Sunderland Royal Hospital
Emergency Generator

Noise Assessment Report (Planning Condition 8)

On behalf of **City Hospitals Independent Commercial Enterprises**

Project Ref: 332610745 | Rev: 0 | Date: January 2024

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Document Control Sheet

Project Name: **Sunderland Royal Hospital Emergency Generator**

Project Ref: **332610745**

Report Title: **Noise Assessment Report (Planning Condition 8)**

Doc Ref: **ACO/01**

Date: **January 2024**

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For and on behalf of Stantec UK Limited				

Revision	Date	Description	Prepared	Reviewed	Approved

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1 Introduction

1.1 Background

1.1.1 Stantec UK Limited (Stantec) has been commissioned by City Hospitals Independent Commercial Enterprises to undertake acoustic commissioning of the two emergency generators within the electrical sub-station/switch room which serve Sunderland Royal Hospital.

1.1.2 The installation was granted planning permission on 8 December 2021 (ref. 21/02414/FUL). Planning Condition 8 of the Decision Notice requires a noise assessment of the installed equipment.

1.1.3 This report presents the results of sound survey and an assessment of noise from the installed plant at nearby receptors.

1.1.4 An explanation of the acoustic terminology used in this report is included in **Appendix A**.

1.1 Scope of Report

1.1.1 The objectives of this report are to:

- Summarise levels of noise produced by the emergency generators at the identified noise sensitive receptors; and
- Provide an assessment of noise generated by the new equipment.

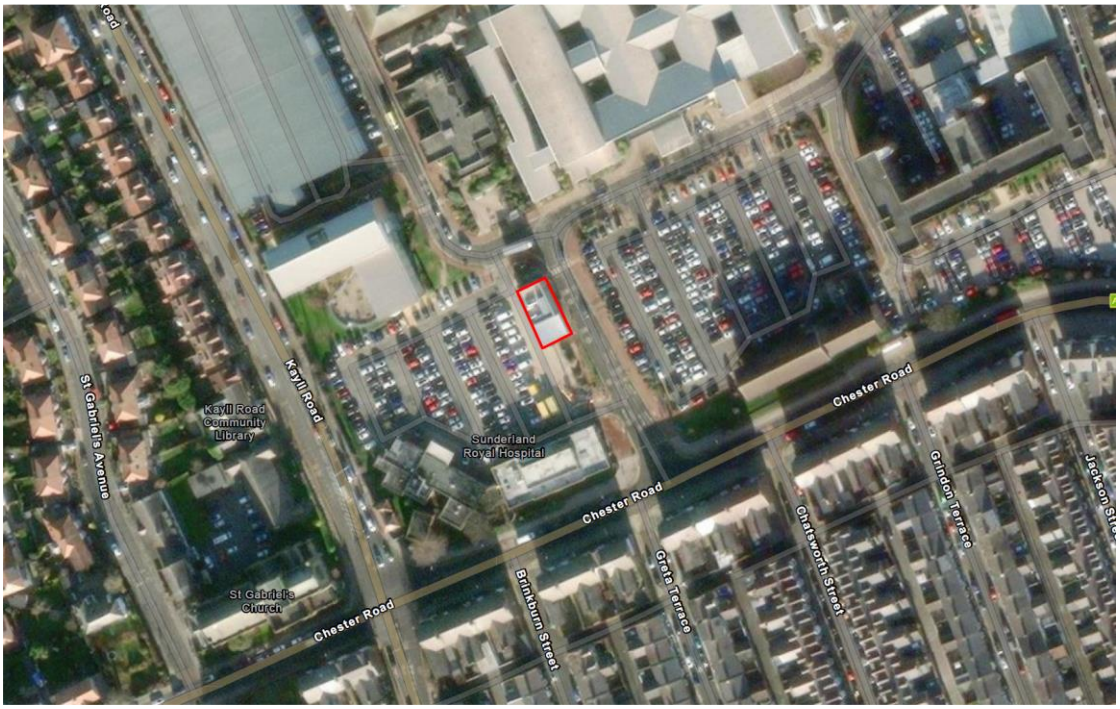
1.2 Site Description

1.2.1 The emergency generators are located within the southern car park of Sunderland Royal Hospital. It is situated approximately 60 m north of Chester Road (A183) and 80 m east of Kayll Road.

1.2.2 To the north of the site are hospital buildings including The Education Centre and Chester Wing. To the east is Chester Wing Car Park. To the south is the STW Unison Health Branch and Chester Lodge, with residential properties on the south side of Chester Road. To the west is hospital car parking. Residential properties and Kayll Road Library are located on the west side of Kayll Road.

1.2.3 The emergency generator site location is indicated in **Figure 1**.

Figure 1: Emergency Generator Site Location



Source: Maxar, Microsoft, Esri Community Maps Contributors, Esri UK, Esri, HERE, Garmin, Foursquare, GeoTechnologies, Inc, METI/NASA, USGS

2 Acoustic Criteria

2.1 Planning Condition 8 (Ref. 21/02414/FUL)

2.1.1 Planning permission for the development was granted on 8 December 2021 (ref.21/02414/FUL). Planning Condition 8 which relates to noise, states the following:

> *"Within one month of the proposed development being operational a noise assessment shall be submitted to demonstrate that the proposed development does not have any significant impacts on the nearby residential properties. Should the report identify mitigation measures are required these shall be implemented in within one month of the discharge of the condition.*
>
> *Reason: To ensure a satisfactory level of amenity, in accordance with CSDP policy HS2."*

2.2 Consultation

2.2.1 Consultation with Sunderland City Council was sought via email on 10 October 2023, with a response provided by the Environmental Protection Team (EPT) on 27 October 2023.

2.2.2 The response outlined that the EPT would have concerns if sound from the emergency generators exceeded the background sound level at night by 10 dB or more at the nearest noise sensitive receptor. The EPT noted that while a power failure may not be frequent, the duration of such a failure may be for more than one night.

2.2.3 The EPT requested that the assessment should be conducted with both emergency generators operating, with background sound level measurements made during night hours, and any noticeable frequency characteristics taken into consideration.

2.3 Assessment Methodology

British Standard 4142:2014 +A1:2019 Methods for Rating and Assessing Industrial and Commercial Sound

2.3.1 BS 4142:2014+A1:2019 (The British Standards Institution, 2019) describes methods for rating and assessing sound of an industrial and/or commercial nature. The methods described in the standard use outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident.

2.3.2 The standard is used to determine the rating levels for sources of sound of an industrial and/or commercial nature and the ambient, background and residual sound levels at outdoor locations. These levels could be used for the purposes of investigating complaints; assessing sound from proposed, new, modified or additional source(s) of sound of an industrial and/or commercial nature; and assessing sound at proposed new dwellings or premises used for residential purposes. However, the determination of noise amounting to a nuisance is beyond the scope of the standard.

2.3.3 The standard should not be used to assess sound from the passage of vehicles on public roads and railway systems; recreational activities; music and other entertainment; shooting grounds; construction and demolition; domestic animals; people; public address systems for speech and other sources falling within the scopes of other standards or guidance. The standard cannot be applied to the derivation of indoor sound levels arising from sound levels outside, or the assessment of indoor sound levels.

2.3.4 The procedure contained in BS 4142 assesses the significance of sound which depends upon the margin by which the rating level of the specific sound sources exceeds the background sound level and the context in which the sound occurs/will occur. It is noted that a BS 4142 assessment is reliant on measuring relevant background sound levels.

2.3.5 An initial estimate of the impact of the specific sound is obtained by subtracting the measured background sound level from the rating level and considering the following:

- Typically, the greater this 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; and
- 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.

2.3.6 When considering the introduction of a new noise sensitive receptor Section 8.5 states:

> "*Measure the background sound at the intended location of any new noise-sensitive receptor(s) in the absence of any specific sound.*
>
> *NOTE Where a new noise-sensitive receptor is introduced and there is extant industrial and/or commercial sound, it should be recognized that the industrial and/or commercial sound forms a component of the acoustic environment. In such circumstances other guidance and criteria in addition to or alternative to this standard can also inform the appropriateness of both introducing a new noise-sensitive receptor and the extent of required noise mitigation*."

2.3.7 To consider the context, BS 4142 advises that the following factors should be considered:

- The absolute level of sound;
- The character and level of the residual sound compared to the character and level of the specific sound; and
- 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 such as:
  - Façade insulation treatment;
  - Ventilation and/or cooling that will reduce the need to have windows open to provide rapid or purge ventilation; and
  - Acoustic screening.

3 Survey Methodology

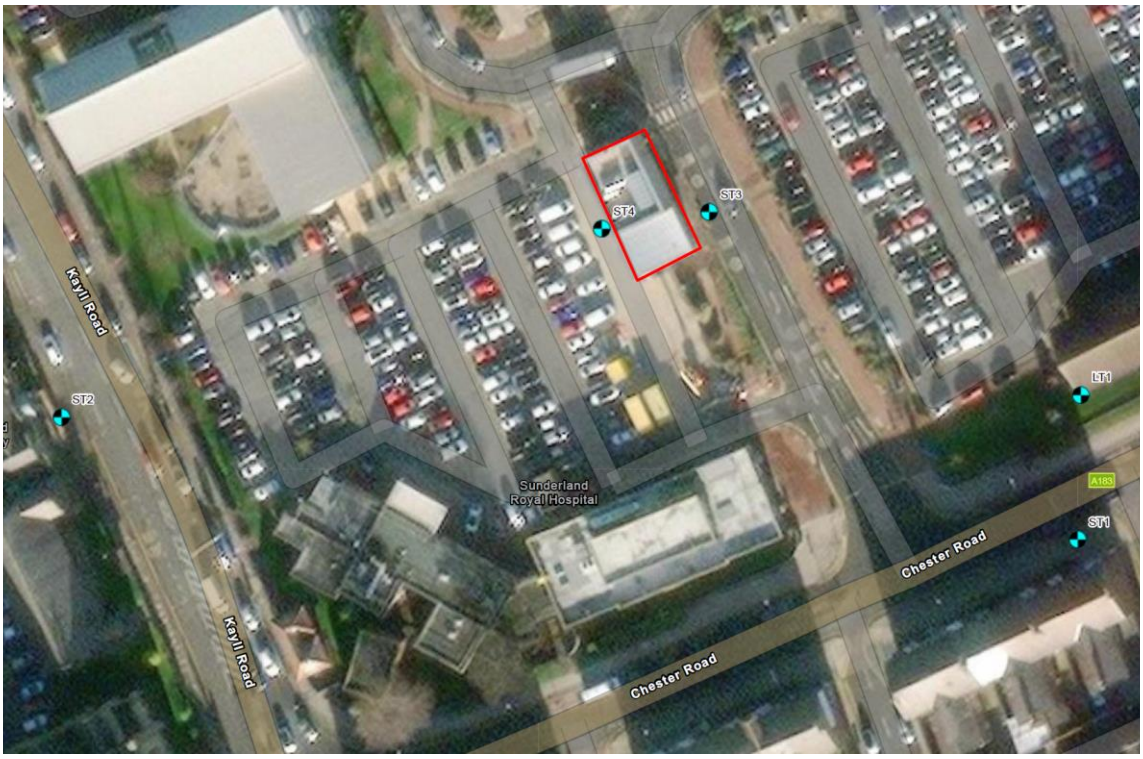
3.1 Procedure

3.1.1 A sound survey was conducted on Friday 10 November 2023 to measure sound levels from the emergency generator and establish background sound levels in the absence of sound from the generator. Both attended and unattended measurements were undertaken at the site.

3.1.2 Field calibrations were performed before and after the measurements with no significant fluctuations recorded (< 0.5 dB). Calibration certificates are available upon request. The instrumentation used in the survey (including calibration information) is listed in **Appendix B**.

3.1.3 The survey locations are indicated in **Figure 2**.

Figure 2: Environmental Sound Survey Locations



Source: Maxar, Microsoft | Esri Community Maps Contributors, Esri UK, Esri, HERE, Garmin, Foursquare, GeoTechnologies, Inc, METI/NASA, USGS

Attended Sound Level Measurements

3.1.4 An attended environmental sound survey was undertaken between approximately 04:00 and 06:00 hours on Friday 10 November 2023 to measure sound levels with the generator in operation and background sound levels with the generator switched off.

3.1.5 Measurements were taken at four locations. ST1 and ST2 were at locations considered to be representative of sound levels experienced at the nearest noise sensitive receptors. ST3 was approximately 1 m from the eastern façade of the generator building. ST4 was approximately 1 m from the western façade of the generator building.

3.1.6 During the measurements the sound level meter was located on a tripod approximately 1.2 m above ground level. The microphone was fitted with the manufacturer's windshield.

3.1.7 While the emergency generator was in operation, the emergency generator was operating at maximum design duty. The engineer noticed no significant change in sound levels from the equipment during equipment start-up.

Unattended Sound Level Measurements

3.1.8 An unattended environmental sound survey was undertaken between approximately 04:00 and 11:00 hours on Friday 10 November 2023 to measure background sound levels at a location considered representative of the nearest noise sensitive receptor in the absence of noise from the generator. The generator was not in operation from 06:00 hours to 11:00 hours.

3.1.9 Measurements were taken at one location (LT1) considered to be representative of sound levels experienced at the nearest noise sensitive receptor, at ST1.

3.1.10 During the measurements, the sound level meter was located on a tripod approximately 1.2 m above ground level. The microphone was fitted with the manufacturer's windshield.

3.2 Meteorological Conditions

3.2.1 Based on observations and on-site measurements, the meteorological conditions during sound the survey are detailed in **Table 3.1**.

Table 3.1: Meteorological Conditions

Description	**Meteorological Conditions**
	10 November 2023
Temperature (°C)	4
Precipitation (mm)	-
Wind Speed (m/s)	5
Wind Direction	NW

3.3 Sound Survey Results

3.3.1 A summary of the sound survey measurements and results is provided in **Table 3.2**. A histogram presenting the spread of measured background sound levels at LT1 over the day and night-time periods is presented in **Appendix C**.

Table 3.2: Summary of Measured Sound Survey Results

Reference	**Position**	**Duration (mm:ss)**	**Description**	**Measured Sound Level (dB)**	
				$L_{Aeq,T}$	$L_{A90,T}$
1	ST1	05:00	Generator switched on (from 04:55 hours to 05:00 hours)	64	46

Reference	Position	Duration (mm:ss)	Description	Measured Sound Level (dB)	
				$L_{Aeq,T}$	$L_{A90,T}$
2		15:00	Generator switched off (from 04:00 hours to 04:15 hours)	56	39
3	ST2	05:00	Generator switched on (from 05:15 hours to 05:20 hours)	60	47
4		15:00	Generator switched off (from 04:19 hours to 04:34 hours)	56	37
5	ST3	00:21	Generator switched on (at 05:37)	61	60
6		00:31	Generator switched off (at 04:45)	37	37
7	ST4	00:29	Generator switched on (at 05:28)	80	80
8	LT1	05:30:00	Generator switched off (from 06:00 hours to 11:30 hours)	70	57

3.3.2 The dominant sound source from the emergency generator was noted to be the ventilation louvres located on the west façade of the building in which the generator is housed.

3.3.3 The measured average $L_{Aeq,T}$ sound levels at the receptors were noted to be significantly affected by passing vehicles on Chester Road and Kayll Road, and are unlikely to be representative of noise due to operation of the emergency generator.

3.3.4 This assessment therefore refers to the $L_{A90,T}$ sound levels, which are considered to be representative of the steady sound level produced by the emergency generator while in operation, as these are considered to provide a clearer indication of noise impact.

4 Acoustic Assessment

4.1 Introduction

4.1.1 This section provides an assessment of noise from the generators at the nearest noise sensitive receptors. The assessment is based on guidance within BS 4142:2014+A1:2019.

4.2 Noise Sensitive Receptors

4.2.1 The nearest noise sensitive receptors to the emergency generators are those located at ST1 and ST2, along Chester Road and Kayll Road respectively. These receptors are dwellings.

4.3 Acoustic Feature Corrections

4.3.1 During breaks in traffic along Chester Road and Kayll Road, sound generated by the emergency generator was audible and considered not to be tonal in nature. The spectral content of the measured sound levels is presented in **Appendix D**. The measured spectral values have been assessed using the objective one-third octave method for assessing the audibility of tones in sound as presented in Annex C of BS 4142:2014+A1:2019. The assessment indicates that the level difference thresholds as outlined within the method are not exceeded in any band at the receptor locations. On this basis, no correction for tonality has been applied.

4.3.2 The emergency generator is unlikely to switched on and off intermittently as it is will only to run during power failures. An intermittency feature correction has therefore not been applied as the generator it is not anticipated to switch on/off within the same reference period (1 hour during the day, 15 minutes at night).

4.3.3 The generator did not generate impulsive noise during operation and an impulsivity correction has not been applied.

4.3.4 The existing sound climate at the identified residential receptors does not currently comprise plant noise, although the sound climate is dominated by vehicular movements on Chester Road and Kayll Road. With this in mind, a 3 dB correction has been applied as sound from the generator may be readily distinctive against the residual acoustic environment.

4.4 Specific Sound Level

4.4.1 The specific sound level from operation of the generator can be obtained via two methods from the measured sound data.

4.4.2 One method is through measurement of the sound level at ST1 and ST2 which are representative of the resultant sound levels at the nearest noise sensitive receptors. The specific sound level is obtained through subtracting the background sound level with the generator switched off, from the background sound level with the generator switched on.

4.4.3 Another method is to use the measured sound levels at ST3 to calculate the resultant sound levels at Receptors ST1 and ST2.

4.4.4 To provide validation of the measured sound level data, both methods have been used to establish the specific sound level at Receptors ST1 and ST2. **Table 5.1** outlines the measured and calculated specific sound level at the receptors. Calculations have been undertaken on non-rounded measured sound levels, with the outcome being rounded to the nearest whole number.

Table 5.1: Measured and Calculated Specific Sound Level

Measured Specific Sound Level dBA*		Calculated Specific Sound Level dBA	
ST1	**ST2**	**ST1**	**ST2**
45	46	45	44
*Derived from subtracting the residual sound level from the ambient sound level. As per paragraph 3.3.5, the L_{A90} sound levels have been used within the assessment to define the specific sound level.			

4.4.5 As indicated in **Table 5.1**, the measured and calculated specific sound levels are within 2 dB of one another. To ensure a worst-case assessment, the measured specific (i.e. higher) sound levels have been used within the assessment.

4.5 Noise Rating Level

4.5.1 The resultant noise rating levels for the emergency generator at the identified receptors are provided in **Table 5.2**.

Table 5.1: Noise Rating Levels at Receptors

Parameter	Sound Level (dB)	
	ST1	**ST2**
Noise Rating Level ($L_{Ar,Tr}$)	48	49
Background Sound Level – Daytime ($L_{A90,15min}$) As measured at LT1 between 07:00 and 23:00 hours	57	
Background Sound Level – Night-time($L_{A90,15min}$) As measured at ST1 and ST2 between 04:00 04:45 hours	39	37

Dwellings on Chester Road (Receptor ST1)

4.5.2 The noise rating level from the emergency generator is calculated to be 9 dB below the daytime background sound level, and 9 dB above the night-time background sound level.

Dwellings on Kayll Road (Receptor ST2)

4.5.3 The noise rating level from the emergency generator is calculated to be 8 dB below the daytime background sound level, and 12 dB above the night-time background sound level.

4.6 Context and Mitigating Factors

4.6.1 Various factors influence the context of the assessment including the absolute level of sound, the character and level of the residual sound compared to the character and level of the specific sound and the sensitivity of the receptor.

4.6.2 Within the assessment it is important to note the potential frequency of use of the generator. Routine testing of the generators would only take place during daytime hours, and the generator would only operate at night in the event of a power failure, in an emergency.

Absolute Sound Level

Dwellings on Chester Road (Receptor ST1)

4.6.3 During the daytime, the noise rating level at Receptor ST1 is noted to be more than 20 dB below the ambient sound level at location LT1, which is considered to be representative of noise experienced at Receptor ST1.

4.6.4 During the night-time, the noise rating level at Receptor ST1 is noted to be 8 dB below the ambient sound level at location ST1, which is considered to be representative of noise experienced at Receptor ST1.

4.6.5 The noise rating level from the emergency generator is therefore anticipated to be consistently below the ambient sound level at Receptor ST1, and unlikely to be distinguishable when vehicles are passing on Chester Road during the day or night.

Dwellings on Kayll Road (Receptor ST2)

4.6.6 During the daytime, the noise rating level at Receptor ST2 is noted to be more than 20 dB below the ambient sound level at location LT1, which is considered to be representative of noise experienced at Receptor ST2.

4.6.7 During the night-time, the noise rating level at Receptor ST2 is noted to be 7 dB below the ambient sound level at location ST2, which is considered to be representative of noise experienced at Receptor ST2.

4.6.8 The noise rating level from the emergency generator is therefore anticipated to be consistently below the ambient sound level at Receptor ST2, and unlikely to be distinguishable when vehicles are passing on Kayll Road during the day or night.

Character of the Residual Sound and Specific Sound

4.6.9 The area surrounding the proposed development is urban and subject to consistent traffic flow on the surrounding road network. At night, noise from the emergency generator was audible at the receptor locations when vehicles were not passing on Chester Road and Kayll Road. However, as noted within **Section 4.2**, a 3dB correction has been applied to the noise rating level to account for the fact that plant noise is not currently experienced at either receptor.

Sensitivity of Receptor

4.6.10 The receptors considered within the assessment are located close to the entrance to Sunderland Royal Hospital and overlook Chester Road and Kayll roads, which both experience traffic through the day and night. The receptors are therefore anticipated to be used to experiencing relatively high noise levels from traffic movements around the site.

4.6.11 The equipment is to be used to provide emergency power in the event of a power failure, is critical to provide life support within the hospital.

4.6.12 Health Technical Memorandum HTM 08-01: Acoustics provides the following guidance in relation to emergency plant noise:

> *"2.30 An increase in internal and external noise levels of up to 10 dB(A) over the noise criteria is normally considered acceptable, provided regular testing only takes place during the daytime on a weekday.*
>
> *2.31 Audible alarms need to be sufficiently noisy to attract the attention of the relevant people.*

…

2.47 Noise from healthcare premises can affect properties outside the site. This should be considered when stipulating environmental noise criteria for the project. These external criteria should be agreed with the local authority and should include any differences allowed for emergency equipment.

…

2.49 A relaxation of acoustic criteria for emergency situations and sporadic events (for example standby generators and helicopter flights) can be considered. This is subject to agreement by the local authority or other relevant body."

4.6.13 Although related to helicopter noise, the Department of Health's 'Emergency Care Health Building Note 15-03 Hospital Helipads' paragraph 2.13 provides the following guidance with respect to life-saving situations and resultant noise:

"…The public can appreciate the usefulness of a hospital helipad in life-saving situations, especially when fully informed of the purpose and importance, the infrequency and short duration of the environmental impact and any mitigation activities proposed…"

4.6.14 The noise impact of the proposed development should therefore be balanced against factors such as the short duration and infrequent occurrence of noise events and the advantage of the proposed development in life-threatening situations.

4.6.15 On the basis that it provides emergency life support, residents may be more tolerable to noise from the emergency generator.

4.7 Uncertainty

4.7.1 Care has been taken to reduce uncertainty as far as reasonably possible. However, it should be recognised that in any environmental sound survey and assessment process uncertainty exists.

Uncertainty in Measured Sound Levels

4.7.2 Uncertainty in measured background sound levels can occur due to variation in temporary/non-representative meteorological conditions affecting the survey result. Uncertainty has been reduced within our assessment by obtaining background sound levels at locations considered representative of the nearest noise-sensitive receptors.

4.7.3 Source data used in our calculations was obtained by Stantec under controlled conditions at positions close to the respective sound source. The amount of uncertainty arising from the use of these measurements is therefore low.

Uncertainty in the Operation or Sound Emission Characteristics of the Specific Sound

4.7.4 The characteristics of the specific sound were observed close to the generator, and at the receptor locations. The uncertainty in sound emission characteristics is therefore considered to be low.

Uncertainty in the Calculation Method

4.7.5 The estimated accuracy of the ISO 9613-2 calculation procedure is presented in Section 9 of the standard. Where the mean height of the source and receiver is below 5 m, the accuracy of the calculation procedure for broadband noise is noted to be ±3 dB at distances up to 1000 m.

4.7.6 The measured specific sound level has been validated using the calculated specific sound level based on measurements conducted close to the main noise sources, and therefore the uncertainty in the calculation method is considered to be low.

4.8 Summary of Assessment

4.8.1 The assessment indicates that the operation of the emergency generator is likely to result in a noise rating level which is 20 dB below the background sound level during the daytime at both receptors.

4.8.2 The assessment indicates that the operation of the generator is likely to result in a noise rating level which 9-12 dB above the background sound level during the night-time at both receptors.

4.8.3 The emergency generator will be subject to routine testing during daytime hours, which is unlikely to result in noise impact at the noise sensitive receptors as noise from the generators is unlikely to be audible due to the noise rating level being 20 dB below the background sound level during the day.

4.8.4 Under a power failure, the emergency generator could operate at night, and while in operation is likely to be audible when vehicles are not passing on Chester Road and Kayll Road.

4.8.5 Dwellings on Chester Road and Kayll Road are already noted to be subjected to relatively high noise levels when vehicles pass on these roads.

4.8.6 The equipment is to be used to provide emergency power in the event of a power failure, and will be critical to provide life support within the hospital. On the basis that it provides emergency life support, residents may be more tolerable to noise from the emergency generator.

4.8.7 Based on the outcome of the assessment the context, the use of the emergency generators is considered likely to result in a low impact, based on guidance provided within BS 4142:2014+A1:2019. The operation of the emergency generators is therefore not likely to cause a significant adverse impact at the identified noise sensitive receptors.

5 Conclusions

5.1.1 Stantec UK Limited (Stantec) has been commissioned by City Hospitals Independent Commercial Enterprises to undertake acoustic commissioning of the emergency generator within the electrical sub-station/switch room which serves the Sunderland Royal Hospital.

5.1.2 The installation gained planning permission on 8 December 2021 (ref. 21/02414/FUL). Planning Condition 8 of the Decision Notice requires a noise assessment of the installed equipment.

5.1.3 This report presents the results of sound survey, and an assessment of noise from the installed plant at nearby receptors.

5.1.4 The assessment indicates that the operation of the emergency generator is likely to result in a noise rating level which is 20 dB below the background sound level during the daytime at both receptors.

5.1.5 The assessment indicates that the operation of the generator is likely to result in a noise rating level which is 9-12 dB above the background sound level during the night-time at both receptors.

5.1.6 The emergency generator will be subject to routine testing during daytime hours, which is unlikely to result in noise impact at the noise sensitive receptors.

5.1.7 Under a power failure, the emergency generator could operate at night, and during the time of operation is likely to be audible when vehicles are not passing on Chester Road and Kayll Road. However, based on dwellings along Chester Road and Kayll Road being subject to relatively high noise levels when vehicles pass on the roads, and that the generator provides emergency life support in the event of a power failure, the residents are expected to have a reduced sensitivity to noise from the generator.

5.1.8 Based on the outcome of the assessment the context, the use of the emergency generators are considered likely to result in a low impact, based on guidance provided within BS 4142:2014+A1:2019.

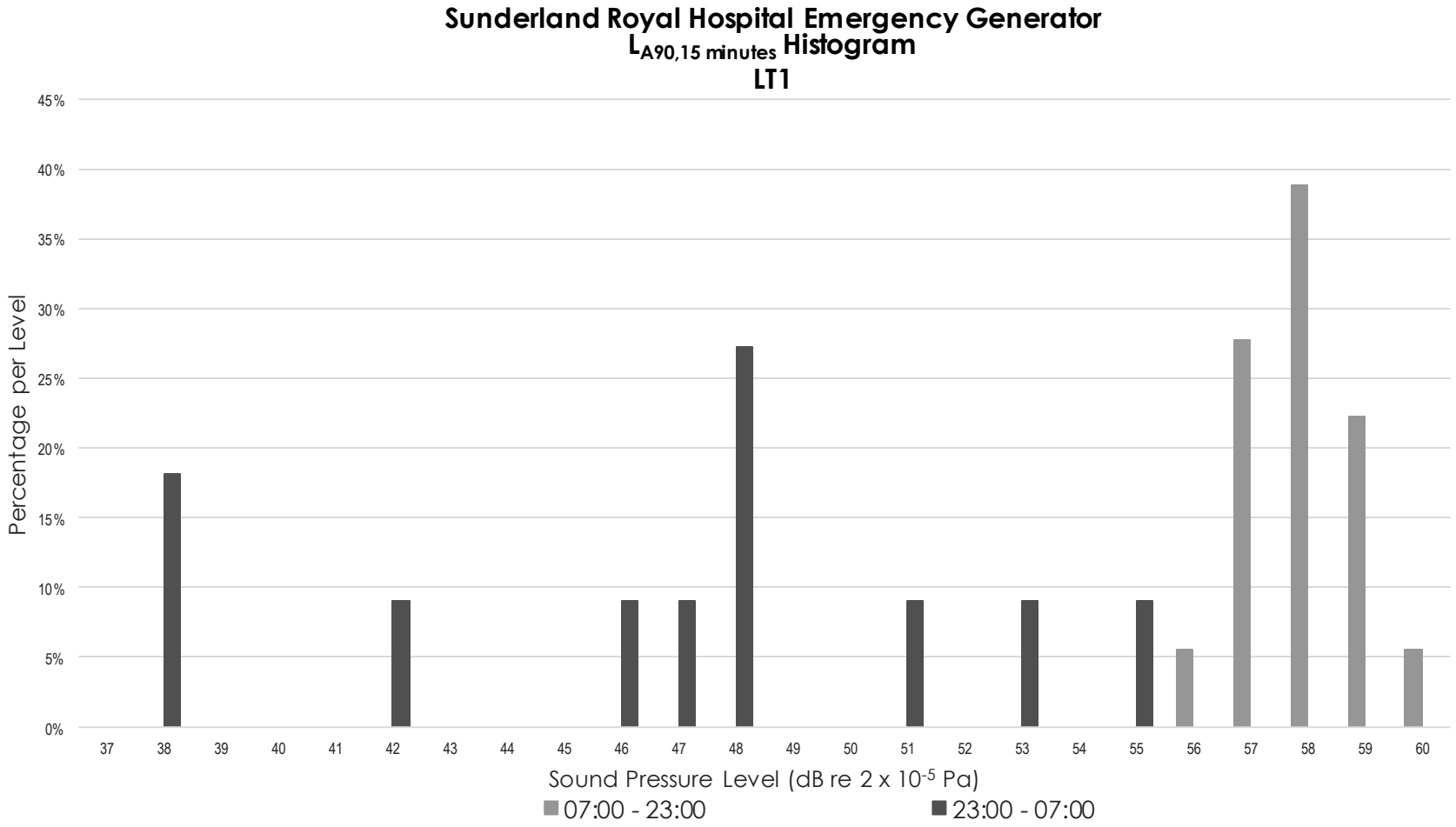
Appendix A Glossary

Parameter	Description
Ambient Noise Level	The totally encompassing sound in a given situation at a given time, usually composed of a sound from many sources both distant and near ($L_{Aeq,T}$).
Daytime	The period 07:00-23:00 hours.
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. The threshold of normal hearing is in the region of 0 dB and 140 dB is the threshold of pain. A change of 1 dB is only perceptible under controlled conditions.
dB(A), L_{Ax}	Decibels measured on a sound level meter incorporating a frequency weighting (A weighting) which differentiates between sounds of different frequency (pitch) in a similar way to the human ear. Measurements in dB(A) broadly agree with people's assessment of loudness. A change of 3 dB(A) is the minimum perceptible under normal conditions, and a change of 10 dB(A) corresponds roughly to halving or doubling the loudness of a sound.
Free-field	Sound pressure level measured outside, far away from reflecting surfaces (except the ground), usually taken to mean at least 3.5 metres
$L_{Aeq,T}$	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.
$L_{90,T}$ or Background Noise Level	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.
Night-time	The period 23:00-07:00 hours.

Appendix B Instrumentation

Description	Manufacturer	Type	Serial Number	Laboratory Calibration Date
Sound Level Meter	Brüel & Kjær	2250	3012156	04/11/2022
½" Pre-polarised microphone		4189	3349717	04/11/2022
Pre-amplifier		ZC0032	27836	04/11/2022
Sound Level Meter	RION	NL-52	542901	10/01/2022
½" Pre-polarised microphone		UC-59	06478	10/01/2022
Pre-amplifier		NH-25	42929	10/01/2022
Sound Calibrator	Brüel & Kjær	4231	2619375	03/01/2023

Appendix C Background Sound Level Histogram



Appendix D Measured Sound Spectrum