Virtus HoldCo Ltd

VIRTUS DATACENTRES SLOUGH CAMPUS LON12 PERMIT VARIATION

Noise Report

RP AC 01
OCTOBER 2024

CONFIDENTIAL

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PROJECT NO. 70114956

OUR REF. NO. RP AC 01

DATE: OCTOBER 2024

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Noise Report

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APPENDICES

1. INTRODUCTION

New emergency backup generators are proposed at a data centre known as LON12, which forms part of the Virtus Slough Campus of data centres. The other data centres in this cluster are LON3, LON4, and LON10. An existing permit is held for LON3, LON4 and LON10, and a variation is being sought to include the new generators at LON12 within the same permit.

The generators will only be used to supply power in the event of a mains power failure. However, each generator will be tested individually once a month.

Noise emissions from the pre-existing generators at LON3, LON4 and LON10 were previously assessed by WSP, and the results presented in report 70092911 RP AC 01 dated August 2022. Elements of the noise survey and modelling presented in that report have informed the assessment described herein.

This report, which is intended to be appended to the application to vary the environmental permit application for the generators, details the best available techniques (BAT) that have been employed to reduce the noise impact of the generators, and presents a noise assessment that predicts the noise levels expected to occur at nearby noise sensitive locations during the testing of the generators.

A technical glossary is provided in Appendix A.

A site plan showing the proposed locations of the generators and the nearest residential properties can be found in Appendix B.

2. POLICY AND REQUIREMENTS

2.1. ENVIRONMENT AGENCY REQUIREMENTS

2.1.1. DATA CENTRE FAQ HEADLINE APPROACH

The Environment Agency's *Data Centre FAQ Headline Approach*[1] document states that no special treatment is required for data centre noise, compared to any other sources that are the subject of a permit application:

"1.10.6 Noise

Generally same rules acceptable for planning though clearly noise control is a BAT issue within the permit application. See https://www.gov.uk/government/publications/environmental-permitting-h3-part-2-noise-assessment-and-control"

2.2. ENVIRONMENT AGENCY GUIDANCE: *NOISE AND VIBRATION MANAGEMENT: ENVIRONMENTAL PERMITS*

The Environment Agency's environmental permitting guidance is published online in a publication entitled Noise and Vibration Management: Environmental Permits (2021)[2] and supersedes the previous H3[3] guidance.

The document references the impact assessment method described in BS 4142 (see below). The document also outlines the operator's responsibilities to use 'best available techniques' (BAT)[4] to prevent or minimise noise pollution.

2.3. BRITISH STANDARD 4142

BS 4142:2014 +A1:2019[5] provides an assessment method for sound arising from commercial sound sources, including external plant and on-site vehicle movements and unloading, at residential receptors. It uses a relative assessment approach whereby the predicted commercial sound level (suitably penalised for annoyance character if appropriate) is compared with the prevailing background sound level. A summary of the BS 4142 approach is set out as follows:

- Establish the specific sound level of the source(s).
- Measure the representative background sound level.

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[1] *Data Centre FAQ Headline Approach*, DRAFT version 10.0 H. Tee 01/06/18 – Release to Industry, Environment Agency, 11/01/2019
[2] *Noise and Vibration Management: Environmental Permits* (2021), Environment Agency. Available at: https://www.gov.uk/government/publications/noise-and-vibration-management-environmental-permits/noise-and-vibration-management-environmental-permits
[3] *Horizontal Guidance for Noise Part 2 – Noise Assessment and Control* (version 3, June 2004), Environment Agency
[4] In this report, Best Available Techniques (BAT) are as defined in the Industrial Emissions Directive 2010/75/EU (Integrated Pollution Prevention and Control)
[5] BS 4142:2014 +A1:2019 Methods for rating and assessing industrial and commercial sound, British Standards Institute

- Correct the specific sound level for on-time and interferences if necessary.
- Rate the specific sound level to account for distinguishing characteristics.
- Estimate the impact by subtracting the background sound level from the rating level.
- Consider the initial estimate in the context of the sound and its environs.

The representative background sound level should be established by measurements at the receptor locations.

The specific sound level is rated using the following penalties:

- Tonality up to 6 dB
- Impulsivity up to 9 dB
- Other sound characteristics up to 3 dB
- Intermittency 3 dB

An initial estimate of the impact of the specific sound is obtained by subtracting the measured background sound level from the rating level as described in section 11 of BS 4142:2014. The results of this comparison are assessed on the basis of the following guidance:

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

The specific factors that should be taken into account in the consideration of context are as follows:

- The absolute level of the sound.
- The character and level of the residual sound compared to the character and level of the specific sound.
- The sensitivity of the receptor and whether dwellings or other premises used for residential purposes will already incorporate design measures that secure good internal and/or outdoor acoustic conditions.

The method described in BS 4142:2014 specifically states that it is "*not intended to be applied to the derivation of indoor sound levels arising from sound levels outside, or the assessment of indoor sound levels*" (section 1.3). Therefore, this guidance has only been used for assessing sound levels outside the houses.

2.4. ISO 9613-2:2024

ISO 9613-2:2024[6] specifies an engineering method for calculating the attenuation of sound during propagation outdoors in order to predict the levels of environmental noise at a distance from a variety of sources. The calculation method is implemented in CadnaA noise modelling software (see section 4).

This standard has been recently updated (the previous version was published in 1996) and the changes in calculation method result in differences in predicted noise levels. The previous noise report for LON3, LON4 and LON10 was produced prior to 2024, and therefore used the 1996 version of this standard. For consistency, noise predictions presented for the generators serving LON3, LON4 and LON10 have been updated using the latest version of the standard.

[6] ISO 9613-2:2024 *Acoustics – Attenuation of sound during propagation outdoors – Part 2: Engineering method for the prediction of sound pressure levels outdoors*. International Organization for Standardization

3. BEST AVAILABLE TECHNIQUES

Best available techniques (BAT) have been employed in the design of the data centre and associated generator plant, to reduce the noise impact of the generators at residential properties. These can be summarised as follows:

- The site is located in a predominantly industrial area, to avoid having noise-sensitive land uses immediately adjacent, and to ensure that existing noise levels at nearby noise sensitive locations are not excessively low
- The site has two connections to the National Grid, which will reduce the likelihood of power failures, and thereby reduce the likelihood of the generators being required to operate in a genuine emergency scenario
- The existing generators are installed adjacent to the LON3, LON4, and LON10 data centre buildings, using the surrounding buildings to provide as much acoustic screening as possible between the generators and the receptors
- New generators will be installed adjacent to the east and south elevations of the LON12 data centre building, using the surrounding buildings, which will provide acoustic screening between the generators and the receptors
- Generators are to be installed in enclosures that include sound attenuation measures to reduce the radiated sound levels, including attenuators on the air inlet and outlet, and the flue
- The generator testing regime is such that generators are each tested individually and for only short periods, which reduces the level of sound produced during the tests
- Generators will only be tested during the daytime, when residual and background sound levels are typically higher
- ‘On-load’ tests will be carried out in the middle of the day when background sound levels are at their highest

To demonstrate the sound impact associated with the proposed generators, a noise assessment has been carried out using the procedure defined in BS 4142:2014.

4. ENVIRONMENTAL NOISE SURVEY

4.1. OVERVIEW

Noise surveys have been undertaken at and around the development site, as follows:

- A baseline environmental noise survey to establish the background and residual sound levels at existing noise sensitive receptors; and
- A sound source survey to determine the sound levels produced by the generators.

The sound source measurements are not directly related to the LON12 generators – for full details, refer to WSP report 70092911 RP AC 01.

4.2. BASELINE NOISE SURVEY

An environmental noise survey was carried out at locations that are representative of the closest noise-sensitive receptors, between approximately 09:30 and 17:00 on 14 April 2022.

4.2.1. POSITIONS

Sound level monitoring was carried out at the following four positions:

1. To the front of 5 Montrose Avenue. The microphone was installed atop a fence post, approximately 2 metres above the ground, in free-field conditions, adjacent to the public footpath approximately 10m west of 5 Montrose Avenue.
2. To the north of residential receptors at Farnham Road. The microphone was installed on a tripod at approximately 1.5m height, in free-field conditions, on publicly-accessible grass area approximately 10m to the rear/north of 172 Farnham Road.
3. To the north of residential receptors at Hadlow Court. The microphone was installed on a tripod at approximately 1.5m height, in free-field conditions, on public footpath approximately 50m to the north of 32 Hadlow Court.
4. To the northeast of residential receptors at Cippenham. The microphone was installed on a tripod at approximately 1.5m height, beside the public footpath, in free-field conditions.

In all locations the microphone was installed on a tripod at a height of approximately 1.5 metres above the ground, and more than 1 metre from the façade.

The positions are indicated on the site plan in Appendix B.

4.2.2. MEASUREMENT EQUIPMENT

The following equipment was used to carry out the measurements.

Table 4-1 – Sound measurement equipment

Position	Equipment Description	Manufacturer & Type No.	Serial No.	Calibration Due Date
1	Sound Level Meter	01 dB-CUBE	10630	18 October 2021
	Pre-amplifier	01 dB PRE 22	10184	
	Microphone	GRAS 40CD	288065	
	Calibrator	01 dB-CAL 21	34344461	31 August 2021

2	Sound Level Meter	01 dB-SOLO	060845	17 December 2020
	Pre-amplifier	01 dB PRE21S	13164	
	Microphone	MCE212	182024	
	Calibrator	01 dB- CAL 21	51031216	20 December 2021
3	Sound Level Meter	01 dB-SOLO	11810	18 October 2021
	Pre-amplifier	01 dB PRE21S	14425	
	Microphone	MCE212	57685	
	Calibrator	01 dB- CAL 21	34323996	
4	Sound Level Meter	01 dB-SOLO	61331	18 October 2021
	Pre-amplifier	01 dB PRE21S	14575	
	Microphone	MCE212	92344	
	Calibrator	Norsonic 1251	31460	

The sound level meters had been calibrated to traceable standards at a laboratory within two years, and the calibrators within one year. The calibration of each measurement chain was verified using the field calibrators before and after the survey. No deviation greater than 0.1 dB was found to have occurred. The microphones were each fitted with the standard manufacturer supplied windshields.

4.2.3. EXISTING SOUNDSCAPE

The soundscape at the four measurement positions can be described as follows:

1. Local road traffic was the dominant noise source. No sounds from LON3, LON4, and LON10 were audible.
2. Local road traffic was the dominant noise source. Distant industrial sounds were audible. No sounds from LON3, LON4, and LON10 were audible.
3. Local road traffic was the dominant noise source. Distant industrial sounds were audible. No sounds from LON3, LON4, and LON10 were audible.
4. Local road traffic was the dominant noise source. No sounds from LON3, LON4, and LON10 were audible.

Foliage was present close (within 10 m) to monitoring locations 2, 3, and 4. However, wind speed was less than 1.5 m/s and foliage movement did not affect measurements.

4.2.4. WEATHER CONDITIONS

The weather during the baseline survey was fine and dry throughout. Wind speeds were less than 1.5 m/s at all locations.

4.2.5. RESULTS

The generators will only be tested during daytime hours of 07:00 – 19:00. Therefore, measurements were made during daytime hours only. The measured background sound levels at the receptor locations are shown in Table 4-2.

For consistency with the proposed daytime operation and BS 4142 guidance, 1-hour background sound level monitoring periods have been adopted in all cases.

Table 4-2 – Summary of background sound levels (free-field)

Location	Time	dB $L_{A90,1hour}$			Adopted background sound levels
		Mean	Mode	Min	
No. 1 Montrose Ave	09:38 – 14:57	52	52	51	**52**
No. 2 Farnham Rd	10:05 – 15:09	51	51	51	**51**
No. 3 Melbourne Ave	10:22 – 15:24	51	51	51	**51**
No. 4 Cippenham	10:49 – 16:58	50	50	49	**50**

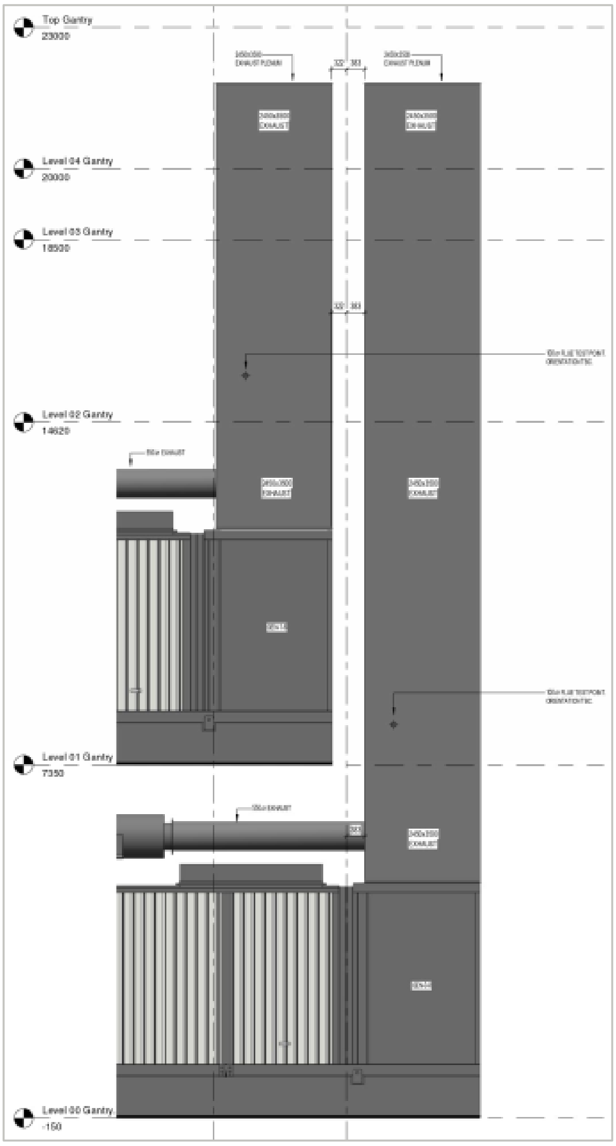
5. LON12 PROPOSALS

5.1. OVERVIEW

A total of sixteen generators are proposed, with ten being on the east side of the building (refs. A39 – A48), and six on the south (refs. A33 – A38). They will be installed in a stacked arrangement, with half at ground level and half on a gantry above. Air will be drawn in from the inlet louvre on the front of the unit, and exhaust air will exit vertically via a duct. Exhaust air from the ground level generator will have a longer exhaust duct so that it discharges at the same level as the gantry unit above, and flue gases will vent into the exhaust air via the exhaust ductwork, as shown in Figure 5-1. A plan showing the locations of the proposed generators is presented in Figure 5-2.

Figure 5-1 – Section showing exhaust ductwork arrangement (from AVK drawing LON12-AVK-ZZ-GA-DR-X-500006 C01)

Section showing exhaust ducts



Section showing flue in exhaust air ducts

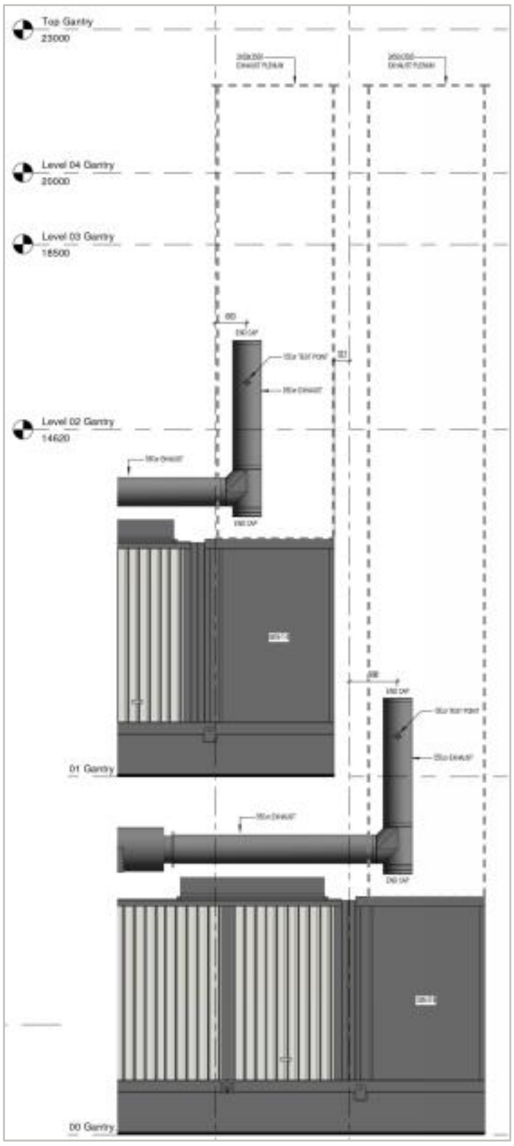
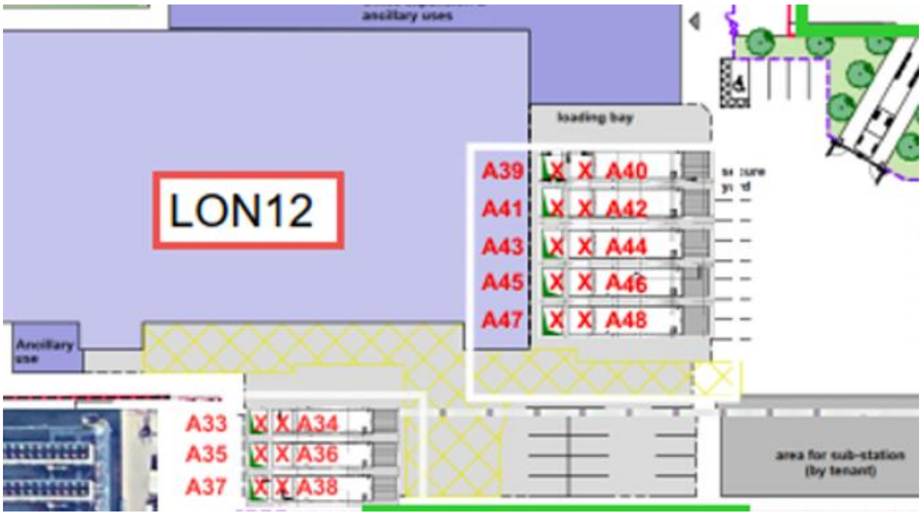


Figure 5-2 – Plan showing locations and references of proposed LON12 generators



5.2. NOISE DATA

Each generator will be installed in an acoustic enclosure measuring 14 m in length, 3.5 m in width and 4 m in height, which shall include the following noise control measures:

- Inlet attenuator
- Outlet attenuator
- Flue attenuator
- Walls are to be lined internally with plasterboard and insulated with Rockwool
- Floor lined with 4.5 mm chequer plate steel

Noise data have been supplied by the generator supplier, in *Acoustic Enclosure Technical Submittal* (LON12-AVK-ZZ-GA-TS-X-500103 rev 02) dated 2 August 2024. The following sound power levels and sound pressure levels are presented:

Table 5-1 – Generator sound levels from AVK tech sub (A-weighted)

Sound level parameter	63	125	250	500	1k	2k	4k	8k	dBA
Casing radiated, dB L_{wA}	81.3	89.0	94.8	96.3	90.3	81.9	76.6	70.8	**99.8**
Casing radiated, dB L_{pA} at 1 m	56.5	64.2	70.0	71.5	65.5	57.1	51.8	46.0	**75.0**
Casing radiated, dB L_{wA}/m^2 (calculated)	59.1	66.8	72.6	74.1	68.1	59.7	54.4	48.6	**77.6**
Inlet, dB L_{wA}	74.7	75.1	64.1	71.4	74.0	73.5	72.7	77.4	**83.0**
Inlet, dB L_{pA} at 1 m	66.7	67.1	56.1	63.4	66.0	65.8	64.7	69.4	**75.0**
Exhaust, dB L_{wA}	79.9	72.5	65.1	72.0	69.4	75.1	89.6	87.4	**92.1**
Exhaust, dB L_{pA} at 1 m	71.9	64.5	57.1	64.0	61.4	67.1	81.6	79.4	**84.1**

6. NOISE ASSESSMENT

6.1. GENERATOR OPERATING CONDITIONS

Each generator is tested once a month. In each year, each generator will be tested once under load for 2½ hours, and eleven times off-load for a 15-minute start-up test.

Under normal circumstances, only one of the generators would be tested simultaneously.

As the most representative scenario, noise predictions for the closest individual generators to each of the dwellings have been made, the highest of which has been used in the assessment.

6.2. SOURCE SOUND POWER LEVELS

Source sound power levels (SWLs) for the LON3, LON4 and LON10 generators can be found in WSP report 70092911 RP AC 01. Sound power levels for the proposed LON12 generators are based on data provided by the supplier of the generator and noise control equipment – AVK – as quoted in Table 5-1 above. For walls and roof elements that do not have louvres, the total sound power level for each element has been calculated in the noise model, based on the sound power level per unit area (dB L_{wA}/m^2) calculated in Table 5-1.

6.3. NOISE MODEL

A computerised noise model of the site and surrounding area has been created using the CadnaA noise prediction software (version 2024 MR1), which implements calculations of sound propagation in accordance with ISO 9613-2:2024, and assumes a moderately downwind condition in all calculations.

Model data sources and calculations settings are as follows:

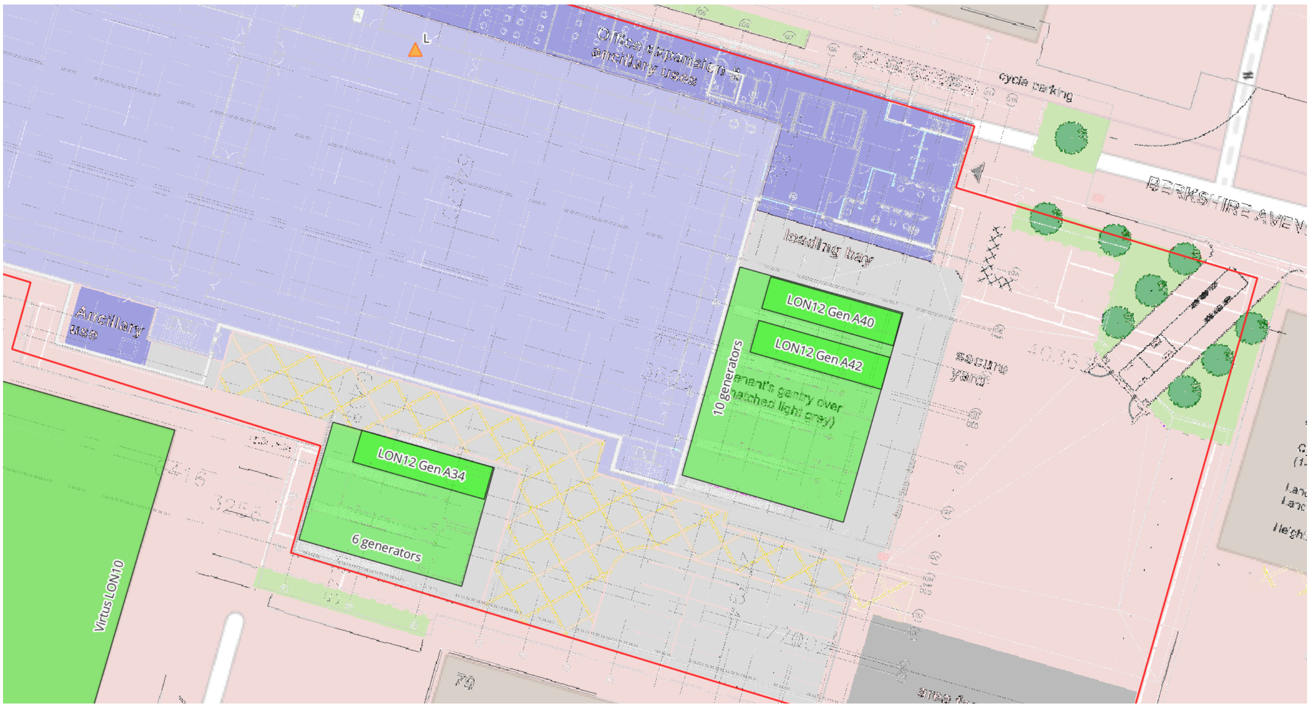
- The model was set to apply the prediction methodology set out in the ISO 9613-2:2024 for industrial/commercial noise source
- The model assumed flat topography
- Building locations and geometry were drawn manually using satellite imagery
- On-site buildings are 12m tall and off-site industrial buildings between 4m and 8m tall
- Houses have not been included in the model
- Maximum order of reflection set at 3
- Globally, ground absorption was set to G = 0 (100% acoustically reflective ground), reflective of the local area
- Buildings have an absorption coefficient of 0.1
- Noise level receiver points and grids were set at 4m

To determine which LON12 generator would represent the worst case for each receptor, a simple model was produced, which included a point source for each of the gantry level generators (chosen as these will be less screened by intervening structures), at a height of 21.8 m (i.e. the height of the proposed exhaust terminal). The sound levels were predicted at the four receptors, and the generator with the highest predicted sound level was noted, as summarised in Table 6-1. The locations of the worst-case generators for each of the representative receptors are illustrated in Figure 6-1.

Table 6-1 – Generator of each type with highest predicted noise level at representative receptors

Receptor	LON12 generator with highest predicted noise level
No. 1 Montrose Ave	A40
No. 2 Melbourne Avenue	A40
No. 3 Cippenham	A34
No. 4 Farnham Road	A42

Figure 6-1 – Plan showing generators assessed to each receptor location (annotations in green boxes)



Noise levels were then modelled with each generator in Table 6-1 represented as area sources, using the sound power levels in Table 5-1.

The predicted noise levels for each of the generators assessed are presented in Table 6-2.

For comparison, sound levels have also been modelled for the LON3, LON4 and LON10 generators that had the greatest influence on the outcomes of the previous assessment, using the updated ISO 9613-2 methodology.

Table 6-2 – Predicted noise levels

Receptor	Predicted specific sound level for AVK generators at LON3, LON4 & LON10 (dB $L_{Aeq,1hr}$) – based on ISO 9613-2:1996	Predicted specific sound level for AVK generators at LON3, LON4 & LON10 (dB $L_{Aeq,1hr}$) – using ISO 9613-2:2024	Predicted specific sound level for LON12 (dB $L_{Aeq,1hr}$)
No. 1 Montrose Ave	34.0	38.2	38.8
No. 2 Melbourne Avenue	40.2	38.2	42.9
No. 3 Cippenham	23.4	34.5	35.8
No. 4 Farnham Road	27.4	36.9	42.8

These predictions indicate that the specific sound levels from the LON12 generators will be higher than noise from those installed at LON3, LON4 and LON10. As the tests are carried out for each generator individually, assessing noise from the LON12 generators therefore represents the most robust approach.

When modelled with the 2024 version of ISO 9613-2, the specific sound levels predicted for most of the generators installed at LON3, LON4 and LON10 are higher than previously reported. This is largely due to changes in the ISO 9613-2 methodology.

6.4. SOURCE, RATING AND TIME PERIOD CORRECTIONS

The assessment has adopted the following corrections for source data, on-time and BS 4142 rating corrections:

- **Off-load start-up test**

Closest generator to each receptor as shown in Table 6-1

  - -6 dB correction for time period (15 minute) being ¼ of the assessment period (1 hour)
  - +3 dB intermittency correction as the source turns on and off during the 1-hour assessment period
  - No reduction applied to compensate for the potential for off-load test having lower sound power levels than on-load

- **On-load test**

Closest generator to each receptor as shown in Table 6-1

  - No intermittency as the on-time (2 hours) is twice as long as the assessment period (1 hour)
  - No increase to account for any potential increase in sound power due to the generator being on-load, as the supplier's sound power data apply during 100 % load conditions

6.5. PREDICTED SOUND LEVELS

The following tables present the generator sound levels predicted at the receptors identified above. In both cases, these are based on the worst-case generator for each assessment location, and therefore represent the highest sound levels expected to occur during the tests.

Table 6-3 – Predicted sound levels during LON12 off-load start-up tests

Calculation step	No. 1 - Montrose Ave	No. 2 - Melbourne Ave	No. 3 - Cippenham	No. 4 - Farnham Rd
Specific level, dB $L_{Aeq,15min}$	39	43	36	43
Rating level, dB $L_{Ar,1hour}$	36	40	33	40
Background sound level, dB $L_{A90,1hour}$	52	51	51	50
Difference	-16	-11	-18	-10

Table 6-4 – Predicted sound levels during LON12 on-load duty tests

Calculation step	No. 1 - Montrose Ave	No. 2 - Melbourne Ave	No. 3 - Cippenham	No. 4 - Farnham Rd
Specific level, dB $L_{Aeq,15min}$	39	43	36	43
Rating level, dB $L_{Ar,1hour}$	39	43	36	43
Background sound level, dB $L_{A90,1hour}$	52	51	51	50
Difference	-13	-8	-15	-7

The predicted rating levels are at least 7 dB lower than the background sound levels, which is an indication of a low impact, depending on the context.

6.6. CONTEXT

BS 4142 requires that the results of the assessment are considered within the context of the existing soundscape.

The site lies within a predominantly industrial area, but residential land uses are nearby. The generator sound sources are broadband, and produce consistent, unvarying sound while they are operational. As such, they produce a sound that is similar in nature to many of the existing sound sources noted during the survey (see section 4.2).

The absolute levels predicted are relatively low. The existing houses are relatively modern and incorporate double-glazed windows that will offer a substantial sound level reduction (likely to be at least 25 dB). With windows closed, indoor sound from the generator tests is likely to be less than 20 dBA, and, therefore, lower than many sounds associated with normal residential activities, especially considering that the tests would only take place during the daytime.

On this basis, the context appraisal supports the finding of a low impact at all receptors.

6.7. UNCERTAINTY

Where it is necessary to make assumptions in the assessment described above, these have been worst-case, and present a robust case. These are summarised as follows, along with an estimate of the likely uncertainty (positive values indicate an over-estimate of the potential impact of the specific source compared to the background sound.

Table 6-5 – Summary of uncertainty estimation

Description of uncertainty	Lower bound of impact uncertainty (under-estimation)	Upper bound of impact uncertainty (over-estimation)
ISO 9613-2 calculation method for predictions at 0 – 5 m height (from Table 4 of ISO 9613-2:2024)	-3 dB	+3 dB
Measurement of specific source and background sound level corrections	-1 dB	+2 dB
Derivation of specific source SWLs using measurements (LON3, LON4 & LON10 generators only)	-2 dB	+2 dB
Use of supplier's data for modelling LON12 generators (the supplier is contractually obliged to meet the sound levels quoted in the technical submittal)	0 dB	+2 dB
Use of closest specific source to calculate receptor levels	0 dB	+1 dB
+3 dB increase applied to account for on-load conditions (LON3, LON4 & LON10 generators only)	Not quantified	Not quantified
Adverse wind direction as implemented in CadnaA	0 dB	< +1 dB

The principle of uncertainty estimation is not that one should assume all uncertainty deviations to occur simultaneously (in either polarity). However, it can be seen from the above that uncertainty is generally estimated to be greater in the direction that would over-estimate the specific sound's impact than to under-estimate. On this basis, considering the overall low levels of uncertainty (all estimates are within 3 dB in either direction), it is not considered necessary to apply any uncertainty corrections to the results.

6.8. DISCUSSION

The impact assessment detailed above indicates, based on numerical prediction and consideration of the context in which the sound sources are present, that a low impact is predicted at all identified receptors, for off-load start-up and on-load supply tests.

7. CONCLUSION

A number of emergency generators serve three data centre buildings at Slough known as the Virtus Slough Campus. A permit variation is sought, to add new generators which would supply emergency backup power to a new data centre known as LON12. The generators will only be used to supply power in the event of a mains power failure. However, each generator will be tested once a month.

This report details the best available techniques (BAT) that have been employed to reduce the noise impact of the generators, and a noise assessment that has been carried out to quantify the impact.

The BAT employed include the location of the scheme and generators, use of acoustic enclosures, as well as the programme of testing which only requires that generators are tested individually and for short periods.

The quantitative noise impact indicates a low impact at noise-sensitive properties due to sound from the generators.

Appendix A

TECHNICAL GLOSSARY

Noise is defined as unwanted sound. Human ears are able to respond to sound in the frequency range 20 Hz (deep bass) to 20,000 Hz (high treble) and over the audible range of 0 dB (the threshold of perception) to 140 dB (the threshold of pain). The ear does not respond equally to different frequencies of the same magnitude, but is more responsive to mid-frequencies than to lower or higher frequencies. To quantify noise in a manner that approximates the response of the human ear, a weighting mechanism is used. This reduces the importance of lower and higher frequencies, in a similar manner to the human ear.

Furthermore, the perception of noise may be determined by a number of other factors, which may not necessarily be acoustic. In general, the impact of noise depends upon its level, the margin by which it exceeds the background level, its character and its variation over a given period of time. In some cases, the time of day and other acoustic features such as tonality or impulsiveness may be important, as may the disposition of the affected individual. Any assessment of noise should give due consideration to all of these factors when assessing the significance of a noise source.

The most widely used weighting mechanism that best corresponds to the response of the human ear is the ‘A’-weighting scale. This is widely used for environmental noise measurement, and the levels are denoted as dB(A) or L_{Aeq}, L_{A90} etc., according to the parameter being measured.

The decibel scale is logarithmic rather than linear, and hence a 3 dB increase in sound level represents a doubling of the sound energy present. Judgement of sound is subjective, but as a general guide a 10 dB(A) increase can be taken to represent a doubling of loudness, whilst an increase in the order of 3 dB(A) is generally regarded as the minimum difference needed to perceive a change under normal listening conditions.

7.1.1.1. Terminology relating to noise

Terminology	Description
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 (20^{x10-6} 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.
$L_{90,T}$	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.
Free-Field	Far from the presence of sound reflecting objects (except the ground), usually taken to mean at least 3.5m.
Façade	At a distance of 1m in front of a large sound reflecting object such as a building façade.
Octave Band	A range of frequencies whose upper limit is twice the frequency of the lower limit.

Appendix B

SITE PLAN

Figure B-1 – Plan showing LON12 site location (red), nearest noise sensitive receptors (blue) and noise survey positions (orange)

Appendix C

LIMITATIONS TO THIS REPORT

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