UKBIC

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Coventry

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RTO Noise Assessment

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A	J.Willmott MIOA CEng	Jack Holmes MIOA	06/12/24	Issue	For Review

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Executive Summary

CPW Acoustics were commissioned to undertake an assessment of noise emission from the RTO machine at the UKBIC's Baginton facility. The purpose of the assessment was to determine whether the RTO's noise emission was compliant with Warwick District Council's (WDC) planning condition requirements and to develop a scheme of noise control if necessary.

Planning conditions 51 & 52 require the plant/equipment from the facility to achieve a noise level resulting at nearby residences of no greater than 3 dB above the representative background noise level.

A background noise survey was undertaken during May 2024 over a six-day period to establish the representative background noise levels at the nearest residences to the facility. Based on the background noise level and WDC's requirements, operational noise level limits applicable to building services noise emission at the nearby residences were derived.

The noise emission from the RTO was predicted in combination with the noise from other noise producing services systems used by the facility, namely the chillers and compressors. The RTO was modelled with the inclusion of an acoustic enclosure around its Process Fan and the resulting noise emission when combined with other sources of noise, was found to be compliant with the requirements of WDC.

1.0 Introduction

The UK Battery Industrialisation Centre (UKBIC) is based in Baginton, Coventry, near the airport. It is an industrial facility and has been in operation since 2020.

CPW Acoustics was commissioned by UKBIC to undertake a noise impact assessment of a Regenerative Thermal Oxidiser (RTO) machine, proposed to be located to the exterior of the main building.

This report presents details of the site, the RTO, the noise measurements undertaken to support the assessment, the assessment methodology, a comparison of the predicted noise levels to the requirements of the planning conditions and details of the mitigation measures developed to control noise to the required level.

Appendices are provided at the end of this report providing supporting information where necessary.

2.0 Assessment Criteria

Consideration has been given to relevant planning policy and regulations. The National Planning Policy Framework (NPPF)[1], the Noise Policy Statement for England (NPSE)[2] and Noise Planning Practice Guidance[3] provide a framework for how noise should be considered within the national planning system. Generally, noise policy and guidance give local authorities the flexibility to develop specific requirements appropriate to their area and the Site in question.

The core aim of these documents is to avoid and reduce significant adverse impacts and other adverse impacts on health and quality of life. A more detailed overview of these documents is included within Appendix B of this document.

2.1 British Standard BS 4142

BS 4142[4]. provides a method to assess the likelihood of adverse comment caused by noise from new industrial or commercial sources. A relevant summary of BS 4142 is included within Appendix B of this document.

BS 4142 presents an initial guide for assessing the noise impacts of industrial and commercial sound sources by subtracting the measured Background Sound Level from the Rating Sound Level. The Rating Level includes for penalty corrections to the Specific Sound Level (the cumulative noise level produced by the proposed plant) for the presence of any negative acoustic characteristics. BS4142 states 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 context.

c) A difference of around +5 dB is likely to be an indication of a significant 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.

2.2 Warwick District Council (WDC) Planning Conditions

WDC has issued planning conditions as part of the approval for the UKBIC development. Two of the Conditions apply to noise and are presented below.

> ***51**. Noise arising from any plant or equipment within the application site, when measured one metre from the façade of any residential property, shall not exceed the background noise level by more than 3dB(A) (measured as LAeq(5 minutes)). If the noise in question involves sounds containing a distinguishable, discrete, continuous tone (whine, screech, hiss, hum etc) or if there are discrete impulses (bangs, clicks, clatters, thumps etc) or if the noise is irregular enough to attract attention, 5dB(A) shall be added to the measured level.*

> ***52**. None of the buildings hereby permitted shall be first occupied until: i) a report detailing noise mitigation measures for the development (including noise calculations) has been submitted to and approved in writing by the District Planning Authority; and ii) the noise mitigation measures approved under (i) have been implemented in strict accordance with the approved details. The approved noise mitigation measures shall be maintained in a manner that achieves the noise attenuation specified in the report approved under (i) at all times thereafter.*

The above Conditions require an assessment similar in approach to that of BS 4142, in that the noise from the facility's building services systems should achieve a level relative to the measured background noise level at the nearest affected residential properties. Furthermore, a penalty should be applied to the specific noise from the plant, should it contain characteristics that could attract attention.

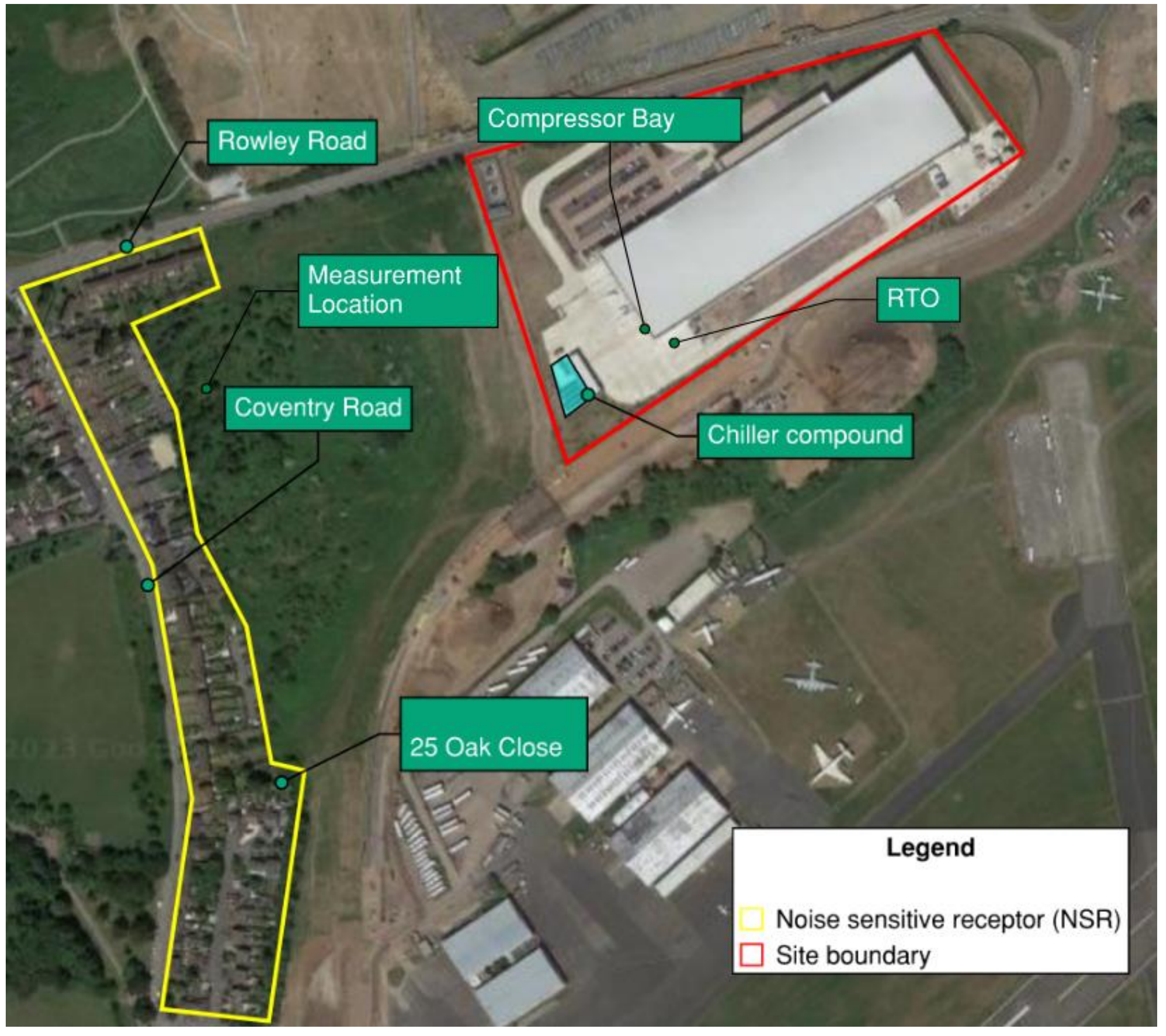
For clarity BS 4142 refers to the background level as a Background Sound Level, whereas the WDC Condition refers to the background noise level. They are the same parameter and referred to herein as the 'background noise level'.

[1] Department for Communities and Local Government (DCLG) (2021); 'The National Planning Policy Framework', TSO.
[2] Department for Environment, Food and Rural Affairs (DEFRA) (2010); 'Noise Policy Statement for England', DEFRA.
[3] DCLG (2014); 'Planning Practice Guidance website', DCLG. (http://planningguidance.planningportal.gov.uk/)
[4] BS 4142:2014 Methods for rating and assessing industrial and commercial sound

3.0 Site & Surroundings

The following image shows the location of the site, the location of the nearest noise sensitive receptors and the locations of the key noise producing items of external plant associated with the facility.

Figure 3.1: Site Layout and Measurement Locations



The compressor bay is situated within the envelope of the main UKBIC building and its intake and exhaust air passes through louvres located in the building's facade.

The chiller compound is located at the boundary of the site and accommodates six chillers.

To the west of the site, beyond the facility's boundary, is a large earth bund which extends north to south and provides the residential properties to the north-west with an extent of screening from the facility's noise producing plant.

4.0 Background Noise Survey

In order to assess the noise emission from the development's building services systems, the background noise levels at the nearest residential properties were measured.

A background noise survey was undertaken between 2nd – 7th May 2024 and the measurement location is shown in Figure 3.1. The measurement location was chosen to capture background noise levels representative of those at the noise sensitive receptors shown in Figure 3.1.

The background noise level at the measurement position was dominated by noise from nearby road infrastructure. The noise was monitored in-person at key day and nighttime periods to ensure there was no contribution from noise from any of the facilities building services systems.

Environmental noise monitoring was undertaken in general accordance with BS 7445-2:1991[5]. The following table presents details of the equipment used for the measurements.

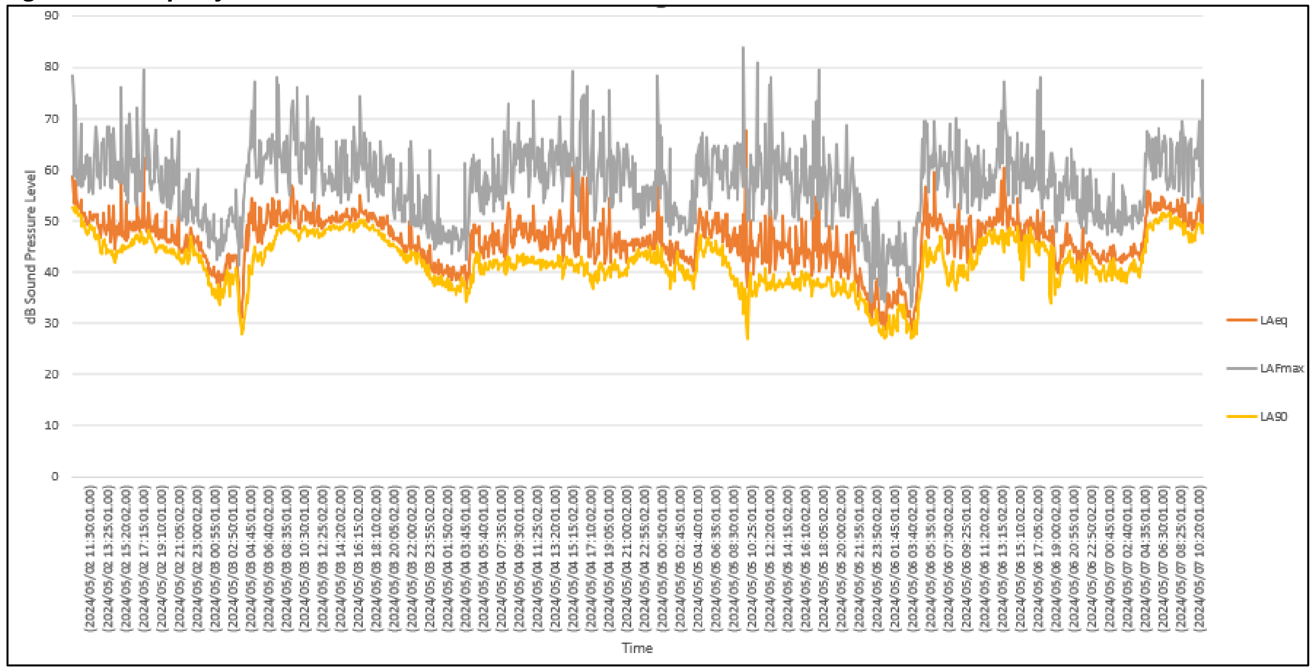
Table 4.1: Noise Measurement Equipment

Equipment
1 x Norsonic 140 Class 1 Sound Level Meter
1 x Norsonic 1251 calibrator
Accuracy: The sound level meter were field-checked and calibrated at the start and end of the survey periods. No significant drift in calibration was observed.
Sound calibrator: The accuracy of the sound calibrator used can be traced to National Physical Laboratory Standards.
Weather: Conditions were calm and warm for the duration of the survey. Wind speeds were monitored remotely and were generally below 5 m/s.

The following graph presents the time history of the noise measurements taken over a six-day period at the receptor position. The maximum noise levels (L_{AFmax}) are represented by the **grey line** and these are typically dictated by aircraft, birdsong and road traffic noise. The orange line represents the average noise level (L_{Aeq}) and this is mainly dictated by traffic noise and other continuous noise in the area. The yellow line represents the background noise level (L_{A90}) and this is dictated by distant traffic noise from the nearby major road infrastructure.

[5] British Standards Institute BS7445-2:1991 Description and measurement of environmental noise part 2: guide to the acquisition of data pertinent to land use

Figure 4.1: Graph of Measured Noise Levels



4.1 Representative Background Noise Level

As discussed within BS 4142, when determining the Background Sound/Noise Level, the objective is not simply to ascertain the lowest or modal measured value but to quantify what is typical during a given period. The absolute lowest background noise levels commonly occur during the middle of the night which can be of a lesser importance when compared to the start and end of the night when people are falling asleep or waking.

For this assessment, the 10th percentile value of the L_{A90} dataset has been chosen as the representative background noise level over the day and night-time period. This means the level used is amongst the lowest during the day and night-time period. This reflects a cautionary approach compared to using the modal or average value and is less restrictive than using the absolute lowest value.

The representative background noise levels captured over the entire duration of the six-day period at the receptor location are presented in the table below.

Table 4.2: Background Sound Level at Receptor Location

Period	Background Noise level, dB L_{A90}
Daytime (07:00 – 23:00)	37
Night-time (23:00 – 07:00)	31

4.2 Operational Plant Noise Limits

Operational plant limits have been derived based on the background noise level and the planning condition requirements. The planning condition states that the noise from plant / equipment should not exceed the background noise level by more than 3 dB. Therefore, the following limits have been derived for the day and night-time periods.

Table 4.3: Operational Noise Limits

Period	Background noise level, dB L_{A90}	+ 3 dB allowance
Daytime (07:00 – 23:00)	37	40 dB $L_{Aeq\ 5\ minutes}$
Night-time (23:00 – 07:00)	31	34 dB $L_{Aeq\ 5\ minutes}$

As the plant is operational over the day and night, only the night-time limits have been used for assessment as these are the more onerous limit.

5.0 Current Noise Emission from Chiller & Compressor Systems

The noise emission from the RTO when combined with the noise from the other plant systems installed at the facility must not cause the planning condition limits to be exceeded. Therefore, the predicted noise emission from the RTO must be combined with the noise from the other systems so that an overall level of noise emission from the facility can be identified.

The principal existing building services systems dominating the facility's noise emission are the chillers and compressors. The noise emission from these systems has been assessed and mitigation derived so that the overall noise emission meets WDC's planning condition requirements. Full details of the assessment are provided in report ref *211435 UKBIC 030624 2024 NIA JW PS.*

A summary of the predicted noise emission from the existing plant systems is provided in the following table. The systems run 24 hours a day and therefore only the nighttime predicted noise levels are shown, as the noise emission criterion during the night is more onerous than the criterion for day.

Table 5.1: Predicted Noise Level from Chillers & Compressors

Location	Time	Predicted plant level, $L_{Aeq,5min}$	Correction for acoustic features (+5 dB)	Plant limit, $L_{Aeq,5min}$	Compliant (Y/N)
Rowley Road	23:00–07:00	27	32	34	Y
Coventry Road	23:00–07:00	25	30	34	Y
Oak Close	23:00–07:00	21	26	34	Y

The predicted noise emission from the RTO will be combined with the above noise levels and the compared against the WDC planning condition requirements.

6.0 RTO Noise Emission Assessment

This section presents details of the RTO systems, the assessment of its noise emission and any mitigation measures derived to control noise.

6.1 RTO Details

The RTO is a machine used to clean air using a thermal process. It therefore relies on air intake and exhaust systems and these components create the majority of the machine's noise emission. The location of the RTO can be seen in Figure 6.1

and Figure 6.2 presents a diagram of the RTO's three noise producing elements, namely the Process Air Fan, the Combustion Air Fan the Gas Blower and the Exhaust Stack.

Figure 6.1: RTO Location

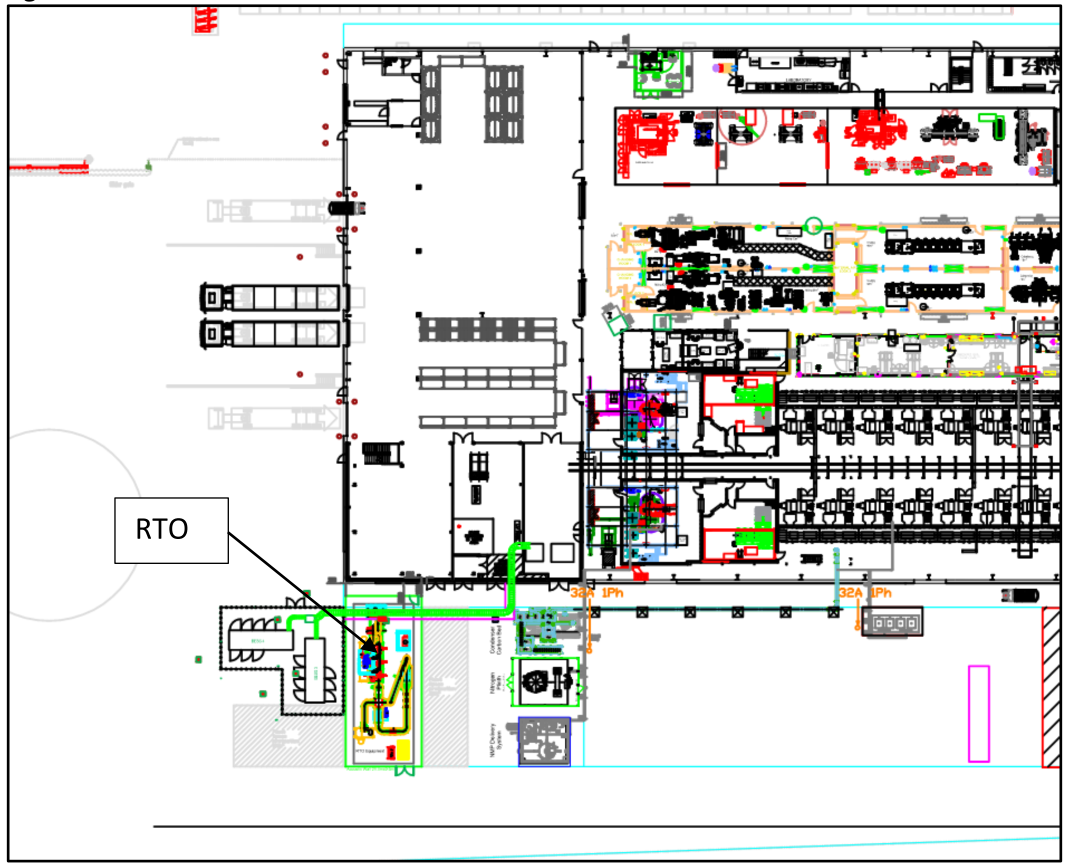
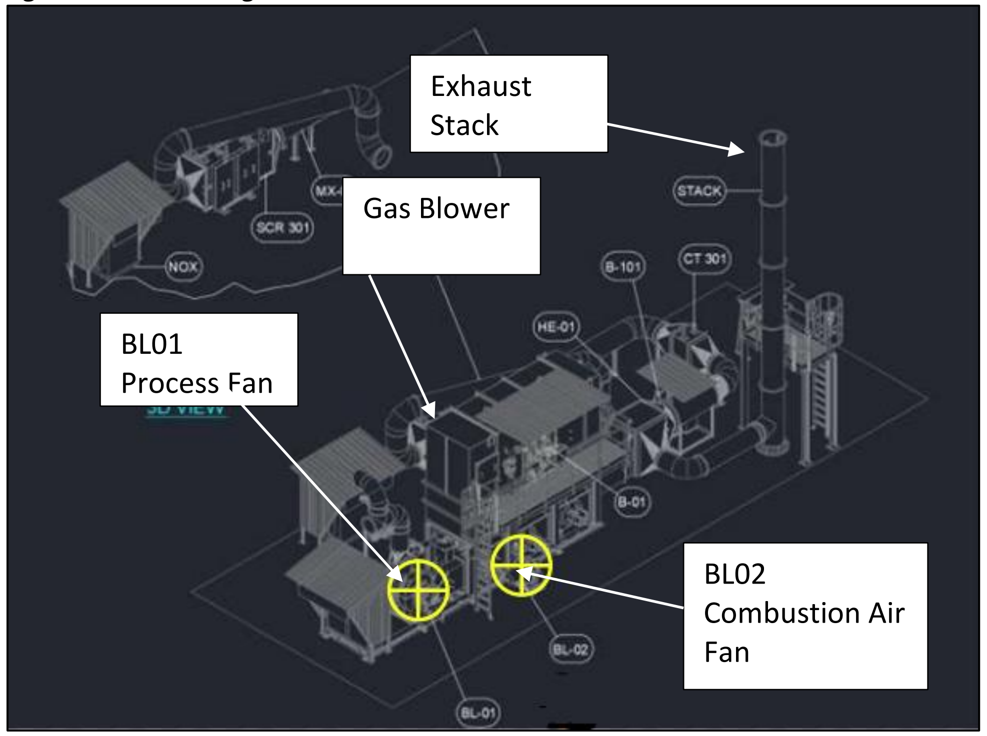


Figure 6.2: RTO Arrangement



6.2 RTO Sound Data

The following data was received from the supplier relating to the noise emission from the Combustion Air Fan, Process Fan and Exhaust Stack.

Table 6.1: RTO Sound Data

Fan	Sound Pressure Level dB(A)	Distance
BL01 Process Fan*	68	1.5 m
Gas Blower	76	1.0 m
BL 02 Combustion Air Fan	77	1.5 m
Exhaust Stack	75	1.5 m

* Noise emission when enclosed with a proprietary enclosure provided by the manufacturer.

The BL01 Process Fan will be fitted with a sound attenuating enclosure. Details of the enclosure were provided by the supplier of the RTO as follows:

> *The cabinet will be realized with a soundproofing panel in mineral wool and hot galvanized panel (it will possible Stainless steel too). BL-01 and K-01 cabinet will be provided with a cooling fans (it will evaluated ATEX zone for K-01).*
>
> *Each supplier is confident to be in compliance with a maximum sound pressure level of : 68dBA @ 1.5m of the perimeter of each soundproofing cabinet.*

The supplier has provided the following frequency content applicable to the noise from the RTO's fans.

Table 6.2: Frequency Shape

Octave Band Centre Frequency (Hz)							
63	125	250	500	1K	2K	4K	8K
-11	-4	+2	+8	0	-3	-8	-12

Full octave band data was received for the Exhaust Stack and this can be seen in the following table:

Table 6.3: Exhaust Stack Noise Levels

	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1K	2K	4K	8K
dB Lp	86	80	76	71	64	60	52	40

7.0 Noise Model and Predictions

This section presents details of the noise modelling process undertaken and predictions of noise emission RTO.

A model has been prepared in CadnaA noise mapping software to calculate the propagation of noise. Predictions have been undertaken in general accordance with BS 9613[6].

The modelling considers factors including geometrical spreading, local topography, ground absorption, screening, noise control measures and meteorological effects in undertaking the calculations. The calculations were based on the following:

- Plant dimensions as per manufacturers measurements, shown in figures 6.1 & 6.2.
- Buildings in the study area modelled based on open-source mapping data (OpenStreetMaps 2024).
- Global modelling parameters as defined in Table 7.1.

Table 7.1: List of Global Modelling Configuration Parameters and Values

Parameter	Value
Industry standards	ISO 9613
Co-ordinates system	British Transverse Mercator Co-ordinates
Max order of reflections	2.0
Default ground absorption	0.25
Building absorption	0.21

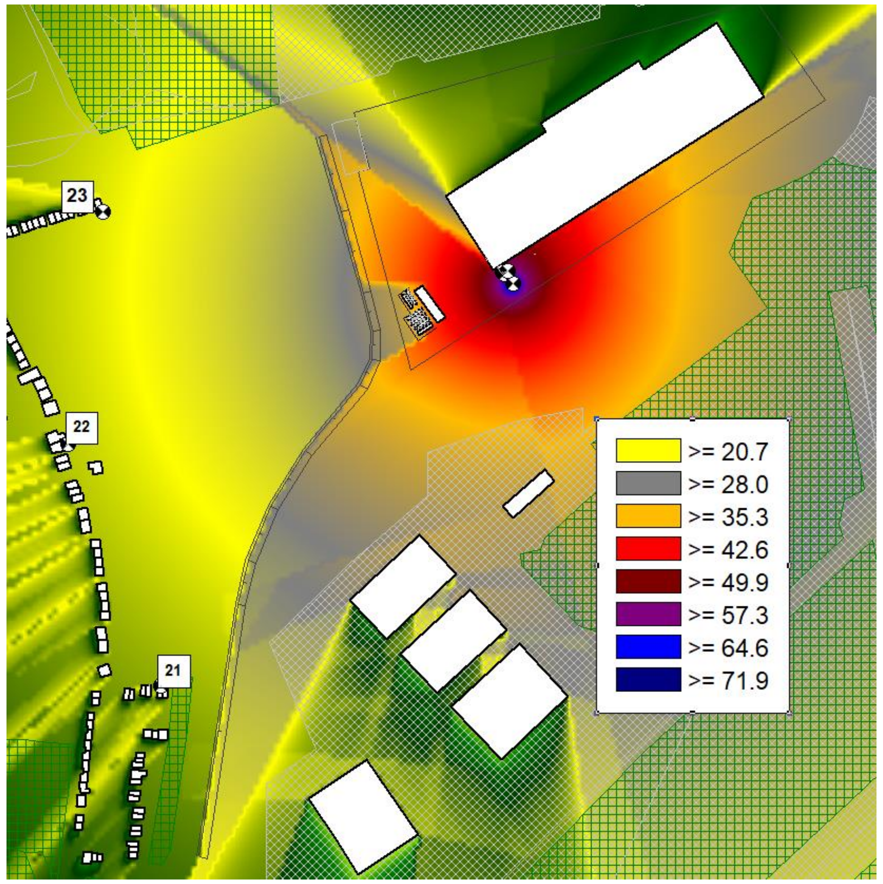
The predicted noise emission from the RTO resulting at the receptors can be seen in the following table. At this stage it is not clear whether the noise from the RTO contains any tones or other features likely to attract attention. Therefore, to assess the RTO conservatively, it has been assumed that at least one of these features will be present and accordingly, a 5 dB penalty has been assigned to its noise emission.

Table 7.2: RTO Noise Emission Predictions

Location	Time	Predicted plant level, $L_{Aeq,5min}$	Correction for acoustic features (+5 dB)	Plant limit, $L_{Aeq,5min}$	Compliant (Y/N)
Rowley Road	23:00–07:00	23	28	34	Y
Coventry Road	23:00–07:00	22	27	34	Y
Oak Close	23:00–07:00	21	26	34	Y

The following image shows an image of the model outputs and the facade noise levels resulting from the RTO at each receptor. The noise levels are the levels predicted at 1 m from the facade of each receptor.

Figure 7.1: RTO Noise Emission Prediciton



[6] British Standards Institute BS 9613-2: 1996 'Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation'

The noise level of the chillers and compressors when combined with the predicted noise from RTO is presented in the following table.

Table 7.3: Combined Noise Emission

Location	Time	Predicted RTO Noise Level, $L_{Aeq,5min}$	Predicted Chiller & Compressor Noise Level, $L_{Aeq,5min}$	Combined Noise Level $L_{Aeq,5min}$	Correction for acoustic features (+5 dB)	Plant limit, $L_{Aeq,5min}$	Compliant (Y/N)
Rowley Road	23:00–07:00	23	27	28	33	34	Y
Coventry Road	23:00–07:00	22	25	27	32	34	Y
Oak Close	23:00–07:00	21	21	25	30	34	Y

7.1 Conclusion

It can be seen that the predicted combined noise level emission from the RTO, the chillers and compressors meets the planning condition requirement and no further recommendations are necessary.

It is recommended that the noise emission from the RTO is confirmed with measurements, once it is setup and running at normal duty.

Appendix A – Glossary of Acoustic Terminology

The Appendix provides a non-specialists explanation of common acoustics terms that may occur in reports and technical notes. It is intended to give a brief overview of the term only.

Term	Definition
Decibel, **dB**	Is a unit of measurement of sound and is expressed on a logarithmic (base 10) scale. The human ear has a large dynamic range in sound reception, the logarithmic scale is a convenient way of compressing a range of sound pressures into a smaller range of numbers.
Sound Pressure Level, ***Lp***	$L_p = 20log10\left(\frac{P_{rms}}{P_{ref}}\right)dB$ This is the pressure deviation against a reference pressure caused by a passing sound wave. Where P_{rms} is the root mean square measured pressure and P_{ref} is the reference pressure, which is $2x10^{-5}$ pascals for air.
Sound Power Level, L_w	$L_W = 10log10\left(\frac{P}{P_0}\right)dB$ This is the total sound energy radiated from a given source. P_0 is the reference sound power level ($1x10^{-12}$) and the measured power.
Noise Rating Level, **NR dB**	Commonly used when describing noise from building services systems. This is a single figure value derived by plotting a noise spectrum against a set of curves. The lowest curve under which the level fits is the resulting NR level. The overall NR value is the highest of the individual NR values for each frequency band.
Frequency, **Hz**	$f = \frac{1}{T} = \frac{v}{\lambda}$ Where f is the frequency, T is the time to complete one cycle, v is the speed of sound and λ is the wavelength of a given sound pressure wave. Different frequencies are divided into octave and one third octave bands.
Frequency Weightings	Weightings are often applied to a spectrum of sound and act as a filter to account for different sensitivities and conditions. Weightings are often used to present a single figure value from a spectrum of sound.
A-weighted sound pressure level, L_{pA}	The sound pressure level with the A-weighting applied. The A-weighting is used for most environmental noise measurements and is used to weight a spectrum of sound to match the sensitivity of the human ear.
Measurement Time Weightings, **Fast, Slow**	Depending upon the measurement in question the time response of a sound level meter can be adjusted. For most measurements the Fast time weighting is selected (F) however, a slow time weighting (S) is often used to for the measurement train noise and vibration.
Equivalent continuous A-weighted sound pressure level, $L_{Aeq,T}$	An energy average and defined as the level of sound which, through a given period of time (T) would equate to the same A-weighted sound energy as the actual measured fluctuating sound.
Octave Band	A frequency band where the upper frequency of the band is twice the frequency of the lower limit.
Maximum noise Level, L_{AFmax}	With the meter set with a fast time response, F, this is the maximum instantaneous noise level measured during a given period of time.
Percentile level, $L_{AN,T}$ **(**$L_{A90,T}$**,** $L_{A10,T}$**)**	A sound pressure level which is exceeded for a given N% of a specified time period with an A-weighting and measured with a fast time response.
Background Sound/Noise Level, L_{A90}	Typically, these are amongst the lowest noise levels referenced over a given period and act to describe the noise level that is consistently exceeded 90% of the time. The background sound level excludes short term, intermittent noise sources and often acts to describe noise sources that operate consistently through a given period.
Ambient Noise Level	The most commonly used value to describe the ambient noise level the $L_{Aeq,\ lt}$ is the noise level in a given environment whilst it is subject to all of its normal sources of noise.
Rating Level, $L_{Ar,Tr}$	As defined in BS 4142. The equivalent continuous A-weighted sound pressure level that includes corrections for the presence of any acoustic characteristics such as tonality, impulsivity and intermittency.
Fast Fourier Transform (FFT) Analysis	This is a process which converts a signal into individual spectral components and thereby provides frequency information about the signal. FFTs are used for fault analysis, quality control, and condition monitoring of machines or systems.
Reverberation Time, ***T***	The time needed for the sound pressure level to decrease by 60 dB after the sound source has stopped, often written RT60. *T* is often followed by descriptors to present type of reverberation time value. For example, a T_{mf} is the mid-frequency (500 Hz – 2 kHz) reverberation time.
Absorption Coefficient, **α**	The fraction of reverberant sound energy absorbed by a material. It is expressed as a value between 1.0 which equates to perfect absorption and 0 which equates to zero absorption.
Acoustic Absorption, **A**	$A = \alpha S$ This is a measure of how much sound energy is absorbed by a material rather than reflected. Acoustic absorption is derived from the multiplication of the absorption coefficient by the surface area, S m^2 of a given material.
Absorption Class, **A - E**	The process of classifying materials into discreet Classes A-E, with Class A having the highest level of absorption. Each class band has upper and lower reference curve for

	absorption coefficients between 200 Hz and 5 kHz. Materials should be tested in accordance with BS EN ISO 354 and classified according to BS EN ISO 11654.
NRC	A single-number value ranging from 0 (no absorption) – 1 (100% absorption) describing the absorption performance of a material. NRC of a material is calculated by averaging its Sound Absorption Coefficients between250 Hz – 2 kHz .
Sound Insulation	The capacity of building elements to reduce sound transmission between spaces across a range of frequencies.
Sound Reduction Index, ***R***	$R = L_1 - L_2 + 10log10\left(\frac{S}{A}\right) dB$ A laboratory measure of the sound insulation performance of a material in a given frequency band or range. Where L_1 is the average sound pressure level in the source room and L_2 is the average sound pressure level in the receive room, S is the area of the tested element and A is the equivalent sound absorption area.
Weighted Sound Reduction Index, ***R_w***	A single figure value derived from a range of frequencies that characterises the sound reduction of a material. A reference curve is compared to the measured sound reduction indices and is adjusted until the total of unfavourable deviations below the reference curve is as close to but does not exceed 32.
Weighted Level Difference, ***D_w***	$D = L_1 - L_2$ The difference in noise level between a source room and a receive room. Where L_1 is the average sound pressure level in the source room and L_2 is the average sound pressure level in the receive room. The difference is then weighted and stated as a single figure.
Standardized Weighted Level Difference, ***$D_{nT'w}$***	$D_{nT} = D + 10log10\left(\frac{T}{T_0}\right) dB$ Where D is the measured level difference standardised for the reference reverberation time, T_0 and then weighted.
Weighted, Normalised Flanking Level Difference, *D_{nFw}*	The level difference via a flanking element, such as a mullion or ceiling detail, which is normalised and weighted.
Weighted, Normalised Element Level Difference, *D_{new}*	The level difference through a small element such as a trickle ventilator, which is normalised and weighted.
C_{tr}	A spectrum adaption term applied to the sound insulation single-number values (R_w, D_w, and $D_{nT,w}$). The C_{tr} adaption term acts to describe the performance of an element in the context of low frequency noise, such as that generated by traffic.
Impact Sound	Is the noise generated by an impact on a structure, such as walking or weight drops.
Weighted standardized impact sound pressure level, ***$L_{nT,w}$***	$L_{nT} = L_i - 10log10\left(\frac{T}{T_0}\right) dB$ Where L_i is the measured impact sound pressure level standardised for the reference reverberation time, T_0. It is used to describe the impact sound insulation performance of a

	floor. This is a measured noise level in a receive room generated by a standardised impact source in the room above.
Insertion Loss, IL	The reduction of noise level due to the presence of a noise control device such as an attenuator, excluding any regeneration noise created by its presence. A dynamic insertion loss, DIL, would include the impact of any regenerated noise.
Cross-talk	This references noise transmission via ventilation duct or similar air path between rooms.
Vibration	The vibratory motion of a surface can be described by the **displacement (m)**, **velocity (m/s)** or the **acceleration (m/s²)** of its oscillation. Depending upon the circumstance it is often useful to quantify the magnitude of vibration in a range of ways, including **Peak to Peak**, **Peak, r.m.s.** and **dB**. A reference level of 10-6 m/s² r.m.s. is usually used for acceleration.
Ground borne noise	Where the noise propagation path from a source is transmitted through the ground into a structure and is radiated via the structure, such as noise experienced from an underground train within a building above ground.
Structure borne noise	Noise caused by vibrating of elements of a structure, the source of which is within a building or structure with common elements.
Vibration Dose Value, VDV	$VDV = (\int_0^T a^4(t)dt)^{\frac{1}{4}}$ Where a(t) is the frequency weighted acceleration (m/s²), T is the total measurement period in seconds, VDV is the Vibration Dose Value ($m/s^{1.75}$) and is the dose a person is expected to be exposed to over the course of the day or night.
Estimated Vibration Dose Value, eVDV	$eVDV = k.a_{rms}.t^{0.25}$ Where k is a constant for crest factors (typically 1.41), a_{rms} is the weighted rms acceleration and t is the cumulative time of the period Typically used on short duration measurements of transients with known durations and occurrences

Appendix B – Summary of Relevant Planning Policy and Guidance

National Planning Policy Framework, 2021

The National Planning Policy Framework sets out the Government's planning policies for England and how these should be applied. It provides a framework within which locally prepared plans for housing and other developments can be produced.

One of the stated aims of the NPPF is to conserve and enhance the natural environment, as part of this new and existing developments should be prevented from contributing to or being put at risk from or being adversely affected by unacceptable levels of noise pollution. Planning policies and decisions should aim to mitigate and reduce to a minimum potential adverse impact resulting from noise or as a result of noise from a new development.

The NPPF refers to the Noise Policy Statement for England.

Noise Policy Statement for England, 2010

The aim of the NPSE is to provide clarity regarding current policies and practices to enable noise management decisions to be made within the wider context, at the most appropriate level, in a cost-effective manner and in a timely fashion.

The following are the general national noise policy aims:

- 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.

To define and quantify noise impacts the NPSE presents the following measures:

No Observed Effect Level (NOEL)	This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.
Lowest Observed Adverse Effect Level (LOAEL)	This is the level above which adverse effects on health and quality of life can be detected.
Significant Observed Adverse Effect Level (SOAEL)	This is the level above which significant adverse effects on health and quality of life occur.

It is not possible to have a single objective noise-based measure that defines SOAEL that is applicable to all sources of noise in all situations. Consequently, the SOAEL is likely to be different for different noise sources, for different receptors and at different times. It is acknowledged that further research is required to increase our understanding of what may constitute a significant adverse impact on health and quality of life from noise. However, not having specific SOAEL values in the NPSE provides the necessary policy flexibility until further evidence and suitable guidance is available.

Planning Practice Guidance, Noise 2019

The Planning Practice Guidance provides an online resource appraising when noise is relevant to the planning process, it's relationship with other planning concerns and how noise impacts can be determined. The resource references the NPSE and its approach for determining whether significant adverse effects are likely to occur.

The document presents a noise exposure hierarchy which is a useful framework for assessing the likely responses elicited by noise and whether action should be taken to mitigate. The noise exposure hierarchy is presented in Figure B1.

The guidance document seeks to explain the subjective nature of noise and the factors that apply when determining the level of impact experienced.

The document also outlines how planning and design can address the adverse effects of noise

Figure B1: Noise Exposure Hierarchy

Response	Examples of outcomes	Increasing effect level	Action
No Observed Effect Level			
Not present	No Effect	No Observed Effect	No specific measures required
No Observed Adverse Effect Level			
Present 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			
Present 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

British Standard 4142 2014 – Methods for rating and assessing industrial and commercial sound

BS 4142 describes methods for rating and assessing sound of an industrial and/or commercial nature, which includes:

a) sound from industrial and manufacturing processes;

b) sound from fixed installations which comprise mechanical and electrical plant and equipment;

c) sound from the loading and unloading of goods and materials at industrial and/or commercial premises; and

d) sound from mobile plant and vehicles that is an intrinsic part of the overall sound emanating from premises or processes, such as that from forklift trucks, or that from train or ship movements on or around an industrial and/or commercial site.

BS 4142 is applicable to the determination of the following levels at outdoor locations:

a) rating levels for sources of sound of an industrial and/or commercial nature; and

b) ambient, background and residual sound levels, for the purposes of:

   1) investigating complaints;

   2) assessing sound from proposed, new, modified, or additional source(s) of sound of an industrial and/or commercial nature; and

   3) assessing sound at proposed new dwellings or premises used for residential purposes.

BS 4142 defines the following terms:

Rating Level, $L_{Ar,Tr}$	The specific sound level plus any adjustment for the characteristic features of the sound. Characteristic features include tonality (up to +6 dB correction), impulsivity (up to + 9 dB correction) and intermittency (up to + 3 dB correction). For corrections of + 3 dB can be applied should any other characteristics be present that are distinctive against the residual acoustic environment.
Residual Sound, L_r	Is 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.
Specific Sound Level, Ls = $L_{Aeq,Tr}$	Is the equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval, T_r.

BS 4142 presents a range of methods and examples on how ratings and assessments can be carried out.

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+44 (0) 121 709 6600

Interface 100
Arleston Way, Solihull
B90 4LH

birmingham@cpwp.com
www.cpwp.com

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