UCLH

National Hospital of Neurology and Neurosurgery - Generator Replacement

Noise Assessment

UCLH-ARP-002-ZZ-RP-Y-001-S3-A_Noise Assessment

Issue | 29 November 2016

Job number 245279-00

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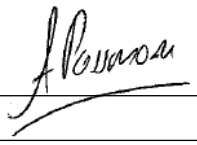
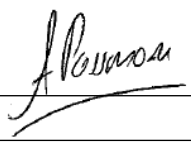
Document Verification

ARUP

Job title		National Hospital of Neurology and Neurosurgery - Generator Replacement			**Job number** 245279-00
Document title		Noise Assessment			**File reference**
Document ref		UCLH-ARP-002-ZZ-RP-Y-001-S3-A_Noise Assessment			
Revision	**Date**	**Filename**	2016-11-29 R01-pba ISSUE.docx		
Issue	29 Nov 2016	**Description**	Issue		
			Prepared by	Checked by	Approved by
		Name	Paul Adams BSc MIOA	Adrian Passmore BEng CEng MIOA	Adrian Passmore BEng CEng MIOA
		Signature			
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Appendices

1 Introduction

As part of upgrade works at the National Hospital of Neurology and Neurosurgery (NHNN), it is proposed to replace one of the existing generators. Arup has been appointed by UCLH to undertake a noise assessment of the replacement generator.

An environmental background noise survey has been undertaken to establish existing noise levels around the site. This report summarises the results of the noise survey, discusses noise limits for the generator and compares predicted noise levels with the noise limits.

A glossary of acoustic terminology is presented in Appendix A.

2 The Site and Surroundings

NHNN is located on Queen Square, London. The new generator will be located in an existing plantroom towards the rear of the building below ground level. The intake and exhaust louvres will vent into the service yard which is located on Guilford Street, with the generator flues terminating at roof level.

The nearest residential dwellings are located on Guilford Street, approximately 40m from the intake and exhaust louvres.

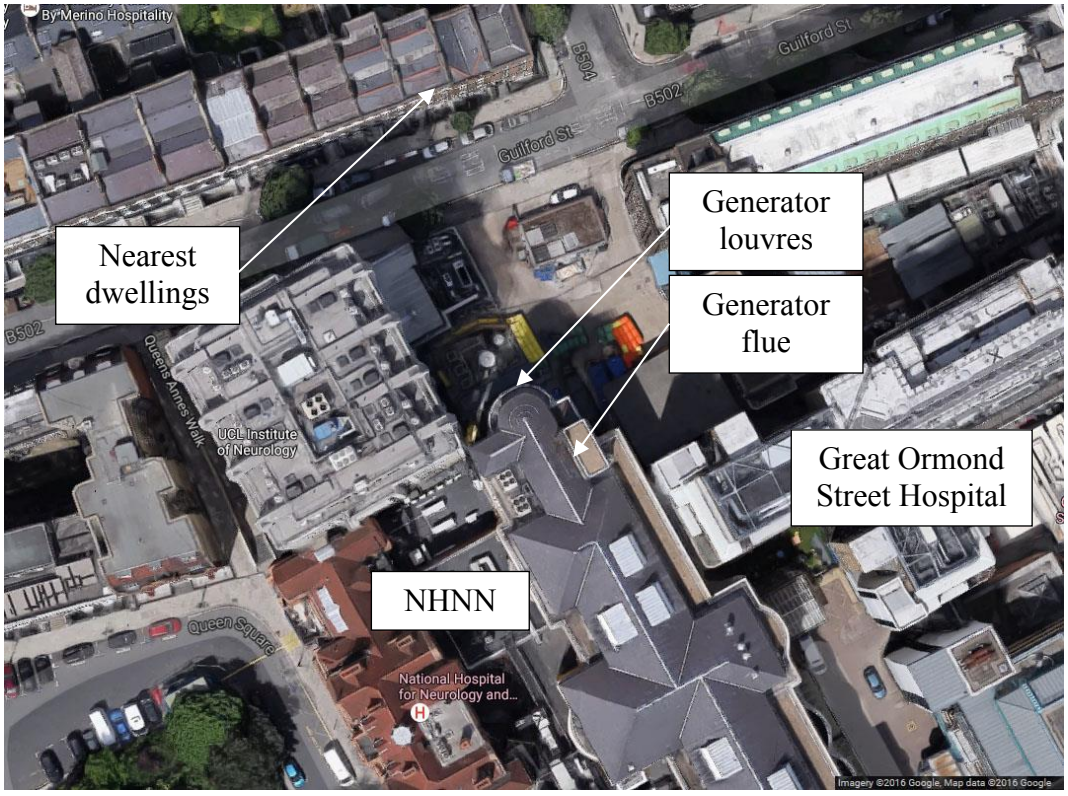

Figure 1: Site plan showing NHNN and generator louvres

3 Noise Policy

Policy SD8 of the London Borough of Camden (LBC) Replacement Unitary Development Plan (Adopted June 2006) states:

> *The Council will only grant planning permission for plant or machinery, including ventilation or air handling equipment, if it can be operated without causing a loss to local amenity and does not exceed the thresholds set out in Appendix 1 - Noise and Vibration (Table E).*

Table E in Appendix 1 sets out noise levels from plant and machinery at which planning permission will not be granted. In essence, these levels are 5dB below the prevailing background noise level (L_{A90}), unless the plant has attention catching features in which case the level is 10dB below the prevailing background noise level. Noise from plant is also capped at a maximum of 55dBL_{Aeq}.

The above applies to normal plant and machinery. Through discussions with the Noise Officer at LBC, it has been clarified that the following limit will apply to the proposed generator installation:

> *"...noise emitted by standby or emergency generators during power outages or testing does not exceed the lowest daytime LAeq(15min) as measured or calculated according to BS4142:2014."*

4 Environmental Noise Survey

An environmental noise survey has been undertaken to establish the existing prevailing background noise levels around the site using an unattended noise monitor.

4.1 Dates, Times and Personnel

The noise monitors were installed by Paul Adams of Arup, who is a Member of the Institute of Acoustics.

Continuous noise measurements were carried out over a 48 hour period between approximately 15:00 on Wednesday 23rd November and 15:00 on Friday 25th November 2016.

4.2 Measurement Location

The noise monitor was installed on the roof of the substation at the entrance to the NHNN service yard, overlooking Guilford Street. The monitor was located at a similar distance to the road as the dwellings opposite and is therefore considered representative of the prevailing noise climate at the dwellings.

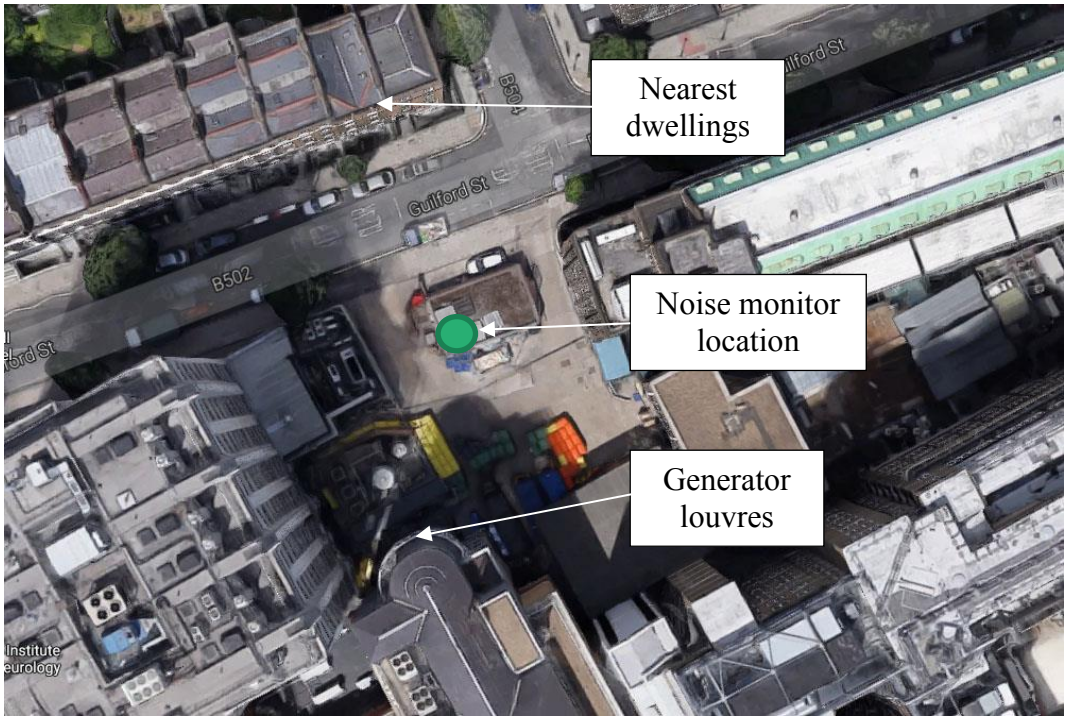

Figure 2: Location of noise monitor

Noise levels at the monitoring location are dominated by road traffic on Guilford Street, activities within the service yard and existing plant associated with the hospitals.

4.3 Equipment and Methodology

During the measurements, statistical noise levels were recorded, storing L_{Aeq}, L_{A90} and L_{Amax} indices. Octave band frequency spectra were also recorded.

All measurements during the survey were made over 5 minute periods.

Measurements were carried out using the equipment detailed in Table 1. The sound level meter and microphone are Type 1 conforming to BS EN 61672-1: 2003. The sound level meter and microphone were calibrated before and after use, to confirm that there was no significant drift in meter response at the calibrator frequency and level. This verification indicated that there was no more than a 0.1 dB variation between checks. The meter is annually calibrated and this calibration is traceable to international standards. All measurements were made with A-weighting and fast (0.125 s) time constant.

Manufacturer	Type Number	Instrumentation
Rion	NC-74	Sound Pressure Level Calibrator
Rion	NL-52	Sound Level Meter
Rion	UC-59	½" Microphone
Rion	NH-25	Preamplifier

Table 1: Noise survey measurement equipment

4.4 Results

A summary of the results from the noise survey is presented in Table 1. A full time history of the measurements is presented in Appendix B.

	$L_{Aeq,15mins}$	$L_{Aeq,5mins}$	$L_{A90,5mins}$	$L_{Amax,5mins}$
Daytime (07:00 – 23:00)	61 – 79	60 – 79	59 – 79	65 – 99
Night time (23:00 – 07:00)	59 – 80	59 – 83	58 – 77	62 – 99

Table 2: Summary of results from noise measurements

The results of the survey indicate that the lowest background noise level was 59dB$L_{A90,5mins}$ during the day and 58dB$L_{A90,5mins}$ during the night.

The lowest daytime $L_{Aeq,15mins}$ was 61dB.

5 Noise Limits

The replacement generator will be used, as the existing generator, to provide emergency back-up power to the hospital in the event of a power failure. It is used to maintain continuity of hospital operations, such as operating theatres.

As such, it is considered that the noise from the generator must not exceed the lowest daytime $L_{Aeq,15mins}$ as advised by LBC. Therefore, the maximum noise from the generator is 61dB$L_{Aeq,15mins}$.

6 Noise from the Generator

This section describes the generator and the proposed mitigation measures required to ensure that the noise criteria are achieved. The results from noise predictions at the nearest buildings are also summarised.

6.1 Noise Sources

The generator is located in the same generator room as the existing generator, below ground level.

The generator has intake and exhaust paths terminating at louvres at ground floor level within the service yard. The louvres are the considered to be the main source of noise.

The generator also has a flue which discharges at roof level.

The generator is a 1500kVA engine with a sound pressure level at 1m (as provided by the manufacturer) of 110dB(A) under 100% load. Based on the dimensions of the generator, the sound power level is estimated to be 130dB(A).

The manufacturer has also advised that the sound pressure level at the outlet of the flue is 75dB(A) at a distance of 1m.

6.2 Mitigation Measures

The generator air intake path includes a large 3.5m long attenuator to reduce noise levels to the environment. The generator exhaust path has two attenuators (one 2m long attenuator and one 1.2m long attenuator).

In addition, the generator flue will include an attenuator.

The layout of the generator room and proposed noise mitigation measures is shown in Figure 3.

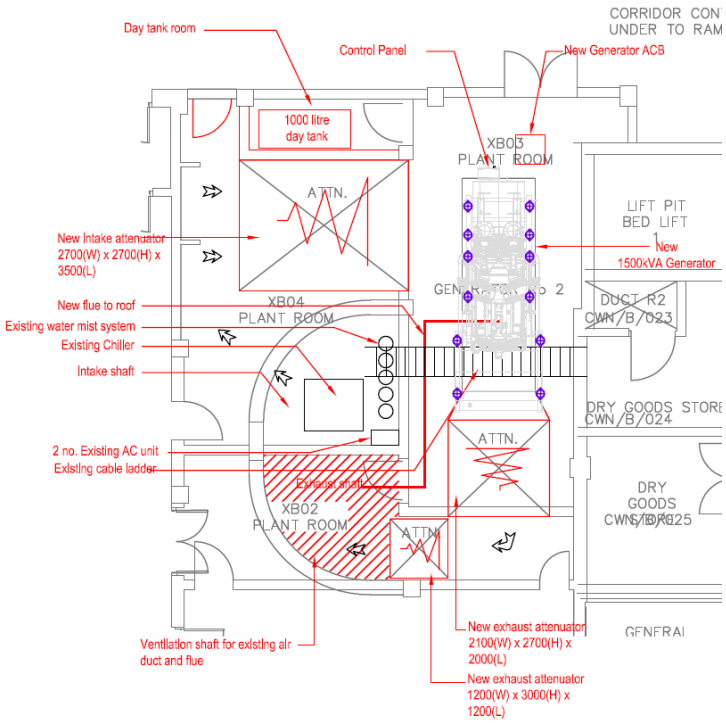

Figure 3: Proposed layout of generator room showing attenuators

6.3 Noise Predictions

Noise predictions have been undertaken for the intake louvre, exhaust louvre and generator flue based on the generator noise levels supplied by the manufacturer and the proposed attenuators.

The total predicted noise level at 1m from the façade of the nearest dwelling on the opposite side of Guilford Street is 55dBL_{Aeq}.

The total predicted noise level at the façade of the Great Ormond Street Hospital is also 55dBL_{Aeq}.

The noise predictions indicate that noise levels from generator will be below the lowest daytime $L_{Aeq,15mins}$ of 61dB and therefore comply with the local authority requirements.

7 Summary

An assessment has been undertaken of noise from the proposed replacement generator at the National Hospital of Neurology and Neurosurgery.

London Borough of Camden has indicated that noise levels from emergency / life safety plant should not exceed the lowest daytime $L_{Aeq,15mins}$.

An environmental noise survey has been undertaken to determine the existing background noise levels representative of the nearest noise sensitive receptors. The survey indicates that the lowest daytime $L_{Aeq,15mins}$ is 61dB.

Predictions of noise from the generator have been undertaken. These indicate that the noise level at the façade of both the nearest dwellings and the Great Ormond Street Hospital will be 55dBL_{Aeq}. Therefore the proposed replacement generator will comply the noise requirements set out by London Borough of Camden.

Appendix A

Glossary of Acoustic Terminology

A1 Glossary of Acoustic Terminology

Decibel (dB)

The ratio of sound pressures which we can hear is a ratio of 10^6:1 (one million:one). For convenience, therefore, a logarithmic measurement scale is used. The resulting parameter is called the 'sound pressure level' (L_p) and the associated measurement unit is the decibel (dB). As the decibel is a logarithmic ratio, the laws of logarithmic addition and subtraction apply.

dB(A)

The unit used to define a weighted sound pressure level, which correlates well with the subjective response to sound. The 'A' weighting follows the frequency response of the human ear, which is less sensitive to low and very high frequencies than it is to those in the range 500Hz to 4kHz.

In some statistical descriptors the 'A' weighting forms part of a subscript, such as L_{A10}, L_{A90}, and L_{Aeq} for the 'A' weighted equivalent continuous noise level.

Equivalent continuous sound level

An index for assessment for overall noise exposure is the equivalent continuous sound level, L_{eq}. This is a notional steady level which would, over a given period of time, deliver the same sound energy as the actual time-varying sound over the same period. Hence fluctuating levels can be described in terms of a single figure level.

Maximum noise level

The maximum noise level identified during a measurement period. Experimental data has shown that the human ear does not generally register the full loudness of transient sound events of less than 125ms duration and fast time weighting (F) has an exponential time constant of 125ms which reflects the ear's response. Slow time weighting (S) has an exponential time constant of 1s and is used to allow more accurate estimation of the average sound level on a visual display.

The maximum level measured with fast time weighting is denoted as $L_{Amax,\,F}$. The maximum level measured with slow time weighting is denoted $L_{Amax,\,S}$.

Sound power level

The sound power level (L_w) of a source is a measure of the total acoustic power radiated by a source. The sound power level is an intrinsic characteristic of a source (analogous to its volume or mass), which is not affected by the environment within which the source is located.

Sound pressure level

The sound power emitted by a source results in pressure fluctuations in the air, which are heard as sound.

The sound pressure level (L_p) is ten times the logarithm of the ratio of the measured sound pressure (detected by a microphone) to the reference level of 2 x 10^{-5}Pa (the threshold of hearing).

Thus L_p (dB) = 10 log $(P1/P_{ref})^2$ where P_{ref}, the lowest pressure detectable by the ear, is 0.00002 pascals (ie $2x10^{-5}$ Pa).

The threshold of hearing is 0dB, while the threshold of pain is approximately 120dB. Normal speech is approximately 60dBL_A and a change of 3dB is only just detectable. A change of 10dB is subjectively twice, or half, as loud.

Statistical noise levels

For levels of noise that vary widely with time, for example road traffic noise, it is necessary to employ an index which allows for this variation. The L_{10}, the level exceeded for 10% of the time period under consideration, and can be used for the assessment of road traffic noise (note that L_{Aeq} is used in BS 8233 for assessing traffic noise). The L_{90}, the level exceeded for 90% of the time, has been adopted to represent the background noise level. The L_1, the level exceeded for 1% of the time, is representative of the maximum levels recorded during the sample period. A weighted statistical noise levels are denoted L_{A10}, dBL_{A90} etc. The reference time period (T) is normally included, e.g. dB$L_{A10, 5min}$ or dB$L_{A90, 8hr}$.

Appendix B

Noise Survey Time History

B1 Noise Survey Time History