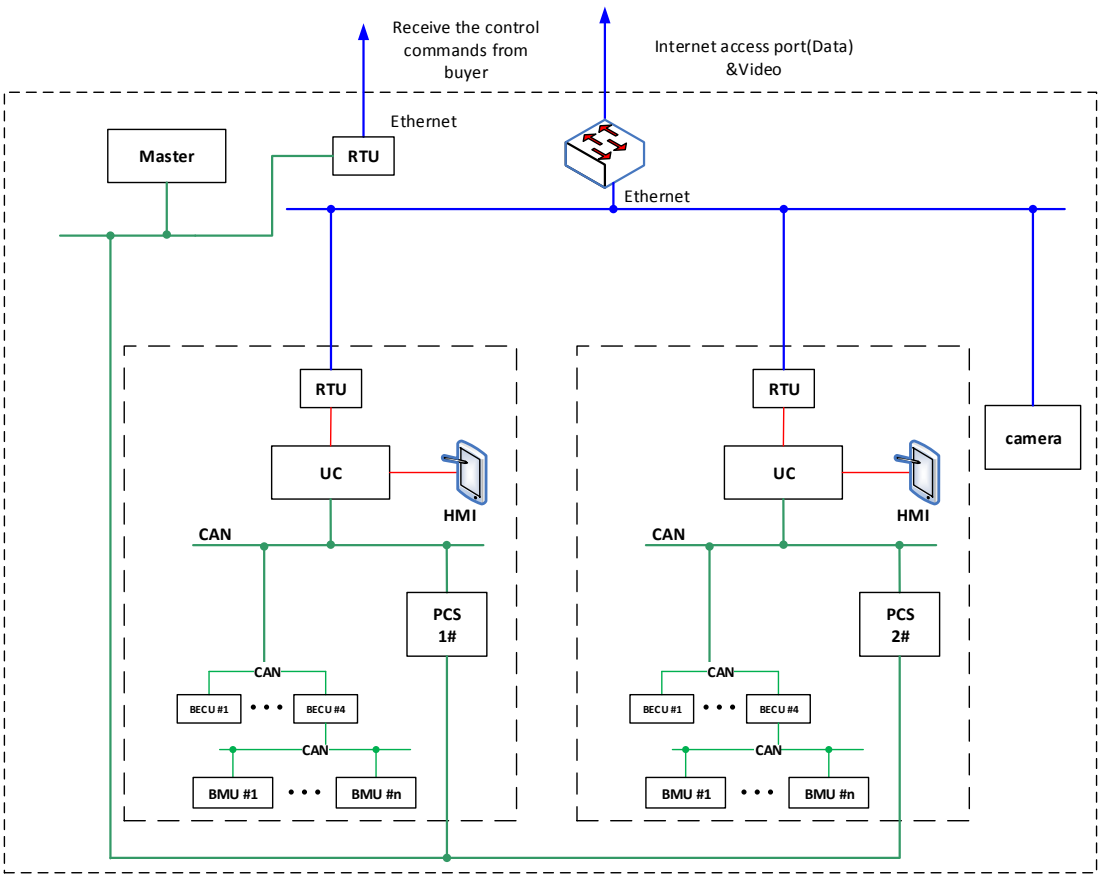


Figure 2 Communication topology

6 Container outlet and installation requirements

1) The site shall be flat. The obliquity of the ground shall within 3 Degree;
2) The container shall be installed with 2m area away from another container and 1.5m away from each side of site.
3) The foundation must be capable of carrying a magnitude 8 earthquake。
4) The static load capacity of the foundation shall not be less than 1.5 times the total weight of the ESS.
5) The installation site shall be far from the sea and less dust area, with no dangerous gases or explosive around the container
6) Cement substrate's construction requirements are shown as follows:

Construction Requirements for Cement Base		
Serial No.	Project	Parameters
1	Weight of Container	The weight of the power

		container is about 29 ton.
2	Overground Height of Cement Base	Shall Higher than the Historical Maximum Flood Level
3	Number of Cement Support	6 PCS
4	Load Bearing of Each Cement Support	No Less Than 7 tons
5	Foundation Base Service Life	Employer shall design according to actual condition

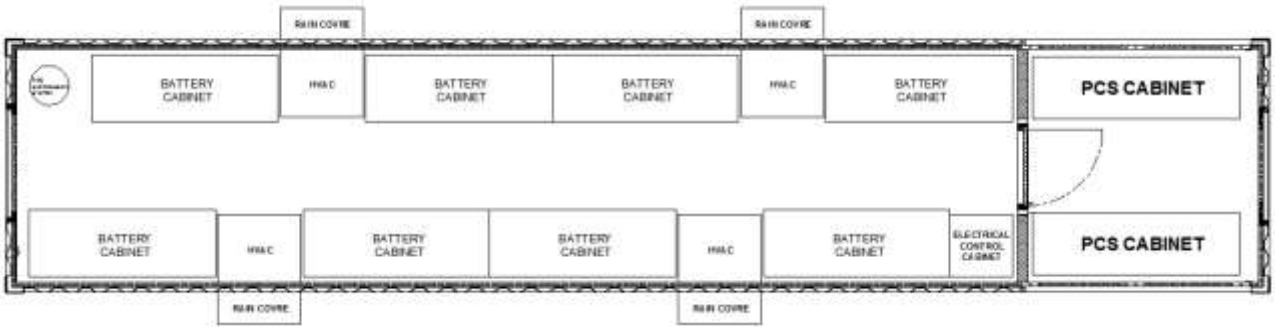


Figure 3 Location of AC power cable point(for reference)

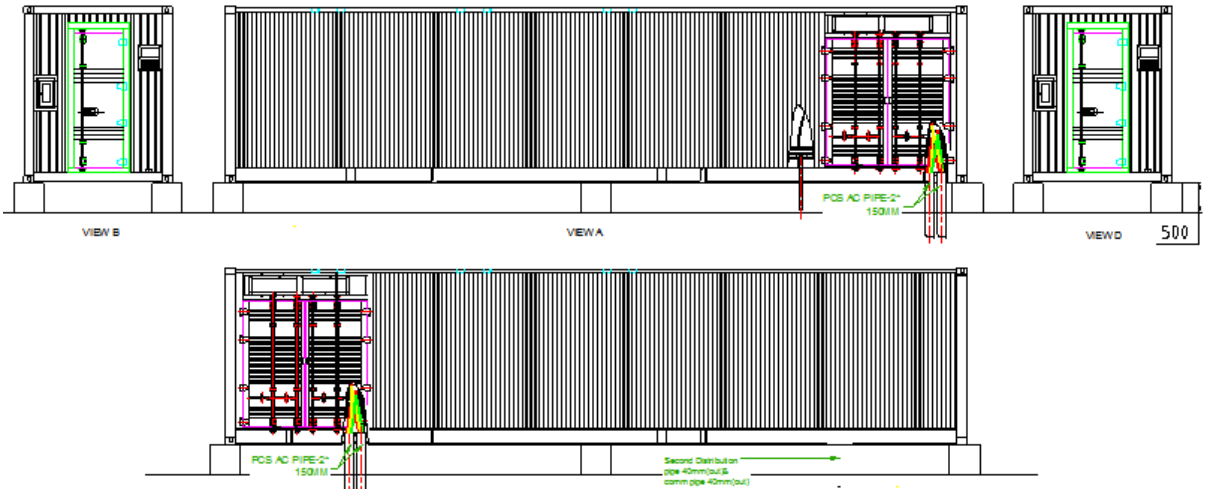


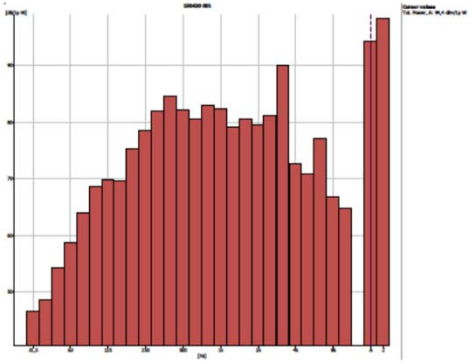
Figure 4 ESS container installation (for reference)

NOISE REDUCTION SCS 2200



1 SOUND POWER WITHOUT NOISE REDUCTION MEASURES

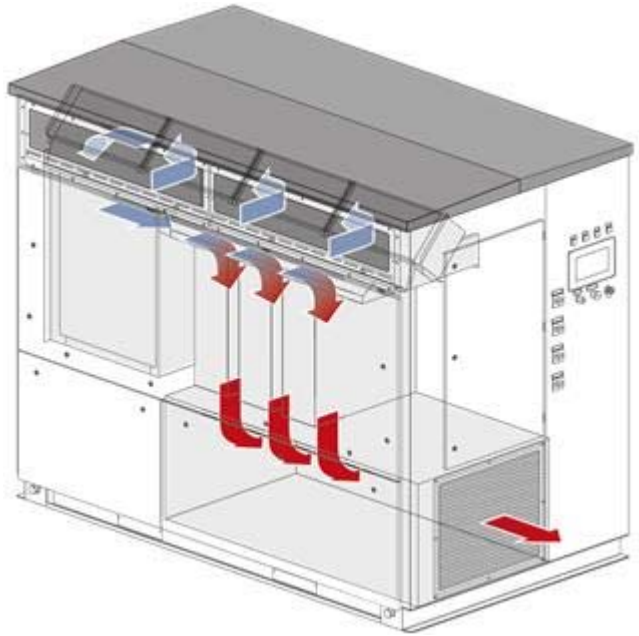
Measurments without any noise reduction measures.
20.04.2015 11:22 Uhr
P AC 2200 kW, Ventilation 100%.



150420 001

Frequency	Tot.Pwr,A
25 Hz	40,56
31,5 Hz	46,56
40 Hz	48,66
50 Hz	54,4
63 Hz	58,83
80 Hz	64,02
100 Hz	68,58
125 Hz	69,88
160 Hz	69,75
200 Hz	75,38
250 Hz	78,65
315 Hz	81,95
400 Hz	84,65
500 Hz	82,19
630 Hz	80,56
800 Hz	82,94
1 kHz	82,35
1,25 kHz	79,23
1,6 kHz	80,52
2 kHz	79,47

The standard hardware of the inverter has most of the sound power leaving the inverter from the air-inlet and air-outlet



Measurement of the sound power, d-click to open

SMA 2200 SCS Inverter	
Hz	Lw (dBA)
25 Hz	40.56
31.5 Hz	46.58
40 Hz	48.66
50 Hz	54.4
63 Hz	58.83
80 Hz	64.02
100 Hz	68.58
125 Hz	69.88
160 Hz	69.75
200 Hz	75.38
250 Hz	78.65
315 Hz	81.95
400 Hz	84.65
500 Hz	82.19
630 Hz	80.56
800 Hz	82.94
1 kHz	82.35
1.25 kHz	79.23
1.6 kHz	80.52
2 kHz	79.47
2.5 kHz	81.75
3.15 kHz	90
4 kHz	72.58
5 kHz	71.26
6.3 kHz	77.19
8 kHz	67.43
10 kHz	65.28

Total Lw (dBZ)	99
Total Lw (dBA)	94.4

Name	EW
Date	03.12.19
Project Number	13755
Project Name	Hazlehead

Input the specifications of the Transformer (Tx)	
Tx Power (kVA)	1260
Cooling	ONAN
Location	L1
Surface Area (m^2)	18

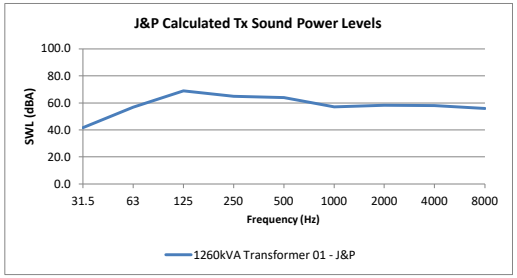
Cooling Requirements		
ONAN	Oil Natural, Air Natural	No Mechanical Cooling Required
ONAF	Oil Natural, Air Forced	Fan Cooling Required
OFAF	Oil Forced, Air Forced	Oil Pump and Fan Cooling Required
OFAN	Oil Forced, Air Forced	Oil Pump Required

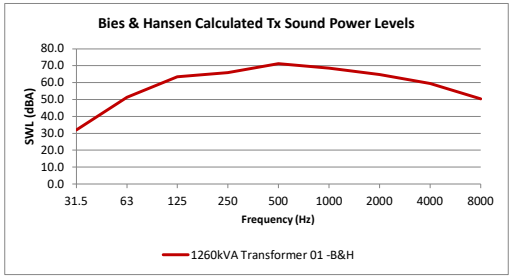
Location	
L1	Outdoors or in a large mechanical room with a large amount of of mechanical equipment
L2	Indoors in small rooms or large rooms with only a small amount of other equipment
L3	Any critical location where a problem would result if the transformer should become noisy above it's NEMA rating following installation

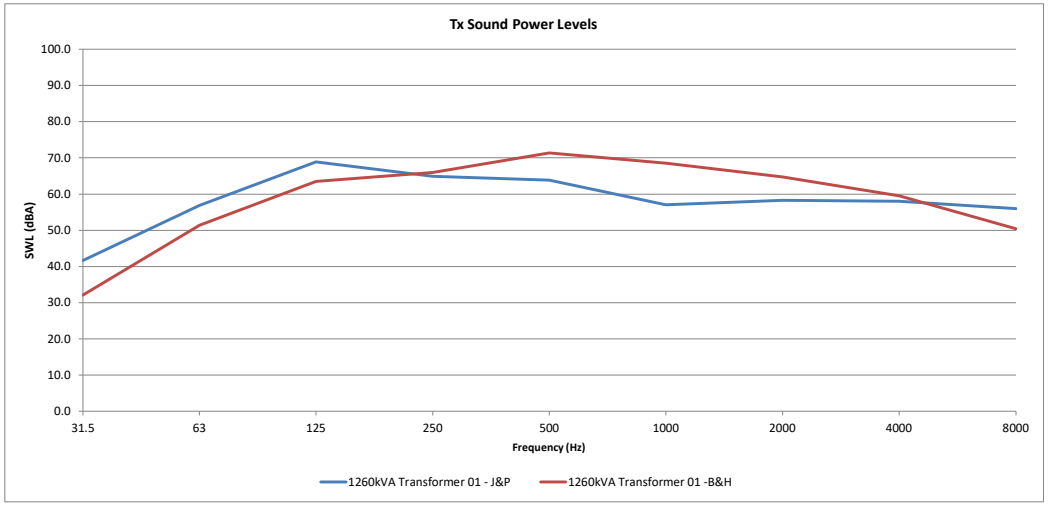
Surface Area	
This is the surface area (m^2) of all 4 sides but not the top	
Height	1.5
Width	4
Depth	2
Total	18

ID	TxJP01								
Name	1260kVA Transformer 01 - J&P								
Source	J & P Transformer Book								
Type	Lw								
Spectrum	A-weighted								
Frequency (Hz)	31.5	63	125	250	500	1000	2000	4000	8000
	41.6	56.8	68.9	64.9	63.8	57.0	58.2	58.0	55.9

ID	TxBH01								
Name	1260kVA Transformer 01 -B&H								
Source	Engineering Noise Control, Theory and Practice (Bies & Hansen)								
Type	Lw								
Spectrum	A-weighted								
Frequency (Hz)	31.5	63	125	250	500	1000	2000	4000	8000
	32.2	51.4	63.5	66.0	71.4	68.6	64.8	59.6	50.5







Appendix E – Figures

Legend

- Indicative Site Location

Noise Monitoring Locations (NMLs) - Not Used Within Assessment

- NML01
- NML02
- NML05

Noise Monitoring Locations (NMLs) - Used Within Assessment

- NML03
- NML04

Nearest Noise Sensitive Receptors (NSRs)

- NSRs Represented by NML03
- NSRs Represented by NML04

0 100 200 Metres

N

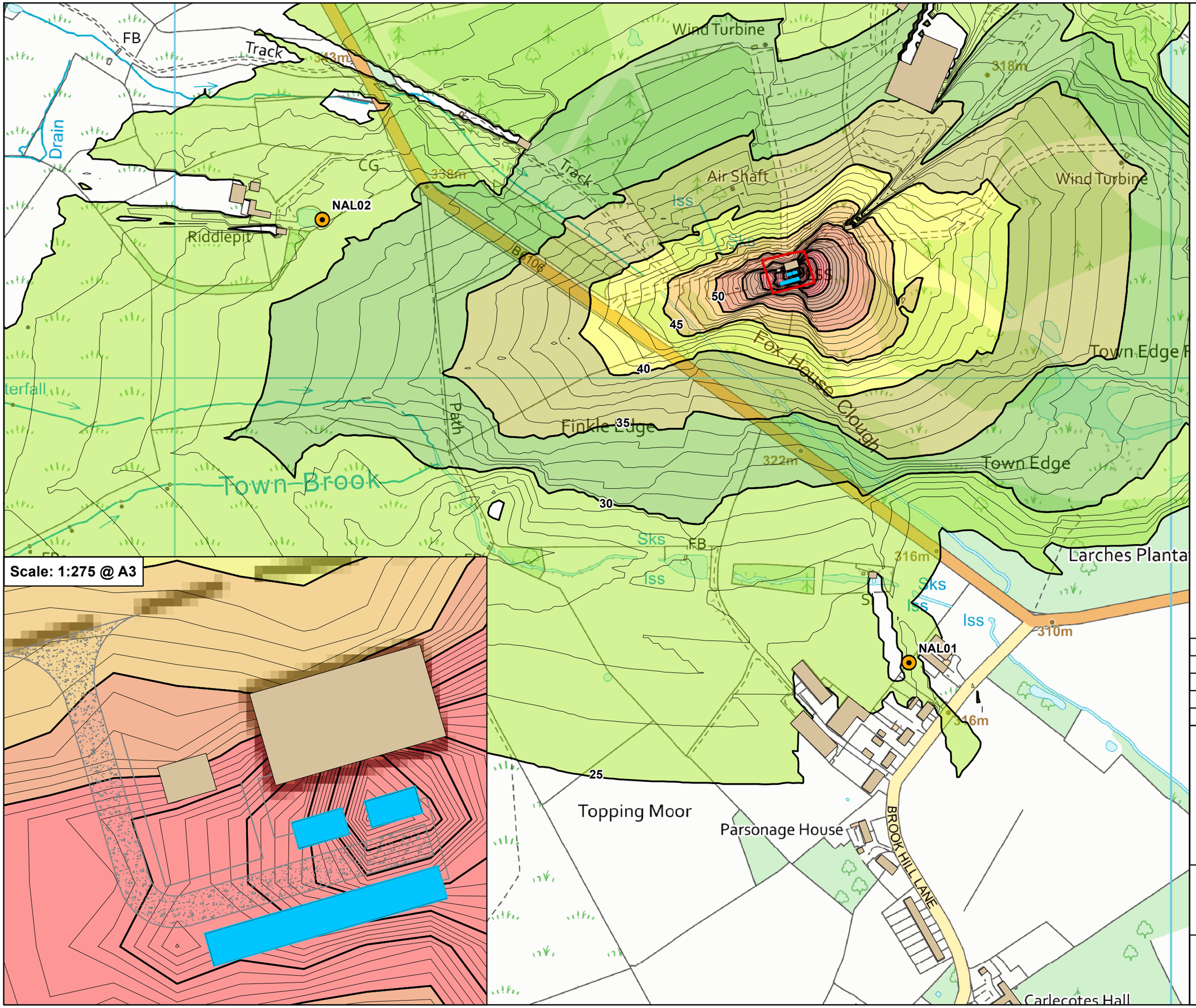
Contains Ordnance Survey data © Crown copyright and database right 2020

REV.	DETAILS	DRAWN	CHK'D	APP'D	DATE
R1	FIRST ISSUE	EW	JS	JS	04/02/2020

Project	Hazlehead Energy Storage Development
Client	Banks Group
Title	Noise Monitoring Locations (NMLs)
Figure No.	1
Scale	1:7,000 @A3
Doc. Ref.	13755-002

BANKS Renewables
development with care

tnei



Legend

- Noise Assessment Locations
- Indicative Site Boundary
- Site Layout
- Modelled Noise Sources
- Modelled Buildings
- Predicted Noise Contours (1dB Increments)
- Predicted Noise Contours (5dB Increments)

Predicted Noise Levels (dBA)

- 25-30
- 30-35
- 35-40
- 40-45
- 45-50
- 50-55
- 55-60
- 60>

Noise contours modelled in accordance with ISO 9613 Part 2:1996 at a height of 1.5m and displayed on a 5m by 5m grid. All noise sources assumed to be operating concurrently at typical noise level output. All levels shown as dB LAeq(t).

0 50 100 Metres

N

Contains Ordnance Survey data © Crown copyright and database right 2020

REV.	DETAILS	DRAWN	CHK'D	APP'D	DATE
R1	FIRST ISSUE	EW	JS	JS	04/02/2020

Project	Hazlehead Energy Storage Development
Client	Banks Group
Title	Noise Contour Plot
Figure No.	2
Scale	1:3,500 @A3
Doc. Ref.	13755-003

BANKS Renewables
development with care

tnei