# Yaxley Synchronous Condenser

## Noise Impact Assessment for Planning Application

2nd August 2022

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# 1. INTRODUCTION

## 1.1. Overview

inacoustic has been commissioned to assess the impact of potential noise arising from a proposed Synchronous Condenser facility on Land at The Leys and Ivy Farm, Mellis Road, Yaxley, Eye, IP23 8DB.

This report details the existing background sound climate at the nearest noise-sensitive receptors, as well as the potential sound emissions associated with the Proposed Development.

The assessment considers the potential noise generation from the plant associated with the Proposed Development, with respect to existing sound levels in the area. The assessment methodology contained in British Standard 4142:2014+A1:2019 *Method for rating and assessing industrial and commercial sound* has been used.

Accordingly, the following technical noise assessment has been produced to accompany the Planning Application to Mid Suffolk District Council and is based upon environmental noise measurements undertaken at the site and a subsequent 3-dimensional noise modelling exercise.

This noise assessment is necessarily technical in nature; therefore a glossary of terms is included in Appendix A to assist the reader.

## 1.2. Scope and Objectives

The scope of the noise assessment can be summarised as follows:

- A sound monitoring survey was undertaken at discrete locations representative of the closest noise-sensitive receptors to the Site;
- A 3-dimensional noise modelling exercise, in order to quantify the potential noise generation of the proposed site uses;
- An assessment of potential noise impacts with respect to the prevailing acoustic conditions at existing off-site receptors; and
- Recommendation of mitigation measures, where necessary, to comply with the requirements of the National Planning Practice Guidance in England: Noise[1].

[1] Department for Communities and Local Government (DCLG), 2019. National Planning Practice Guidance for England: Noise. DCLG England: Noise. DCLG.

# 2. Legislation and Policy Framework

The development proposals for the Site are guided by the following policy directives and guidance:

## 2.1. National Policy

### 2.1.1. National Planning Policy Framework, 2021

The *National Planning Policy Framework* (NPPF)[2] sets out the Government's planning policies for England. Planning policy requires that applications for planning permission must be determined in accordance with the development plan, unless material considerations indicate otherwise.

The NPPF is also a material consideration in planning decisions. It sets out the Government's requirements for the planning system and how these are expected to be addressed.

Under Section 15; *Conserving and Enhancing the Natural Environment*, in Paragraph 174, the following is stated:

*"Planning policies and decisions should contribute to and enhance the natural and local environment by:*

*e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability".*

Paragraph 185 of the document goes on to state:

*"Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:*

*a) mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life;*
*b) identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason"*

Paragraph 185 refers to the Noise Policy Statement for England, which is considered overleaf.

[2] Ministry of Housing, Communities and Local Government (MHCLG), July 2021. National Planning Policy Framework. HMSO. London.

### 2.1.2. Noise Policy Statement for England, 2010

The underlying principles and aims of existing noise policy documents, legislation and guidance are clarified in *DEFRA: 2010: Noise Policy Statement for England* (NPSE)[3]. The NPSE sets out the *"Long Term Vision"* of Government noise policy as follows:

*"Promote good health and good quality of life through the effective management of noise within the context of Government policy on sustainable development".*

The NPSE outlines three aims for the effective management and control of environmental, neighbour and neighbourhood noise:

- *"Avoid significant adverse impacts on health and quality of life;*
- *Mitigate and minimise adverse impacts on health and quality of life; and*
- *Where possible, contribute to the improvement of health and quality of life".*

The guidance states that it is not possible to have a single objective noise-based measure that defines *"Significant Observed Adverse Effect Level (SOAEL)"* that is applicable to all sources of noise in all situations and that not having specific SOAEL values in the NPSE provides the necessary policy flexibility until further evidence and suitable guidance is available.

### 2.1.3. National Planning Practice Guidance in England: Noise, 2019

Further guidance in relation to the NPPF and the NPSE has been published in the *National Planning Practice Guidance in England: Noise* (NPPG Noise)[4], which summarises the noise exposure hierarchy, based on the likely average response. The following three observed effect levels are identified below:

- **Significant Observed Adverse Effect Level**: This is the level of noise exposure above which significant adverse effects on health and quality of life occur;
- **Lowest Observed Adverse Effect Level**: This is the level of noise exposure above which adverse effects on health and quality of life can be detected; and
- **No Observed Adverse Effect Level**: This is the level of noise exposure below which no effect at all on health or quality of life can be detected.

Criteria related to each of these levels are reproduced in Table 1.

[3] Department for Environment, Food and Rural Affairs (DEFRA), 2010. Noise Policy Statement for England. DEFRA.
[4] Department for Communities and Local Government (DCLG), 2019. National Planning Practice Guidance for England: Noise. DCLG.

TABLE 1: SIGNIFICANCE CRITERIA FROM NPPG IN ENGLAND: NOISE

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

## 2.2. Assessment Criteria

### 2.2.1. BS4142:2014+A1:2019

BS4142:2014+A1:2019 sets out a method to assess the likely effect of sound from factories, industrial premises or fixed installations and sources of an industrial nature in commercial premises, on people who might be inside or outside a dwelling or premises used for residential purposes in the vicinity.

The procedure contained in BS4142:2014+A1:2019 for assessing the effect of sound on residential receptors is to compare the measured or predicted sound level from the source in question, the $L_{Aeq,T}$ *specific sound level*, immediately outside the dwelling with the $L_{A90,T}$ background sound level.

Where the sound contains a tonality, impulsivity, intermittency and other sound characteristics, then a correction depending on the grade of the aforementioned characteristics of the sound is added to the specific sound level to obtain the $L_{Ar,Tr}$ *rating sound level*. The effect of uncertainty in sound measurements, data and calculations should also be considered when necessary.

BS4142:2014+A1:2019 states: *"The significance of sound of an industrial and/or commercial nature depends upon both the margin by which the rating level of the specific sound source exceeds the background sound level and the context in which the sound occurs"*. An estimation of the impact of the specific sound can be obtained by the difference of the rating sound level and the background sound level and considering the following:

- *"Typically, the greater this difference, the greater the magnitude of the impact."*
- *"A difference of around +10dB or more is likely to be an indication of a significant adverse impact, depending on the context."*
- *"A difference of around +5dB is likely to be an indication of an adverse impact, depending on the context."*
- *"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."*

During the daytime, the assessment is typically carried out over a reference time period of 1-hour, with a reference period of 15-minutes used for the night-time assessment. The periods associated with day or night, for the purposes of the Standard, are considered to be 07.00 to 23.00 and 23.00 to 07.00, respectively.

### 2.2.2. Relative Change in Ambient Noise Level

The IEMA Guidelines[5] define 'Noise Impact' as the difference in the acoustic environment before and after the implementation of the proposals, also known as the magnitude of change. In circumstances where a noise environment may be altered by addition or removal of a noise source, considered to be largely anonymous or within the prevailing acoustic character of an area, for example, changes to traffic quantum or patterns, it is normal to consider this relative change in ambient noise level. The assessment, therefore, considers this phenomenon to add context.

The impact scale adopted in this assessment is shown in Table 2 below, which relates to established human responses to noise, in line with '*Table 7-12 Effect Descriptors*' of the IEMA Guidelines and set in the context of NPPG.

TABLE 2: IMPACT SCALE FOR COMPARISON OF FUTURE NOISE AGAINST EXISTING NOISE

| Noise Level Change dB(A) | Subjective Response | Significance | NPPG Context |
|---|---|---|---|
| Less than 1.0 | No perceptible | Negligible | NOEL |
| 1.0 – 2.9 | Barely perceptible | Minor impact | NOAEL |
| 3.0 – 4.9 | Noticeable | Moderate impact | LOAEL |
| 5.0 – 9.9 | Up to a doubling or halving of loudness | Substantial impact | SOAEL |
| 10.0 or more | More than a doubling or halving of loudness | Major impact | UAEL |

The criteria above reflect the key benchmarks that relate to human perception of sound. A change of 3 dB(A) is generally considered to be the smallest change in environmental noise that is perceptible to the human ear. A 10 dB(A) change in noise represents a doubling or halving of the perception of loudness. The difference between the minimum perceptible change and the doubling or halving of the noise level is split to provide greater definition to the assessment of changes in noise level.

It is considered that the criteria specified in Table 2 provide a good indication as to the likely significance of changes in noise levels in this case and can be used to inform the context in which the sound occurs in order to assess the impact of noise from the proposed development.

[5] Institute of Environmental Management & Assessment (IEMA), Version 1.2 (November 2014). Guidelines for Environmental Noise Impact Assessment

# 3. Site Description

## 3.1. Site and Surrounding Area

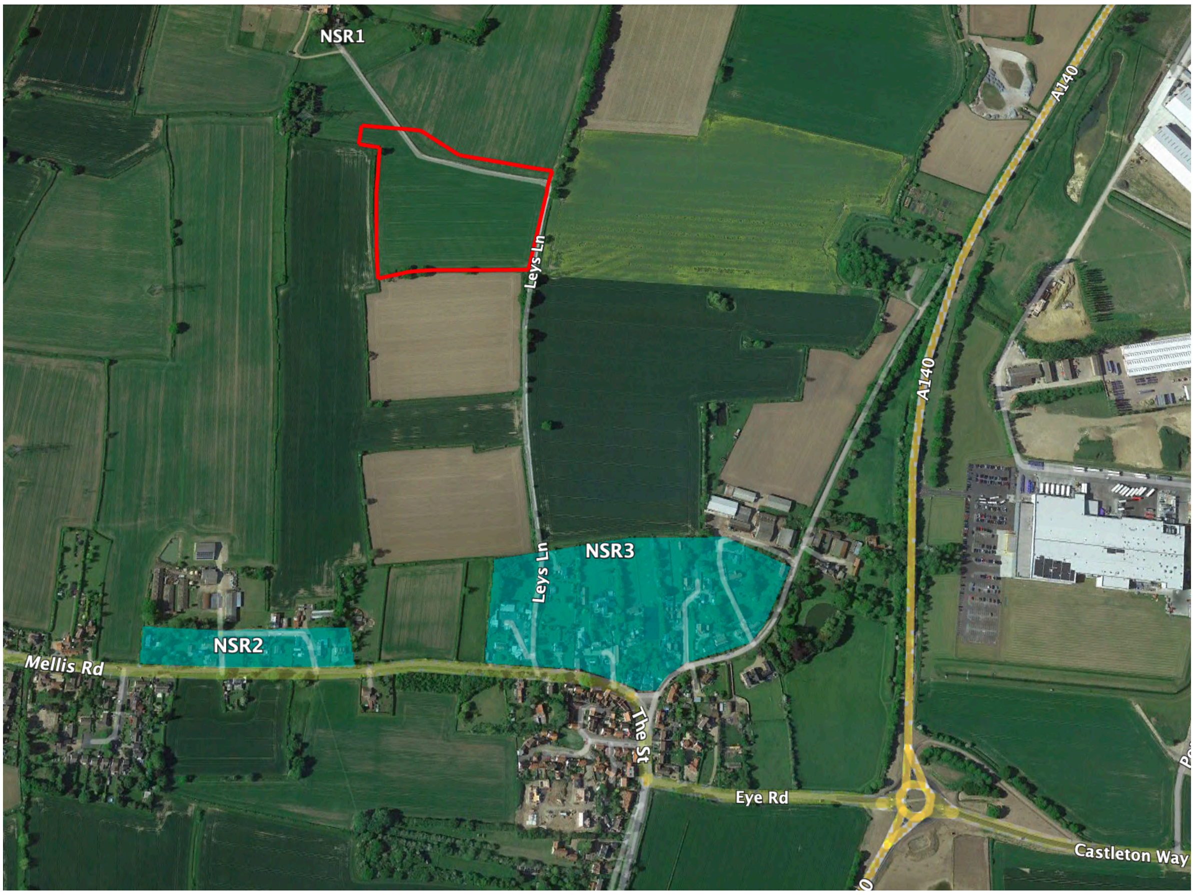
The Proposed Development is on a parcel of land to the west of the A140 route corridor and to the north of Mellis Road.

The site is surrounded by agricultural land. The closest noise sensitive receptor (NSRs) to the site comprises a group of dwellings at NSR1, one of which is within the same land ownership as the site, approximately 215m to the north west of the site boundary, with the other third-party dwelling in this group, Meadow Barn, located 235 m north of the site, and residential dwellings along Mellis Road, approximately 500m to the south of the site boundary.

The ambient sound environment in the area was influenced by local road traffic noise and natural sources.

The Proposed Development site and the surrounding area can be seen in Figure 1.

Figure 1: Proposed Development Site and Surrounding Area



## 3.2. Proposed Development Overview

As traditional coal and gas plants are phased out from Britain's energy system, the transmission system inertia and short circuit levels are falling. Inertia is the mass of the system used to control frequency, while short circuit level is the amount of current that flows on the system during a fault. Renewable generators like wind and solar connect to the grid in a different way, which doesn't provide the network the same stabilising properties.

Historically, grid stability has been provided by large synchronous generators (Coal, Nuclear, Gas) which can respond to changes in grid frequency. The increasing use of non-synchronous generation, such as Wind and Solar energy, is reducing the amount of synchronous generation on the grid. The lack of synchronous inertia becomes a larger problem when power demand is low but renewable energy production is high.

This can lead to grid operators constraining renewable generation to ensure grid stability or running coal or gas powered plants in reserve just in case there is a fault. Synchronous Condensers help to provide the same synchronous inertia as coal or gas power plants, without the associated $CO_2$ emissions and high running costs.

National Grid is therefore focused on increasing the inertia and short circuit level in England and Wales by the implementation of Synchronous Condensers sites, which can be despatched as and when required by the system operator.

The proposed development plans and elevations at Yaxley are presented below.

FIGURE 2: PROPOSED DEVELOPMENT LAYOUT

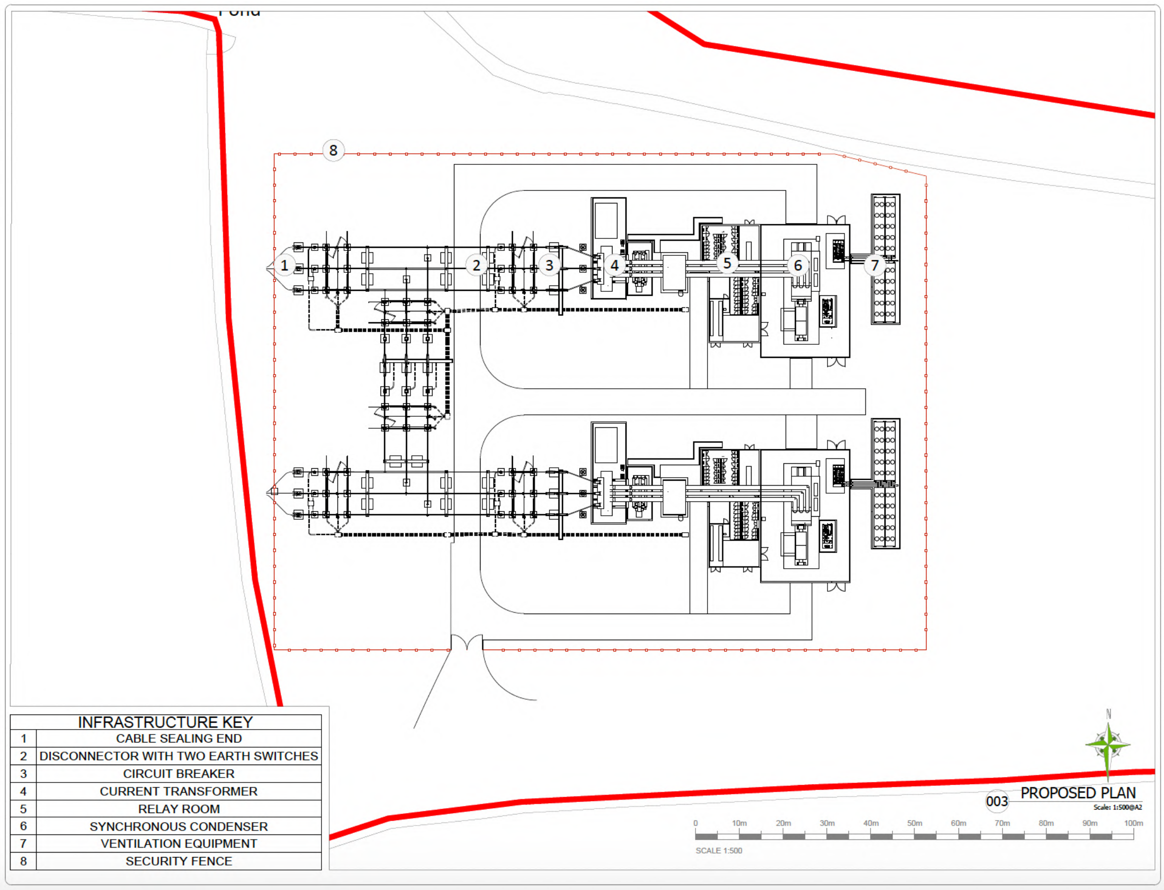
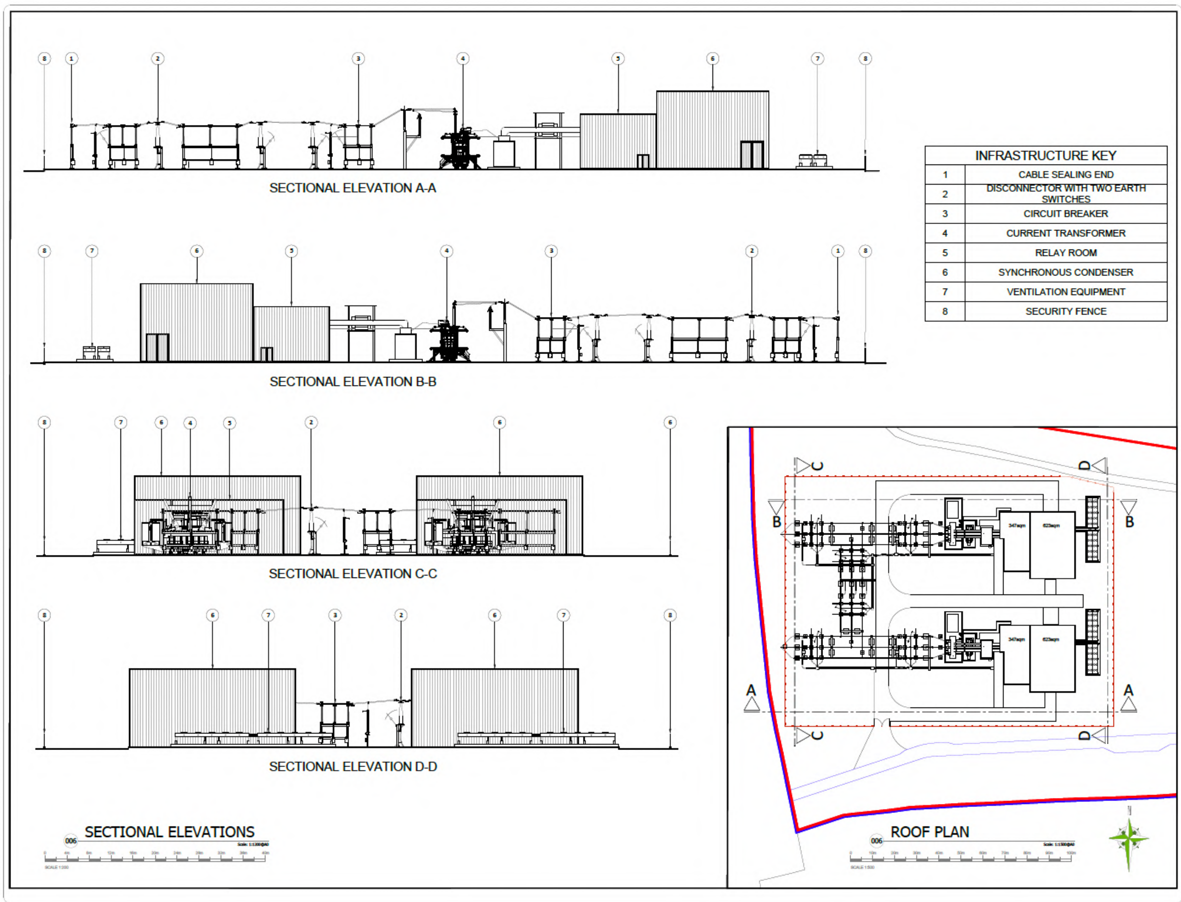


Figure 3: Proposed Development Elevations



# 4. MEASUREMENT METHODOLOGY

## 4.1. General

The prevailing noise conditions in the area have been determined by an environmental noise survey conducted during both daytime and night-time periods between Tuesday 17th and Wednesday 25th May 2022.

## 4.2. Measurement Details

All noise measurements were undertaken by a consultant certified as competent in environmental noise monitoring, and, in accordance with the principles of BS 7445[6].

All acoustic measurement equipment used during the noise survey conformed to Type 1 specification of British Standard 61672[7]. A full inventory of this equipment is shown in Table 3 below.

TABLE 3: INVENTORY OF SOUND MEASUREMENT EQUIPMENT

| Measurement Position | Make, Model & Description | Serial Number | Certificate Number | Calibration Expiry Date |
|---|---|---|---|---|
| MP1 | Rion NL-52 Sound Level Meter | 764926 | 199989 | 11/06/2022 |
| | Rion NH-25 Preamplifier | 76427 | | |
| | Rion UC-59 Microphone | 12922 | | |
| MP2 | Bruel & Kjaer 2238 | 2328256 | 1123444 | 11/02/2024 |
| | B&K Preamplifier ZC 0030 | - | | |
| | B&K 4188 | 2793288 | | |
| Both | Cirrus CR:515 Calibrator | 80029 | TCRT22/1229 | 7/04/2023 |

The sound measurement equipment used during the survey was field calibrated at the start and end of the measurement period. A calibration laboratory has calibrated the field calibrator used within the twelve months preceding the measurements. A drift of less than 0.2 dB in the field calibration was found to have occurred on the sound level meter.

The weather conditions during the survey were conducive to environmental noise measurement; it being largely dry, with wind speeds typically below 5 $ms^{-1}$, as recorded on site with a weather station. When periods of inclement weather were noted to occur, they have been removed from the dataset used to derive the typical background sound level.

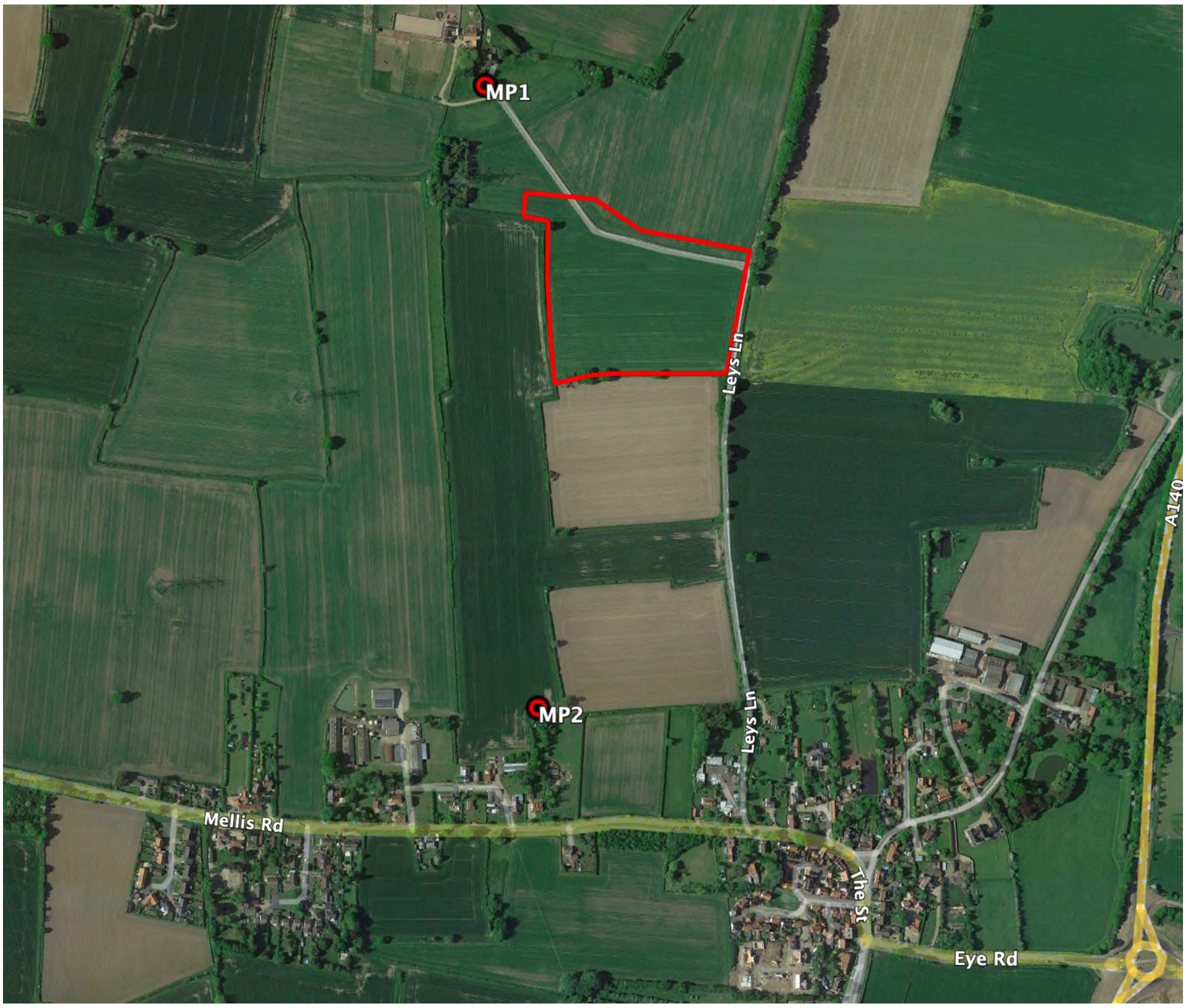
The microphone was fitted with a protective windshield for the measurements, which is described in Table 4, with an aerial photograph indicating its location shown in Figure 4.

[6] British Standard 7445: 2003: Description and measurement of environmental noise. BSI
[7] British Standard 61672: 2013: Electroacoustics. Sound level meters. Part 1 Specifications. BSI.

Table 4: Measurement Position Description

| Measurement Position | Description |
|---|---|
| MP1 | A largely unattended daytime and night-time measurement of sound at the Farm House to the north west of the Site, under free-field conditions, at a height of 1.5 metres above local ground level.<br>The sound environment at this location during our time on site was influenced by electrical buzzing noise from overhead power lines, wind turbines in the distance and natural sounds such as birdsong and wind-induced vegetation movement. Very infrequent car passbys on the lane to the farm were also noted. Construction vehicles to the south, associated with another site were also noted, although they were not active during the attended period. |
| MP2 | A largely unattended daytime and night-time measurement of sound at the closest NSRs to the south of the Site, off Mellis Road, under free-field conditions, at a height of 1.5 metres above local ground level.<br>The sound environment at this location during our time on site was influenced by road traffic noise contributions from vehicles travelling on Mellis Road and natural sounds such as birdsong and wind-induced vegetation movement. Agricultural vehicles on the surrounding land were also noted occasionally. |

Figure 4: Measurement Positions



## 4.3. Sound Indices

The parameters reported are the average Equivalent Continuous Sound Level, $L_{Aeq,T}$ , the statistical index (typical) Background Sound Level, $L_{A90,T}$, as well as the and the typical Maximum Sound Pressure Level, $L_{AFmax}$. An explanation of the sound units presented is given in Appendix A.

The measured $L_{Aeq}$, $L_{AFmax}$, and $L_{AF90}$ sound levels are presented as time histories in a graph in Appendix B. Furthermore, the statistical distribution of the measured background sound levels to derive the typical representative $L_{A90,T}$ values are presented in a graphical format in Appendix C.

## 4.4. Summary Results

The summarised results of the environmental sound measurements, during the day and night-time periods, can be seen below in Table 5. Values have been rounded to the nearest whole number.

TABLE 5: SOUND MEASUREMENT RESULTS

| Measurement Position | Period | $L_{Aeq,T}$ (dB) | $L_{AF90,T}$ (dB) | $L_{AFmax}$ (dB) |
|---|---|---|---|---|
| MP1 | Day | 49 | **37** | 73 |
| | Night | 44 | **36** | 66 |
| MP2 | Day | 47 | **34** | 73 |
| | Night | 45 | **32** | 66 |

# 5. Operational Noise Assessment

## 5.1. Noise Modelling

### 5.1.1. Source Data

The A-weighted sound power levels of external plant associated with the Proposed Development can be seen below in Table 6. At this stage, these are considered robust candidate source noise levels representative of typical technology available for this kind of plant, to be achieved by the scheme design.

Table 6: Sound Source Data

| Plant | Quantity | Sound Power Level per unit, $L_{WA}$ (dB) |
|---|---|---|
| Main Transformer | 2 | 92 |
| Auxiliary Transformer | 2 | 46 |
| Start Up Transformer | 4 | 46 |
| Outdoor Cooling | 8 | 82 (day - nominal speed)<br>76 (night – reduced speed) |

The maximum 1/3 octave sound power level for the main transformers at 100Hz is assumed to not exceed 99 dB (lineal).

In addition, it is assumed that the Synchronous Generators and Flywheels will be housed within an acoustic enclosure to limit noise emissions to 85 dB(A) at 1m, including the ventilation system. The acoustic enclosure themself will be located within the Main Generation Buildings. The reverberant Sound Pressure Level within the Main Generation Buildings is calculated to be 90 dB(A), and should be achieved by design.

The Main Generation Buildings are assumed to comprise standard thermal insulated panels in the walls and roof, with a minimum sound reduction performance of 24 dB $R_w$, which is typical on this kind of systems.

Ventilation louvres on the Main Generation Buildings should be designed such that they do not downgrade the acoustic performance of the building, either by orientation away from the direction of noise-sensitive receptors or by the use of acoustically attenuated louvres where required.

### 5.1.2. Calculation Process

Calculations were carried out using Cadna/A, which undertakes its calculations in accordance with guidance given in ISO9613-1:1993 and ISO9613-2:1996.

### 5.1.3. Model Assumptions

Given that the land between the proposed development and nearest receptors is largely soft, the ground factor has been set to 0.8 within the calculation software, with 2 orders of reflection. Full octave frequency spectrum has been used in the calculations. For the Main Transformers, 1/3 octave frequency bands have been considered. It has been assumed that all processes will occur simultaneously, representing a worst-case scenario.

In order to accurately model the land surrounding the development, an AutoCAD DXF drawing was produced based on Ordnance Survey, along with associated topographic contours sourced from Defra.

### 5.1.4. Mitigation by Design

As mentioned before, embedded mitigations include the Synchronous Generators and Flywheels being housed within an acoustic enclosure to limit noise emissions to 85 dB(A) at 1m, including the ventilation system, with the acoustic enclosure themself located within the Main Generation Buildings.

In order to reduce the potential noise impact of the Proposed Development, an iterative assessment of other suitable noise mitigation techniques has been undertaken.

Section 5.1.1 presents the maximum sound emission levels required to achieve compliance at the most potentially noise-affected receptors. To achieve this, acoustic mitigation might need to be employed on the Main Transformers, in order to achieve the emission levels presented in Section 5.1.1, depending on the final manufacturer and plant selection.

### 5.1.5. Specific Sound Level Map

The sound map showing the specific sound level emissions from the Proposed Development can be seen in Figure 5 and Figure 6 for daytime and night-time periods respectively.

Figure 5: Specific Sound Level Map - Daytime

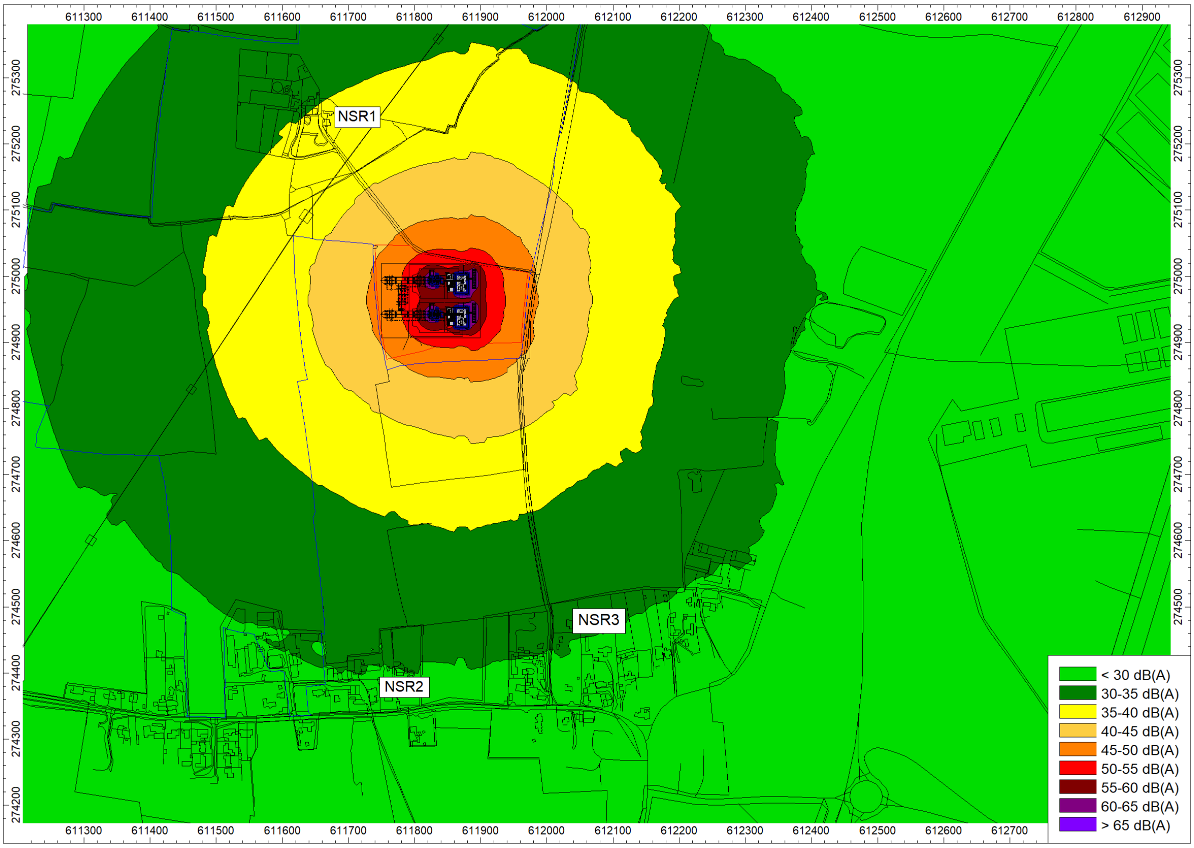
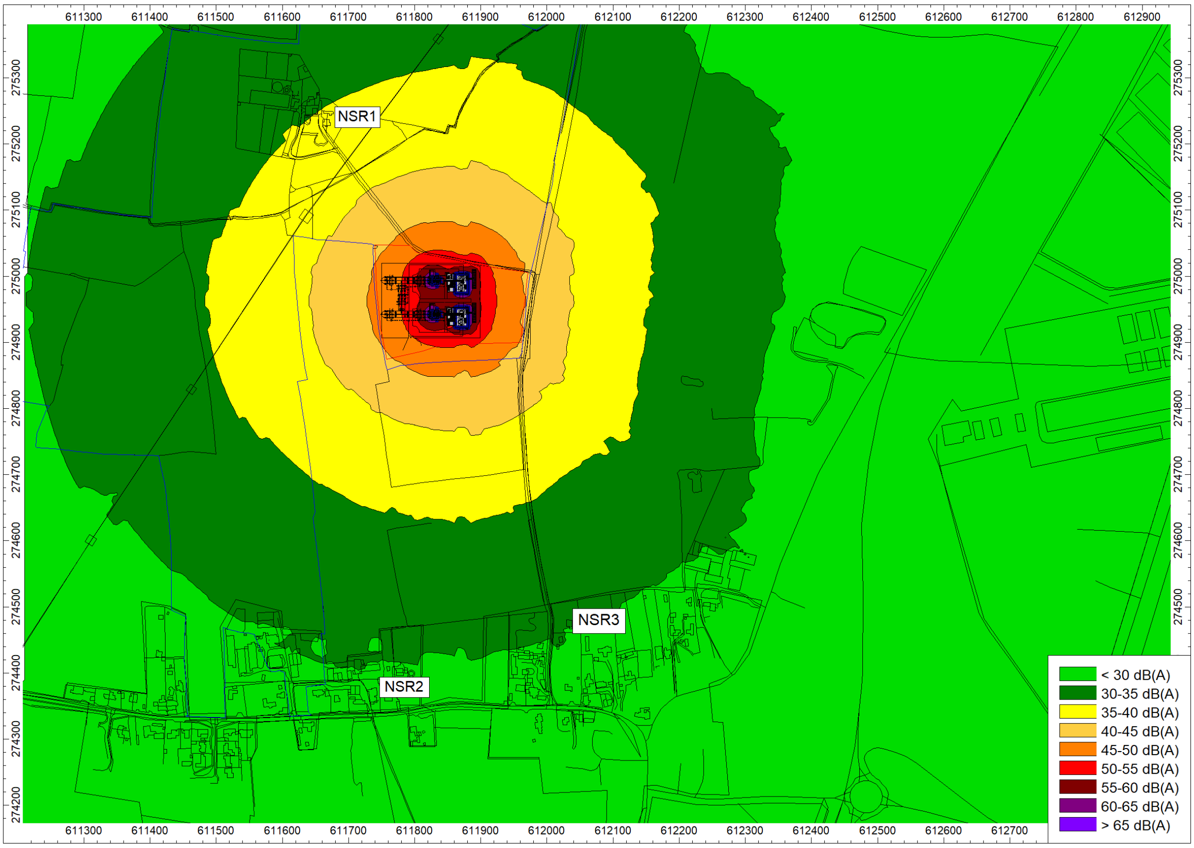


FIGURE 6: SPECIFIC SOUND LEVEL MAP – NIGHT-TIME




### 5.1.6. Specific Sound Level Summary

A summary of the predicted specific sound levels at the closest NSRs, based on the sound maps shown in Figure 5 and Figure 6 can be seen below in Table 7.

TABLE 7: PREDICTED SPECIFIC SOUND LEVEL SUMMARY

| NSR | Period | Specific Sound Level (dB) |
|---|---|---|
| NSR1 | Daytime (07:00-23:00) | 36 |
| | Night-time (23:00-07:00) | 35 |
| NSR2 | Daytime (07:00-23:00) | 30 |
| | Night-time (23:00-07:00) | 29 |
| NSR3 | Daytime (07:00-23:00) | 31 |
| | Night-time (23:00-07:00) | 30 |

## 5.2. Assessment

### 5.2.1. Rating Penalty Principle

Section 9 of BS4142:2014+A1:2019 describes how the rating sound level should be derived from the specific sound level, by determining a rating penalty. BS4142:2014+A1:2019 states:

*"Certain acoustic features can increase the significance of impact over that expected from a basic comparison between the specific sound level and the background sound level. Where such features are present at the assessment location, add a character correction to the specific sound level to obtain the rating level. This can be approached in three ways:*

*a) subjective method;*
*b) objective method for tonality;*
*c) reference method."*

Given that the Proposed Development is not operational, the subjective method has been adopted to derive the rating sound level from the specific sound level. This is discussed in Section 9.2 of BS4142:2014+A1:2019, which states:

*"Where appropriate, establish a rating penalty for sound based on a subjective assessment of its characteristics. This would also be appropriate where a new source cannot be measured because it is only proposed at that time, but the characteristics of similar sources can subjectively be assessed.*

*Correct the specific sound level if a tone, impulse or other characteristics occurs, or is expected to be present, for new or modified sound sources."*

BS4142:2014+A1:2019 defines four characteristics that should be considered when deriving a rating penalty, namely; tonality; impulsivity; intermittency; and other sound characteristics, which are defined as:

**Tonality**

A rating penalty of +2 dB is applicable for a tone which is *"just perceptible"*, +4 dB where a tone is *"clearly perceptible"*, and +6 dB where a tone is *"highly perceptible"*.

**Impulsivity**

A rating penalty of +3 dB is applicable for impulsivity which is *"just perceptible"*, +6 dB where it is *"clearly perceptible"*, and +9 dB where it is *"highly perceptible"*.

**Intermittency**

BS4142:2014+A1:2019 states that when the *"specific sound has identifiable on/off conditions, the specific sound level ought to be representative of the time period of length equal to the reference time interval which contains the greatest total amount of on time … if the intermittency is readily distinctive against the residual acoustic environment, a penalty of +3 dB can be applied."*

**Other Sound Characteristics**

BS4142:2014+A1:2019 states that where *"the specific sound features characteristics that are neither tonal nor impulsive, though otherwise are readily distance against the residual acoustic environment, a penalty of +3 dB can be applied."*

### 5.2.2. Rating Penalty Assessment

Considering the content of Section 5.2.1, an assessment of the various sound sources associated with the Proposed Development, in terms of whether any rating penalties are applicable, has been detailed in Table 8 below.

Table 8: Rating Penalty Assessment

| Source | Tonality | Impulsivity | Intermittency | Other Sound Characteristics | Discussion |
|---|---|---|---|---|---|
| Synchronous Condenser Site | +2 dB | 0 dB | 0 dB | 0 dB | Synchronous Condenser sites can be despatched as and when required by the system operator, however, once operating, do not cycle on and off. The plant does not produce impulsive noises. Therefore, intermittency or impulsivity penalties are not applicable.<br><br>Based on the character of the main transformer, this kind of plant will typically produce a tone at the 1/3 octave band of 100Hz at source. The specific sound level at 100 Hz from the main transformer is predicted to be <35dB at SNR1 and <30dB at NSR2 and NSR3. This will ensure that the level is sufficiently low so that the tonality is unlikely to be noticeable, due to the lower sensitivity of the human ear at low frequencies and masking from the residual acoustic environment.<br><br>However, to consider a worst-case scenario, a penalty of +2 dB has been applied for a tone just perceptible at the noise-sensitive receptor. |

In summary, a rating penalty of +2 dB has been included in the assessment as a worst-case scenario.
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### 5.2.3. Uncertainty

BS4142:2014+A1:2019 requires that the level of uncertainty in the measured data and associated calculations is considered in the assessment. The Standard recommends that steps should be taken to reduce the level of uncertainty.

**Measurement Uncertainty**

BS4142:2014+A1:2019 states that measurement uncertainty depends on a number of factors, including the following, which are applicable to the Proposed Development:

*"  ...*
*b) the complexity and level of variability of the residual acoustic environment;*
*...*
*d) the location(s) selected for taking the measurements;*
*...*
*g) the measurement time intervals;*
*h) the range of times when the measurements have been taken;*
*i) the range of suitable weather conditions during which measurements have been taken;*
*...*
*k) the level of rounding of each measurement recorded; and*
*l) the instrumentation used."*

Each of the measurement uncertainty factors outlined above have been considered and discussed in Table 9 below.

TABLE 9: MEASUREMENT UNCERTAINTY FACTORS

| Measurement Uncertainty Factor Reference | Level of Uncertainty | Discussion |
|---|---|---|
| b) | 0 dB | Residual acoustic environment is relatively constant, hence no correction for a complex residual acoustic environment. |
| d) | 0 dB | Measuring at the closest affected receptors to the site has enabled the determination of robust background sound levels. |
| g) | 0 dB | Measurement time intervals were set in accordance with BS4142:2014+A1:2019, hence no further correction needs to be made. |
| h) | 0 dB | Measurements were undertaken over a continuous 8-day interval, including midweek and weekend periods. |
| i) | 0 dB | A weather station was deployed on site. Periods of significant wind or precipitation were excluded from the dataset used to derived the representative background sound levels. |
| k) | 0 dB | Measured values were rounded to 0.1 dB, therefore rounding would not have had a significant impact on the overall typical background sound levels. |
| l) | 0 dB | The acoustic measurement equipment accorded with Type 1 specification of British Standard 61672, and were deployed with appropriate wind shields. |

In summary, no uncertainty budget has been considered in the assessment, to account for measurement uncertainty.

**Calculation Uncertainty**

BS4142:2014+A1:2019 states that calculation uncertainty depends on a number of factors, including the following, which are applicable to the Proposed Development:

*" ...*

*b) uncertainty in the operation or sound emission characteristics of the specific sound source and any assumed sound power levels;*
*c) uncertainty in the calculation method;*
*d) simplifying the real situation to "fit" the model (user influence on modelling); and*
*e) error in the calculation process."*

Each of the calculation uncertainty factors outlined above have been considered and discussed in Table 10 below.

TABLE 10: CALCULATION UNCERTAINTY FACTORS

| Calculation Uncertainty Factor Reference | Level of Uncertainty | Discussion |
|---|---|---|
| b) | 0 dB | Sound source levels are based on robust candidate plant data, to be achieved by the design. |
| c) | 0 dB | Calculations were undertaken in accordance with ISO 9613-2, which is considered a *"validated method"* by BS4142:2014+A1:2019. |
| d) | 0 dB | The real situation has not been simplified for the purposes of this assessment. |
| e) | ±2 dB | ISO 9613-2 indicates that there is a ±2 dB accuracy to the prediction method, therefore, an uncertainty factor of ±2 dB is considered appropriate and proportional, given the separation distances involved. |

In summary, an uncertainty budget of ±2 dB has been considered in the assessment, to account for calculation uncertainty.

The overall uncertainty is considered to be small enough that it would not affect the conclusions of the assessment. It is also noted that because the assessment considers a worst-case scenario, such as downwind sound propagation (which in reality cannot happen at all NSRs at the same time) the relevance of the uncertainty is further reduced.

### 5.2.4. BS4142:2014+A1:2019 Assessment

The rating sound level, as calculated from the predicted specific sound level, has been assessed in accordance with BS4142:2014+A1:2019, at the closest NSRs, and can be seen in Table 11.

TABLE 11: BS4142 ASSESSMENT AT NSR1

| NSR | Period | Rating Sound Level (dB) | Background Sound Level (dB) | Excess of Rating over Daytime Background Sound Level (dB) | Impact (Depending on Context) |
|---|---|---|---|---|---|
| 1 | Daytime | 38 | 37 | +1 | Low/Adverse Impact |
| | Night-time | 37 | 36 | -1 | Low Impact |
| 2 | Daytime | 32 | 34 | -2 | Low Impact |
| | Night-time | 31 | 32 | -1 | Low Impact |
| 3 | Daytime | 33 | 34 | -1 | Low Impact |
| | Night-time | 32 | 32 | 0 | Low Impact |

It can be seen that the Proposed Development is predicted to have a 'Low Impact' at the nearest noise-sensitive receptors, with a potential 'Low to Adverse Impact' during the daytime periods at NSR1, depending on the context, which is discussed below.

### 5.2.5. Discussion on Context

The results set out in Table 11 identify that the operation of the scheme, as proposed, can occur without affecting the amenity of the closest residential receptors to the site, with only a slight exceedance above background predicted at NSR1 during the daytime, on the basis of a worst-case operational scenario.

BS4142:2014+A1:2019, however, recognises the importance of the context in which a sound occurs when assessing impacts.

It should be noted that the assessment includes a +2dB penalty for tonality as a worst-case scenario, when in reality tonality is unlikely to be readily noticeable. The specific sound level in the 100Hz 1/3 octave band is predicted to be <35 dB (lineal) at NSR1. The average $L_{Aeq,T}$ measured in the same frequency band at MP1 during the day was measured to be 47 dB (lineal). The specific sound level at 100Hz is well below the prevailing sound level, which provides confidence perceptible tonality is unlikely.

The effect of the Proposed Development on the relative change in ambient noise levels at the nearest residential receptors should also be considered as part of the context.

The differential between the predicted daytime specific sound level at NSR1 (as shown in Table 7), when compared to the measured ambient $L_{Aeq,T}$ levels (as shown in Table 5) would ensure that any increase in the prevailing ambient sound level would be negligible; thus ensuring that the development would be categorised as no greater than *No Observed Adverse Effect Level* (NOAEL), in this regard in the context of NPPG England criteria

### 5.2.6. Cumulative Noise Assessment

For completeness, potential cumulative noise effects from the Proposed Development along with the recently approved National Grid Yaxley Substation Connection within the same land ownership (Planning Reference DC/19/02267), has been assessed. The location of the substation, in relation to the proposed Synchronous Condenser site can be seen in Figure 7.

FIGURE 7: CONSENTED YAXLEY SUBSTATION


An acoustic assessment for the Yaxley substation is not available in the Planning Portal. Therefore, a qualitative cumulative assessment has been undertaken.

Typically, substation's transformers have a Sound Power Level in the order of 80 dB(A). That is more than 10 dB lower than the sound emissions from the Main Transformers of the Synchronous Condenser site (as presented in Table 6), which ensure that no increase in the sound levels predicted for the proposed development would be endangered a result of the cumulative operation of both schemes, at the most potentially affected receptors. On that basis, the cumulative assessment of both schemes is expected to be no greater than *No Observed Adverse Effect Level* in the context of NPPG.

# 6. Conclusion

inacoustic has been commissioned to assess the impact of potential noise arising from a proposed Synchronous Condenser facility on Land at The Leys and Ivy Farm, Mellis Road, Yaxley, Eye, IP23 8DB.

This technical noise assessment has been produced to accompany a Planning Application to Mid Suffolk District Council and is based upon environmental noise measurements undertaken at the site and a subsequent 3-dimensional noise modelling exercise.

The assessment considers the potential noise generation from the plant associated with the Proposed Development, with respect to existing sound levels in the area, including maximum sound emission levels presented in Table 6.

The assessment methodology contained in British Standard 4142: 2014+A1:2019 *Method for rating and assessing industrial and commercial sound* has been used in conjunction with supplementary acoustic guidance.

The assessment identifies that the Proposed Development will give rise to rating sound levels that do not normally exceed the measured background sound level in the area, thus giving rise to a 'Low Impact'.

The assessment also identifies that the Proposed Development might give rise to rating sound levels that are 1 dB above the measured background sound level at NSR1 during the day. The assessment goes on to consider the context in which the sound occurs.

The assessment also identifies that no significant tonality or change in ambient sound level at the identified receptor locations will be engendered as a result of the Proposed Development in its proposed and assessed form and that the amenity of residential receptors will not be compromised.

Consequently, the assessment demonstrates that the Proposed Development will give rise to noise impacts that would be within the range of NOAEL of the NPPG England guidance.

For ease of reference, the definition of *No Observed Adverse Effect Level* in PPGNoise is reproduced below:

*"Noise can be heard, but does not cause any change in behaviour, attitude or other physiological response. Can slightly affect the acoustic character of the area but not such that there is a change in the quality of life."*

Since the Proposed Development conforms to British Standard and National Planning Policy requirements, it is recommended that noise should not be a considered constraint to the approval of this Planning Application, providing that the plant is constructed and operated in accordance with the acoustic assumptions of this report.

# 7. Appendices

## 7.1. Appendix A – Definition of Terms

| | |
|---|---|
| Sound Pressure | Sound, or sound pressure, is a fluctuation in air pressure over the static ambient pressure. |
| Sound Pressure Level (Sound Level) | The sound level is the sound pressure relative to a standard reference pressure of 20µPa (20x10$^{-6}$ Pascals) on a decibel scale. |
| Decibel (dB) | A scale for comparing the ratios of two quantities, including sound pressure and sound power. The difference in level between two sounds s1 and s2 is given by 20 log10 ( s1 / s2 ). The decibel can also be used to measure absolute quantities by specifying a reference value that fixes one point on the scale. For sound pressure, the reference value is 20µPa. |
| A-weighting, dB(A) | The unit of sound level, weighted according to the A-scale, which takes into account the increased sensitivity of the human ear at some frequencies. |
| Noise Level Indices | Noise levels usually fluctuate over time, so it is often necessary to consider an average or statistical noise level. This can be done in several ways, so a number of different noise indices have been defined, according to how the averaging or statistics are carried out. |
| $L_{eq,T}$ | A noise level index called the equivalent continuous noise level over the time period T. This is the level of a notional steady sound that would contain the same amount of sound energy as the actual, possibly fluctuating, sound that was recorded. |
| $L_{max,T}$ | A noise level index defined as the maximum noise level during the period T. $L_{max}$ is sometimes used for the assessment of occasional loud noises, which may have little effect on the overall $L_{eq}$ noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response. |
| $L_{90,T}$ | A noise level index. The noise level exceeded for 90% of the time over the period T. $L_{90}$ can be considered to be the "average minimum" noise level and is often used to describe the background noise. |
| $L_{10,T}$ | A noise level index. The noise level exceeded for 10% of the time over the period T. $L_{10}$ can be considered to be the "average maximum" noise level. Generally used to describe road traffic noise. |
| Free-Field | Far from the presence of sound reflecting objects (except the ground), usually taken to mean at least 3.5m |
| Facade | At a distance of 1m in front of a large sound reflecting object such as a building façade. |
| Fast Time Weighting | An averaging time used in sound level meters. Defined in BS 5969. |

In order to assist the understanding of acoustic terminology and the relative change in noise, the following background information is provided.

The human ear can detect a very wide range of pressure fluctuations, which are perceived as sound. In order to express these fluctuations in a manageable way, a logarithmic scale called the decibel, or dB scale is used. The decibel scale typically ranges from 0 dB (the threshold of hearing) to over 120 dB. An indication of the range of sound levels commonly found in the environment is given in the following table.

TABLE 12: TYPICAL SOUND LEVELS FOUND IN THE ENVIRONMENT

| Sound Level | Location |
|---|---|
| 0dB(A) | Threshold of hearing |
| 20 to 30dB(A) | Quiet bedroom at night |
| 30 to 40dB(A) | Living room during the day |
| 40 to 50dB(A) | Typical office |
| 50 to 60dB(A) | Inside a car |
| 60 to 70dB(A) | Typical high street |
| 70 to 90dB(A) | Inside factory |
| 100 to 110dB(A) | Burglar alarm at 1m away |
| 110 to 130dB(A) | Jet aircraft on take off |
| 140dB(A) | Threshold of Pain |

The ear is less sensitive to some frequencies than to others. The A-weighting scale is used to approximate the frequency response of the ear. Levels weighted using this scale are commonly identified by the notation dB(A).

In accordance with logarithmic addition, combining two sources with equal noise levels would result in an increase of 3 dB(A) in the noise level from a single source.

A change of 3 dB(A) is generally regarded as the smallest change in broadband continuous noise which the human ear can detect (although in certain controlled circumstances a change of 1 dB(A) is just perceptible). Therefore, a 2 dB(A) increase would not be normally be perceptible. A 10 dB(A) increase in noise represents a subjective doubling of loudness.

A noise impact on a community is deemed to occur when a new noise is introduced that is out of character with the area, or when a significant increase above the pre-existing ambient noise level occurs.

For levels of noise that vary with time, it is necessary to employ a statistical index that allows for this variation. These statistical indices are expressed as the sound level that is exceeded for a percentage of the time period of interest. In the UK, traffic noise is measured as the $L_{A10}$, the noise level exceeded for 10% of the measurement period. The $L_{A90}$ is the level exceeded for 90% of the time and has been adopted to represent the background noise level in the absence of discrete events. An alternative way of assessing the time varying noise levels is to use the equivalent continuous sound level, $L_{Aeq}$.

This is a notional steady level that would, over a given period of time, deliver the same sound energy as the actual fluctuating sound.

To put these quantities into context, where a receiver is predominantly affected by continuous flows of road traffic, a doubling or halving of the flows would result in a just perceptible change of 3 dB, while an increase of more than 25%, or a decrease of more than 20%, in traffic flows represent changes of 1 dB in traffic noise levels (assuming no alteration in the mix of traffic or flow speeds).

Note that the time constant and the period of the noise measurement should be specified. For example, BS 4142 specifies background noise measurement periods of 1 hour during the day and 15 minutes during the night. The noise levels are commonly symbolised as $L_{A90,1hour}$ dB and $L_{A90,15mins}$ dB. The noise measurement should be recorded using a 'FAST' time response equivalent to 0.125 ms.

## 7.2. Appendix B – Sound Measurement Results

Figure 8: Measured Time History – MP1

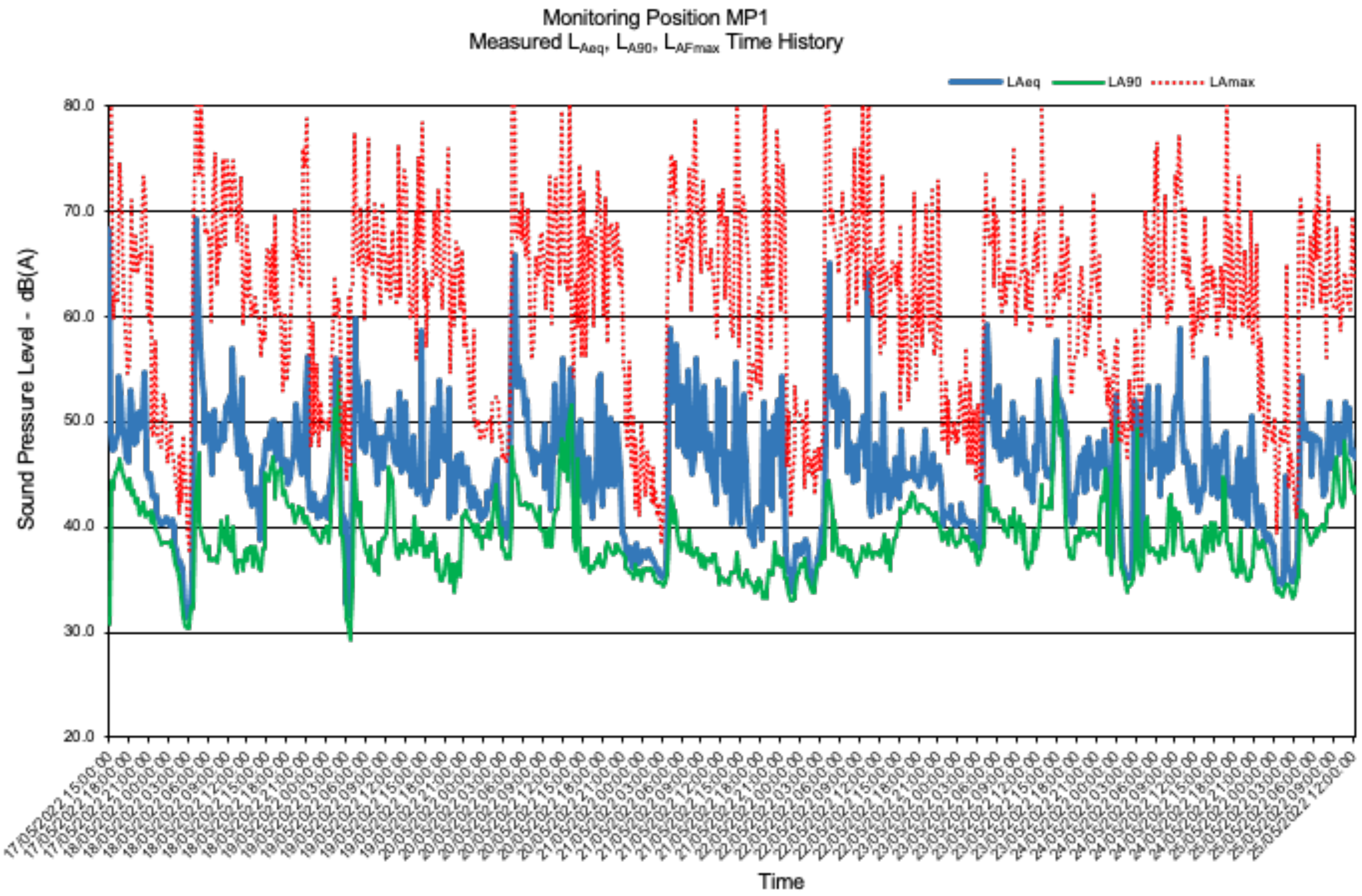
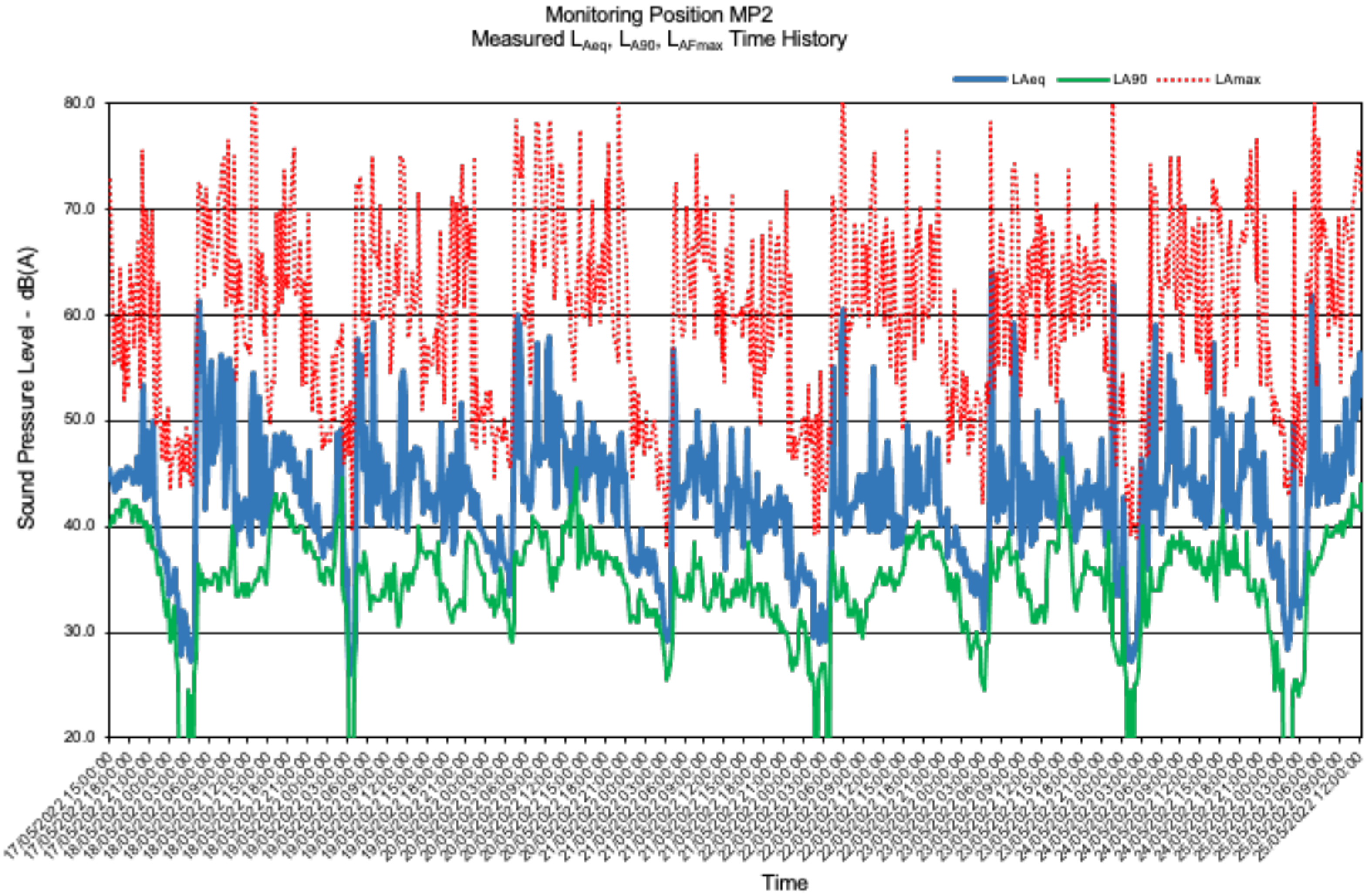


Figure 9: Measured Time History – MP2



## 7.3. Appendix C – Statistical Analysis

FIGURE 10: STATISTICAL ANALYSIS OF $L_{A90}$ BACKGROUND – DAYTIME - MP1

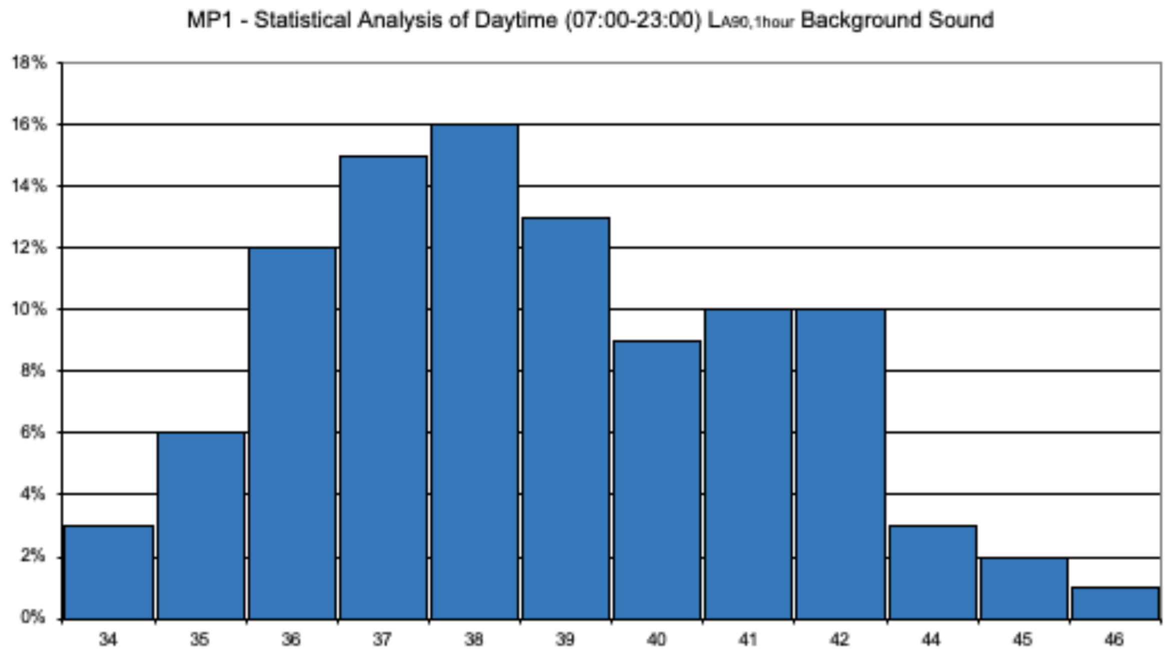



FIGURE 11: STATISTICAL ANALYSIS OF $L_{A90}$ BACKGROUND – NIGHT-TIME – MP1

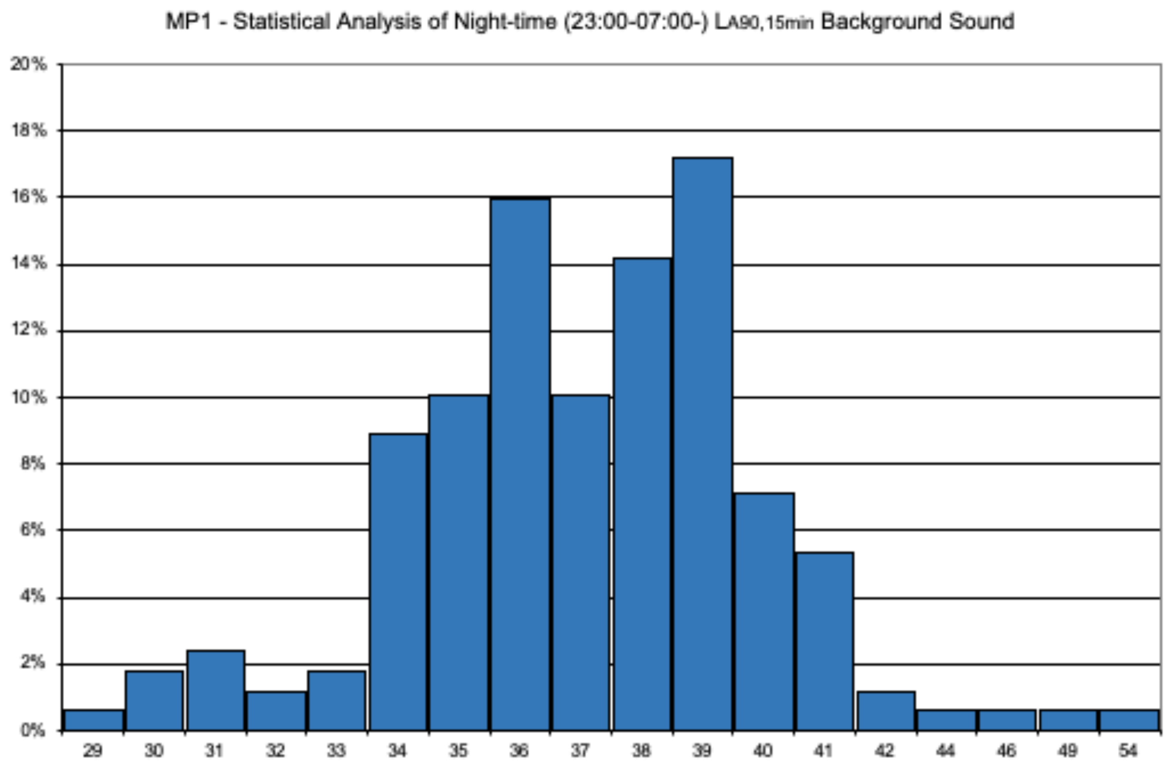


FIGURE 12: STATISTICAL ANALYSIS OF $L_{A90}$ BACKGROUND – DAYTIME – MP2

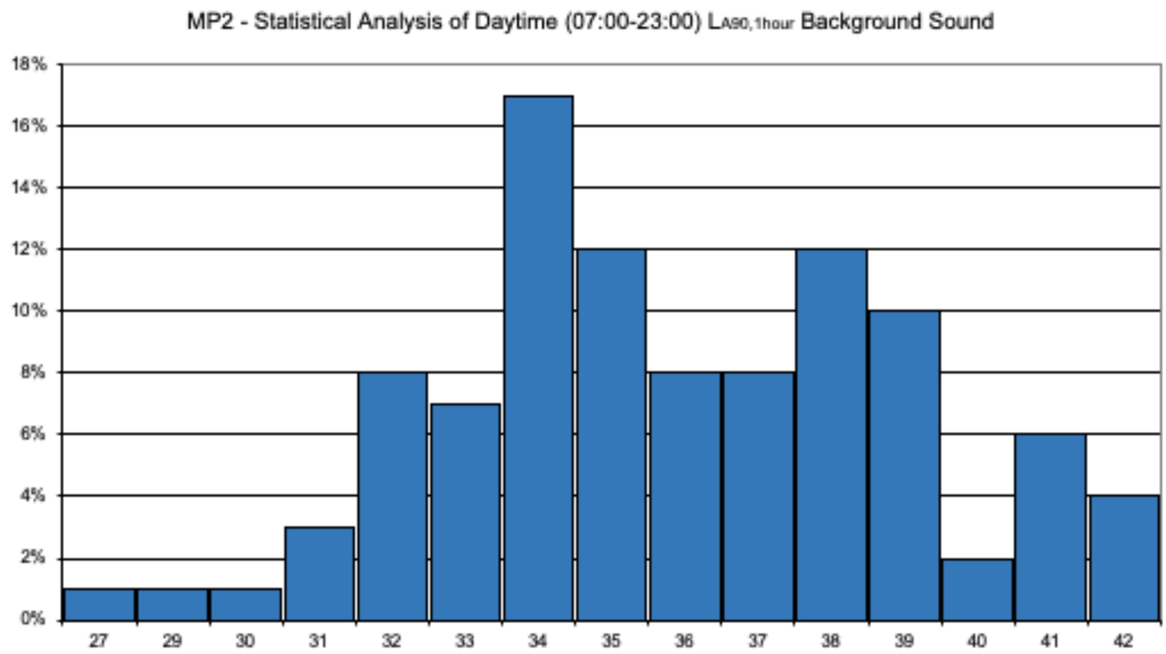



FIGURE 13: STATISTICAL ANALYSIS OF $L_{A90}$ BACKGROUND – NIGHT-TIME – MP12