APPENDIX 12-3

BESS OPERATIONAL NOISE REPORT

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Appendix 12-3

Battery Energy Storage System (BESS) Noise Report

Lackareagh Wind Farm, Co. Clare

EDF Renewables Ireland

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EDF renewables

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1 Introduction

TNEI Ireland Ltd was commissioned by MKO on behalf of EDF Renewables Ireland Ltd to undertake a Noise Impact Assessment (NIA) for the operation of a Battery Energy Storage System (BESS), which forms part of the Proposed Lackareagh Wind Farm (hereinafter referred to as 'the Proposed Project'). The project referencing as laid out in Section 1.1.1 of Chapter 1 will be followed throughout this report also, i.e. 'the Proposed Wind Farm', 'The Proposed Grid Connection Route', 'the site'.

The method of assessment of operational noise for a BESS is very different from that used for the assessment of operational wind turbine noise and the two assessment types cannot be combined. Accordingly, the assessment of operational noise attributable to the BESS is presented separately in this report, and the operational wind farm noise assessment is provided in Technical Appendix 12-2.

The BESS is proposed to be located within an area approximately 1 km east of Kilbane, at approximate ITM grid coordinates 563627, 672541. The land surrounding the proposed BESS is rural in nature, predominantly consisting of commercially forested areas. A small number of residential properties are located within the area, the nearest of which is approximately 825 m to the west.

The aims of this BESS NIA were to:

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

1.1 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 noise levels have been measured;
- **NSRs** (Noise Sensitive Receptors) are all identified receptors which are sensitive to noise; and
- **BNAL** (BESS Noise Assessment Location) refers to any location where the noise immission levels from the BESS are calculated and assessed.

A Glossary of Terms is also provided as Annex 1 of this report.

All figures referenced within the report can be found in Annex 5.

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

All grid coordinates refer to the Irish Transverse Mercator (ITM) coordinate system using ITM X and ITM Y, unless stated otherwise.

2 Proposed Project Description

2.1 Description of the Proposed BESS Compound

The proposed BESS compound would introduce new sound sources to the local area in the form of externally located fixed plant. The BESS is expected to consist of 48 liquid cooled battery cubes, which would be connected into a series of Power Conversion Systems (PCS), each consisting of a pair of inverters and a medium voltage (MV) transformer. It is also assumed that a single High Voltage (HV) Grid Transformer will be located within an adjacent substation. Some auxiliary plant, such as switch gear, will also be installed but would be insignificant in noise output in comparison to the BESS plant and HV transformer.

Specifically, the dominant sound sources considered within this assessment are assumed as follows:

- Fluence Cubes (48 of);
- PE HEMK PCSK Inverter (6 of);
- Chint Electric MV Transformer (3 of); and,
- HV Grid Transformer (1 of).

The assumed plant is indicative only and has been selected as the sound power levels are comparable to other plant available for a BESS of this scale. A layout plan providing an overview of the proposed BESS development in Annex 2. The layout plan may be subject to minor changes but not of sufficient scale to alter the conclusions of the assessment.

2.2 Study Area

All of the Noise Sensitive Receptors (NSRs) considered in this assessment are residential properties. The study area has been defined through the identification of the closest NSRs within 3 km of the site. The closest NSR to the BESS is located approximately 825 m to the west. To the east the closest NSR is approximately 1000 m. There are receptors at similar or greater distances. Figure A5.1 in Annex 5 details the location of the proposed BESS in context of the closest NSRs considered within the assessment. Figures A5.1a-d detail the location of the proposed BESS in the context of all the NSRs considered within the assessment.

3 Assessment Methodology

3.1 Legislation and Policy Context

There is no specific Irish guidance that contains a detailed method for the assessment of environmental noise, however, to address this gap and try to bring consistency across Local Authorities, the Association of Acoustic Consultants of Ireland have published '*Environmental Noise Guidelines (ENG) for Local Authority Enforcement and Planning Sections'*, which states (in relation to Industrial developments); *"Useful guidance is additionally presented in British Standard BS 4142:2014 Methods for rating and assessing industrial and commercial sound (2014), which provides an assessment methodology based on existing background levels."*

The ENG also refers to BS 8233, stating;

"Although not an environmental noise standard, BS 8233:2014 Guidance on sound insulation and noise reduction for buildings (2014) is occasionally referenced in noise impact assessments due to its inclusion of recommendations for internal noise levels. The standard is not directly applicable to the assessment of impacts from external sources on building occupants. However, the standard lists internal noise criteria to facilitate use and enjoyment of certain building types, and these criteria are useful in providing a reference".

3.2 Assessment Methods

Typically, assessments of environmental noise 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 (BS 4142:2014 +A1:2019)

BS 4142:2014+A1:2019 is commonly used to assess the potential impacts of new industrial sound sources on nearby receptors.

The BS 4142 form of assessment is based on the predicted or measured levels of an assessed sound source 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".*

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 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 metric $L_{Aeq\,(t)}$. Also referred to in this Appendix 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 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 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 penalty or penalties (if required) to the Specific Sound Level when the sound source contains audible characteristics such as tonal, impulsive or intermittent components. Described using the metric, $L_{Aeq\,(t)}$.

BS 4142 is a qualitative assessment, not a quantitative assessment i.e. it does not simply provide a pass or fail result by comparing a predicted noise level to a noise limit. Rather, it considers predicted levels in context with the wider setting to estimate whether adverse impacts may occur.

The starting point of the BS 4142 assessment is to compare the Rating Level with the background sound level, however, where background sound levels are very low and where Rating Levels are low, the standard suggests that it may be more appropriate to consider the absolute levels, rather than comparing directly to the background. The Associate of Noise Consultants (ANC) provide additional information on this in the BS 4142 Technical Guide

"BS 4142 does not indicate how the initial estimate of impact should be adjusted when background and rating levels are low, only that the absolute levels may be more important than the difference between the two values. It is likely that where the background and rating levels are low, the absolute levels might suggest a more acceptable outcome than would otherwise be suggested by the difference between the values. For example, a situation might be considered acceptable where a rating level of 30 dB is 10 dB above a background sound level of 20 dB, i.e., an initial estimate of a significant adverse impact is modified by the low rating and background sound levels.

There may be situations where the opposite is true, and it is for the assessor to justify any modifications to the initial estimate of impact. BS 4142 does not define 'low' in the context of background sound levels nor rating levels. The note to the Scope of the 1997 version of BS 4142 defined very low background sound levels as being less than about 30 dB L_{A90}, and low rating levels as being less than about 35 dB $L_{Ar,Tr}$. The WG [Working Group] suggest that similar values would not be unreasonable in the context of BS 4142, but that the assessor should make a judgement and justify it where appropriate."

3.2.2 Fixed Guideline Levels (BS 8233:2014)

BS 8233 '*Guidance on sound insulation and noise reduction for buildings*' presents guideline noise levels for daytime and night-time for the design of a number of different building types. For residential developments, these are based on guidelines issued by the World Health Organisation (WHO).

The Standard states; *"In general, for steady external noise sources, 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 (*BS 8233:2014 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 $L_{Aeq(16hour)}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq(16hour)}$	30 dB $L_{Aeq(8hour)}$

The *Acoustics, Ventilation and Overheating Guide (AVO)* (January 2020), jointly published by the UK's ANC and the Institute of Acoustics (1), suggests that a value of 13 dB (3) is an appropriate to convert between internal and external sound levels for a partially open window. Therefore, an assessment of external noise levels can assume an external noise level limit of 13 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 43 dB $L_{Aeq(8hour)}$.

3.3 Calculation Method

3.3.1 Noise Propagation Model (ISO 9613-2:1996)

To predict the noise immission levels attributable to the proposed BESS a noise propagation model was created using the propriety noise modelling software CadnaA. Within the software, complex models can be produced to simulate the propagation of noise according to a wide range of international calculation standards.

For this assessment, noise propagation was calculated in accordance with ISO 9613 '*Acoustics – Attenuation of Sound During Propagation Outdoors* (2) using the following input parameters:

- Temperature was assumed to be 10 °C and relative humidity as 70%;
- A ground attenuation factor of 0.5 (mixed ground) has been used; and
- Receiver heights were set to 4 m, to replicate the height of a first floor (bedroom) window. At lower heights, noise levels would also typically be lower.

3.3.2 Uncertainties and Limitations

Modelled sound sources represent candidate plant only and an indicative site layout. The noise output of individual items of plant may vary from what is presented in this report after final plant specification and procurement.

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;
- 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; and,
- The model assumes all sound sources are operating continuously, simultaneously and at maximum noise output.
- All of these elements will favour noise propagation and predicted levels will tend to be higher than the noise levels that will actually occur.

4 Baseline Sound Level Monitoring

TNEI undertook an operational wind turbine noise assessment for the Proposed Wind Farm. As part of the study, TNEI undertook continuous background sound level monitoring for the period between 4th April 2023 and 21st of June 2023 at seven neighbouring properties. The dataset collected during the period 19th of May – 21st of June has been used for the purpose of this assessment.

Table 4.1 details all seven Noise Monitoring Locations (NMLs), which are being used in this assessment. The NMLs are also shown in Figure A5.1 included within Annex 5.

Table 4.1: Baseline Noise Monitoring Locations

NML	Approximate Distance and bearing to BESS plant (m)	Coordinates (ITM X, Y)	
NML01	2,066 m WNW	561633	673082
NML02	883 m WNW	562790	672823
NML03	1,329 m SW	562528	671793
NML04	1,927 m ESE	565465	671963
NML05	1,130 m E	564756	672486
NML06	1,299 m NE	564796	673108
NML07	1,579 m NNE	564713	673687

The noise monitoring equipment consisted of Rion NL-31's, Rion NL-32's and a Rion NL-52 Sound Level Meter (SLM), fitted with appropriate environmental wind shields. All noise monitoring equipment (calibrator, SLM and microphones) used for the study are categorised as Class 1, as specified in IEC 61672-1 *'Electroacoustics. Sound level meters. Specifications'* (3). The equipment was calibrated onsite at the beginning and end of each measurement period with no significant deviations noted.

Wind speed and direction data was measured continuously during the noise survey using a LIDAR unit, which was temporarily installed within the Proposed Wind Farm site for the purposes of background noise collection. For wind farm operational noise assessments, the measured noise data is organised into wind speed 'bins' to determine wind-speed specific noise limits. In contrast, BS 4142 states, *"Exercise caution when making measurements in poor weather conditions, such as wind speeds greater than 5 m/s."* Accordingly, the noise data was filtered to remove any data points that were measured during periods of high wind speeds and rain. In this particular case, all noise data measured with wind speeds at or above 5 ms^{-1} has been removed. Time series charts are provided in Annex 3 for each of the NMLs, which present the measured 10-minute LAeq and LA90, the wind speed (m/s) and any periods were data has been removed, including for precipitation events.

It should be noted that the wind speed data used in this assessment is based on measurements made at wind speeds at 10 m height (standardised). BS4142 suggest that wind speed measurements should be undertaken at the NMLs, at comparable measurement heights to the Sound Level Meters. Therefore, the approach undertaken here in using wind speed measurements captured by a LiDAR unit on the site, measuring at the turbine hub height and then standardising to 10 m, is a more cautious approach. This is due to the resulting higher wind speeds than if measurements were undertaken at each NML at a height of 1.5 m.

Table 4.2 presents an overview of the measured baseline sound levels.

Table 4.2: Measured baseline sound levels

NML	Average $L_{Aeq(10mins)}$		Mean $L_{A90(10mins)}$		Mode $L_{A90(10mins)}$		Range $L_{A90(10mins)}$	
	Day	Night	Day	Night	Day	Night	Day	Night
NML01	41	35	35	32	36	32	30	18
NML02	44	32	33	26	35	23	32	23
NML03	41	32	34	29	35	29	44	20
NML04	42	30	33	26	36	22	26	23
NML05	43	30	32	26	35	26	29	22
NML06	45	32	34	27	34	25	36	21
NML07	41	30	31	26	34	23	42	25

Subjective observations during site visits (for installation and collection of equipment and period calibrations), noted the following;

- At NML01 watercourses were audible both to the east and the west of the house, therefore the kit was sited such that the separation distance from the two watercourses was maximised. In addition, birdsong and wind induced noise from the vegetation were audible.
- At NML02 birdsong, wind induced noise from the vegetation and dogs barking were the main noise sources observed during installation and collection.
- At NML03 cattle lowing, wind induced noise from the vegetation, birdsong and machinery operating within a cattle yard approximately 100 m from the monitoring location were the main noise sources observed.
- At NML04 wind induced noise from the surrounding vegetation and birdsong were the main noise sources observed.
- At NML05 birdsong, wind induced noise from the vegetation and trees and cars passing were the main noise sources observed. In addition, a watercourse to was faintly audible to the south of the property.
- At NML06 birdsong and wind induced noise from the vegetation were the main noise sources observed. Distant road noise was also audible.
- At NML07 birdsong and wind induced noise from the vegetation were the main noise sources observed. Distant road noise was also audible.

Table 4.3 details the representative background sound levels, $L_{A90\,(10mins)}$, which have been determined after considering the distribution of data for each measurement period. Typically, baseline sound level measurements made in accordance with BS 4142 are undertaken in 15-minute periods. However, as the baseline data was measured as part of the operational wind turbine noise assessment, a 10-minute measurement period was adopted for use as part of this assessment. Annex 3 contains the statistical and distribution analysis charts used to ascertain the representative background sound levels.

Table 4.3: Representative Background Sound level, dB $L_{A90(10mins)}$

NML ID	Daytime $L_{A90(10mins)}$	Night-time $L_{A90(10mins)}$
NML01	33	29
NML02	32	25
NML03	33	28
NML04	33	22
NML05	31	24
NML06	33	25
NML07	30	23

The daytime representative background sound level at all NMLs is 30dB $L_{A90(10mins)}$ or higher. During the night-time, however, the background sound level is below 30 dB $L_{A90(10mins)}$ at all NMLs, which can be classified as 'very low' (see Section 3.2.1).

5 Operational Noise Impacts

5.1 Modelling of Individual Sound Sources

The noise model considers all the sound sources detailed within Section 2.1 and the following paragraphs describe how each sound source has been incorporated into the noise model.

5.1.1 Fluence Cube and MV Transformer

TNEI have used noise data for a Fluence Cube, offered by the supplier, Fluence.

Each Fluence Cube includes a number of internally and externally located sound sources, most notably the HVAC and chiller units, which are housed within the Cube. Each Fluence Cube has been modelled as a box with the outer façade being modelled as an area source.

Chint Electric MV Transformers and Power Electronics (PE) E HEMK PCSK Inverters were also assumed. The MV transformers and accompanying Inverters have been modelled as boxes consisting of five area sources (four facades and the roof). Each area source has been modelled with 7 dB of attenuation such that the logarithmic sum of the five area sources per piece of plant equates to the overall sound power of their respective plant.

The noise data for the Cubes, MV Transformers and Inverters has been provided to TNEI under a Non-Disclosure Agreement and as such detailed noise level data cannot be provided in this report. TNEI would be happy to discuss this data in more detail with the Local Authority, if required.

5.1.2 High Voltage (HV) Grid Transformer

The modelled HV transformer has been assumed to be an ABB HV transformer with a broadband sound power level (SWL) value of 88 dBA. The transformer has been modelled as a box consisting of five area sources (four facades and the roof). Each area source has been modelled with 7 dB of attenuation such that the logarithmic sum of the five sources equates to the overall sound power level of 88 dBA. Table 5.1 details the resulting SWL used within the noise model and the relevant data sheets are included within Annex 4.

Table 5.1: 1/3 Octave Band SWL, dBA used to model the HV Grid Transformer

	Frequency (Hz)							
Hz	**50**	**63**	**80**	**100**	**125**	**160**	**200**	**250**
dBA	63.8	47.8	55.1	72.1	68.6	78.4	74.1	76.5
Hz	**315**	**400**	**500**	**630**	**800**	**1000**	**1250**	**1600**
dBA	80.1	77.1	77.1	79.3	78.6	76.7	74.5	72.4
Hz	**2000**	**2500**	**3150**	**4000**	**5000**	**6300**	**8000**	**10000**
dBA	70.2	68.5	67.6	67.0	64.9	61.9	59.8	58.2

5.2 Calculated Immission Levels

Noise immission levels have been calculated at seven BESS Noise Assessment Locations (BNALs), which have been selected to represent the closest NSRs. The BNALs have been set on the side of the property facing the proposed BESS compound, representing the closest point of the property's amenity area.

The BNALs are detailed in Table 5.2 and shown on Figure A5.1 and Figures A5.1a-d within Annex 5.

Table 5.2: BESS Noise Assessment Locations (BNALs)

BNAL ID	ITM X	ITM Y
BNAL01 (NSR10)	564702	673649
BNAL02 (NSR2)	564689	673091
BNAL03 (NSR7)	564759	672513
BNAL04 (NSR65)	565439	671960
BNAL05 (NSR34)	562540	671813
BNAL06 (NSR8)	562288	672235
BNAL07 (NSR11)	561663	673086

The immission levels (Specific Sound Level) are calculated assuming all plant is operating continuously and concurrently. The levels are detailed in Table 5.3 as dB $L_{Aeq(t)}$. No time period is specified as the model assumes that noise levels will not fluctuate and will remain the same for all time periods.

Table 5.3: Predicted Immission Levels, dB $L_{Aeq(t)}$

Noise Assessment Location, BNAL ID	Immission Level, dB $L_{Aeq(t)}$
BNAL01 (NSR10)	10
BNAL02 (NSR2)	19
BNAL03 (NSR7)	15
BNAL04 (NSR65)	13
BNAL05 (NSR34)	23
BNAL06 (NSR8)	28
BNAL07 (NSR46)	22

The levels presented in Table 5.3 represent the noise immission levels at the closest NSRs only. For completeness, predictions at all identified NSRs are provided in Annex 6.

Noise Impact Assessment

5.3 Quantitative Assessment

An assessment is detailed below in **Table 5.4** against the most stringent of the guideline levels presented in BS 8233:2014 (as detailed in Table 3.1).

Table 5.4: Derived BS 8233 Fixed Level Limits

Assessment Parameter	BS 8233 Guideline Level	Allowance for Open Window Attenuation	Equivalent External Level
Daytime 07:00-23:00	35	13	48 dB $L_{Aeq\ (16\text{-}hour)}$
Night-time 23:00-07:00	30	13	43 dB $L_{Aeq\ (8\text{-}hour)}$

Table 5. below compares the predicted immission levels with the derived noise limits.

Table 5.5: Quantitative Assessment

Noise Assessment Location	Daytime		Night-time	
BNAL ID	Immission Level, dB $L_{Aeq(t)}$	Margin above/below Noise Level Limit, dB	Immission Level, dB $L_{Aeq(t)}$	Margin above/below Noise Level Limit, dB
BNAL01 (NSR10)	10	-38	10	-33
BNAL02 (NSR2)	19	-29	19	-24
BNAL03 (NSR7)	15	-33	15	-28
BNAL04 (NSR65)	13	-35	13	-30
BNAL05 (NSR34)	23	-25	23	-20
BNAL06 (NSR8)	28	-20	28	-15
BNAL07 (NSR46)	22	-26	22	-21

The predictions are at least 15 dB below the night-time guideline levels and 20 dB below the daytime guideline levels of BS 8233.

5.4 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 BS 4142, the Specific Sound Level must be converted into a Rating Level. The Rating Level allows for character corrections to be added to account

for particular characteristics of the sound that may be perceived as more annoying. In particular the Rating Level considers tonality, impulsivity and intermittency of the sound, as well other sound characteristics that are neither tonal, impulsive, or intermittent, but are otherwise readily distinctive against the residual acoustic environment.

5.4.1 Tonality

With regards to tonality, BS4142 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."

Some electrical plant such as power transformers are inherently tonal at source, typically in the 100 Hz frequency band, however, the BS 4142 corrections are only applied if noise characteristics are present at the receptor location. Consideration of the one third octave predicted levels does not suggest that tonality from any plant will be noticeable. For example, predicted noise immissions at BNAL06 in the 100 Hz third octave band are 7.2 dB, well below the night-time background sound level of 25 dB. As such, no tonal character correction has been applied.

5.4.2 Impulsivity

With regards to impulsivity, BS 4142 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 and substation as when operational, the noise level will be predictable and consistent.

5.4.3 Intermittency

The intermittency of the sound source needs to be considered when it has identifiable on/off conditions with regards to intermittency, BS4142 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, noise levels may fluctuate by a small amount over long periods of time, but no regular step changes in noise level are anticipated.

5.4.4 Other Sound Characteristics

With regards to other sound characteristics, BS4142 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."

Based on TNEI's understanding and experience of this type of plant, it is not anticipated that any additional sound characteristics that would be considered readily distinctive against the residual acoustic environment.

5.4.5 Calculation of the Rating Level

With due regard to the above, no character corrections are required. Therefore, the BS4142 Rating Levels are equal to the Specific Sound Levels. At all NALs the Rating Level is less than 35 dB LAeq(t), which can be classed as 'low' (see Section 3.2.1.).

5.4.6 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."

To determine a Magnitude of Impact, the following criteria has been adopted;

- Where BS 4142 indicates a significant adverse impact, this is a Major Magnitude of Impact;
- Where BS 4142 indicates adverse impact, this is a Moderate Magnitude of Impact;
- Where BS 4142 indicates no adverse impact, this is a Minor Magnitude of Impact;
- Where the BS 4142 Rating Level is less than the measured background sound levels, this is a Negligible Magnitude of Impact.

With due regard to the sensitivity of the assessed residential receptors being high, the following criteria has been adopted to determine the significance criteria;

- Where a Major Magnitude of Impact is predicted, this is a Major Significant Effect;
- Where a Moderate Magnitude of Impact is predicted, this is a Moderate Significant Effect;
- Where a Minor Magnitude of Impact is predicted, this is a Minor Significant Effect;
- Where a Negligible Magnitude of Impact is predicted, this is a Negligible Significant Effect.

Table 5. presents a comparison of the Rating Levels to the daytime and night-time background sound levels. Annex 6 present a comparison of the Rating Levels to the daytime and night-time background sound levels at all assessed NSRs.

Table 5.6: Margin Above / Below (+/-) Background Sound Level, dB

Noise Assessment Location	Daytime			Night-time		
BNAL ID	Rating Level, dBA	Representative Background Sound Level, dBA	Margin, dB	Rating Level, dBA	Representative Background Sound Level, dBA	Margin, dB
BNAL01 (NSR10)	10	30	-20	10	23	-13
BNAL02 (NSR2)	19	33	-14	19	25	-6
BNAL03 (NSR7)	15	31	-16	15	24	-9
BNAL04 (NSR65)	13	33	-20	13	22	-9
BNAL05 (NSR34)	23	33	-10	23	28	-5
BNAL06 (NSR8)	28	32	-4	28	25	+3
BNAL07 (NSR46)	22	33	-11	22	29	-7

For all receptors the Rating Levels remain below the background sound levels during the daytime. This is "*an indication of the specific sound source having a low impact, depending on the context.*"

For all NALs except BNAL06, the Rating level also remains below the background sound level during the night-time. This is "*an indication of the specific sound source having a low impact, depending on the context.*"

At BNAL06 the Rating Level exceeds the background sound level by a maximum of +3 dB during the night-time, which is below the level that is "*indication of an adverse impact, depending on the context.*"

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

- The primary noise generation mechanism for all plant associated with this development is related to cooling. The noise model assumes all cooling plant for batteries, inverters and transformers is operating at maximum noise level output, however, this will only occur when ambient temperatures are high or the equipment is under full load. For much of the time cooling equipment will be operating at lower capacities and overall sound output will be reduced.
- Similarly, the noise model assumes all plant is operating concurrently, however not all cooling (or heating) units will necessarily be required to operate at the same time and as such, overall noise levels are likely to be lower than predicted.
- The Rating Levels at all NALs have been classed as 'low' i.e. below 35 dB LAeq(t) and the background sound levels at night are classed as 'very low' (below 30 dB LA90(10mins)). In this situation BS 4142 states that the "*absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at*

night". The absolute levels will remain well below the fixed guideline values as detailed in BS 8233 for all receptors and for all time periods.

Additionally, BS 4142 defines Residual Sound as the *"ambient sound remaining at the assessment location when the specific sound source is suppressed to such a degree that it does not contribute to the ambient sound"*. The Residual Sound Level, Lr, is the 'equivalent continuous A-weighted sound pressure level of the residual sound at the assessment location over a given time interval, T' measured using the $L_{Aeq,t}$ index. In this situation, the specific sound source (i.e. the BESS development) is proposed and as is not currently operational, therefore, baseline $L_{Aeq,t}$ sound level measurements represent the Residual Sound Level.

An analysis of the measured $L_{Aeq,}$t values at NML2 (where the highest levels are predicted – BNAL06) shows the average daytime and night-time levels to be 45 dBA and 32 dBA, respectively. The overall sound level increase during the night-time (32 dB + 28 dB) is less than 1.5 dB. For context, a change of 3 dB(A) is generally considered to be the smallest change in environmental noise that is perceptible to the human ear and is considered *'just perceptible'*. As such, an increase of 1.5 dB is not anticipated to result in an adverse impact.

With due regards to the context of the development, **the outcome of the BS 4142 assessment is that the Proposed Project is not expected to have an adverse impact in terms of noise resulting from the BESS.**

6 Summary

In order to assess the impact of noise emissions from the proposed BESS compound within the Proposed Project, TNEI has produced a noise propagation model in accordance with ISO 9613-2:1996 that predicts the noise immission levels at the nearest identified residential receptors. The model is based on a layout and candidate plant that is typical for this type of BESS development. A number of residential properties were identified and assessed, the nearest of which is approximately 825 m to the west of the proposed BESS location.

Two assessments considering the nearest residential NSRs have been carried out;

- A quantitative assessment has concluded that levels would remain below the fixed guideline levels detailed in BS 8233 for the daytime and night-time assessment periods.
- A quantitative assessment was undertaken in accordance with BS 4142. This assessment concluded that for all BNALs during the daytime and all BNALs except NAL06 during the night-time, "*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*."
- At BNAL06 the Rating Level exceeds the background sound level during the night-time by +3 dB which is below the level that is an "*indication of an adverse impact, depending on the context.*" After consideration of the context the assessment concludes that there is no indication of an adverse impact at the receptors.

Accordingly, the Noise Impact Assessment concludes that the Proposed BESS Development will not have an adverse noise impact on the local area.

7 References

1. **Association of Noise Consultants.** *Acoustics Ventilation and Overheating (AVO) Residential Design Guide.* 2020.

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

3. **Commission Electrotechnique Internationale (IEC).** *Electroacoustics - Sound level meters - Part 1: Specifications.* Geneva : IEC, 2013. IEC 61672-1:2013.

4. **British Standards Institute.** *Guidance on Sound Insulation and Noise Reduction for Buildings.* UK : BSI, 2014. BS8233:2014.

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

6. **Association of Noise Consultants.** *ANC Good Practice Working Group, BS 4142:2014+A1:2019 Technical Note. s.1.* 2020.

Annex 1 – 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 3 dB(A) is just perceptible;
- a change of 5 dB(A) is clearly perceptible; and
- a change of 10 dB(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.

L_w: 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 L_{WA} is the A - weighted sound power level.

L_{eq}: 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 $L_{Aeq,\,T}$ is the A - weighted equivalent continuous sound level over a given time period (T).

L_{90}: 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 $L_{A90,10min}$ 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.

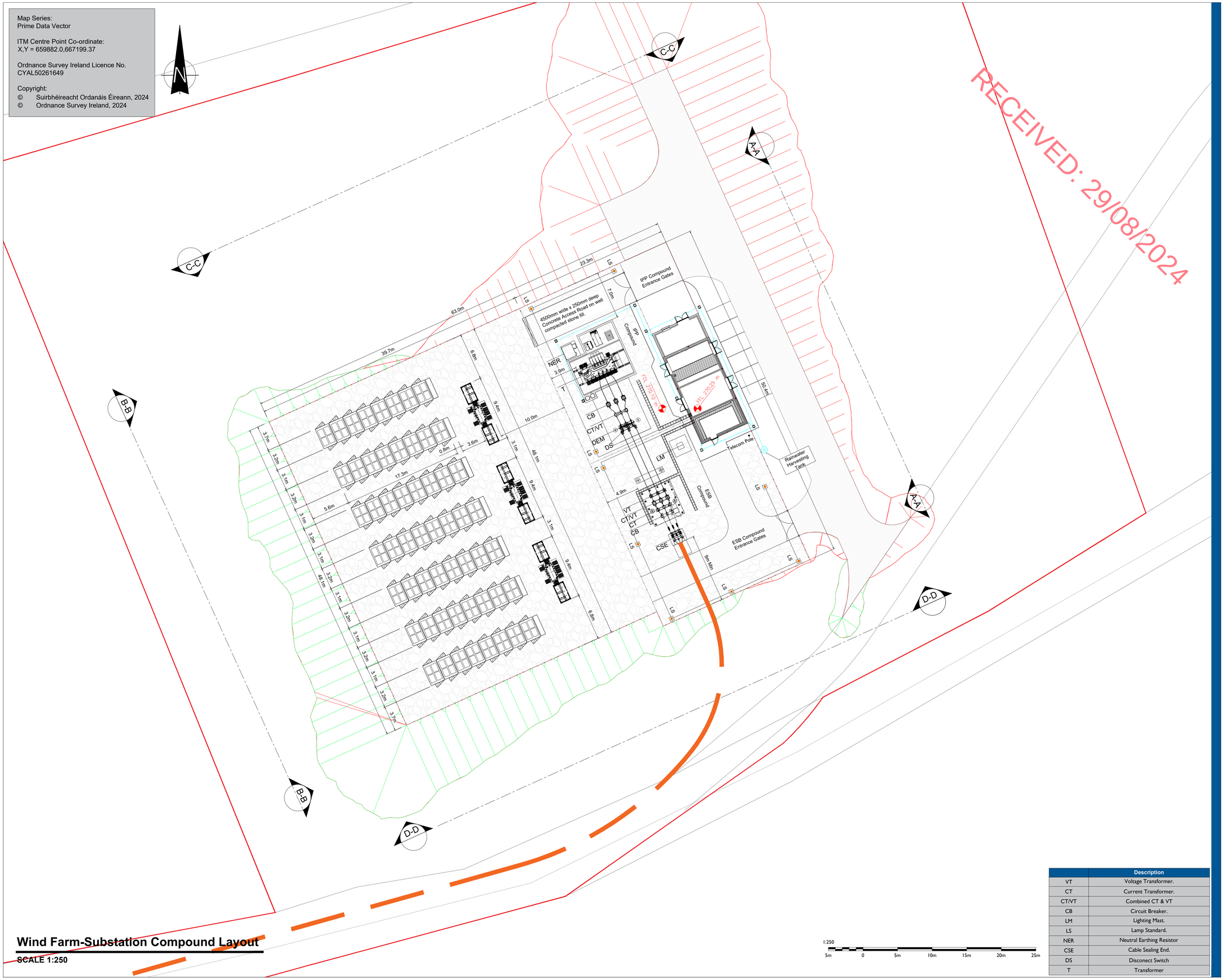
Annex 2– Development Information

ISO A1 594mm x 841mm

Map Series:
Prime Data Vector

ITM Centre Point Co-ordinate:
X,Y = 659882.0,667199.37

Ordnance Survey Ireland Licence No.
CYAL50261649



Wind Farm-Substation Compound Layout

SCALE 1:250

1:250
5m 0 5m 10m 15m 20m 25m

	Description
VT	Voltage Transformer.
CT	Current Transformer.
CT/VT	Combined CT & VT
CB	Circuit Breaker.
LM	Lighting Mast.
LS	Lamp Standard.
NER	Neutral Earthing Resistor
CSE	Cable Sealing End.
DS	Disconect Switch
T	Transformer

Project Management initials: Designer: JC Checked: JVDP Approved: DB

tli GROUP

Head Office
Beenreigh,
Abbeydorney,
Tralee, Co. Kerry
Ireland
Tel: 00353 66 7135710

Regional Office
Basepoint Business Centre
Stroudley Road, Basingstoke,
Hampshire,
RG24 8UP, UK
Tel: 00 44 1256406664

PROJECT

Lackareagh Wind Farm

38kV Grid Connection

CLIENT

EDF renewables

CONSULTANTS

MKO

NOTES: -

- Configuration of substation equipment and infrastructure is subject to detailed design and ESB design approval.
- The proposed substation layout should be used for planning purposes only.
- This drawing is to be read in conjunction with relevant drawings, specifications and reports.
- Dimensions are in millimeters, unless noted otherwise.
- Drawings are not to be scaled use figured dimensions only.

LEGEND: -

Surface water drainage shown thus

Lamp Standard shown thus

Proposed Levels Shown thus (Planning) FCL 54.600

Proposed UGC Route

Contours 14.0

Planning Boundary shown thus

Cut Area shown thus

Fill Area shown thus

ISSUE/REVISION

I/R	DATE	DESCRIPTION
P6	05.03.24	Issued for Planning
P5	21.02.24	Issued for Planning
P4	23.01.24	Issued for Planning
P3	11.10.23	Issued for Planning
P2	09.10.23	Issued for Planning
P1	14.07.23	Issued for Planning

PROJECT NUMBER

05-909

SHEET TITLE

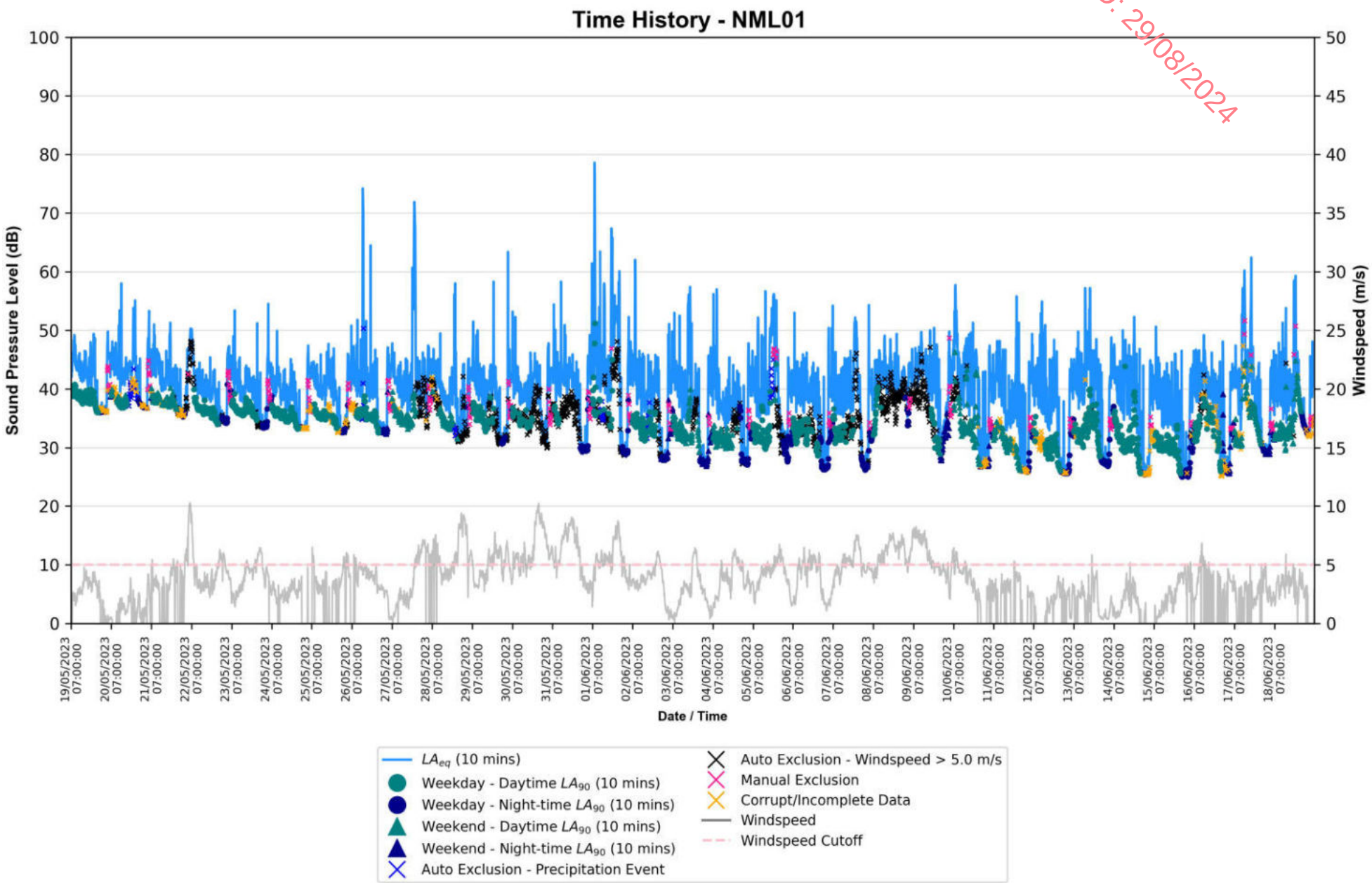
38kV Substation Compound Layout

SHEET NUMBER

05909-DR-150

Annex 3 - Baseline Survey Data

IE00101 - Lackareagh - Measured Sound Levels:



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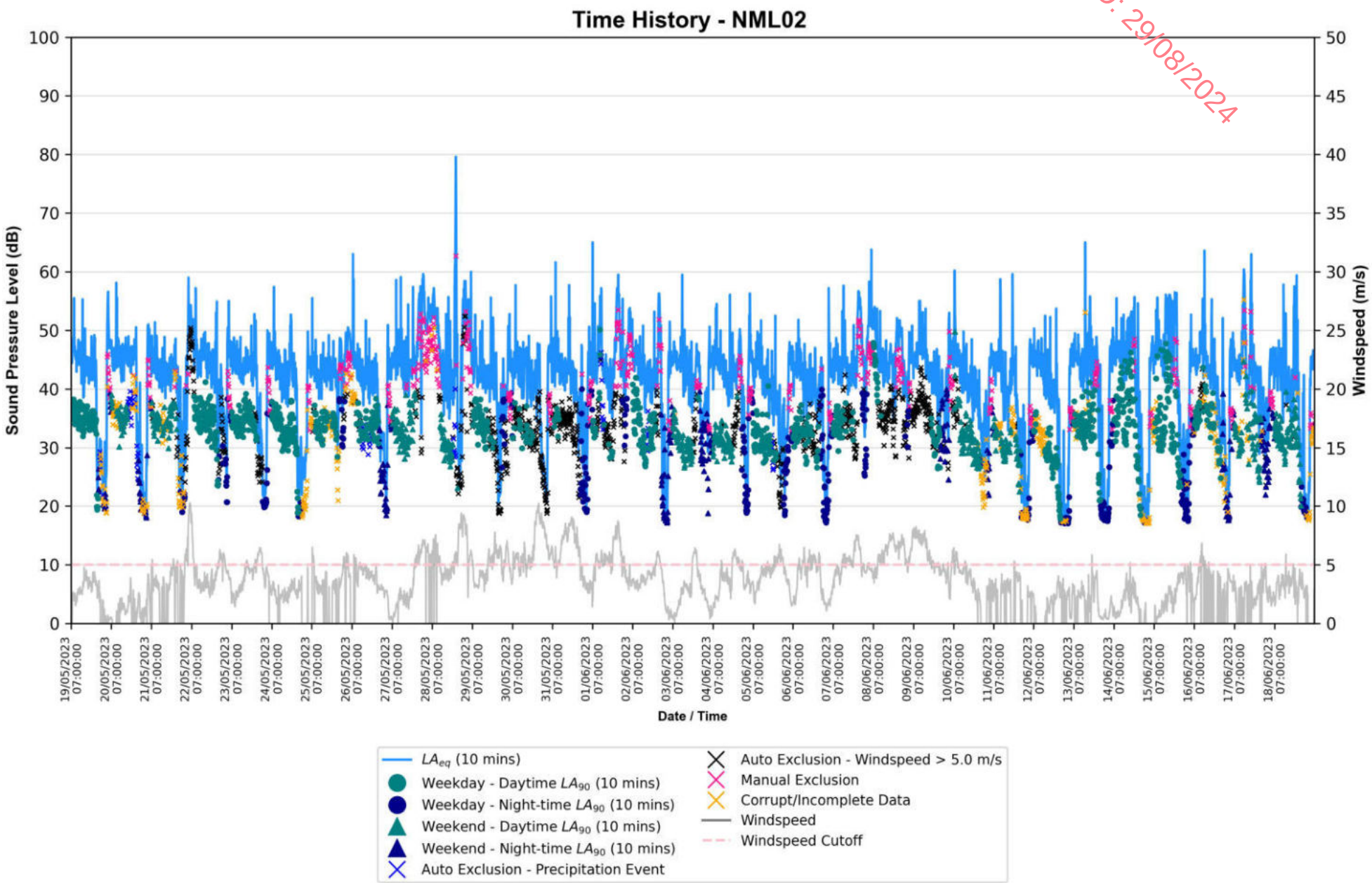

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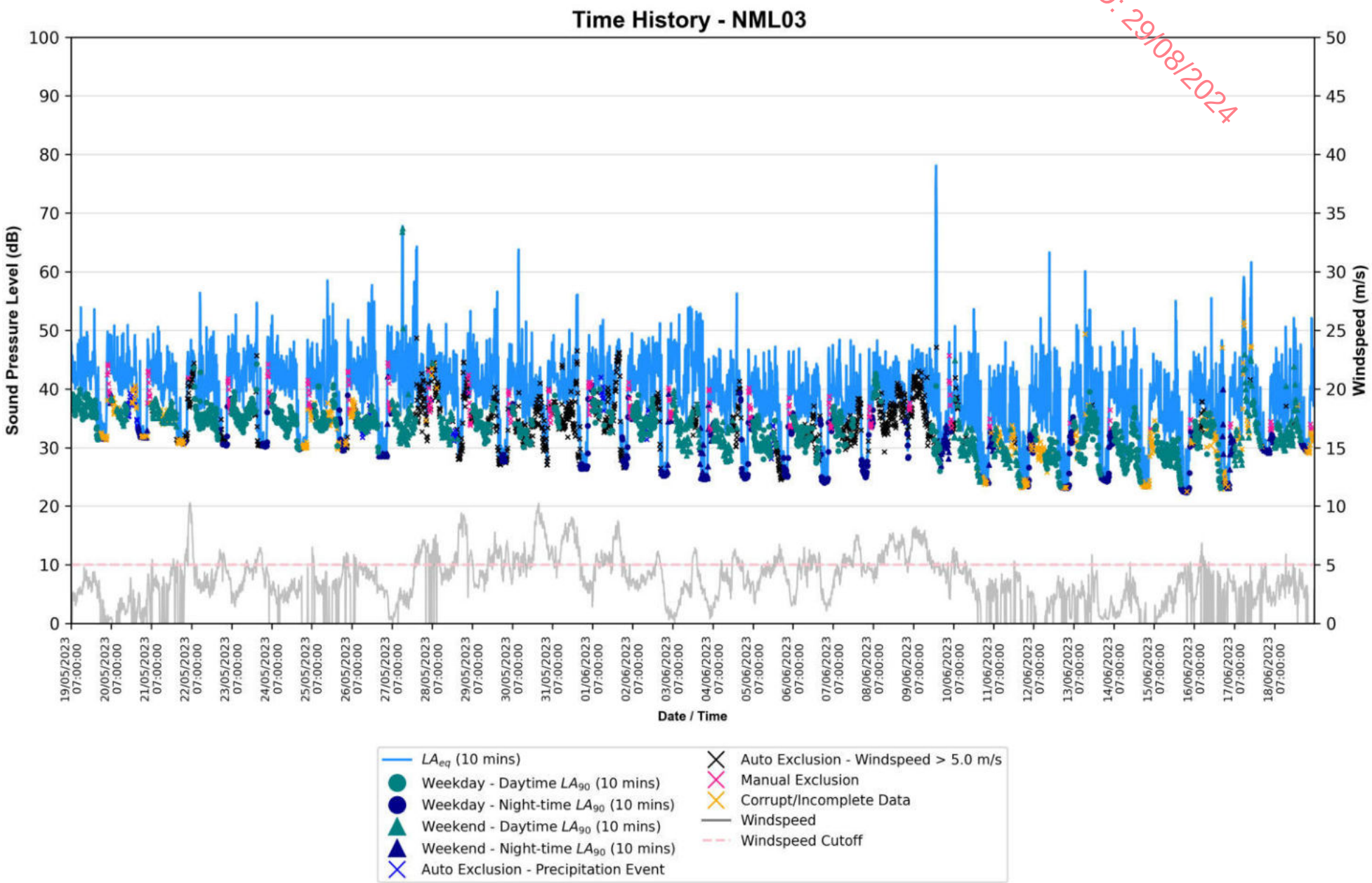

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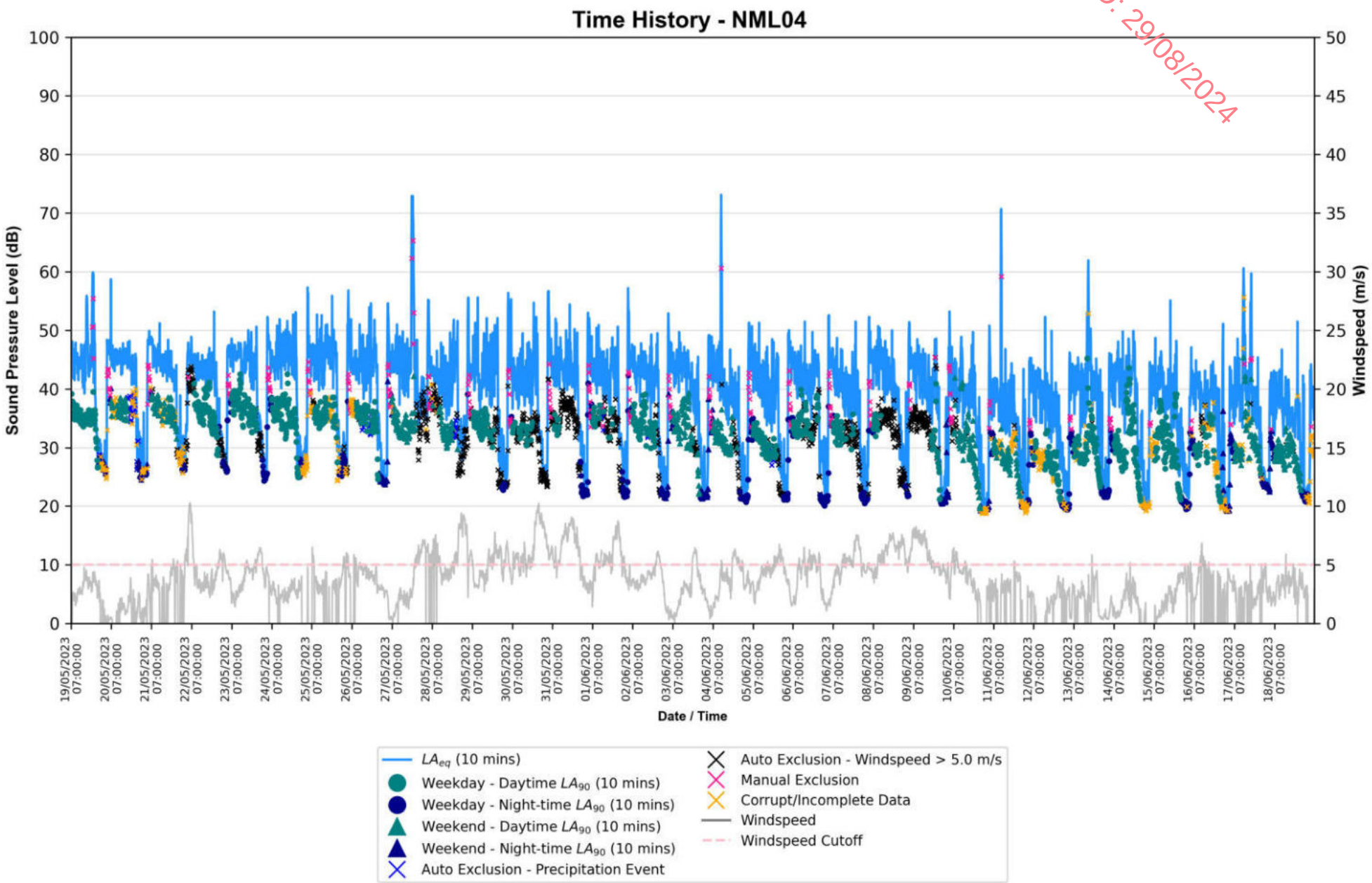

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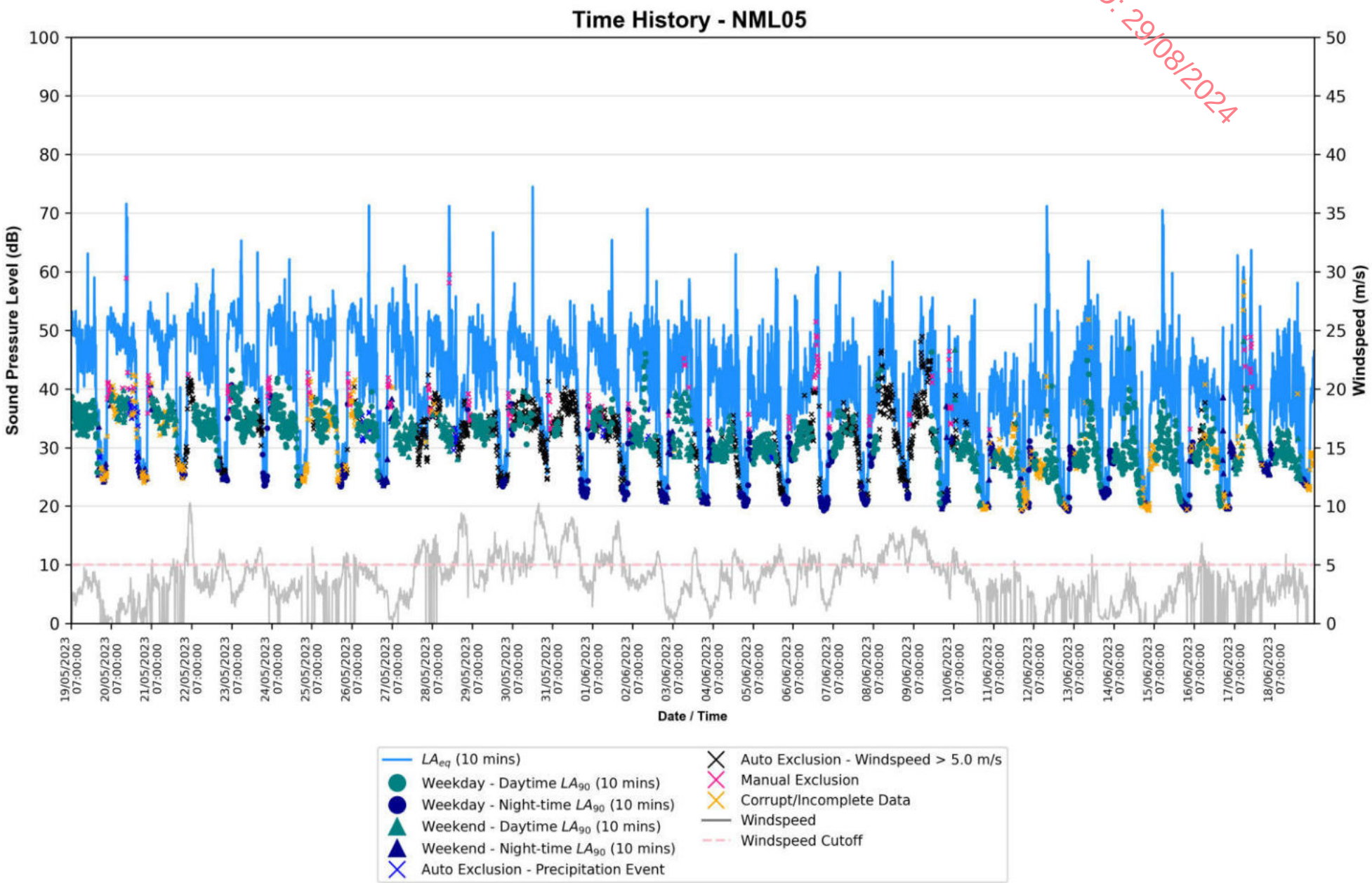

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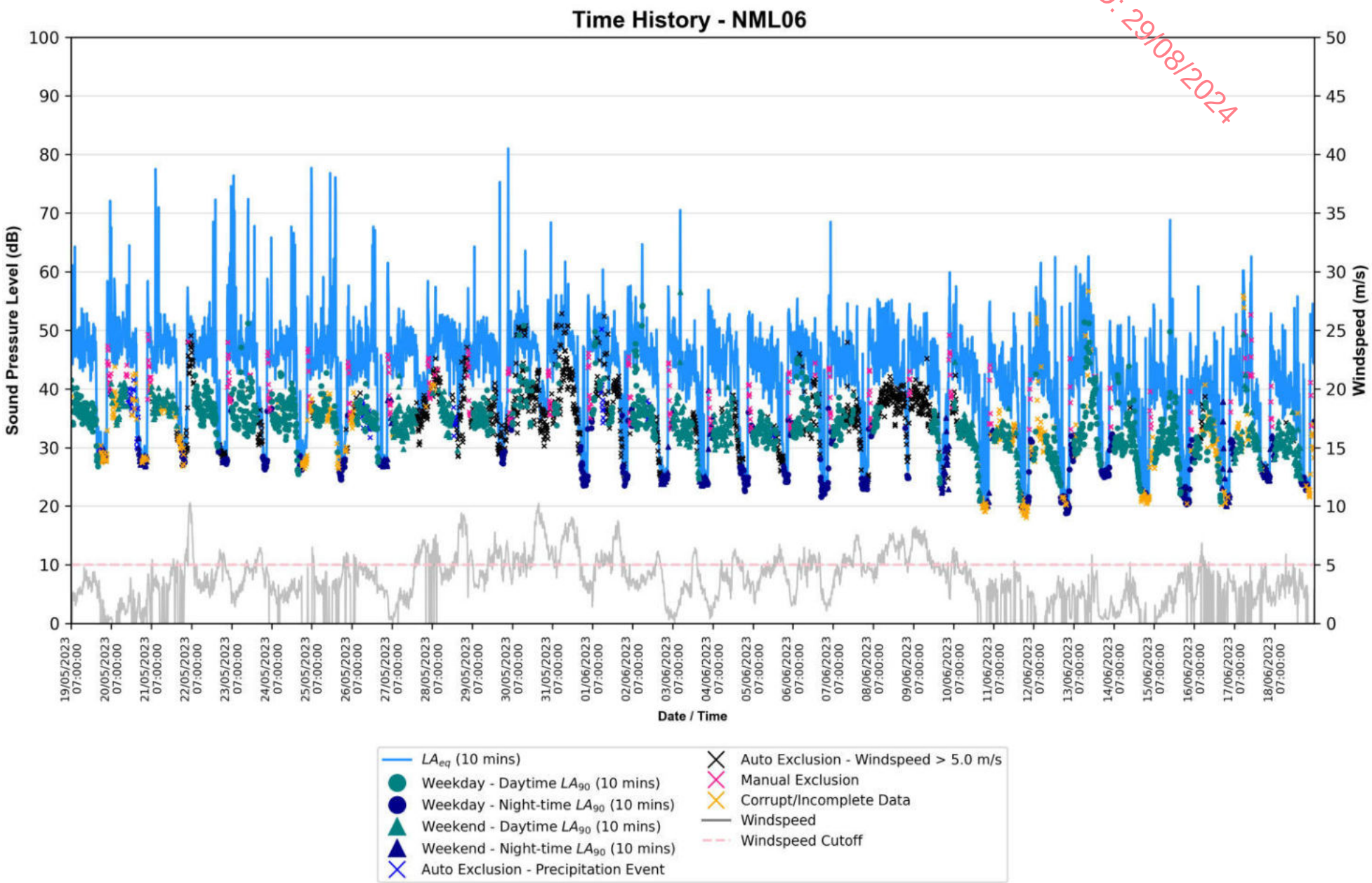

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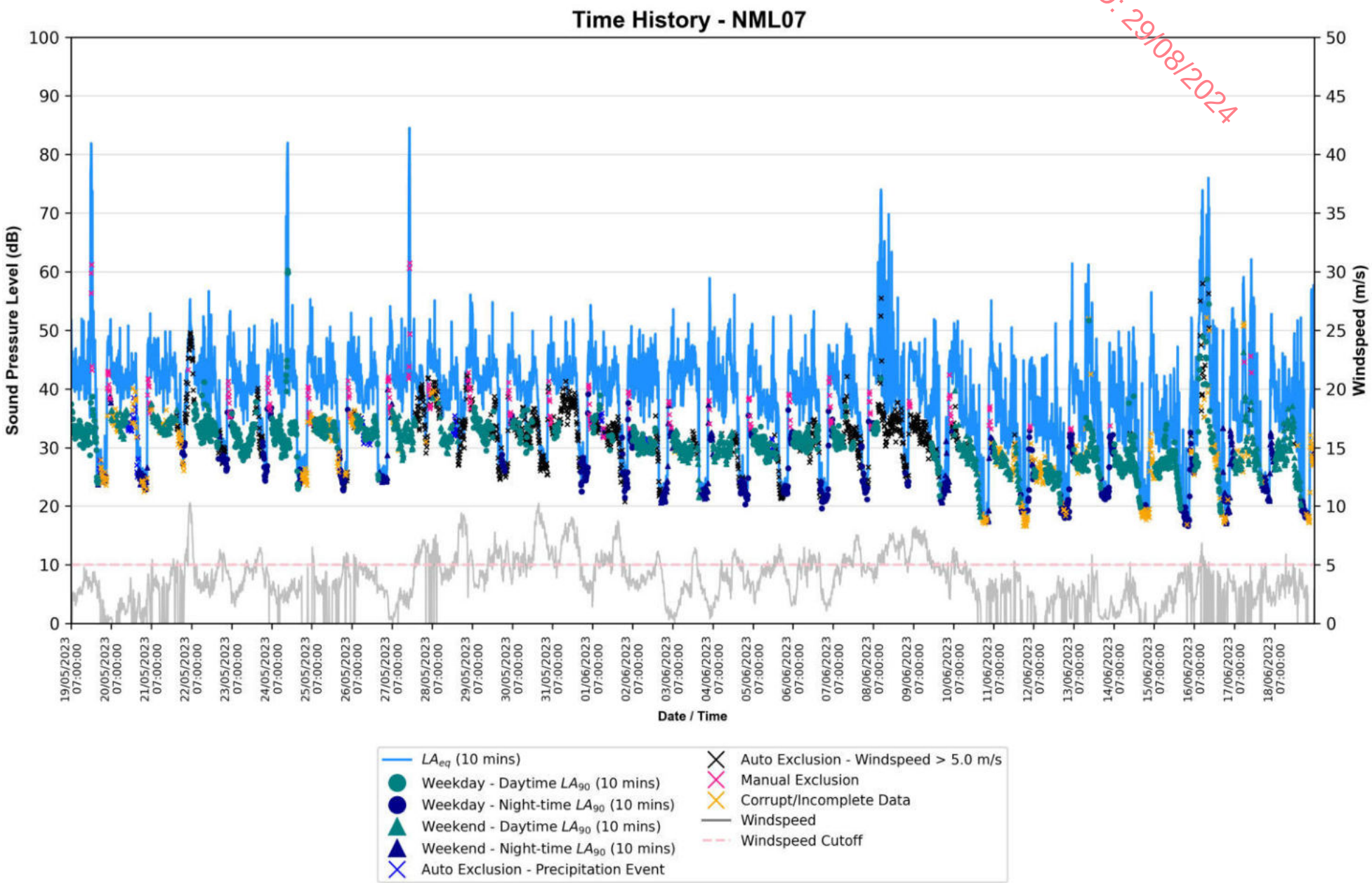
IE00101 - Lackareagh - Measured Sound Levels:



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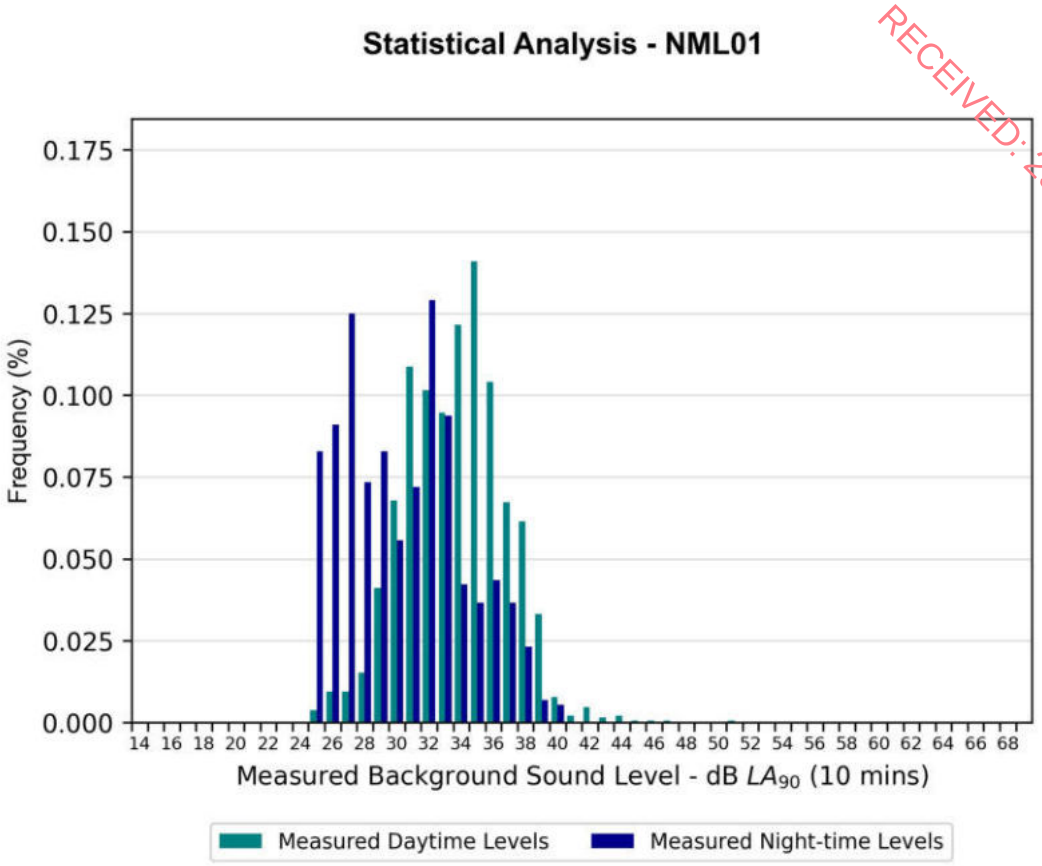

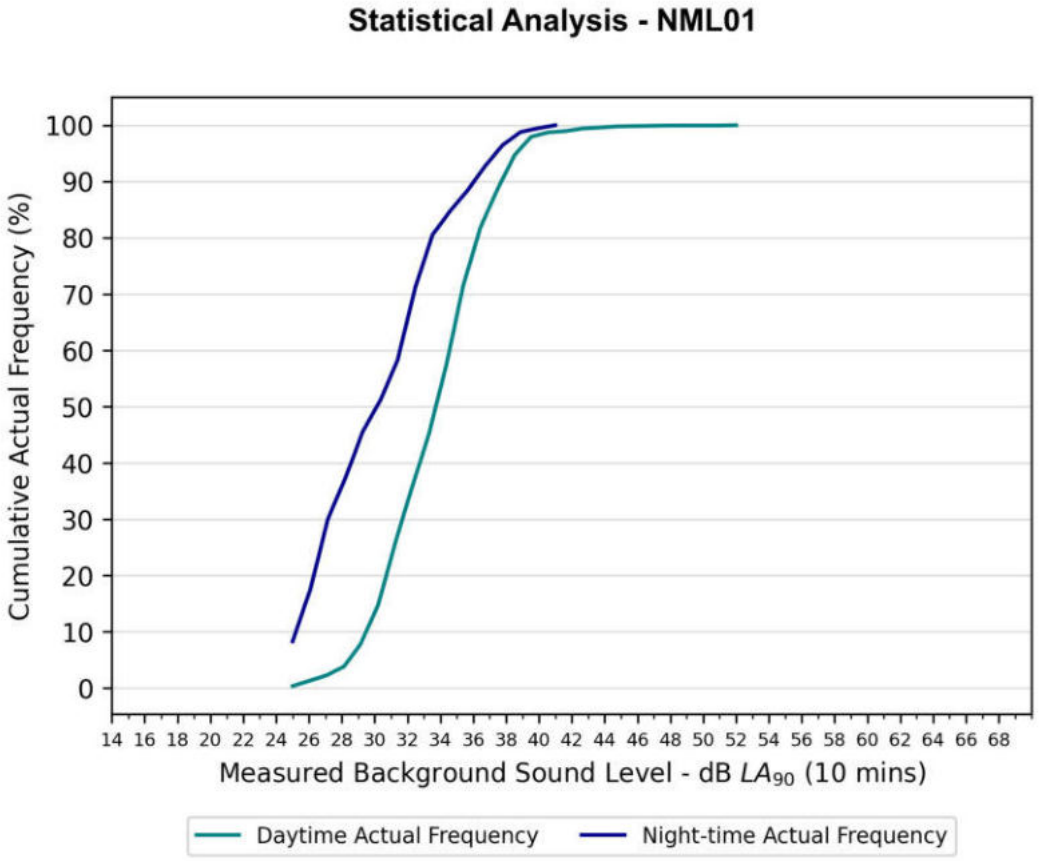

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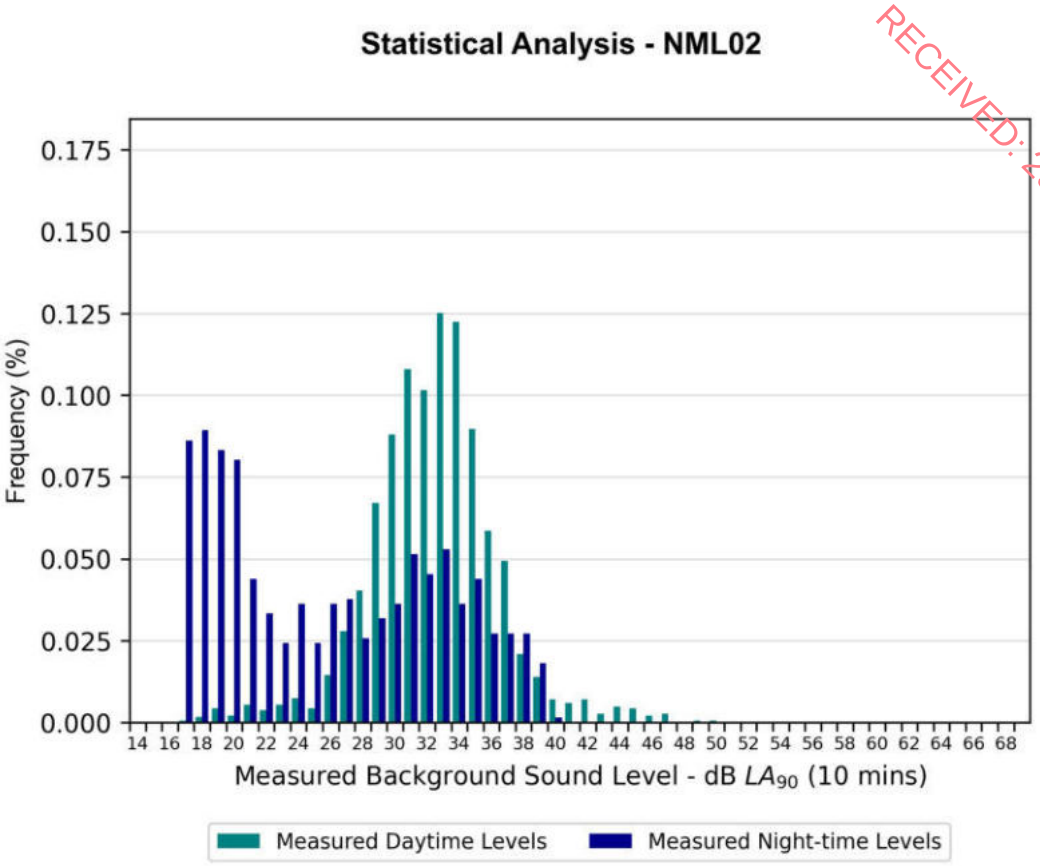

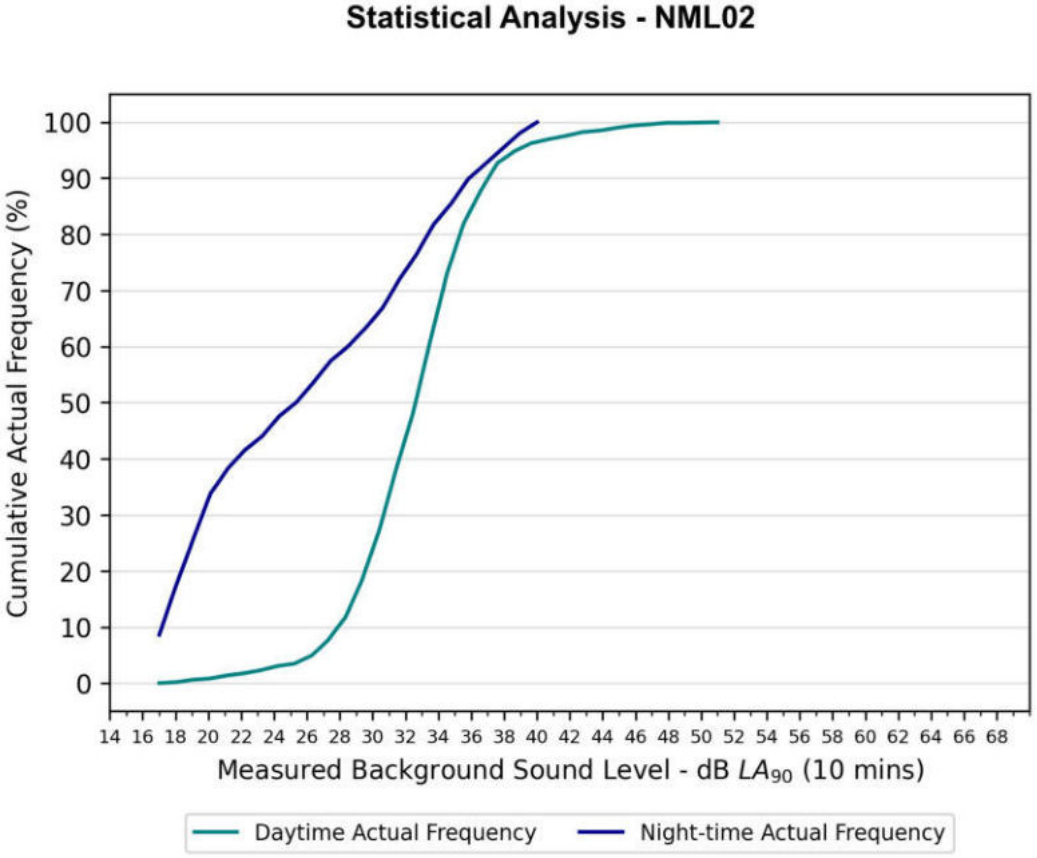

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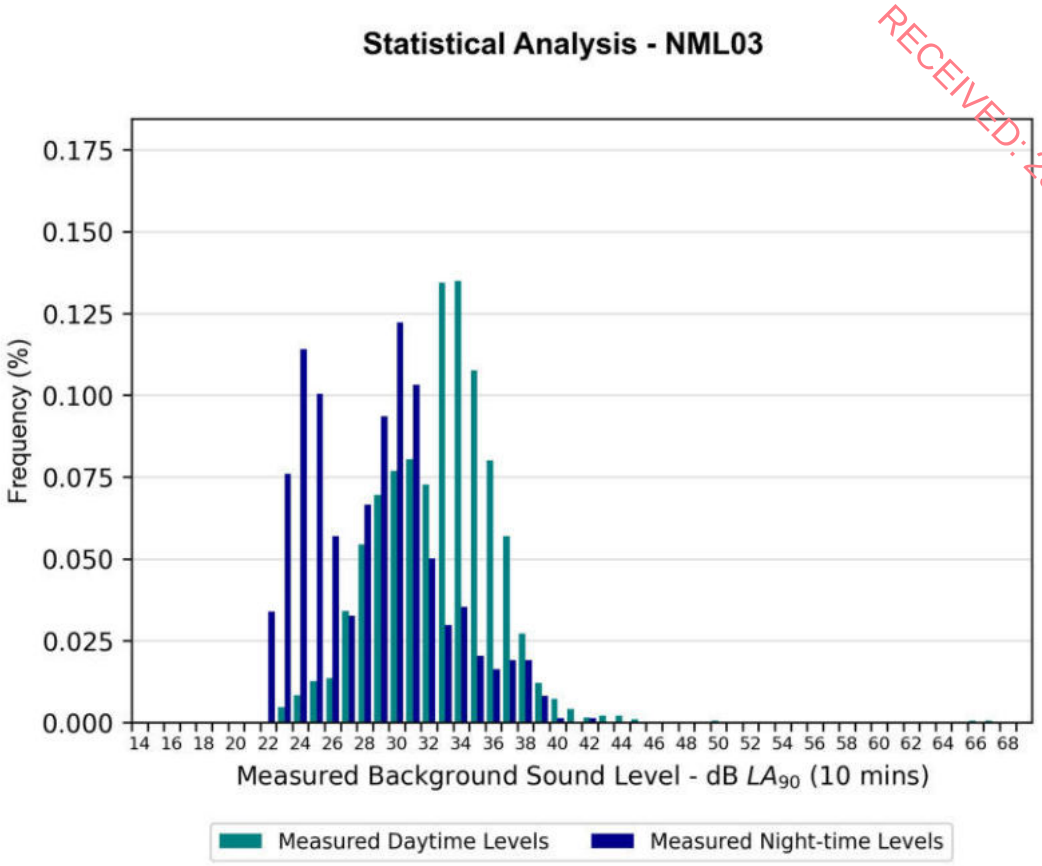

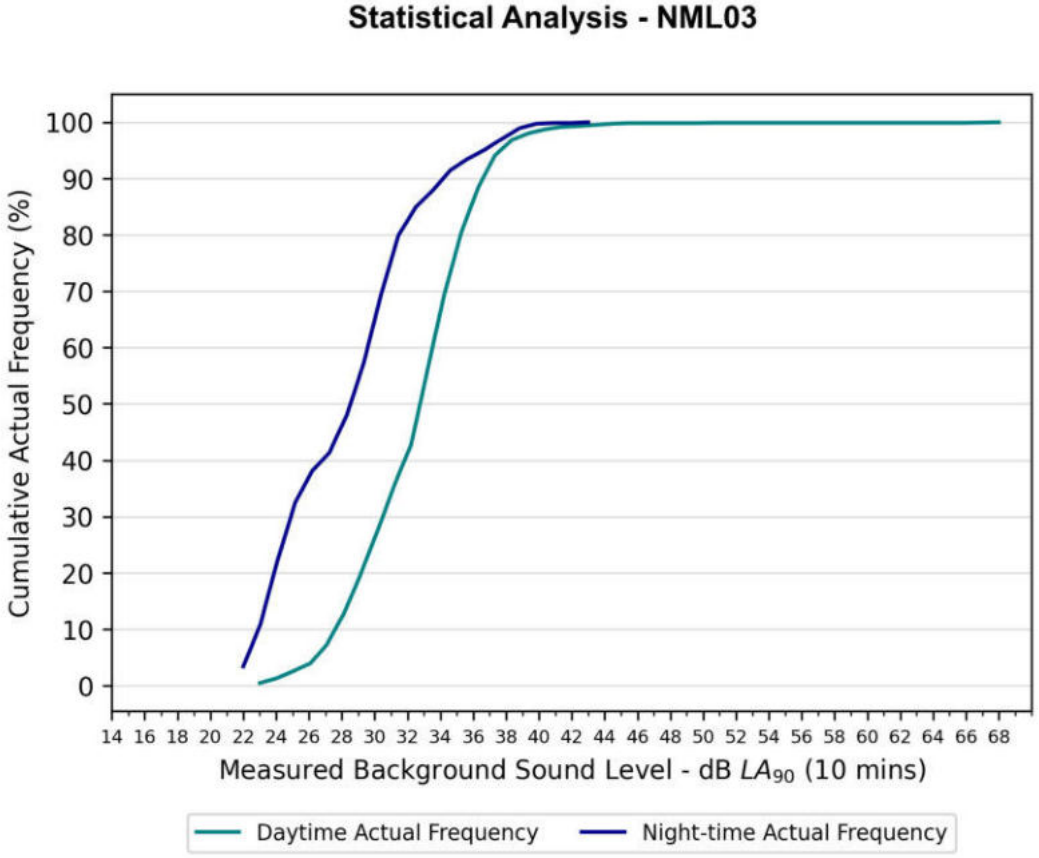

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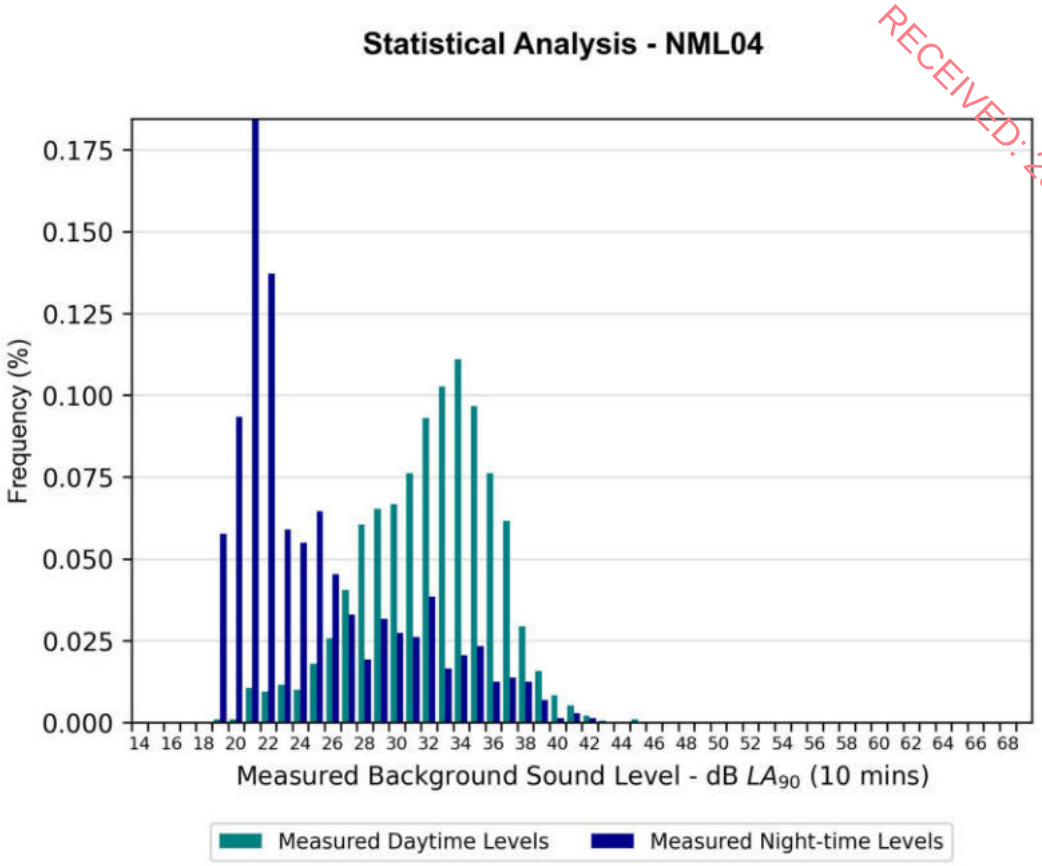

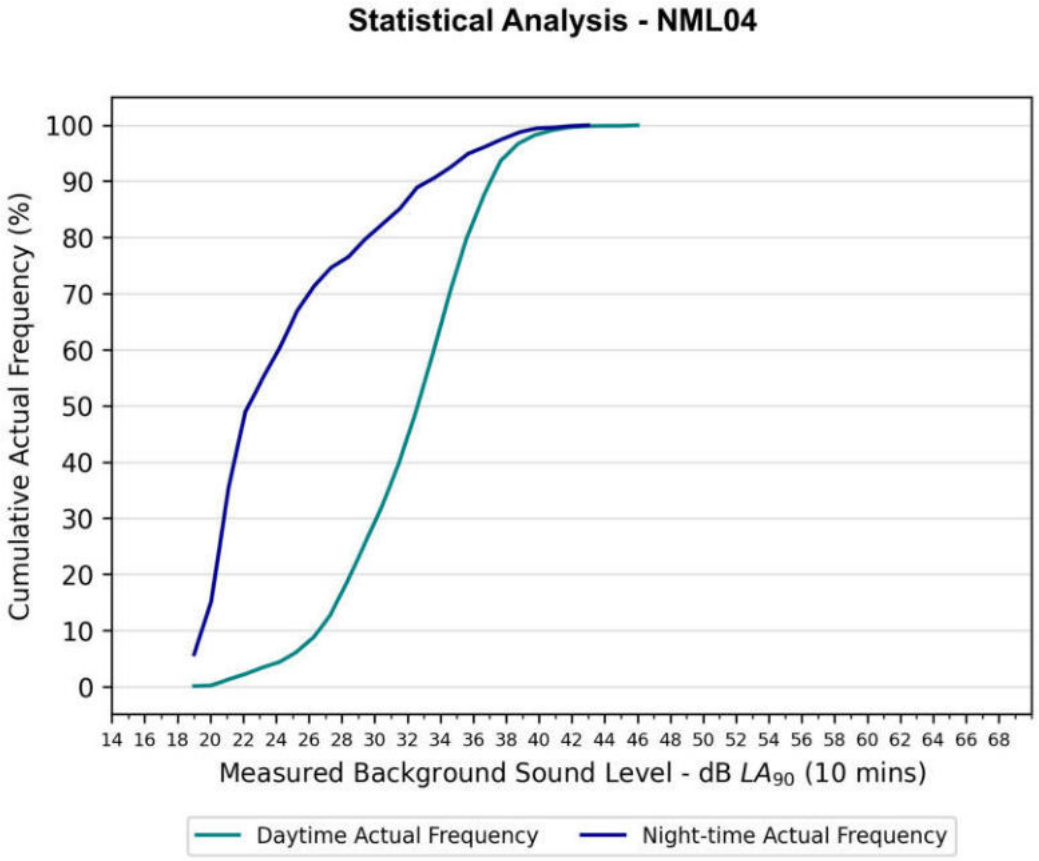

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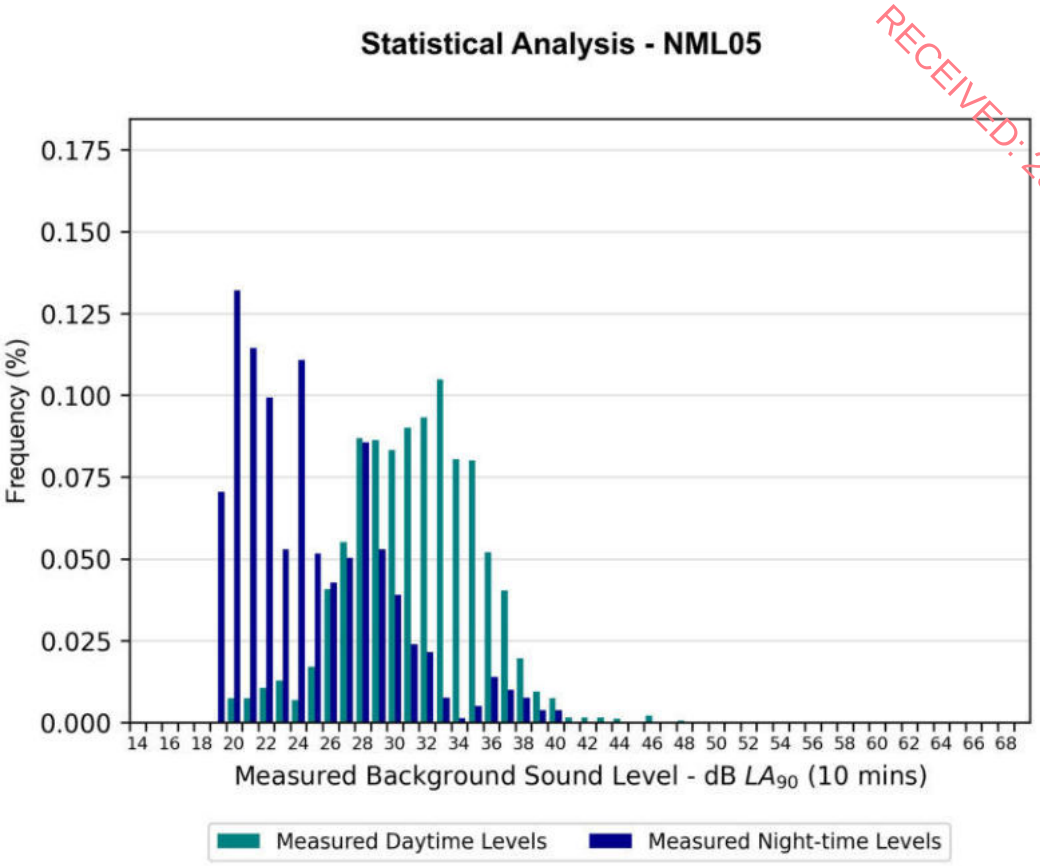
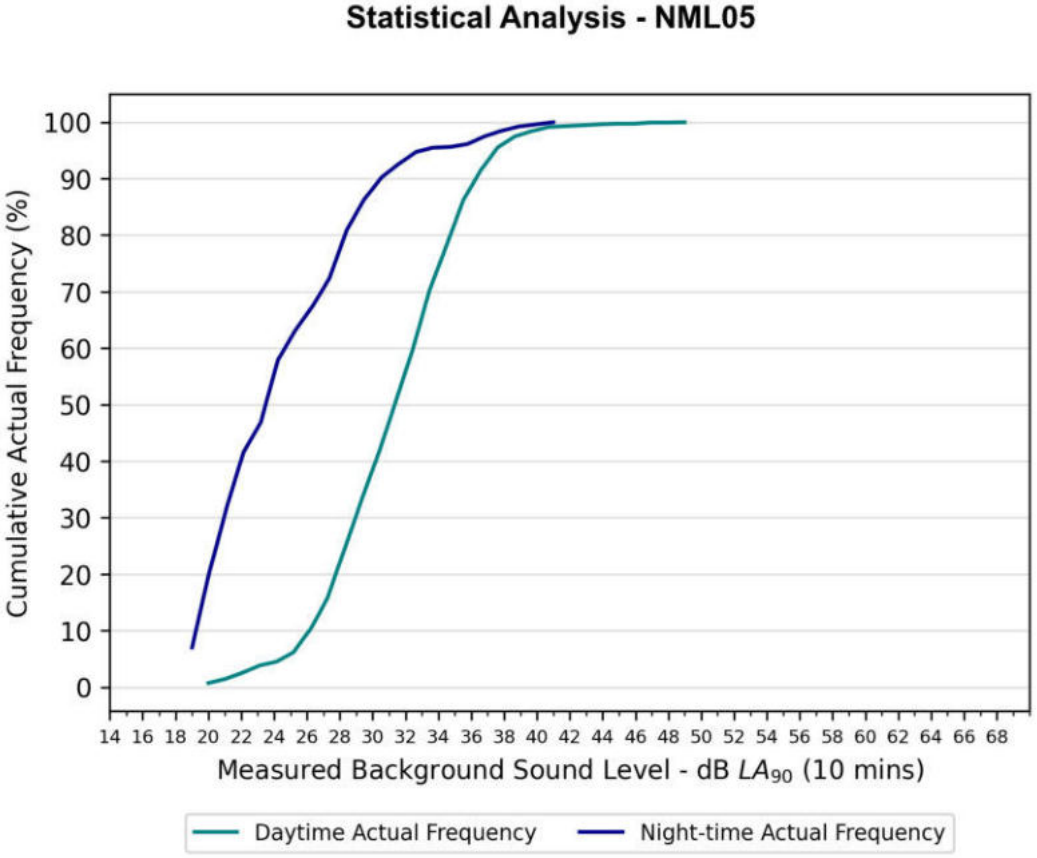
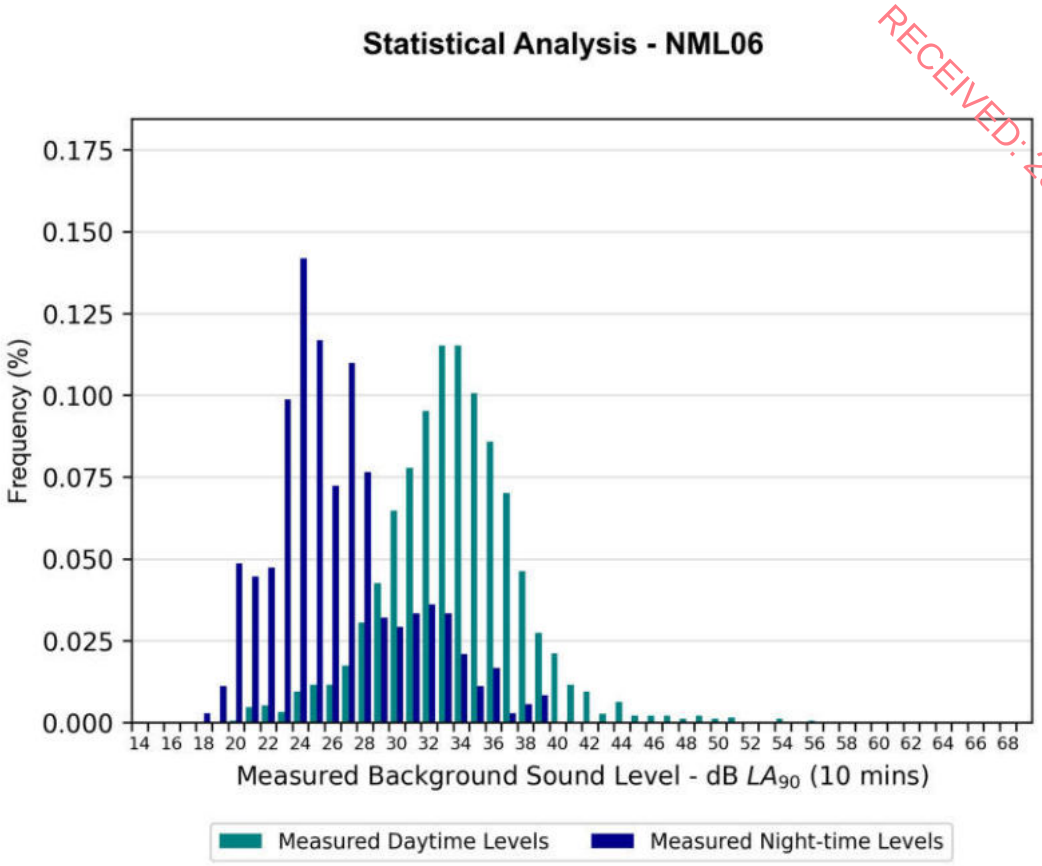
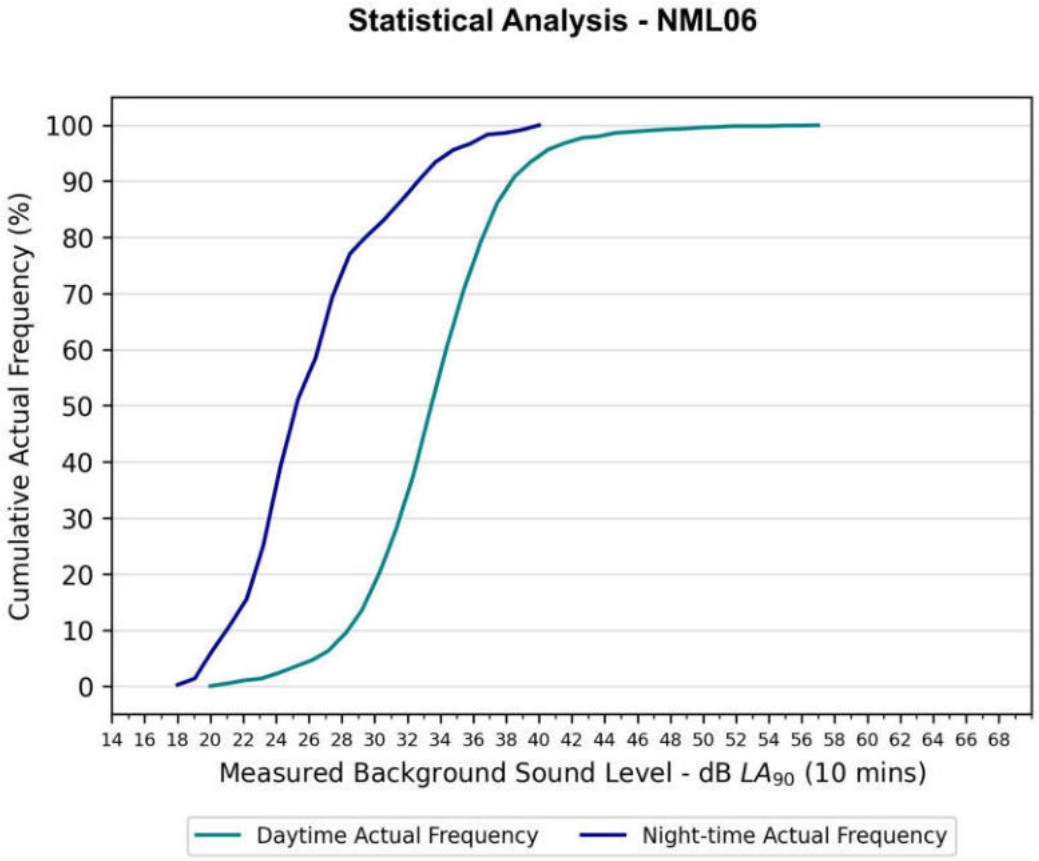




IE00101 - Lackereagh - Measured Sound Levels:





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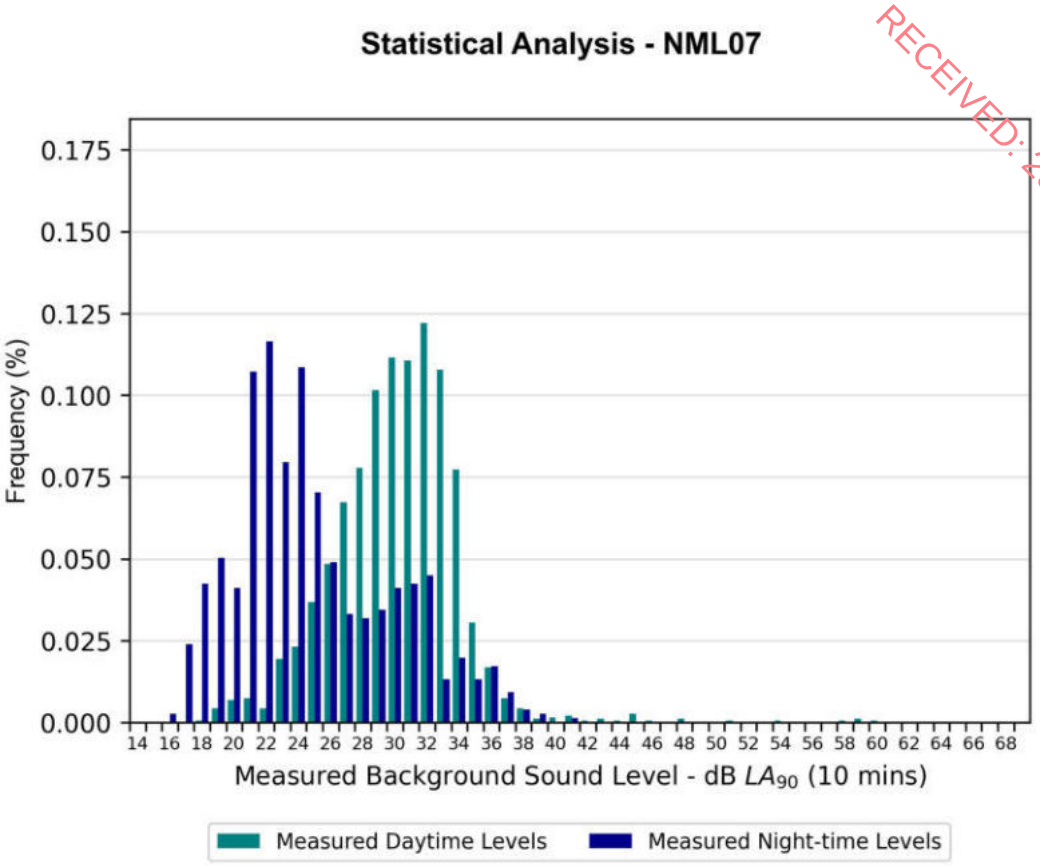
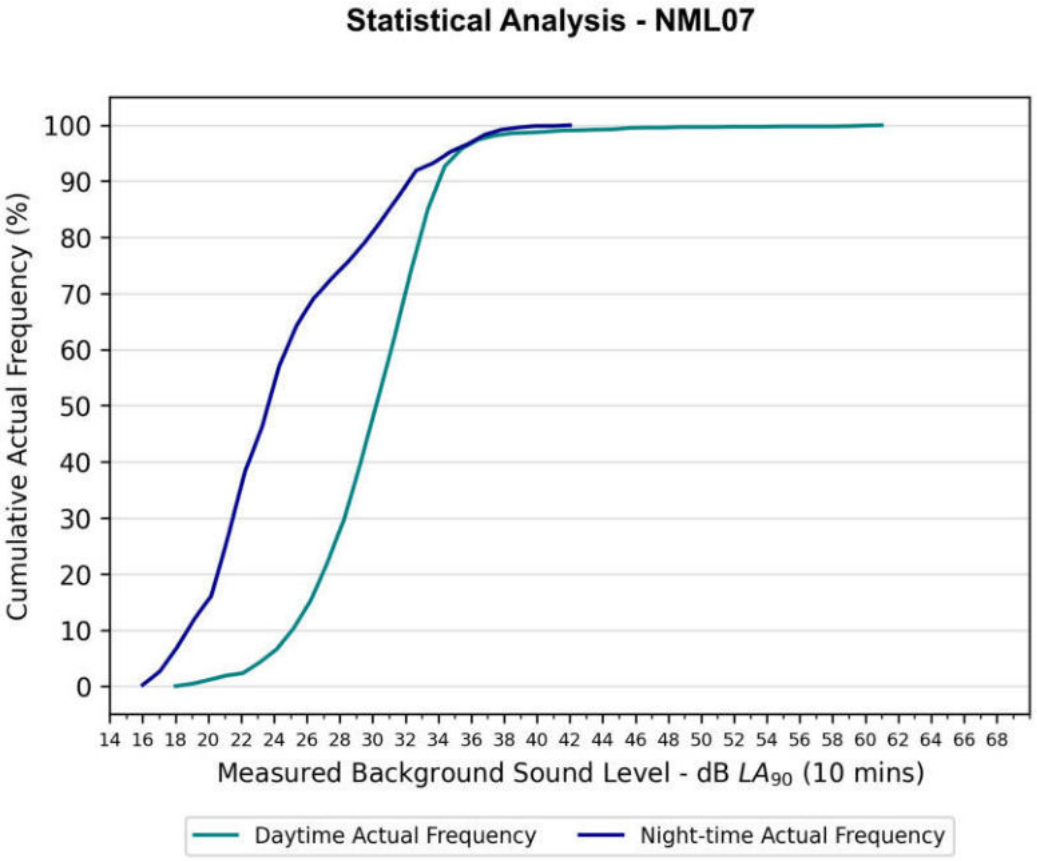




Annex 4 – Noise Modelling Data

Sound Level

Serial No.: 1ZPL0041134582

Measurement Details	
Measurement Standard	IEC 60076-10:2016
Measurement Method	Sound Intensity Method
Measurement Procedure	Walk around
Frequency Resolution	⅓ Octave Band
Acoustic Filter Function	A-weighted

Measurement Instruments	Manufacturer	Type	Serial No.
Sound Level Meter	Brüel & Kjaer	2270	3023666
Sound Level Meter Calibration	Brüel & Kjaer	4297	3082325

X The equipment used has been laboratory calibrated in accordance with manufacturers recommendations and field calibrated before and after each measurement session.

Test Program

Test #	No-Load condition [%]	Load condition [%]	Tap position	Number of fans	Number of pumps	Frequency [Hz]	Distance [m]	Prescribed contour [m]	Height [m]	Surface area [m²]	Surface measure [dB]	Top oil temperature [°C]	Guarantee [dB(A)]	Sound Pressure Level [dB(A)]
1	100		11	0		50	1.0	31.1	5.2	193	22.9			54.0
2	100		11	8		50	2.0	37.5	5.2	270	24.3			63.4
3		100	11	0		50	1.0	31.1	5.2	193	22.9			56.1
4		100	11	8		50	2.0	37.5	5.2	270	24.3			63.5
5														
6														
7														
8														
1+4	100	100		8			2.0						70.0	63.8

Standard: IEC 60076-10

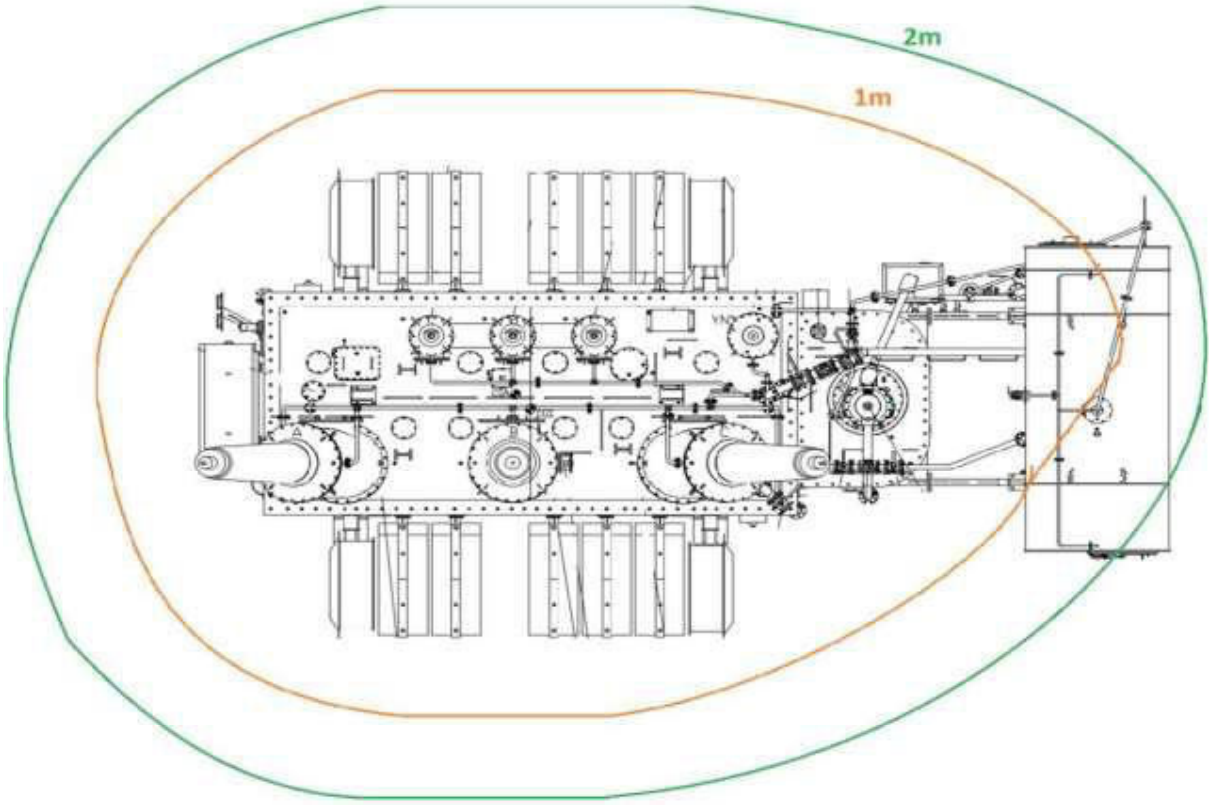
Test Date 16/08/2021

Test Engineer Kamil Maliński

Sound Level

Serial No. : 1ZPL001134582

Prescribed Contours				
x Distance	l_m Prescribed contour	h Height	S Surface area	L_S Surface measure
[m]	[m]	[m]	[m²]	[dB]
1	31.1	5.2	192.82	22,9
2	37.5	5.2	270	24,3



Sound Level

Serial No. : 1ZPL001134582

Measurement 1

Rated voltage	Applied voltage	Rated current	Applied current	Tap position	Fans in operation	Pumps in operation	Frequency	Distance	Prescribed contour	Height	Surface area	Surface measure	Top oil temperature	Guarantee
[%]	[kV]	[%]	[A]				[Hz]	[m]	[m]	[m]	[m²]	[dB]	[°C]	[dB(A)]
100	33			11	0		50	1	31.1	5.2	192.8	22.9		

Measurement duration: 85 s

	Frequency	L_{pA0}		L_{pA0}	$L_{pA0} - L_{pA0}$	Pressure Intensity Correction	L_{pA}	L_{WA}
	[Hz]	[dB(A)]		[dB(A)]	[dB(A)]		[dB(A)]	[dB(A)]
Total Sound Level		**54.0**	**1**	**57.3**	**3.3**	**A**	**54.0**	**76.9**
Octave Band	63	15.5	1	23.3	7.8	A	16.8	39.6
	125	36.6	1	39.9	3.2	A	36.6	59.5
	250	53.3	1	56.2	2.9	A	53.3	76.1
	500	44.5	1	47.5	3.0	A	44.5	67.3
	1000	33.4	1	40.3	6.8	A	33.4	56.3
	2000	28.8	1	40.1	11.3	A	28.8	51.6
	4000	31.3	1	40.8	9.5	A	31.3	54.1
	8000	34.6	1	43.3	8.7	A	34.6	57.4
⅓ Octave Band	50	13.3	1	13.5	0.3	A	13.3	36.1
	63	14.2	1	16.0	1.8	A	14.2	37.0
	80	10.9	-1	21.8	10.9	A	0.0	0.0
	100	35.6	1	37.5	1.9	A	35.6	58.4
	125	24.6	1	34.3	9.6	A	24.6	47.5
	160	28.4	1	31.6	3.2	A	28.4	51.3
	200	40.3	1	43.4	3.1	A	40.3	63.1
	250	38.0	1	41.2	3.1	A	38.0	60.9
	315	52.9	1	55.8	2.9	A	52.9	75.8
	400	38.4	1	41.1	2.7	A	38.4	61.2
	500	40.8	1	43.9	3.1	A	40.8	63.7
	630	39.6	1	42.7	3.1	A	39.6	62.5
	800	30.9	1	36.3	5.4	A	30.9	53.7
	1000	28.6	1	35.3	6.7	A	28.6	51.4
	1250	24.3	1	34.8	10.5	A	24.3	47.1
	1600	24.1	1	35.3	11.2	A	24.1	47.0
	2000	23.8	1	35.5	11.7	A	23.8	46.7
	2500	24.1	1	35.1	11.0	A	24.1	46.9
	3150	25.6	1	35.9	10.4	A	25.6	48.4
	4000	26.7	1	36.1	9.3	A	26.7	49.6
	5000	27.1	1	36.1	9.0	A	27.1	49.9
	6300	28.4	1	37.5	9.2	A	28.4	51.2
	8000	30.1	1	39.1	9.1	A	30.1	52.9
	10000	30.7	1	38.9	8.1	A	30.7	53.6

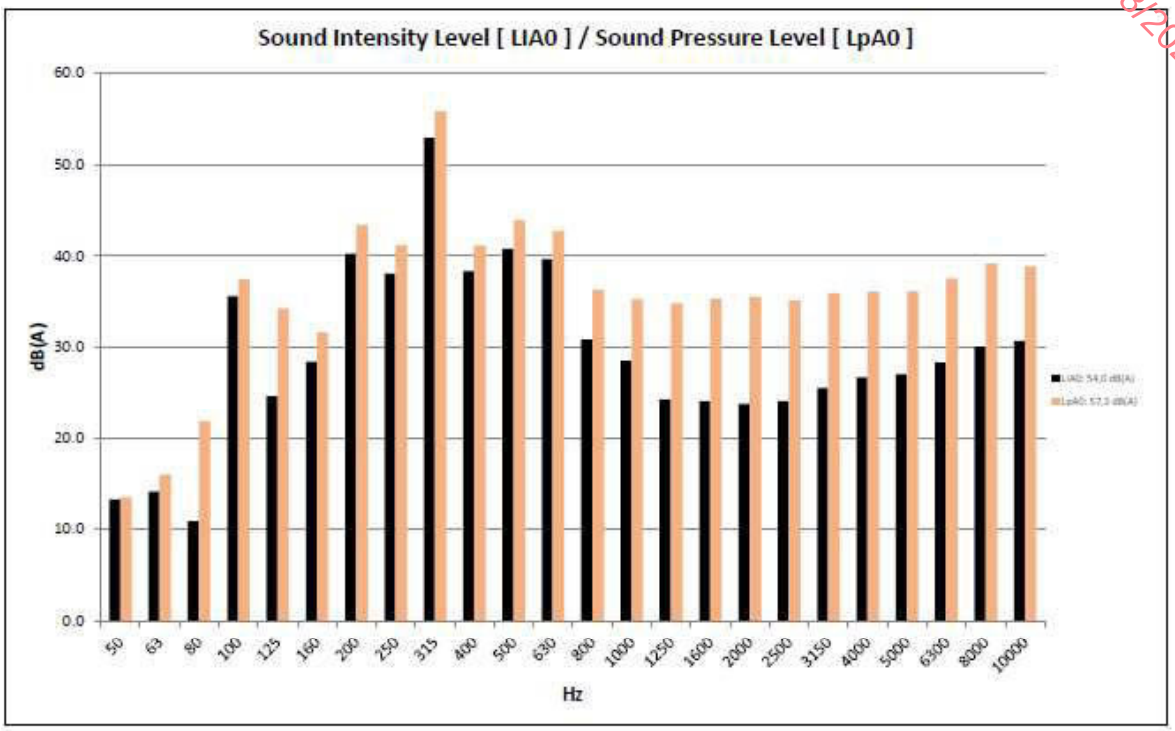
Case A: Applies, if the total P-I index is $\Delta L \leq 4$ dB. Then it follows $L_{pA} = L_{pA0}$ for both the total sound level and sound levels of the individual frequency bands.

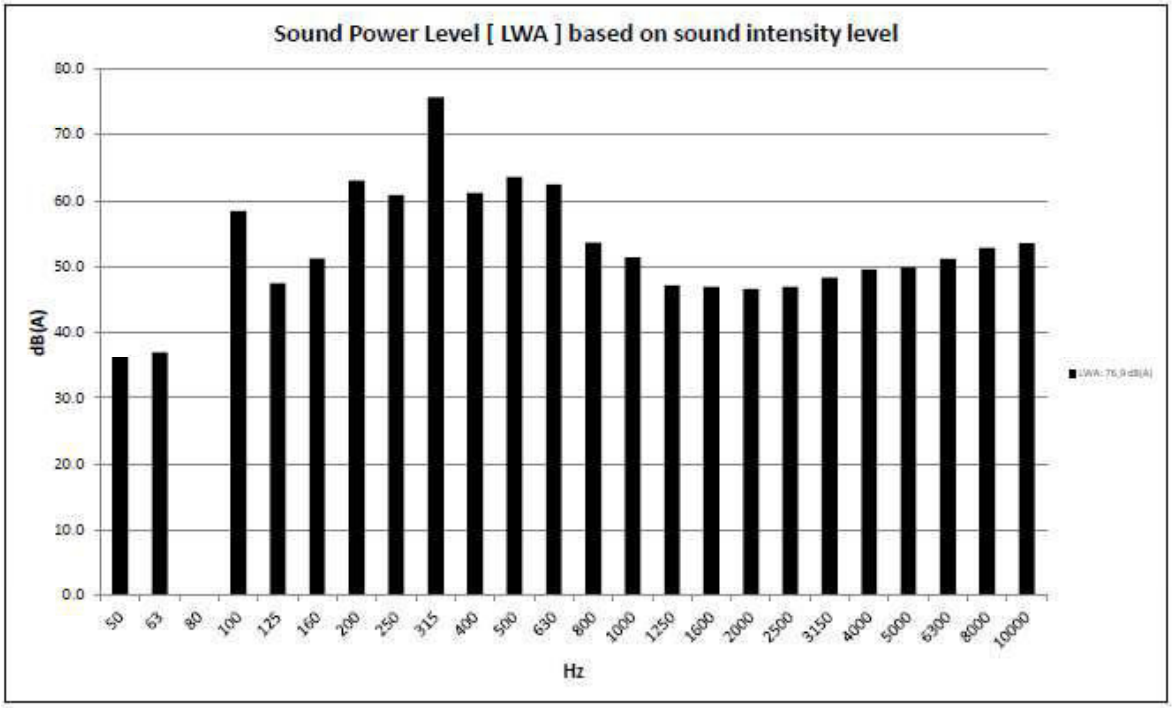
Case B: Applies, if the total P-I index is 4 dB $< \Delta L \leq 8$ dB. Then it follows $L_{pA} = L_{pA0} - 4$ dB for both the total sound level and sound levels of the individual frequency bands.

Sound Level

Serial No. : 1ZPL001134582

Measurement 1





Sound Level

Serial No. : 1ZPL001134582

Measurement 2

Rated voltage	Applied voltage	Rated current	Applied current	Tap position	Fans in operation	Pumps in operation	Frequency	Distance	Prescribed contour	Height	Surface area	Surface measure	Top oil temperature	Guarantee
[%]	[kV]	[%]	[A]				[Hz]	[m]	[m]	[m]	[m²]	[dB]	[°C]	[dB(A)]
100	33			11	8		50	2	37.5	5.2	270.0	24.3		

Measurement duration: 95 s

	Frequency	L_{uA0}		L_{pA0}	$L_{pA0} - L_{uA0}$	Pressure Intensity Correction	L_{uA}	L_{WA}
	[Hz]	[dB(A)]		[dB(A)]	[dB(A)]		[dB(A)]	[dB(A)]
Total Sound Level		**63.4**	**1**	**65.6**	**2.2**	**A**	**63.4**	**87.7**
Octave Band	63	33.4	1	34.1	0.7	A	33.4	57.8
	125	47.7	1	49.2	1.5	A	47.7	72.0
	250	58.5	1	60.3	1.9	A	58.5	82.8
	500	58.5	1	60.7	2.2	A	58.5	82.8
	1000	57.2	1	59.6	2.4	A	57.2	81.5
	2000	50.6	1	53.3	2.6	A	50.6	74.9
	4000	46.7	1	49.8	3.0	A	46.7	71.0
	8000	41.6	1	46.1	4.6	A	41.6	65.9
⅓ Octave Band	50	26.8	1	27.3	0.5	A	26.8	51.1
	63	24.0	1	23.6	-0.4	A	24.0	48.3
	80	31.7	1	32.6	0.9	A	31.7	56.0
	100	39.9	1	41.4	1.5	A	39.9	64.2
	125	43.6	1	45.0	1.4	A	43.6	67.9
	160	44.2	1	45.7	1.5	A	44.2	68.5
	200	49.2	1	50.9	1.7	A	49.2	73.5
	250	52.1	1	53.7	1.6	A	52.1	76.4
	315	56.6	1	58.6	2.0	A	56.6	80.9
	400	52.8	1	55.1	2.2	A	52.8	77.2
	500	52.8	1	55.1	2.3	A	52.8	77.1
	630	55.1	1	57.2	2.2	A	55.1	79.4
	800	54.1	1	56.5	2.4	A	54.1	78.4
	1000	52.1	1	54.5	2.3	A	52.1	76.5
	1250	50.0	1	52.5	2.6	A	50.0	74.3
	1600	47.7	1	50.3	2.6	A	47.7	72.0
	2000	45.3	1	48.0	2.7	A	45.3	69.6
	2500	43.6	1	46.3	2.7	A	43.6	67.9
	3150	42.7	1	45.6	2.9	A	42.7	67.0
	4000	42.3	1	45.4	3.1	A	42.3	66.6
	5000	40.6	1	43.7	3.1	A	40.6	64.9
	6300	37.9	1	41.9	4.0	A	37.9	62.2
	8000	36.3	1	41.1	4.8	A	36.3	60.6
	10000	35.9	1	41.0	5.1	A	35.9	60.3

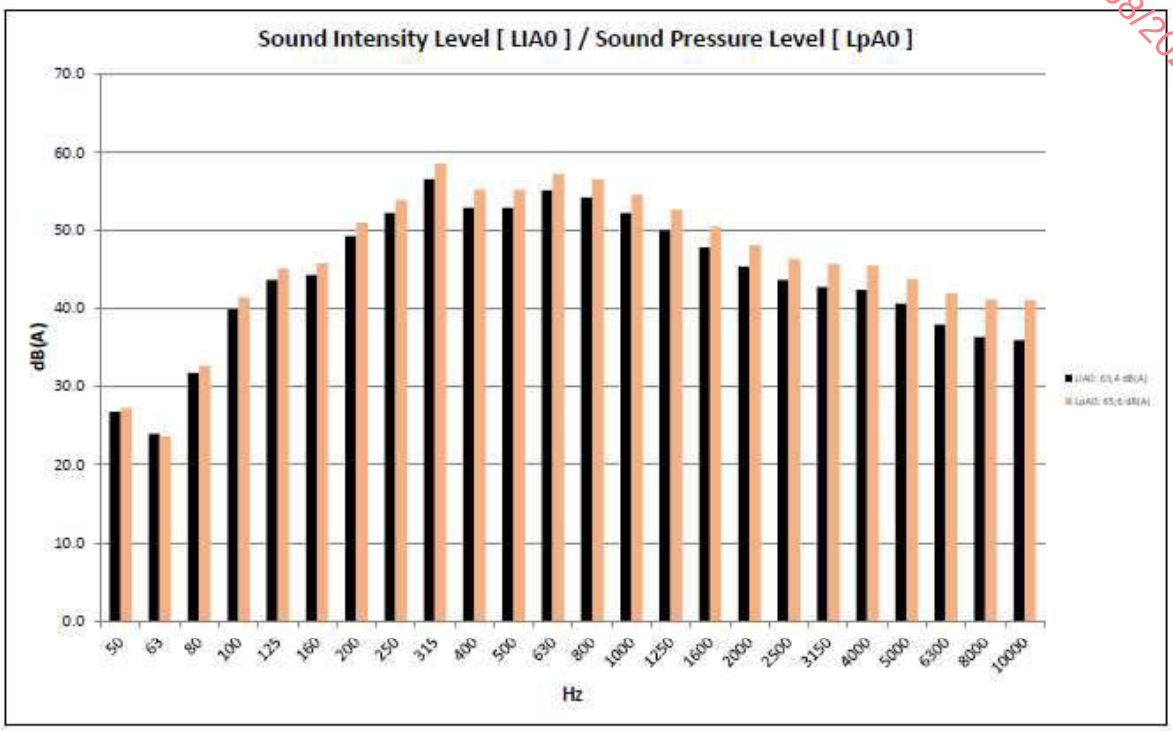
Case A: Applies, if the total P-I index is $\Delta L \leq 4$ dB. Then it follows $L_{uA} = L_{uA0}$ for both the total sound level and sound levels of the individual frequency bands.

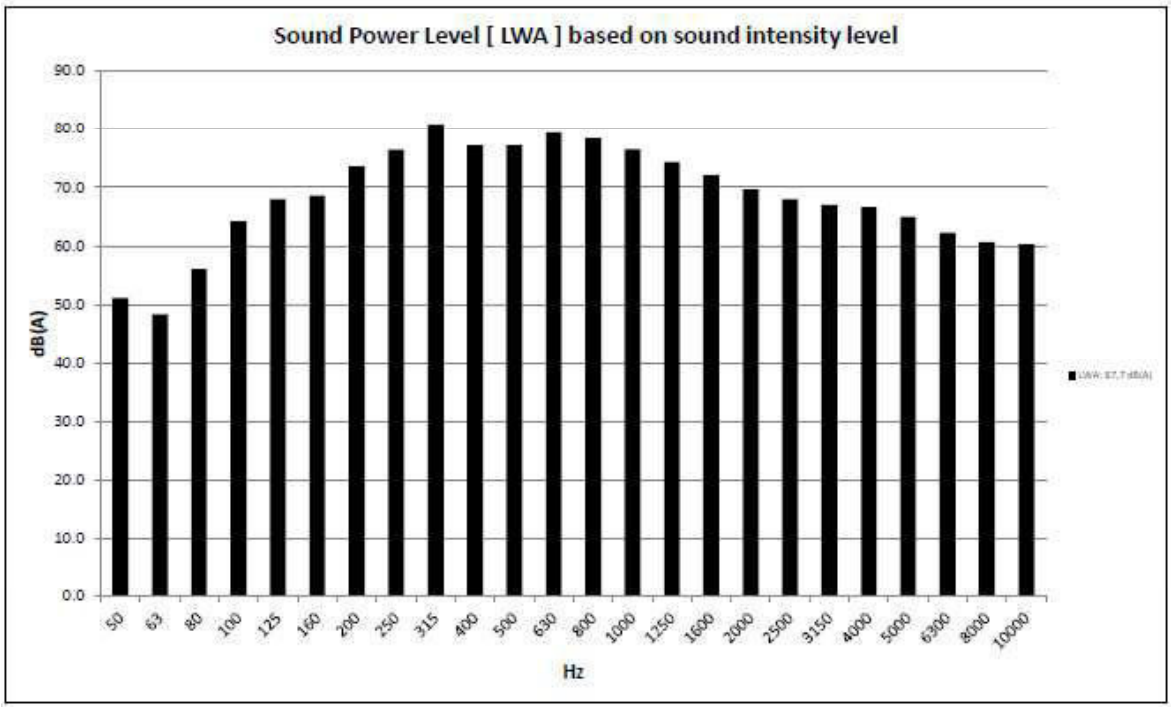
Case B: Applies, if the total P-I index is 4 dB $< \Delta L \leq 8$ dB. Then it follows $L_{uA} = L_{pA0} - 4$ dB for both the total sound level and sound levels of the individual frequency bands.

Sound Level

Serial No. : 1ZPL001134582

Measurement 2





Sound Level

Serial No. : 1ZPL001134582

Measurement 3

Rated voltage	Applied voltage	Rated current	Applied current	Tap position	Fans in operation	Pumps in operation	Frequency	Distance	Prescribed contour	Height	Surface area	Surface measure	Top oil temperature	Guarantee
[%]	[kV]	[%]	[A]				[Hz]	[m]	[m]	[m]	[m²]	[dB]	[°C]	[dB(A)]
		100	262.43	11	0		50	1	31.1	5.2	192.8	22.9		

Measurement duration: 85 s

	Frequency	L_{WA0}		L_{pA0}	$L_{pA0} - L_{WA0}$	Pressure Intensity Correction	L_{pA}	L_{WA}
	[Hz]	[dB(A)]		[dB(A)]	[dB(A)]		[dB(A)]	[dB(A)]
Total Sound Level		**56.1**	**1**	**58.1**	**2.1**	**A**	**56.1**	**78.9**
Octave Band	63	40.3	1	46.7	6.4	A	40.3	63.2
	125	55.0	1	56.5	1.5	A	55.0	77.9
	250	47.0	1	49.4	2.4	A	47.0	69.9
	500	39.9	1	43.3	3.4	A	39.9	62.7
	1000	37.9	1	42.2	4.3	A	37.9	60.7
	2000	39.0	1	43.1	4.1	A	39.0	61.9
	4000	28.6	1	38.2	9.6	A	28.6	51.4
	8000	18.4	1	31.5	13.1	A	18.6	41.4
⅓ Octave Band	50	40.2	1	46.5	6.4	A	40.2	63.0
	63	24.6	1	30.1	5.6	A	24.6	47.4
	80	21.0	1	29.3	8.3	A	21.0	43.9
	100	49.0	1	51.8	2.8	A	49.0	71.8
	125	38.9	1	41.0	2.1	A	38.9	61.7
	160	53.7	1	54.6	0.9	A	53.7	76.5
	200	42.2	1	44.7	2.5	A	42.2	65.1
	250	39.7	1	42.0	2.3	A	39.7	62.5
	315	43.9	1	46.2	2.3	A	43.9	66.7
	400	37.4	1	40.5	3.1	A	37.4	60.3
	500	33.8	1	37.6	3.8	A	33.8	56.7
	630	32.4	1	36.3	3.8	A	32.4	55.3
	800	31.9	1	35.3	3.4	A	31.9	54.8
	1000	32.2	1	37.2	5.0	A	32.2	55.0
	1250	34.7	1	38.9	4.3	A	34.7	57.5
	1600	37.3	1	40.7	3.3	A	37.3	60.2
	2000	31.3	1	37.0	5.7	A	31.3	54.1
	2500	30.8	1	36.0	5.2	A	30.8	53.6
	3150	25.5	1	34.7	9.1	A	25.5	48.4
	4000	24.1	1	33.6	9.5	A	24.1	46.9
	5000	20.2	1	31.3	11.1	A	20.2	43.0
	6300	17.3	1	28.7	11.4	A	17.3	40.2
	8000	12.5	1	26.4	13.9	A	12.5	35.3
	10000	2.9	-1	23.9	21.0	A	0.0	0.0

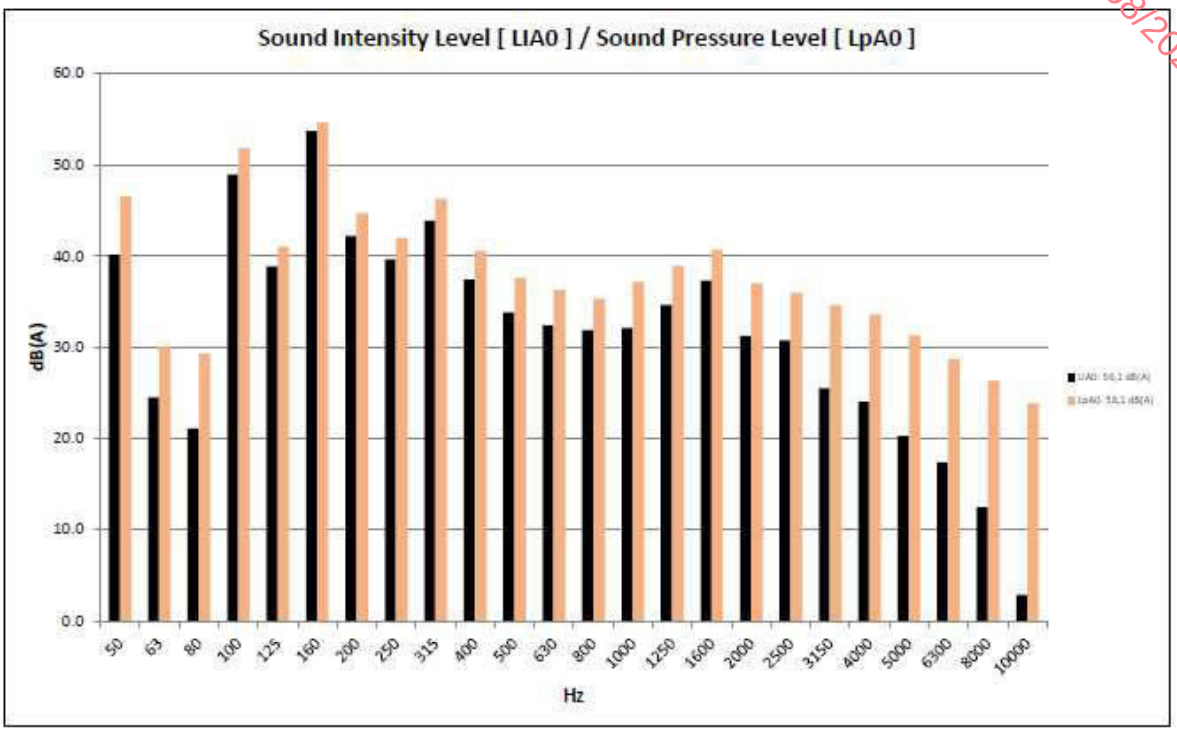
Case A: Applies, if the total P-I index is $\Delta L \leq 4$ dB. Then it follows $L_{pA} = L_{pA0}$ for both the total sound level and sound levels of the individual frequency bands.

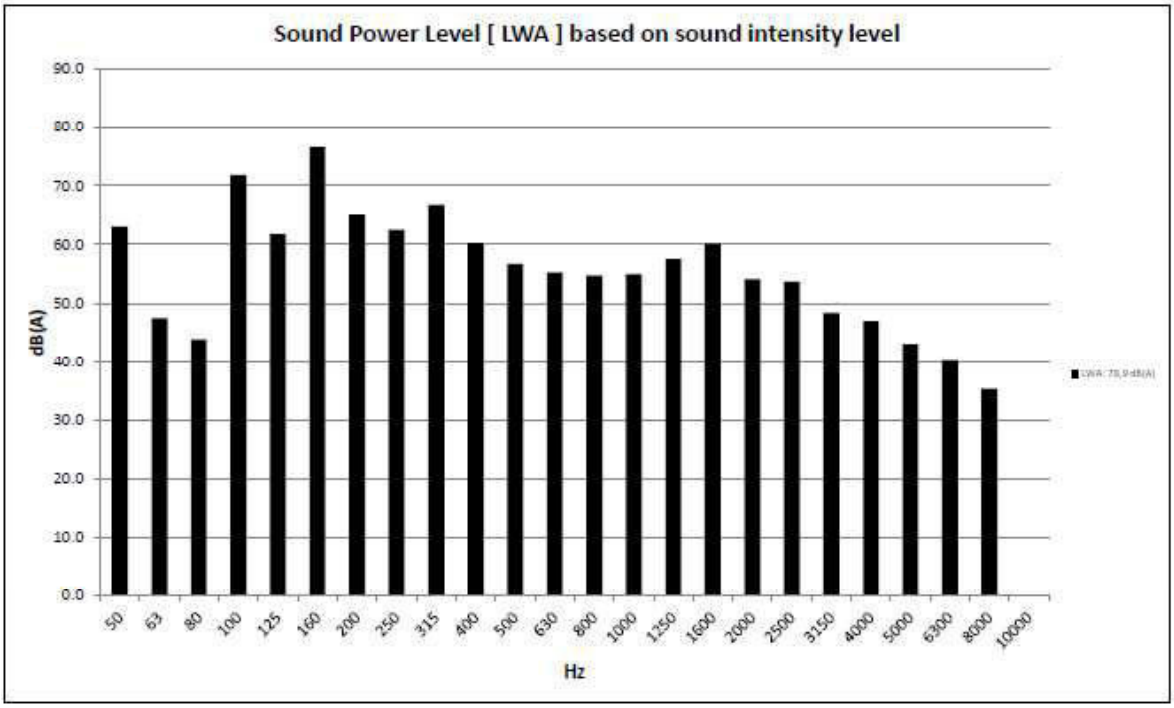
Case B: Applies, if the total P-I index is 4 dB < $\Delta L \leq 8$ dB. Then it follows $L_{pA} = L_{pA0}$ - 4 dB for both the total sound level and sound levels of the individual frequency bands.

Sound Level

Serial No. : 1ZPL001134582

Measurement 3





Sound Level

Serial No. : 1ZPL001134582

Measurement 4

Rated voltage	Applied voltage	Rated current	Applied current	Tap position	Fans in operation	Pumps in operation	Frequency	Distance	Prescribed contour	Height	Surface area	Surface measure	Top oil temperature	Guarantee
[%]	[kV]	[%]	[A]				[Hz]	[m]	[m]	[m]	[m²]	[dB]	[°C]	[dB(A)]
		100	262.43	11	8		50	2	37.5	5.2	270.0	24.3		

Measurement duration: 89 s

	Frequency	L_{WA0}		L_{pA0}	$L_{pA0} - L_{WA0}$	Pressure Intensity Correction	L_{WA}	L_{WA}
	[Hz]	[dB(A)]		[dB(A)]	[dB(A)]		[dB(A)]	[dB(A)]
Total Sound Level		**63.5**	**1**	**65.5**	**2.0**	**A**	**63.5**	**87.8**
Octave Band	63	40.1	1	43.3	3.2	A	40.1	64.4
	125	55.3	1	56.9	1.6	A	55.3	79.6
	250	56.9	1	58.6	1.7	A	56.9	81.2
	500	58.3	1	60.4	2.1	A	58.3	82.6
	1000	57.4	1	59.6	2.2	A	57.4	81.7
	2000	51.1	1	53.5	2.4	A	51.1	75.4
	4000	47.0	1	49.3	2.3	A	47.0	71.3
	8000	39.9	1	41.6	1.8	A	39.9	64.2
⅓ Octave Band	50	39.4	1	42.7	3.3	A	39.4	63.8
	63	23.1	1	28.0	4.9	A	23.1	47.4
	80	30.8	1	33.5	2.6	A	30.8	55.1
	100	47.6	1	50.6	2.9	A	47.6	71.9
	125	44.2	1	45.9	1.7	A	44.2	68.5
	160	54.1	1	55.3	1.2	A	54.1	78.4
	200	49.4	1	50.9	1.6	A	49.4	73.7
	250	52.1	1	53.6	1.6	A	52.1	76.4
	315	53.7	1	55.6	1.9	A	53.7	78.0
	400	52.7	1	54.8	2.1	A	52.7	77.0
	500	52.6	1	54.7	2.1	A	52.6	76.9
	630	54.9	1	56.9	2.1	A	54.9	79.2
	800	54.3	1	56.6	2.3	A	54.3	78.6
	1000	52.3	1	54.4	2.1	A	52.3	76.7
	1250	50.2	1	52.6	2.4	A	50.2	74.5
	1600	48.0	1	50.5	2.5	A	48.0	72.4
	2000	45.9	1	48.2	2.3	A	45.9	70.2
	2500	44.2	1	46.3	2.1	A	44.2	68.5
	3150	43.2	1	45.5	2.3	A	43.2	67.5
	4000	42.6	1	45.0	2.4	A	42.6	66.9
	5000	40.5	1	42.6	2.1	A	40.5	64.8
	6300	37.2	1	39.4	2.1	A	37.2	61.5
	8000	34.5	1	35.9	1.4	A	34.5	58.8
	10000	32.1	1	33.0	0.9	A	32.1	56.4

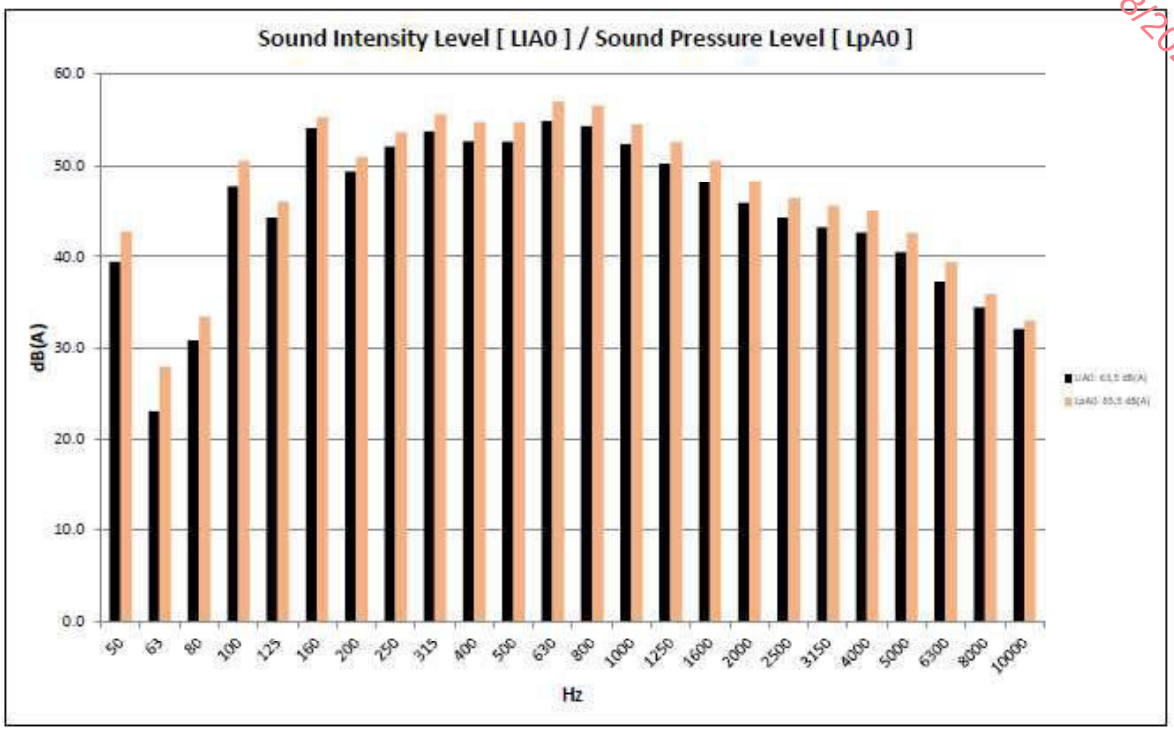
Case A: Applies, if the total P-I index is $\Delta L \leq 4$ dB. Then it follows $L_{WA} = L_{pA0}$ for both the total sound level and sound levels of the individual frequency bands.

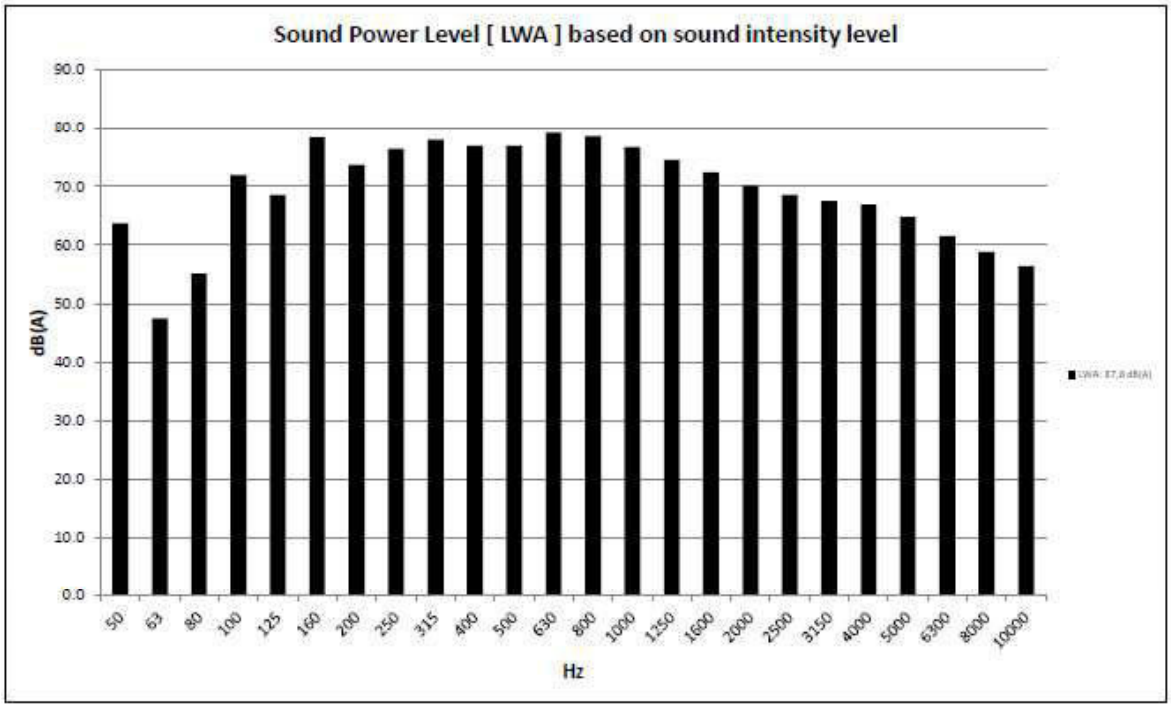
Case B: Applies, if the total P-I index is 4 dB $< \Delta L \leq 8$ dB. Then it follows $L_{WA} = L_{pA0} - 4$ dB for both the total sound level and sound levels of the individual frequency bands.

Sound Level

Serial No. : 1ZPL001134582

Measurement 4





Sound Level

Serial No. : 1ZPL001134582

Combination of sound level measurements

Rated voltage	Applied voltage	Rated current	Applied current	Tap position	Fans in operation	Pumps in operation
[%]	[kV]	[%]	[A]			
100	33	100	262.43		8	

Frequency	Measurement 1 Sound Power Level	Measurement 4 Sound Power Level		Combined Sound Power Level
[Hz]	[dB(A)]	[dB(A)]		[dB(A)]
Total Sound Level	76.9	87.8		**88.2**
Octave Band 63	39.6	64.4		**64.4**
125	59.5	79.6		**79.6**
250	76.1	81.2		**82.3**
500	67.3	82.6		**82.7**
1000	56.3	81.7		**81.7**
2000	51.6	75.4		**75.4**
4000	54.1	71.3		**71.4**
8000	57.4	64.2		**65.0**
⅓ Octave Band 50	36.1	63.8		**63.8**
63	37.0	47.4		**47.8**
80	0.0	55.1		**55.1**
100	58.4	71.9		**72.1**
125	47.5	68.5		**68.6**
160	51.3	78.4		**78.4**
200	63.1	73.7		**74.1**
250	60.9	76.4		**76.5**
315	75.8	78.0		**80.1**
400	61.2	77.0		**77.1**
500	63.7	76.9		**77.1**
630	62.5	79.2		**79.3**
800	53.7	78.6		**78.6**
1000	51.4	76.7		**76.7**
1250	47.1	74.5		**74.5**
1600	47.0	72.4		**72.4**
2000	46.7	70.2		**70.2**
2500	46.9	68.5		**68.5**
3150	48.4	67.5		**67.6**
4000	49.6	66.9		**67.0**
5000	49.9	64.8		**64.9**
6300	51.2	61.5		**61.9**
8000	52.9	58.8		**59.8**
10000	53.6	56.4		**58.2**

Rated voltage	Applied voltage	Rated current	Applied current	Tap position	Fans in operation	Pumps in operation
[%]	[kV]	[%]	[A]			

Frequency				Combined Sound Power Level
[Hz]				[dB(A)]
Total Sound Level				
Octave Band 63				
125				
250				
500				
1000				
2000				
4000				
8000				
⅓ Octave Band 50				
63				
80				
100				
125				
160				
200				
250				
315				
400				
500				
630				
800				
1000				
1250				
1600				
2000				
2500				
3150				
4000				
5000				
6300				
8000				
10000				

Annex 5 – Figures

Sound Level

Serial No.: 1ZPL0041134582

Measurement Details	
Measurement Standard	IEC 60076-10:2016
Measurement Method	Sound Intensity Method
Measurement Procedure	Walk around
Frequency Resolution	⅓ Octave Band
Acoustic Filter Function	A-weighted

Measurement Instruments	Manufacturer	Type	Serial No.
Sound Level Meter	Brüel & Kjaer	2270	3023666
Sound Level Meter Calibration	Brüel & Kjaer	4297	3082325

X The equipment used has been laboratory calibrated in accordance with manufacturers recommendations and field calibrated before and after each measurement session.

Test Program

Test #	No-Load condition [%]	Load condition [%]	Tap position	Number of fans	Number of pumps	Frequency [Hz]	Distance [m]	Prescribed contour [m]	Height [m]	Surface area [m²]	Surface measure [dB]	Top oil temperature [°C]	Guarantee [dB(A)]	Sound Pressure Level [dB(A)]
1	100		11	0		50	1.0	31.1	5.2	193	22.9			54.0
2	100		11	8		50	2.0	37.5	5.2	270	24.3			63.4
3		100	11	0		50	1.0	31.1	5.2	193	22.9			56.1
4		100	11	8		50	2.0	37.5	5.2	270	24.3			63.5
5														
6														
7														
8														
1+4	100	100		8			2.0						70.0	63.8

Standard: IEC 60076-10

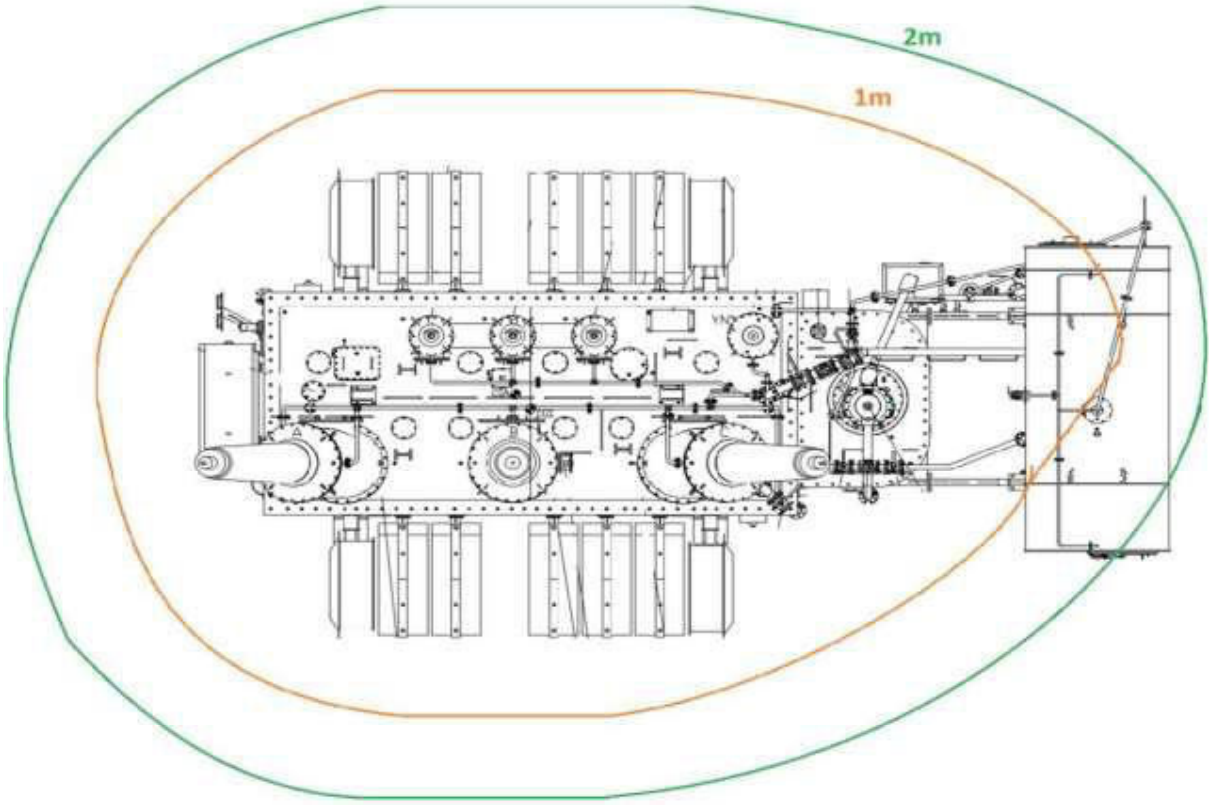
Test Date 16/08/2021

Test Engineer Kamil Maliński

Sound Level

Serial No. : 1ZPL001134582

Prescribed Contours				
x Distance	l_m Prescribed contour	h Height	S Surface area	L_S Surface measure
[m]	[m]	[m]	[m²]	[dB]
1	31.1	5.2	192.82	22,9
2	37.5	5.2	270	24,3



Sound Level

Serial No. : 1ZPL001134582

Measurement 1

Rated voltage	Applied voltage	Rated current	Applied current	Tap position	Fans in operation	Pumps in operation	Frequency	Distance	Prescribed contour	Height	Surface area	Surface measure	Top oil temperature	Guarantee
[%]	[kV]	[%]	[A]				[Hz]	[m]	[m]	[m]	[m²]	[dB]	[°C]	[dB(A)]
100	33			11	0		50	1	31.1	5.2	192.8	22.9		

Measurement duration: 85 s

	Frequency	L_{pA0}		L_{pA0}	$L_{pA0} - L_{pA0}$	Pressure Intensity Correction	L_{pA}	L_{WA}
	[Hz]	[dB(A)]		[dB(A)]	[dB(A)]		[dB(A)]	[dB(A)]
Total Sound Level		**54.0**	**1**	**57.3**	**3.3**	**A**	**54.0**	**76.9**
Octave Band	63	15.5	1	23.3	7.8	A	16.8	39.6
	125	36.6	1	39.9	3.2	A	36.6	59.5
	250	53.3	1	56.2	2.9	A	53.3	76.1
	500	44.5	1	47.5	3.0	A	44.5	67.3
	1000	33.4	1	40.3	6.8	A	33.4	56.3
	2000	28.8	1	40.1	11.3	A	28.8	51.6
	4000	31.3	1	40.8	9.5	A	31.3	54.1
	8000	34.6	1	43.3	8.7	A	34.6	57.4
⅓ Octave Band	50	13.3	1	13.5	0.3	A	13.3	36.1
	63	14.2	1	16.0	1.8	A	14.2	37.0
	80	10.9	-1	21.8	10.9	A	0.0	0.0
	100	35.6	1	37.5	1.9	A	35.6	58.4
	125	24.6	1	34.3	9.6	A	24.6	47.5
	160	28.4	1	31.6	3.2	A	28.4	51.3
	200	40.3	1	43.4	3.1	A	40.3	63.1
	250	38.0	1	41.2	3.1	A	38.0	60.9
	315	52.9	1	55.8	2.9	A	52.9	75.8
	400	38.4	1	41.1	2.7	A	38.4	61.2
	500	40.8	1	43.9	3.1	A	40.8	63.7
	630	39.6	1	42.7	3.1	A	39.6	62.5
	800	30.9	1	36.3	5.4	A	30.9	53.7
	1000	28.6	1	35.3	6.7	A	28.6	51.4
	1250	24.3	1	34.8	10.5	A	24.3	47.1
	1600	24.1	1	35.3	11.2	A	24.1	47.0
	2000	23.8	1	35.5	11.7	A	23.8	46.7
	2500	24.1	1	35.1	11.0	A	24.1	46.9
	3150	25.6	1	35.9	10.4	A	25.6	48.4
	4000	26.7	1	36.1	9.3	A	26.7	49.6
	5000	27.1	1	36.1	9.0	A	27.1	49.9
	6300	28.4	1	37.5	9.2	A	28.4	51.2
	8000	30.1	1	39.1	9.1	A	30.1	52.9
	10000	30.7	1	38.9	8.1	A	30.7	53.6

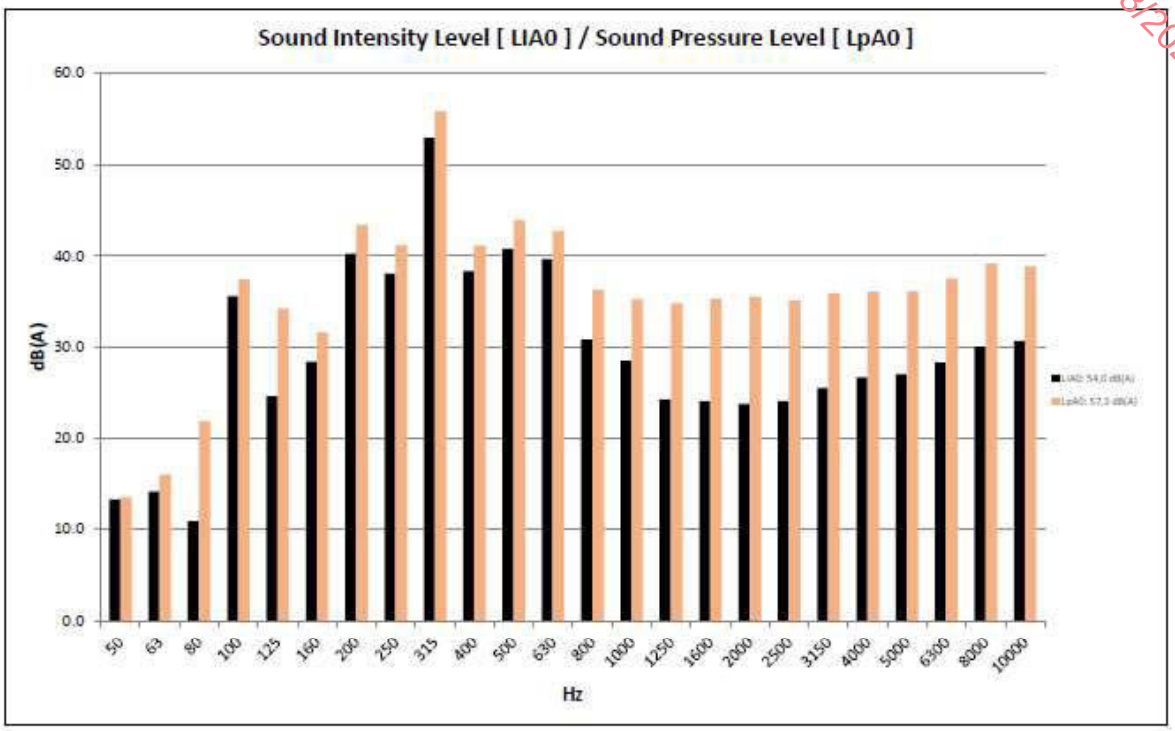
Case A: Applies, if the total P-I index is $\Delta L \leq 4$ dB. Then it follows $L_{pA} = L_{pA0}$ for both the total sound level and sound levels of the individual frequency bands.

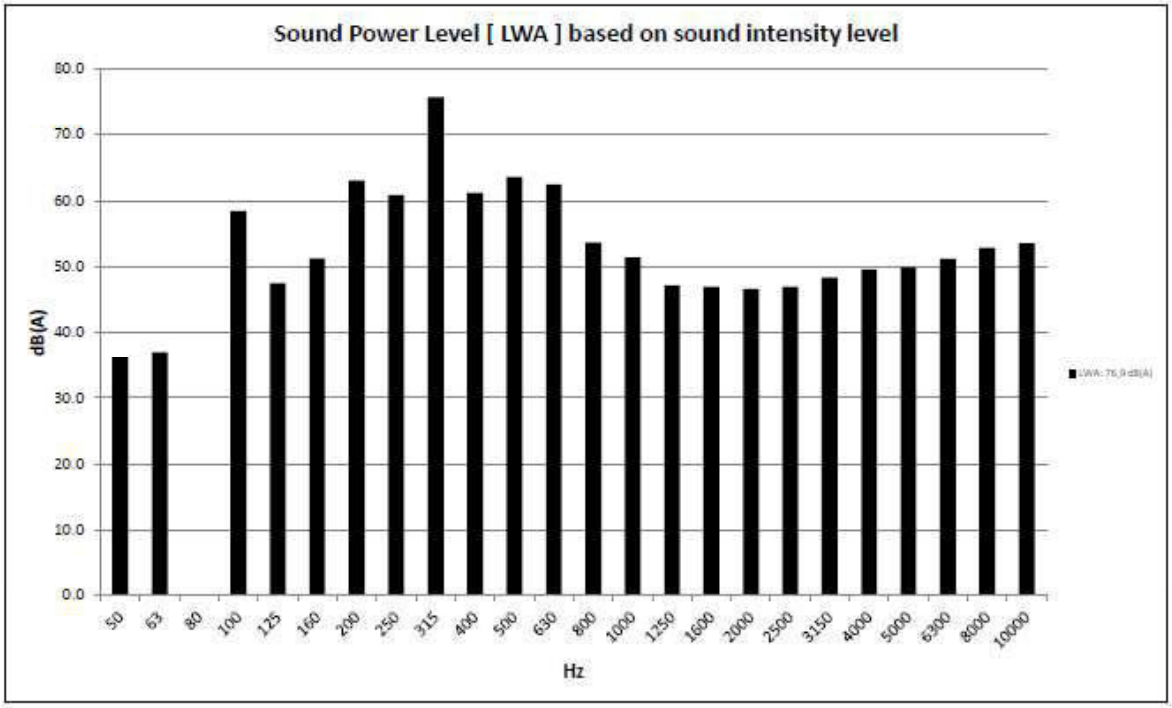
Case B: Applies, if the total P-I index is 4 dB $< \Delta L \leq 8$ dB. Then it follows $L_{pA} = L_{pA0} - 4$ dB for both the total sound level and sound levels of the individual frequency bands.

Sound Level

Serial No. : 1ZPL001134582

Measurement 1





Sound Level

Serial No. : 1ZPL001134582

Measurement 2

Rated voltage	Applied voltage	Rated current	Applied current	Tap position	Fans in operation	Pumps in operation	Frequency	Distance	Prescribed contour	Height	Surface area	Surface measure	Top oil temperature	Guarantee
[%]	[kV]	[%]	[A]				[Hz]	[m]	[m]	[m]	[m²]	[dB]	[°C]	[dB(A)]
100	33			11	8		50	2	37.5	5.2	270.0	24.3		

Measurement duration: 95 s

	Frequency	L_{uA0}		L_{pA0}	$L_{pA0} - L_{uA0}$	Pressure Intensity Correction	L_{uA}	L_{WA}
	[Hz]	[dB(A)]		[dB(A)]	[dB(A)]		[dB(A)]	[dB(A)]
Total Sound Level		**63.4**	**1**	**65.6**	**2.2**	**A**	**63.4**	**87.7**
Octave Band	63	33.4	1	34.1	0.7	A	33.4	57.8
	125	47.7	1	49.2	1.5	A	47.7	72.0
	250	58.5	1	60.3	1.9	A	58.5	82.8
	500	58.5	1	60.7	2.2	A	58.5	82.8
	1000	57.2	1	59.6	2.4	A	57.2	81.5
	2000	50.6	1	53.3	2.6	A	50.6	74.9
	4000	46.7	1	49.8	3.0	A	46.7	71.0
	8000	41.6	1	46.1	4.6	A	41.6	65.9
⅓ Octave Band	50	26.8	1	27.3	0.5	A	26.8	51.1
	63	24.0	1	23.6	-0.4	A	24.0	48.3
	80	31.7	1	32.6	0.9	A	31.7	56.0
	100	39.9	1	41.4	1.5	A	39.9	64.2
	125	43.6	1	45.0	1.4	A	43.6	67.9
	160	44.2	1	45.7	1.5	A	44.2	68.5
	200	49.2	1	50.9	1.7	A	49.2	73.5
	250	52.1	1	53.7	1.6	A	52.1	76.4
	315	56.6	1	58.6	2.0	A	56.6	80.9
	400	52.8	1	55.1	2.2	A	52.8	77.2
	500	52.8	1	55.1	2.3	A	52.8	77.1
	630	55.1	1	57.2	2.2	A	55.1	79.4
	800	54.1	1	56.5	2.4	A	54.1	78.4
	1000	52.1	1	54.5	2.3	A	52.1	76.5
	1250	50.0	1	52.5	2.6	A	50.0	74.3
	1600	47.7	1	50.3	2.6	A	47.7	72.0
	2000	45.3	1	48.0	2.7	A	45.3	69.6
	2500	43.6	1	46.3	2.7	A	43.6	67.9
	3150	42.7	1	45.6	2.9	A	42.7	67.0
	4000	42.3	1	45.4	3.1	A	42.3	66.6
	5000	40.6	1	43.7	3.1	A	40.6	64.9
	6300	37.9	1	41.9	4.0	A	37.9	62.2
	8000	36.3	1	41.1	4.8	A	36.3	60.6
	10000	35.9	1	41.0	5.1	A	35.9	60.3

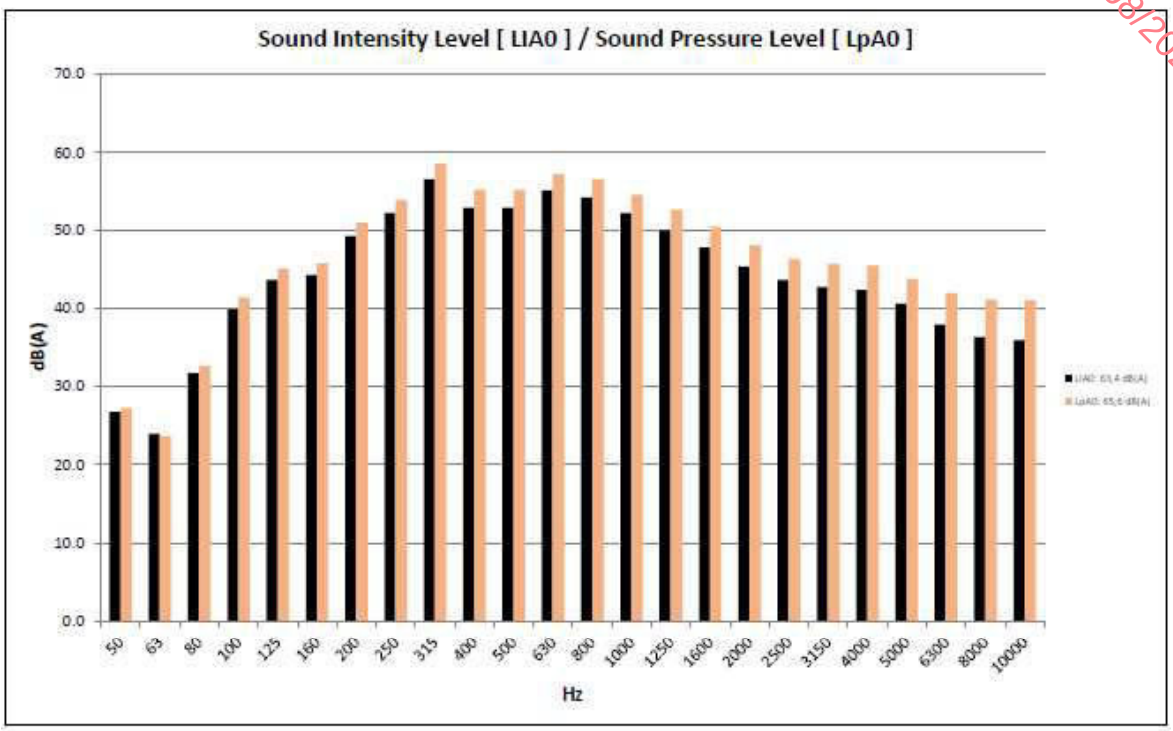
Case A: Applies, if the total P-I index is $\Delta L \leq 4$ dB. Then it follows $L_{uA} = L_{uA0}$ for both the total sound level and sound levels of the individual frequency bands.

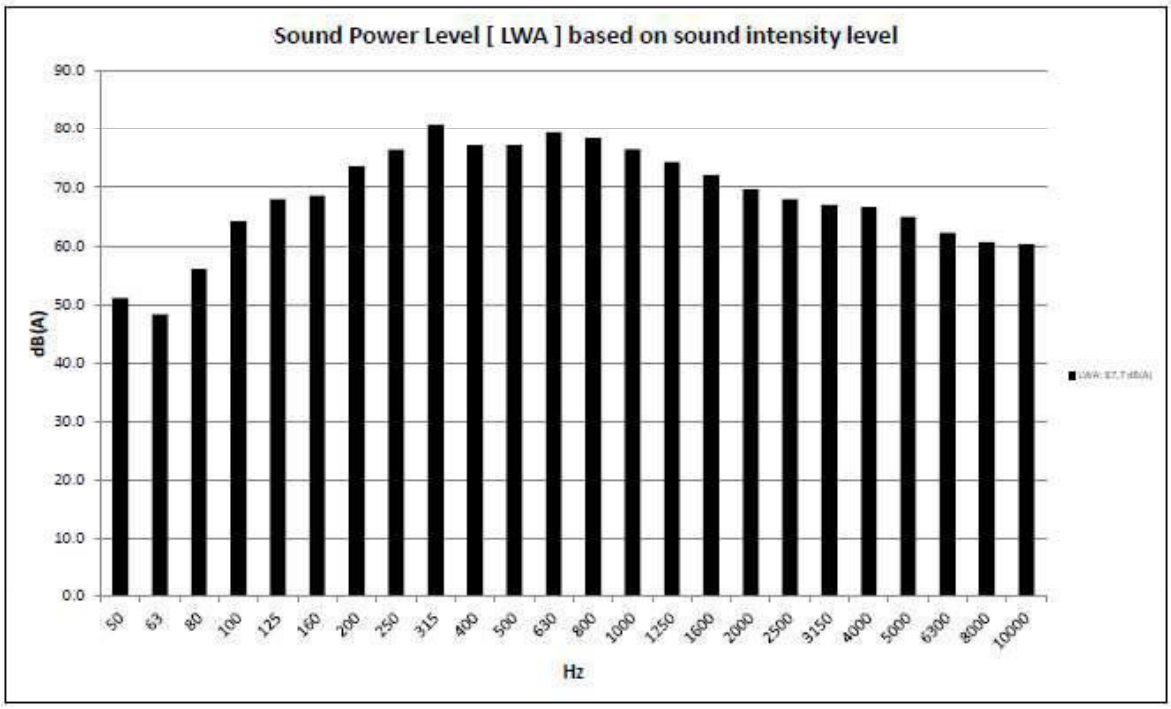
Case B: Applies, if the total P-I index is 4 dB $< \Delta L \leq 8$ dB. Then it follows $L_{uA} = L_{pA0} - 4$ dB for both the total sound level and sound levels of the individual frequency bands.

Sound Level

Serial No. : 1ZPL001134582

Measurement 2





Sound Level

Serial No. : 1ZPL001134582

Measurement 3

Rated voltage	Applied voltage	Rated current	Applied current	Tap position	Fans in operation	Pumps in operation	Frequency	Distance	Prescribed contour	Height	Surface area	Surface measure	Top oil temperature	Guarantee
[%]	[kV]	[%]	[A]				[Hz]	[m]	[m]	[m]	[m²]	[dB]	[°C]	[dB(A)]
		100	262.43	11	0		50	1	31.1	5.2	192.8	22.9		

Measurement duration: 85 s

	Frequency	L_{WA0}		L_{pA0}	$L_{pA0} - L_{WA0}$	Pressure Intensity Correction	L_{pA}	L_{WA}
	[Hz]	[dB(A)]		[dB(A)]	[dB(A)]		[dB(A)]	[dB(A)]
Total Sound Level		**56.1**	**1**	**58.1**	**2.1**	**A**	**56.1**	**78.9**
Octave Band	63	40.3	1	46.7	6.4	A	40.3	63.2
	125	55.0	1	56.5	1.5	A	55.0	77.9
	250	47.0	1	49.4	2.4	A	47.0	69.9
	500	39.9	1	43.3	3.4	A	39.9	62.7
	1000	37.9	1	42.2	4.3	A	37.9	60.7
	2000	39.0	1	43.1	4.1	A	39.0	61.9
	4000	28.6	1	38.2	9.6	A	28.6	51.4
	8000	18.4	1	31.5	13.1	A	18.6	41.4
⅓ Octave Band	50	40.2	1	46.5	6.4	A	40.2	63.0
	63	24.6	1	30.1	5.6	A	24.6	47.4
	80	21.0	1	29.3	8.3	A	21.0	43.9
	100	49.0	1	51.8	2.8	A	49.0	71.8
	125	38.9	1	41.0	2.1	A	38.9	61.7
	160	53.7	1	54.6	0.9	A	53.7	76.5
	200	42.2	1	44.7	2.5	A	42.2	65.1
	250	39.7	1	42.0	2.3	A	39.7	62.5
	315	43.9	1	46.2	2.3	A	43.9	66.7
	400	37.4	1	40.5	3.1	A	37.4	60.3
	500	33.8	1	37.6	3.8	A	33.8	56.7
	630	32.4	1	36.3	3.8	A	32.4	55.3
	800	31.9	1	35.3	3.4	A	31.9	54.8
	1000	32.2	1	37.2	5.0	A	32.2	55.0
	1250	34.7	1	38.9	4.3	A	34.7	57.5
	1600	37.3	1	40.7	3.3	A	37.3	60.2
	2000	31.3	1	37.0	5.7	A	31.3	54.1
	2500	30.8	1	36.0	5.2	A	30.8	53.6
	3150	25.5	1	34.7	9.1	A	25.5	48.4
	4000	24.1	1	33.6	9.5	A	24.1	46.9
	5000	20.2	1	31.3	11.1	A	20.2	43.0
	6300	17.3	1	28.7	11.4	A	17.3	40.2
	8000	12.5	1	26.4	13.9	A	12.5	35.3
	10000	2.9	-1	23.9	21.0	A	0.0	0.0

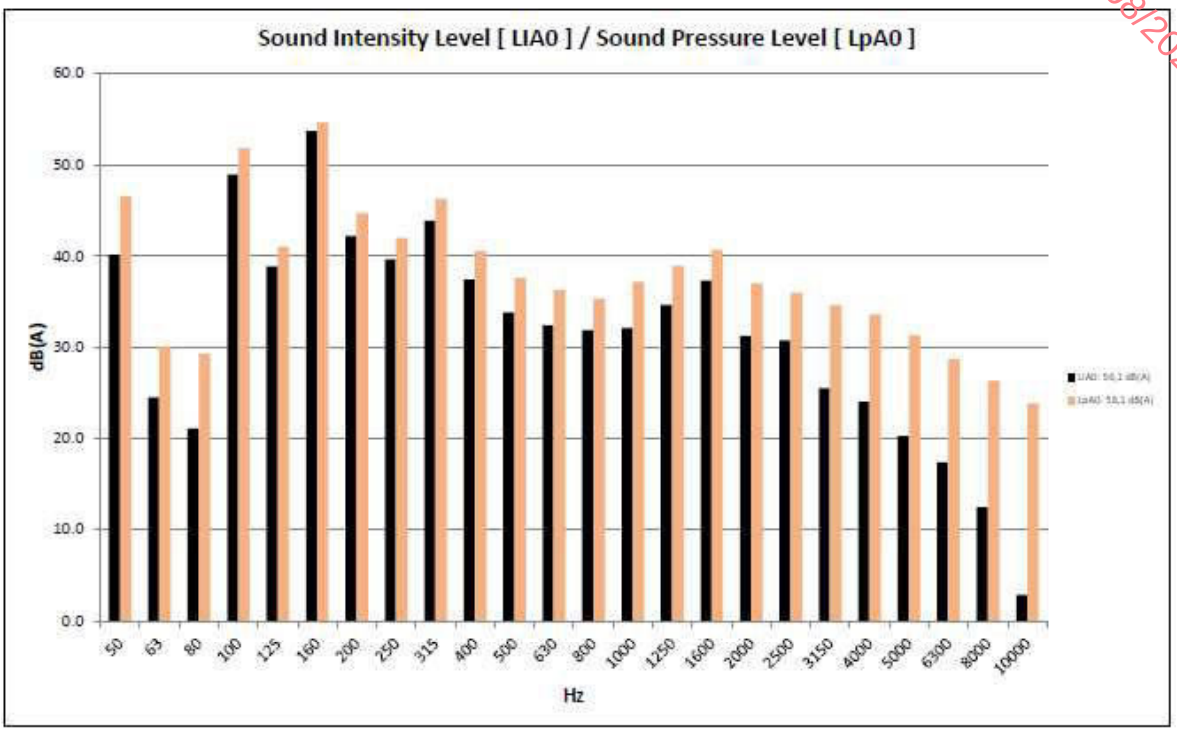
Case A: Applies, if the total P-I index is $\Delta L \leq 4$ dB. Then it follows $L_{pA} = L_{pA0}$ for both the total sound level and sound levels of the individual frequency bands.

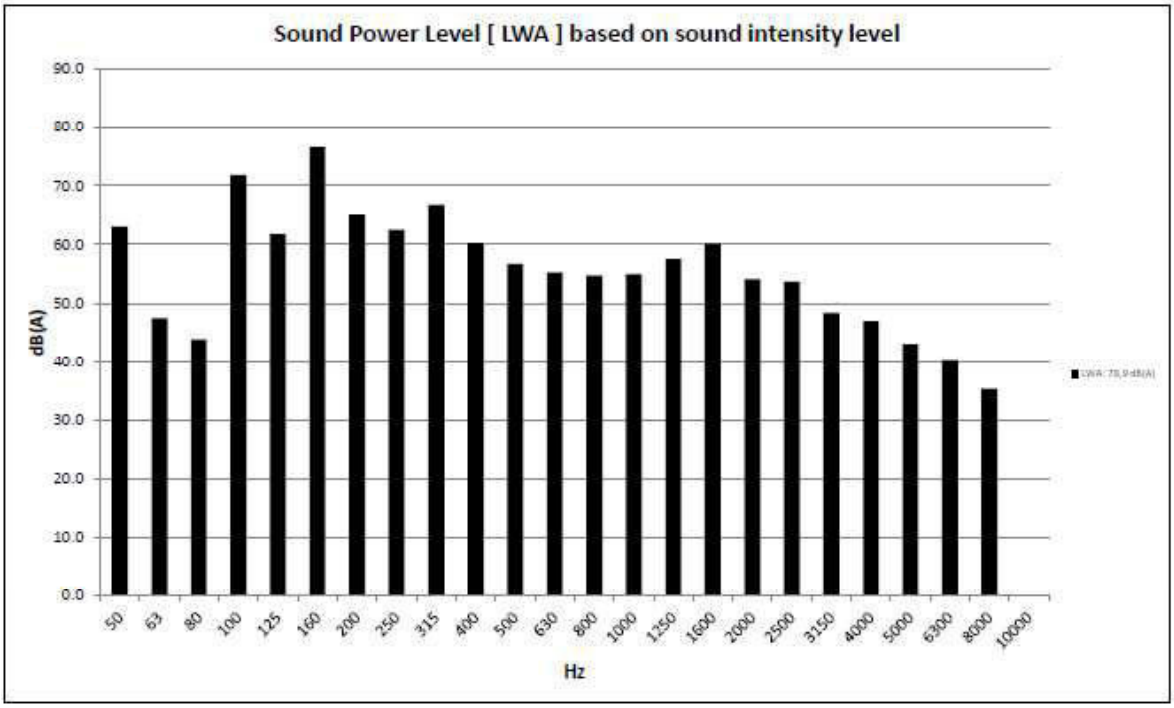
Case B: Applies, if the total P-I index is 4 dB < $\Delta L \leq 8$ dB. Then it follows $L_{pA} = L_{pA0}$ - 4 dB for both the total sound level and sound levels of the individual frequency bands.

Sound Level

Serial No. : 1ZPL001134582

Measurement 3





Sound Level

Serial No. : 1ZPL001134582

Measurement 4

Rated voltage	Applied voltage	Rated current	Applied current	Tap position	Fans in operation	Pumps in operation	Frequency	Distance	Prescribed contour	Height	Surface area	Surface measure	Top oil temperature	Guarantee
[%]	[kV]	[%]	[A]				[Hz]	[m]	[m]	[m]	[m²]	[dB]	[°C]	[dB(A)]
		100	262.43	11	8		50	2	37.5	5.2	270.0	24.3		

Measurement duration: 89 s

	Frequency	L_{WA0}		L_{pA0}	$L_{pA0} - L_{WA0}$	Pressure Intensity Correction	L_{WA}	L_{WA}
	[Hz]	[dB(A)]		[dB(A)]	[dB(A)]		[dB(A)]	[dB(A)]
Total Sound Level		**63.5**	**1**	**65.5**	**2.0**	**A**	**63.5**	**87.8**
Octave Band	63	40.1	1	43.3	3.2	A	40.1	64.4
	125	55.3	1	56.9	1.6	A	55.3	79.6
	250	56.9	1	58.6	1.7	A	56.9	81.2
	500	58.3	1	60.4	2.1	A	58.3	82.6
	1000	57.4	1	59.6	2.2	A	57.4	81.7
	2000	51.1	1	53.5	2.4	A	51.1	75.4
	4000	47.0	1	49.3	2.3	A	47.0	71.3
	8000	39.9	1	41.6	1.8	A	39.9	64.2
⅓ Octave Band	50	39.4	1	42.7	3.3	A	39.4	63.8
	63	23.1	1	28.0	4.9	A	23.1	47.4
	80	30.8	1	33.5	2.6	A	30.8	55.1
	100	47.6	1	50.6	2.9	A	47.6	71.9
	125	44.2	1	45.9	1.7	A	44.2	68.5
	160	54.1	1	55.3	1.2	A	54.1	78.4
	200	49.4	1	50.9	1.6	A	49.4	73.7
	250	52.1	1	53.6	1.6	A	52.1	76.4
	315	53.7	1	55.6	1.9	A	53.7	78.0
	400	52.7	1	54.8	2.1	A	52.7	77.0
	500	52.6	1	54.7	2.1	A	52.6	76.9
	630	54.9	1	56.9	2.1	A	54.9	79.2
	800	54.3	1	56.6	2.3	A	54.3	78.6
	1000	52.3	1	54.4	2.1	A	52.3	76.7
	1250	50.2	1	52.6	2.4	A	50.2	74.5
	1600	48.0	1	50.5	2.5	A	48.0	72.4
	2000	45.9	1	48.2	2.3	A	45.9	70.2
	2500	44.2	1	46.3	2.1	A	44.2	68.5
	3150	43.2	1	45.5	2.3	A	43.2	67.5
	4000	42.6	1	45.0	2.4	A	42.6	66.9
	5000	40.5	1	42.6	2.1	A	40.5	64.8
	6300	37.2	1	39.4	2.1	A	37.2	61.5
	8000	34.5	1	35.9	1.4	A	34.5	58.8
	10000	32.1	1	33.0	0.9	A	32.1	56.4

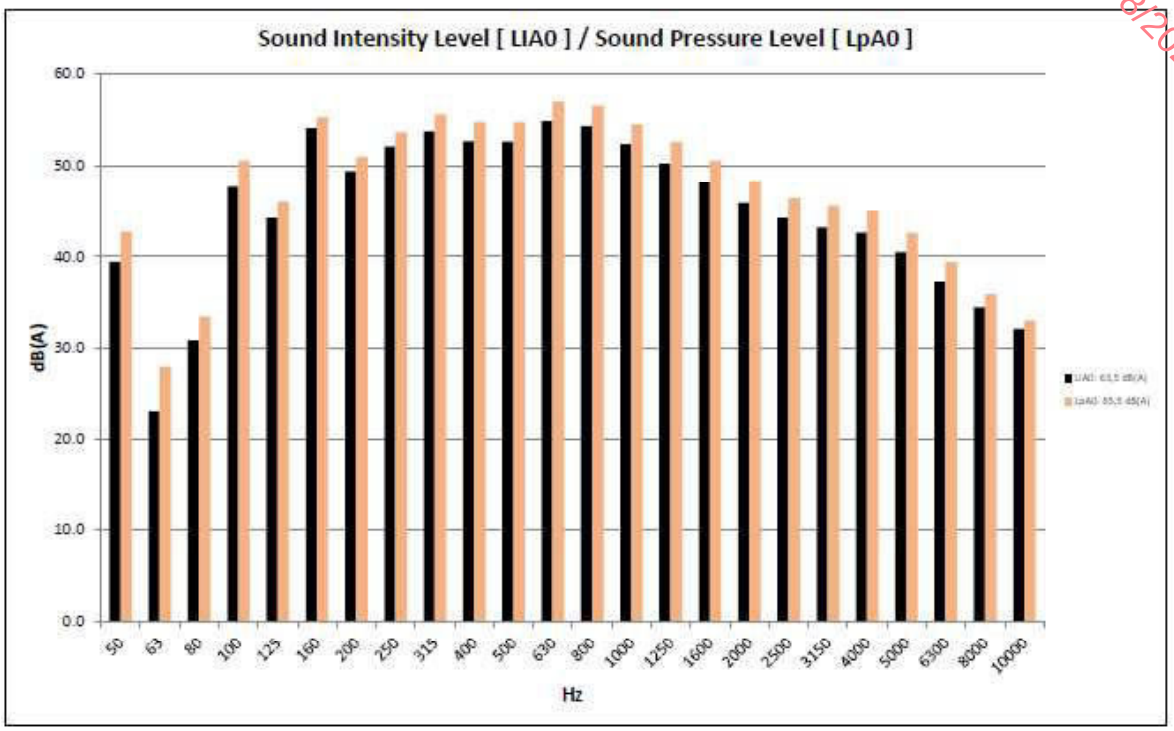
Case A: Applies, if the total P-I index is $\Delta L \leq 4$ dB. Then it follows $L_{WA} = L_{pA0}$ for both the total sound level and sound levels of the individual frequency bands.

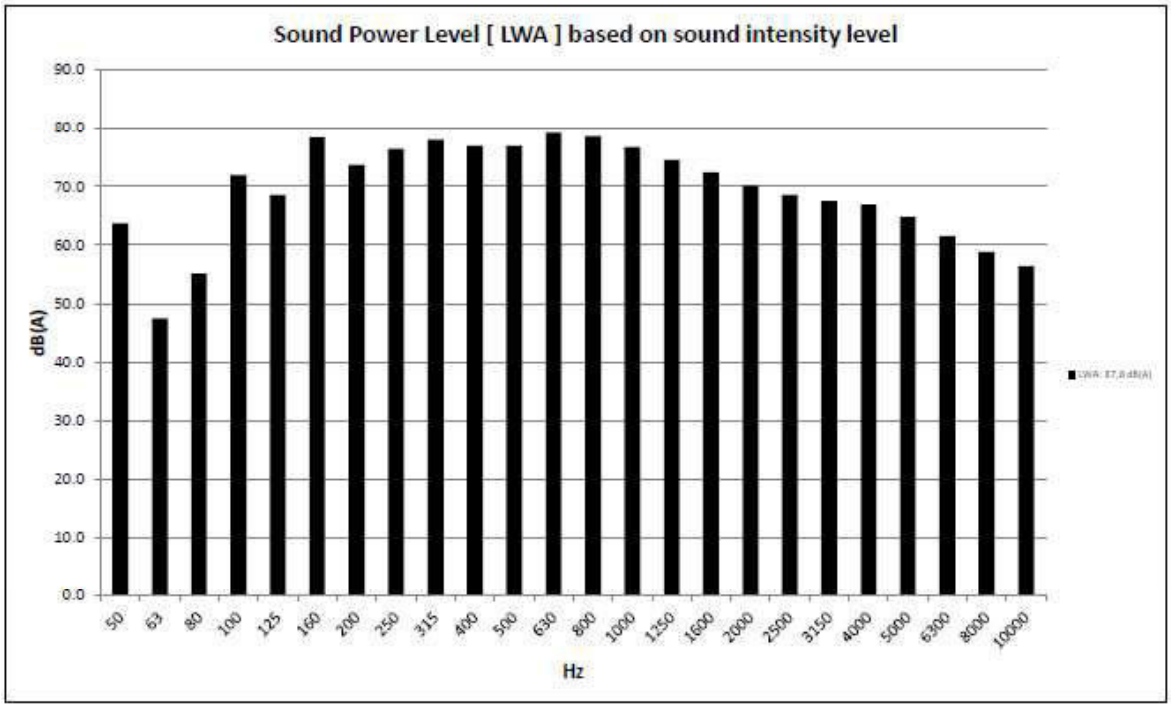
Case B: Applies, if the total P-I index is 4 dB $< \Delta L \leq 8$ dB. Then it follows $L_{WA} = L_{pA0} - 4$ dB for both the total sound level and sound levels of the individual frequency bands.

Sound Level

Serial No. : 1ZPL001134582

Measurement 4





Sound Level

Serial No. : 1ZPL001134582

Combination of sound level measurements

Rated voltage	Applied voltage	Rated current	Applied current	Tap position	Fans in operation	Pumps in operation
[%]	[kV]	[%]	[A]			
100	33	100	262.43		8	

Frequency	Measurement 1 Sound Power Level	Measurement 4 Sound Power Level		Combined Sound Power Level
[Hz]	[dB(A)]	[dB(A)]		[dB(A)]
Total Sound Level	76.9	87.8		**88.2**
Octave Band 63	39.6	64.4		**64.4**
125	59.5	79.6		**79.6**
250	76.1	81.2		**82.3**
500	67.3	82.6		**82.7**
1000	56.3	81.7		**81.7**
2000	51.6	75.4		**75.4**
4000	54.1	71.3		**71.4**
8000	57.4	64.2		**65.0**
⅓ Octave Band 50	36.1	63.8		**63.8**
63	37.0	47.4		**47.8**
80	0.0	55.1		**55.1**
100	58.4	71.9		**72.1**
125	47.5	68.5		**68.6**
160	51.3	78.4		**78.4**
200	63.1	73.7		**74.1**
250	60.9	76.4		**76.5**
315	75.8	78.0		**80.1**
400	61.2	77.0		**77.1**
500	63.7	76.9		**77.1**
630	62.5	79.2		**79.3**
800	53.7	78.6		**78.6**
1000	51.4	76.7		**76.7**
1250	47.1	74.5		**74.5**
1600	47.0	72.4		**72.4**
2000	46.7	70.2		**70.2**
2500	46.9	68.5		**68.5**
3150	48.4	67.5		**67.6**
4000	49.6	66.9		**67.0**
5000	49.9	64.8		**64.9**
6300	51.2	61.5		**61.9**
8000	52.9	58.8		**59.8**
10000	53.6	56.4		**58.2**

Rated voltage	Applied voltage	Rated current	Applied current	Tap position	Fans in operation	Pumps in operation
[%]	[kV]	[%]	[A]			

Frequency				Combined Sound Power Level
[Hz]				[dB(A)]
Total Sound Level				
Octave Band 63				
125				
250				
500				
1000				
2000				
4000				
8000				
⅓ Octave Band 50				
63				
80				
100				
125				
160				
200				
250				
315				
400				
500				
630				
800				
1000				
1250				
1600				
2000				
2500				
3150				
4000				
5000				
6300				
8000				
10000				

N

NML1 BNAL07

NML2 BNAL06

NML3 BNAL05

NML7 BNAL01

BNAL02 NML6

BNAL03 NML5

NML4 BNAL04

25
30
35
40
45
50

Kilometre
0 0.5 1

Scale 1:750

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LEGEND

- Noise Monitoring Locations (NMLs)
- Battery Noise Assessment Locations (BNALs)
- Modelled Noise Sources
- Modelled Buildings

Noise Sensitive Receptors (NSRs)

- NSRs Represented by NML1
- NSRs Represented by NML2
- NSRs Represented by NML3
- NSRs Represented by NML4
- NSRs Represented by NML5
- NSRs Represented by NML6
- NSRs Represented by NML7

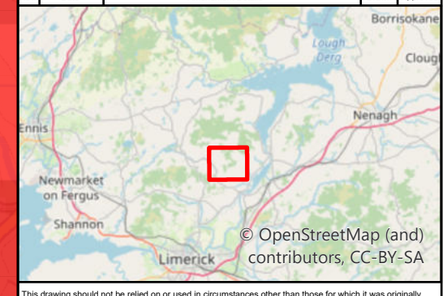
Predicted Noise Levels (dBA)

25 - 30	55 - 60
30 - 35	60 - 65
35 - 40	65 - 70
40 - 45	70 - 75
45 - 50	75 - 80
50 - 55	80 - 85

Noise contours modelled in accordance with ISO9613 Part 2:1996 at a height of 4 m and displayed on a 10 m by 10 m grid. All noise sources assumed to be operating concurrently.

All levels shown as dB LAeq(t)

Rev.	Date	Amendment Details	Drawn	Approved
1	31/07/2024	FINAL ISSUE	AD	GC
0	10/05/2024	FIRST ISSUE	JCM	AD



tnei

Client: EDF renewables

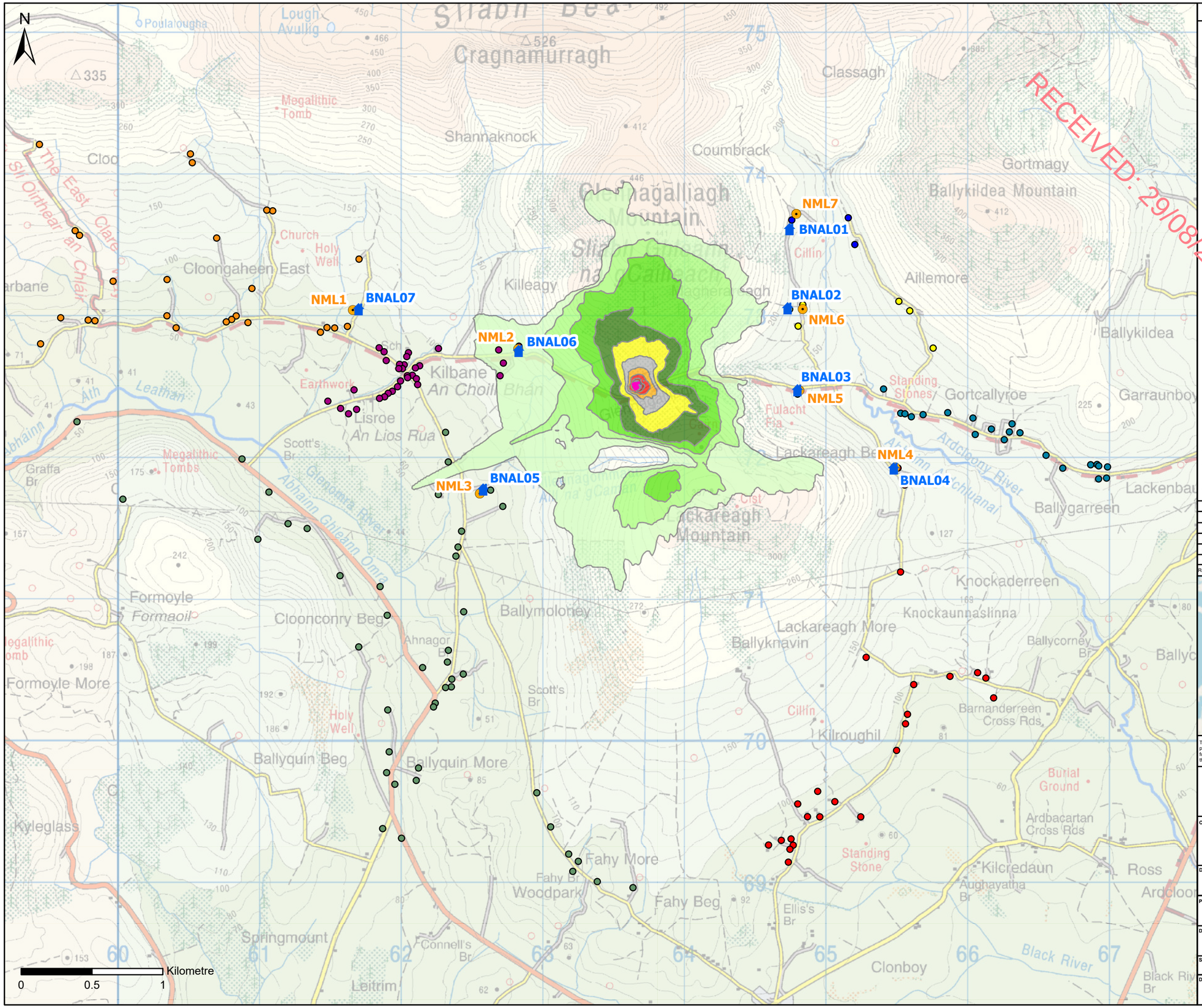
Drawing Status: FOR PLANNING

Project Title: LACKAREAGH WIND FARM, CO. CLARE

Drawing Title: FIGURE A5.1 - BESS NOISE ASSESSMENT LOCATIONS AND NOISE CONTOUR PLOT

Scale:	Original Size:	Spatial Reference:
1:17,500	A3	IRENET95 Irish Transverse Mercator

Drawing Number: IE00101-015



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LEGEND

- Noise Monitoring Locations (NMLs)
- Battery Noise Assessment Locations (BNALs)
- Modelled Noise Sources
- Modelled Buildings

Noise Sensitive Receptors (NSRs)

- NSRs Represented by NML1
- NSRs Represented by NML2
- NSRs Represented by NML3
- NSRs Represented by NML4
- NSRs Represented by NML5
- NSRs Represented by NML6
- NSRs Represented by NML7

Predicted Noise Levels (dBA)

25 - 30	55 - 60
30 - 35	60 - 65
35 - 40	65 - 70
40 - 45	70 - 75
45 - 50	75 - 80
50 - 55	80 - 85

Noise contours modelled in accordance with ISO9613 Part 2:1996 at a height of 4 m and displayed on a 10 m by 10 m grid. All noise sources assumed to be operating concurrently.

All levels shown as dB LAeq(t)

Rev.	Date	Amendment Details	Drawn	Approved
1	31/07/2024	FINAL ISSUE	AD	GC
0	10/05/2024	FIRST ISSUE	JCM	AD

tnei

Client: EDF renewables

Drawing Status: FOR PLANNING

Project Title: LACKAREAGH WIND FARM, CO. CLARE

Drawing Title: FIGURE A5.2a - BESS NOSIE SENSITIVE RECEPTORS AND NOISE CONTOUR PLOT

Scale:	Original Size:	Spatial Reference:
1:25,000	A3	IRENET95 Irish Transverse Mercator

Drawing Number: IE00101-016

N

BNAL01 NML7 BNAL02 NML6 BNAL03 NML5 BNAL04 NML4 BNAL05 NML3 BNAL06 NML2 BNAL07 NML1

RECEIVED: 29/08/2024

NSR137 NSR78 NSR77 NSR51 NSR46 NSR119 NSR117 NSR69 NSR1 NSR109 NSR90 NSR58 NSR134 NSR121 NSR118 NSR95 NSR71 NSR68 NSR64 NSR93 NSR74 NSR36 NSR21 NSR41 NSR31 NSR156 NSR18 NSR19 NSR15

Megalithic Tomb

The East Clare Way / Slí Oirthear an Chláir

Cloo

Cloongaheen East

Barbane

Church

Holy Well

Kilometre
0 0.5 1

LEGEND

- Noise Monitoring Locations (NMLs)
- Battery Noise Assessment Locations (BNALs)
- Modelled Noise Sources
- Modelled Buildings

Noise Sensitive Receptors (NSRs)

- NSRs Represented by NML1
- NSRs Represented by NML2
- NSRs Represented by NML3
- NSRs Represented by NML4
- NSRs Represented by NML5
- NSRs Represented by NML6
- NSRs Represented by NML7

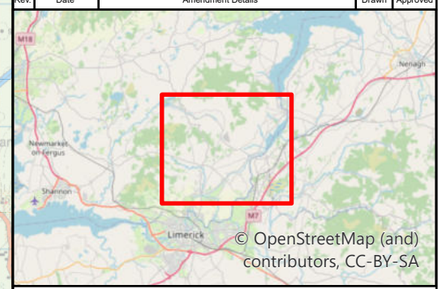
Predicted Noise Levels (dBA)

25 - 30	55 - 60
30 - 35	60 - 65
35 - 40	65 - 70
40 - 45	70 - 75
45 - 50	75 - 80
50 - 55	80 - 85

Noise contours modelled in accordance with ISO9613 Part 2:1996 at a height of 4 m and displayed on a 10 m by 10 m grid. All noise sources assumed to be operating concurrently.

All levels shown as dB LAeq(t)

Rev.	Date	Amendment Details	Drawn	Approved
1	31/07/2024	FINAL ISSUE	AD	GC
0	10/05/2024	FIRST ISSUE	JCM	AD



tnei

Client: EDF renewables

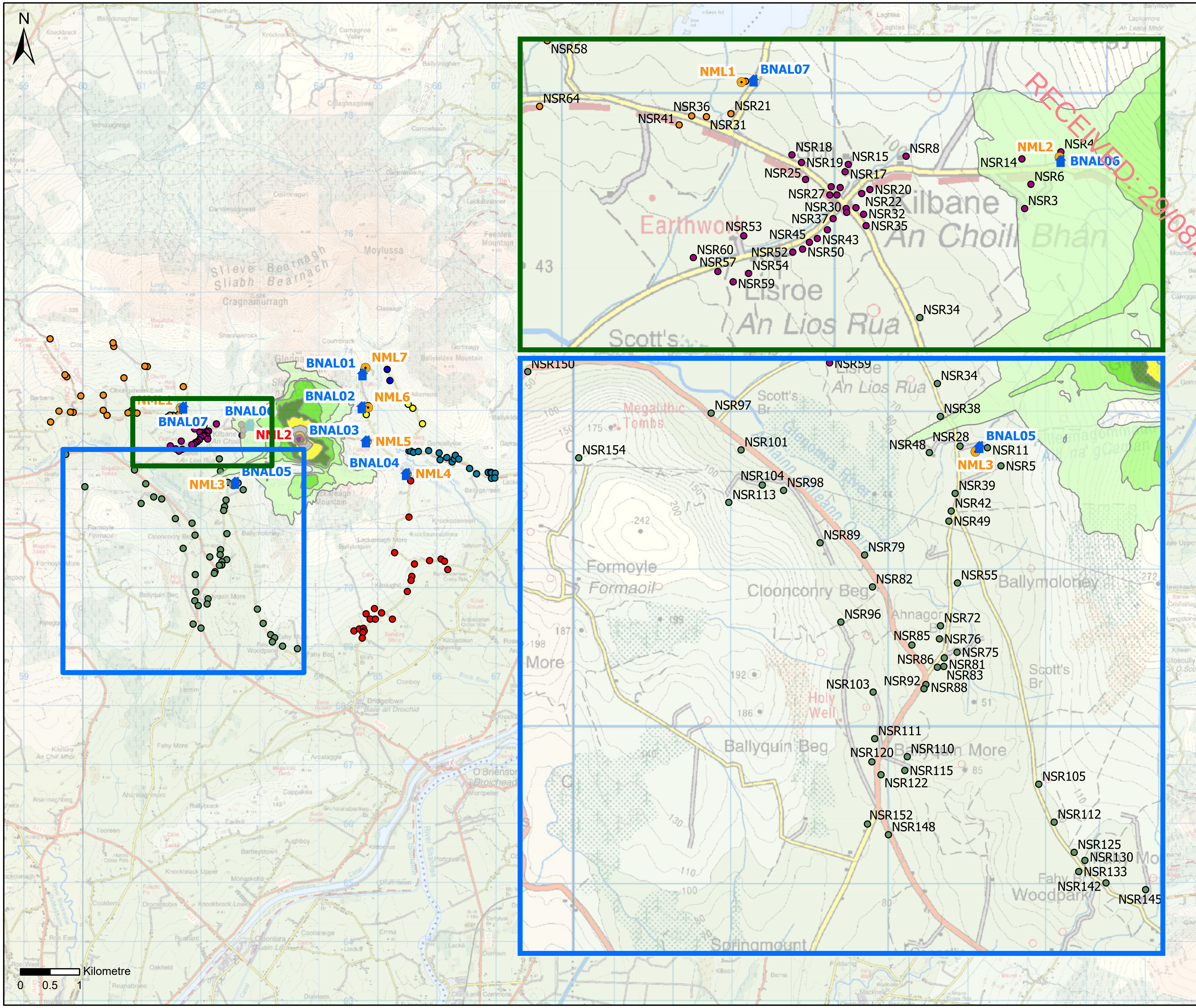
Drawing Status: FOR PLANNING

Project Title: LACKAREAGH WIND FARM, CO. CLARE

Drawing Title: FIGURE A5.2b - BESS NOISE SENSITIVE RECEPTORS AND NOISE CONTOUR PLOT

Scale:	Original Size:	Spatial Reference:
1:50,000	A3	IRENET95 Irish Transverse Mercator

Drawing Number: IE00101-017



LEGEND

- Noise Monitoring Locations (NMLs)
- Battery Noise Assessment Locations (BNALs)
- Modelled Noise Sources
- Modelled Buildings

Noise Sensitive Receptors (NSRs)

- NSRs Represented by NML1
- NSRs Represented by NML2
- NSRs Represented by NML3
- NSRs Represented by NML4
- NSRs Represented by NML5
- NSRs Represented by NML6
- NSRs Represented by NML7

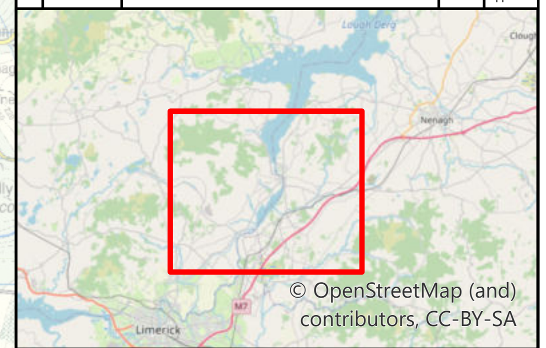
Predicted Noise Levels (dBA)

25 - 30	55 - 60
30 - 35	60 - 65
35 - 40	65 - 70
40 - 45	70 - 75
45 - 50	75 - 80
50 - 55	80 - 85

Noise contours modelled in accordance with ISO9613 Part 2:1996 at a height of 4 m and displayed on a 10 m by 10 m grid. All noise sources assumed to be operating concurrently.

All levels shown as dB LAeq(t)

Rev.	Date	Amendment Details	Drawn	Approved
1	31/07/2024	FINAL ISSUE	AD	GC
0	10/05/2024	FIRST ISSUE	JCM	AD



tnei

Client: EDF renewables

Drawing Status: FOR PLANNING

Project Title: LACKAREAGH WIND FARM, CO. CLARE

Drawing Title: FIGURE A5.2b - BESS NOISE SENSITIVE RECEPTORS AND NOISE CONTOUR PLOT

Scale:	Original Size:	Spatial Reference:
1:60,000	A3	IRENET95 Irish Transverse Mercator

Drawing Number: IE00101-007

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RECEIVED: 29/08/2024

LEGEND

- Noise Monitoring Locations (NMLs)
- Battery Noise Assessment Locations (BNALs)
- Modelled Noise Sources
- Modelled Buildings

Noise Sensitive Receptors (NSRs)

- NSRs Represented by NML1
- NSRs Represented by NML2
- NSRs Represented by NML3
- NSRs Represented by NML4
- NSRs Represented by NML5
- NSRs Represented by NML6
- NSRs Represented by NML7

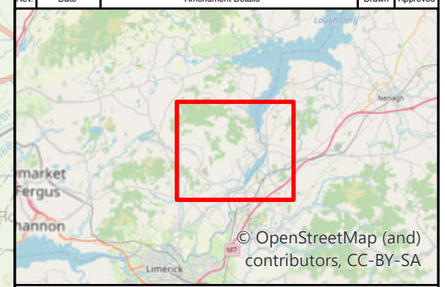
Predicted Noise Levels (dBA)

25 - 30	55 - 60
30 - 35	60 - 65
35 - 40	65 - 70
40 - 45	70 - 75
45 - 50	75 - 80
50 - 55	80 - 85

Noise contours modelled in accordance with ISO9613 Part 2:1996 at a height of 4 m and displayed on a 10 m by 10 m grid. All noise sources assumed to be operating concurrently.

All levels shown as dB LAeq(t)

Rev.	Date	Amendment Details	Drawn	Approved
1	31/07/24	FINAL ISSUE	AD	GC
0	10/05/2024	FIRST ISSUE	JCM	AD



tnei

Client: EDF renewables

Drawing Status: FOR PLANNING

Project Title: LACKAREAGH WIND FARM, CO. CLARE

Drawing Title: FIGURE A5.2d - BESS NOISE SENSITIVE RECEPTORS AND NOISE CONTOUR PLOT

Scale:	Original Size:	Spatial Reference:
1:45,000	A3	IRENET95 Irish Transverse Mercator

Drawing Number: IE00101-019

Annex 6 – Quantitative assessments at all NSRs

Table A6.1 - Noise Sensitive Receptors

Noise Assessment Location	Coordinates		Daytime			Night-time		
	ITM X	ITM Y	Rating Level, dBA	Representative Background Sound Level, dBA	Margin, dB	Rating Level, dBA	Representative Background Sound Level, dBA	Margin, dB
NSR1 (Derelict)	561661	673439	-	-	-	-	-	-
NSR2 (BNAL02)	564701	673085	19	33	-14	19	25	-6
NSR3	562657	672616	26	32	-6	26	25	1
NSR4	562790	672824	28	32	-4	28	25	3
NSR5	562676	671693	23	33	-10	23	28	-5
NSR6	562680	672705	27	32	-5	27	25	2
NSR7 (BNAL03)	564757	672486	15	31	-16	15	24	-9
NSR8 (BNAL06)	562222	672808	24	32	-8	24	25	-1
NSR9	564794	673117	19	33	-14	19	25	-6
NSR10 (BNAL01)	564716	673715	10	30	-20	10	23	-13
NSR11	562590	671808	23	33	-10	23	28	-5
NSR12	564761	672966	23	33	-10	23	25	-2
NSR13	561633	673083	21	33	-12	21	29	-8
NSR14	562647	672798	26	32	-6	26	25	1
NSR15	562010	672778	23	32	-9	23	25	-2
NSR16	562529	671794	23	33	-10	23	28	-5
NSR17	561998	672751	23	32	-9	23	25	-2
NSR18	561803	672813	22	32	-10	22	25	-3
NSR19	561838	672785	22	32	-10	22	25	-3
NSR20	562089	672686	22	32	-10	22	25	-3
NSR21	561579	672964	21	33	-12	21	29	-8
NSR22	562059	672671	22	32	-10	22	25	-3
NSR23	561980	672693	22	32	-10	22	25	-3
NSR24	561947	672696	22	32	-10	22	25	-3
NSR25	561853	672723	22	32	-10	22	25	-3
NSR26	561968	672666	22	32	-10	22	25	-3
NSR27	561942	672666	22	32	-10	22	25	-3
NSR28	562416	671818	23	33	-10	23	28	-5
NSR29	562038	672619	22	32	-10	22	25	-3
NSR30	562002	672616	22	32	-10	22	25	-3
NSR31	561489	672953	21	33	-12	21	29	-8
NSR32	562066	672595	22	32	-10	22	25	-3
NSR33	562004	672602	22	32	-10	22	25	-3
NSR34 (BNAL05)	562272	672216	23	33	-10	23	28	-5
NSR35	562075	672553	22	32	-10	22	25	-3
NSR36	561435	672956	21	33	-12	21	29	-8
NSR37	561954	672579	22	32	-10	22	25	-3
NSR38	562291	672007	24	33	-9	24	28	-4
NSR39	562385	671518	22	33	-11	22	28	-6
NSR40	561933	672538	22	32	-10	22	25	-3
NSR41	561389	672923	20	33	-13	20	29	-9
NSR42	562360	671406	22	33	-11	22	28	-6
NSR43	561896	672506	22	32	-10	22	25	-3
NSR44	565161	673542	21	30	-9	21	23	-2
NSR45	561867	672492	21	32	-11	21	25	-4
NSR46 (BNAL07)	561052	673780	18	33	-15	18	29	-11
NSR47	565115	673731	17	30	-13	17	23	-6
NSR48	562221	671777	23	33	-10	23	28	-5
NSR49	562345	671342	21	33	-12	21	28	-7
NSR50	561842	672467	21	32	-11	21	25	-4
NSR51	561010	673785	18	33	-15	18	29	-11
NSR52	561806	672456	21	32	-11	21	25	-4
NSR53	561626	672516	21	32	-11	21	25	-4
NSR54	561644	672378	21	32	-11	21	25	-4
NSR55	562400	670949	21	33	-12	21	28	-7
NSR56	565364	672522	20	31	-11	20	24	-4
NSR57	561531	672385	20	32	-12	20	25	-5
NSR58	560905	673232	16	33	-17	16	29	-13
NSR59	561587	672347	21	32	-11	21	25	-4
NSR60	561441	672436	20	32	-12	20	25	-5
NSR61	565472	673141	23	33	-10	23	25	-2
NSR62	565485	672351	19	31	-12	19	24	-5
NSR63	565515	672347	19	31	-12	19	24	-5
NSR64	560877	672991	18	33	-15	18	29	-11
NSR65 (BNAL04)	565466	671964	14	33	-19	14	22	-8
NSR66	565549	673074	22	33	-11	22	25	-3
NSR67	565560	672326	19	31	-12	19	24	-5
NSR68	560794	673038	18	33	-15	18	29	-11
NSR69	560656	673588	17	33	-16	17	29	-12

Noise Assessment Location	Coordinates		Daytime			Night-time		
	ITM X	ITM Y	Rating Level, dBA	Representative Background Sound Level, dBA	Margin, dB	Rating Level, dBA	Representative Background Sound Level, dBA	Margin, dB
NSR70	565513	671844	14	33	-19	14	22	-8
NSR71	560762	673013	18	33	-15	18	29	-11
NSR72	562292	670677	20	33	-13	20	28	-8
NSR73	565643	672341	20	31	-11	20	24	-4
NSR74	560724	672996	17	33	-16	17	29	-12
NSR75	562397	670509	20	33	-13	20	28	-8
NSR76	562285	670594	20	33	-13	20	28	-8
NSR77	560484	674120	15	33	-18	15	29	-14
NSR78	560471	674182	15	33	-18	15	29	-14
NSR79	561810	671127	20	33	-13	20	28	-8
NSR80	565714	672811	22	33	-11	22	25	-3
NSR81	562316	670473	19	33	-14	19	28	-9
NSR82	561860	670924	19	33	-14	19	28	-9
NSR83	562313	670419	19	33	-14	19	28	-9
NSR84	565817	672355	21	31	-10	21	24	-3
NSR85	562110	670555	19	33	-14	19	28	-9
NSR86	562272	670414	19	33	-14	19	28	-9
NSR87	565484	671230	9	33	-24	9	22	-13
NSR88	562199	670304	19	33	-14	19	28	-9
NSR89	561527	671204	20	33	-13	20	28	-8
NSR90	560306	673295	16	33	-17	16	29	-13
NSR91	565995	672317	20	31	-11	20	24	-4
NSR92	562187	670277	18	33	-15	18	28	-10
NSR93	560370	672954	16	33	-17	16	29	-13
NSR94	566011	672201	20	31	-11	20	24	-4
NSR95	560305	673039	16	33	-17	16	29	-13
NSR96	561659	670701	19	33	-14	19	28	-9
NSR97	560835	672028	18	33	-15	18	28	-10
NSR98	561295	671537	21	33	-12	21	28	-7
NSR99	566125	672239	19	31	-12	19	24	-5
NSR100	565241	670627	7	33	-26	7	22	-15
NSR101	561025	671794	19	33	-14	19	28	-9
NSR102	566216	672164	19	31	-12	19	24	-5
NSR103	561864	670256	18	33	-15	18	28	-10
NSR104	561160	671571	19	33	-14	19	28	-9
NSR105	562916	669671	17	33	-16	17	28	-11
NSR106	566252	672219	19	31	-12	19	24	-5
NSR107	566271	672276	19	31	-12	19	24	-5
NSR108 (Derelict)	566327	672213	-	-	-	-	-	-
NSR109	559925	673283	15	33	-18	15	29	-14
NSR110	562081	669846	17	33	-16	17	28	-11
NSR111	561874	669960	17	33	-16	17	28	-11
NSR112	563014	669430	16	33	-17	16	28	-12
NSR113	560947	671461	18	33	-15	18	28	-10
NSR114	565577	670435	9	33	-24	9	22	-13
NSR115	562065	669758	17	33	-16	17	28	-11
NSR116	566511	672054	17	31	-14	17	24	-7
NSR117	559688	673607	14	33	-19	14	29	-15
NSR118	559797	673004	14	33	-19	14	29	-15
NSR119	559657	673640	14	33	-19	14	29	-15
NSR120	561856	669813	16	33	-17	16	28	-12
NSR121	559749	673009	14	33	-19	14	29	-15
NSR122	561914	669731	16	33	-17	16	28	-12
NSR123	565833	670493	11	33	-22	11	22	-11
NSR124	565533	670225	8	33	-25	8	22	-14
NSR125	563141	669238	13	33	-20	13	28	-15
NSR126	564758	669592	11	33	-22	11	22	-11
NSR127	564899	669681	10	33	-23	10	22	-12
NSR128	566629	671963	17	31	-14	17	24	-7
NSR129	565519	670158	9	33	-24	9	22	-13
NSR130	563209	669187	12	33	-21	12	28	-16
NSR131	566028	670519	13	33	-20	13	22	-9
NSR132	564827	669502	11	33	-22	11	22	-11
NSR133	563170	669116	12	33	-21	12	28	-16
NSR134	559555	673025	14	33	-19	14	29	-15
NSR135	565020	669608	10	33	-23	10	22	-12
NSR136	565456	669970	10	33	-23	10	22	-12
NSR137	559405	674249	12	33	-21	12	29	-17
NSR138	564914	669501	10	33	-23	10	22	-12
NSR139	566086	670481	14	33	-19	14	22	-8

Noise Assessment Location	Coordinates		Daytime			Night-time		
	ITM X	ITM Y	Rating Level, dBA	Representative Background Sound Level, dBA	Margin, dB	Rating Level, dBA	Representative Background Sound Level, dBA	Margin, dB
NSR140	564552	669302	13	33	-20	13	22	-9
NSR141	564642	669335	13	33	-20	13	22	-9
NSR142	563343	669044	10	33	-23	10	28	-18
NSR143	564711	669345	13	33	-20	13	22	-9
NSR144	566826	671987	16	31	-15	16	24	-8
NSR145	563595	669001	9	33	-24	9	28	-19
NSR146	564726	669301	13	33	-20	13	22	-9
NSR147	566871	671989	16	31	-15	16	24	-8
NSR148	561961	669350	15	33	-18	15	28	-13
NSR149	564703	669272	13	33	-20	13	22	-9
NSR150	559670	672291	14	33	-19	14	28	-14
NSR151	566883	671979	16	31	-15	16	24	-8
NSR152	561828	669418	15	33	-18	15	28	-13
NSR153	566882	671887	16	31	-15	16	24	-8
NSR154	559994	671744	15	33	-18	15	28	-13
NSR155	566141	670341	13	33	-20	13	22	-9
NSR156	559413	672841	13	33	-20	13	29	-16
NSR157	566945	671972	12	31	-19	12	24	-12
NSR158	565203	669501	11	33	-22	11	22	-11
NSR159	566938	671893	12	31	-19	12	24	-12
NSR160	564692	669181	13	33	-20	13	22	-9