Sofidel Group

Sofidel, Baglan Bay - Generator Installation

Noise Impact Assessment

R02/282579/TM

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1 Introduction

Arup has been commissioned by Sofidel UK Limited to assess the noise impact from diesel-powered electricity generators at their paper mill in Baglan Bay, in support of their request for a variation to their permit.

Twelve generators have been installed, of which nine will be used continuously to power the paper mill facility, once the nearby Baglan Power Station goes offline. The generators are proposed as a temporary interim business continuity measure, whilst an alternative electricity energy supply is established.

This report details the site survey and assessment of noise impact.

2 Assessment location and source details

The paper mill is in the northern end of the mostly vacant Baglan Energy Park, bordered to the north by the River Neath, and to the east by the commercial properties on Brunel Way. Immediately to the south is Baglan Power Station.

The proposed generator compound is in the south-western corner of the paper mill site. It is screened by the main paper mill building to the north, and by Baglan Power Station to the south.

The main source of noise in the locale is the M4 motorway, which is elevated as it runs through the area. Further away from the M4 and toward the coastline, noise from the coast could be heard, i.e. waves on the seashore.

The nearest identified noise sensitive receivers (NSR) are:

- NSR 1. Briton Ferry travellers' site
- NSR 2. Residential properties on Handel Avenue
- NSR 3. Ysgol Bae Baglan School

For the Briton Ferry travellers' site, noise measurements were taken at a representative location, as shown in Figure 1 due to potential access issues near the travellers' site. Measurements at Ysgol Bae Baglan School were not possible, however the noise levels measured at location 2 are considered representative, due to their similar distance from the proposed generator compound and similar noise climate.

Near-field sound level measurements of the generators were taken during their testing, to calculate the sound power levels of the generators for noise prediction modelling purposes. These were taken at locations surrounding the generator compound, as shown in Figure 6.

Further noise measurements were taken near to the residential properties on Handel Avenue, but away from any local roads, during and immediately after the generators were being tested, to measure the impact of their operational noise on the most exposed NSR.

Photographs at each measurement location are provided in Appendix B.

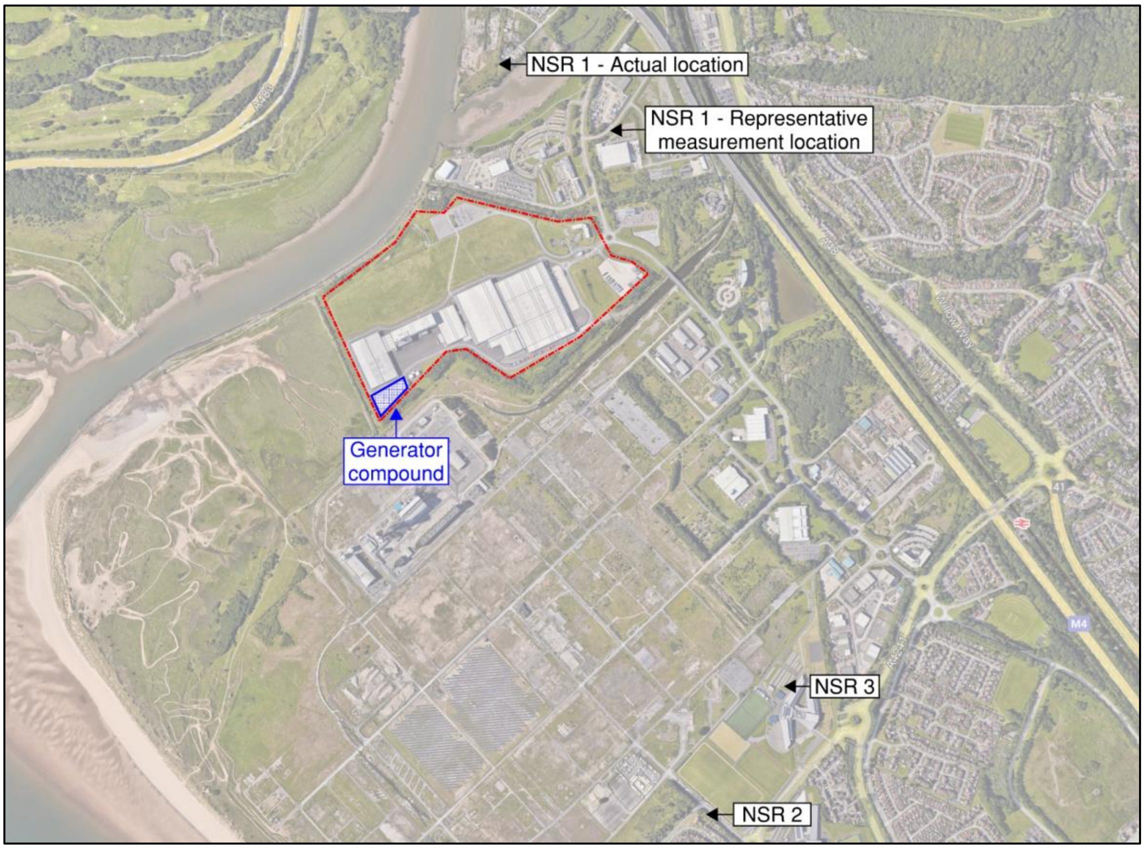

Figure 1: Locations of generator compound and NSRs (1-3)

3 Equipment and meteorology

The meteorological conditions throughout the survey were generally conducive for noise measurements. The temperature was around 18°C during the daytime and 14°C at night. The roads were dry, and the wind speed was low (0.3-0.6 m/s) from the south/east.

A field calibration check was performed before and after the measurements, and no drift was detected.

A table of the noise measurement equipment is given below.

Equipment	Serial no.	Calibration details
B&K 2250 sound level meter	3007217	Calibration due Oct 27th 2021
B&K 4189 microphone	2920108	
B&K 4231 calibrator	3014588	
B&K ZC-0032 pre-amplifier	21701	

Figure 2: Survey equipment details

4 Assessment methodology

Advice was sought from Natural Resources Wales (NRW) on the requirements of this assessment, and the proposed methodology was separately forwarded to both the local authority (Neath Port Talbot) and NRW to invite comments.

The assessment of noise impacts at the NSRs have been calculated using the methods and processes defined in BS 4142[1], following the guidance given by NRW[2].

In summary, this method considers the difference between the existing noise level (the 'background level') and the assessed noise from the new source in isolation (the 'rating level'), at each assessment location.

The 'background level' ($L_{A90,T}$) is the noise existing in the absence of the 'specific sound level' at the assessment location. The 'specific sound level' ($L_{Aeq,Tr}$) is the noise produced solely by the new source, and is subject to corrections where it displays an identifiable acoustic feature, such as tonality, impulsiveness, or intermittency (or any combination of these), to provide a 'rating level' ($L_{Ar,Tr}$).

The difference between the background and rating levels is then used to provide an initial estimate of impact as follows. Typically, the greater this difference, the greater the magnitude of the impact.

5 Measurement data and predictions

5.1 Background sound level measurements

A summary of the measured background sound levels is given in Table 1. Where multiple measurements were taken during a period, the arithmetic average of the individual measurement results are shown.

Measurement periods were selected to represent typical background noise levels, and care was taken to avoid peaks in road traffic. Two 15-minute measurements were made at each NSR during the daytime in separate hours, and one was made at night.

Throughout the measurements at the NSRs, the Sofidel paper mill facility was operational however noise produced by it was not audible. The proposed generators were not operational.

The full survey results can be found in Appendix B.

Location (see Figure 1)	**dB$L_{A90,15mins}$**	
	Daytime (07:00 – 23:00)	**Night-time (23:00 – 07:00)**
NSR 1	58	43
NSR 2	41	38
NSR 3*	41	38

[1] BS 4142:2014 *Methods for rating and assessing industrial and commercial sound*
[2] Noise and vibration management: environmental permits (https://www.gov.uk/government/publications/noise-and-vibration-management-environmental-permits/noise-and-vibration-management-environmental-permits)

* No measurements were taken at NSR 3, the levels measured at NSR 2 are considered representative.

Table 1: Measured background sound levels at the NSRs

5.2 Specific sound level predictions

Predictions of the specific sound level at the NSRs have been made using a computer model, created in SoundPLAN – an industry-standard noise modelling software. The model has been validated using the near-field measurements of the generators, and includes geometry for: the digital ground model, constructed using LiDAR[3]; the massing of all buildings in the area, using OpenStreetMap[4] data; and the generator compound as constructed. An image from the model is shown in Figure 3. The noise prediction method used within SoundPLAN was ISO 9613-2[5].

All twelve generators, nine of which are diesel and three gas, have been modelled as operating. This is representative of a worst-case scenario.

During the near-field measurements the diesel generators were not at full electrical load as they were not yet able to power the paper mill. Therefore, in future usage the engine noise component may differ from that measured. However, through subjective listening and consultation with the generator manufacturer and on-site engineers, the dominant noise source was found to be the fresh air exhaust fans, which were running at full duty throughout the measurements.

For the diesel generators, the noise sources have been modelled as area sources to one end of each generator enclosure, representing the fresh air exhausts. The results from the near-field measurements were used to calculate the sound power level of each diesel generator.

As the gas generators were installed after the on-site measurements, the modelled sound power levels have been taken from datasheets provided by the manufacturer. The noise sources for these generators have been spread evenly across all surfaces of the modelled geometry.

The noise from the generators was assessed to be continuous, with no obvious distinctive characteristics as defined by BS 4142 i.e. tonality, impulsivity, intermittency.

[3] Lle Geo-Portal (https://lle.gov.wales/GridProducts#data=LidarCompositeDataset)
[4] OpenStreetMap (https://www.openstreetmap.org/about)
[5] ISO 9613-2:1996 *Attenuation of sound during propagation outdoors*

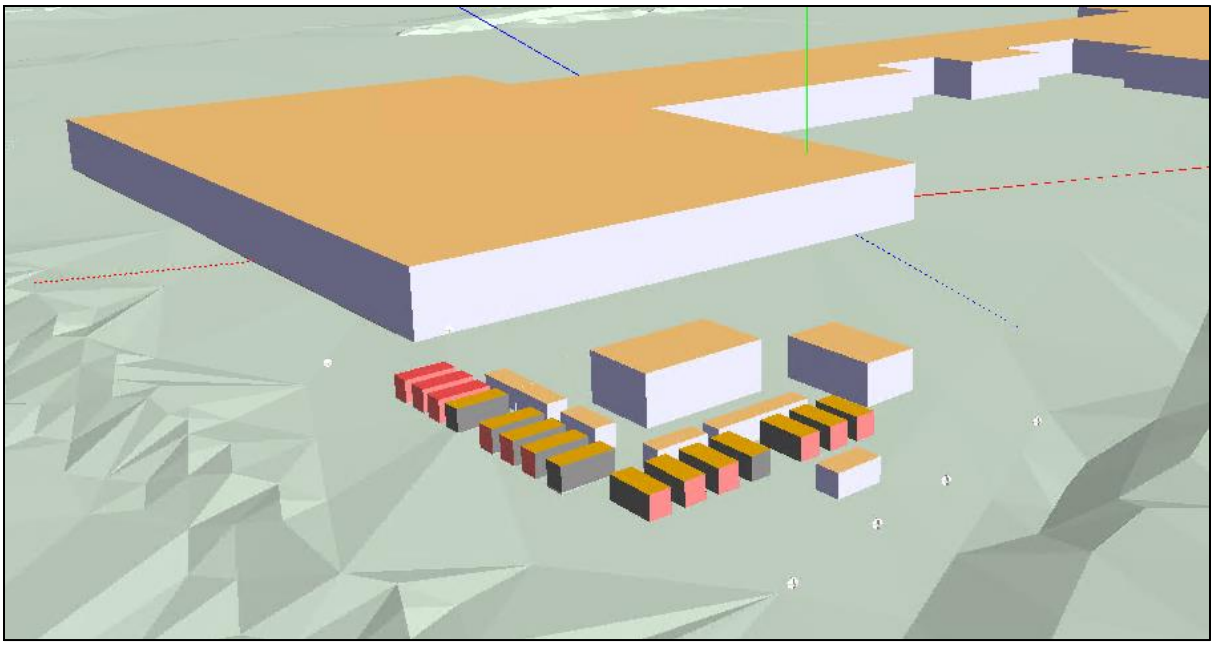

Figure 3: Render of the acoustic model, showing the generators and paper mill building massing. The 3 top-right most are the gas generators.

The acoustic model was used to predict the specific sound level at each NSR, as given in Table 2. A noise map showing the predicted specific sound level throughout the surrounding area is also shown in Figure 4.

Location (see Figure 1)	dBL$_{Aeq}$	
	Daytime (07:00 – 23:00)	Night-time (23:00 – 07:00)
NSR 1	31	31
NSR 2	33	33
NSR 3	34	34

Table 2: Predicted specific sound levels at the NSRs

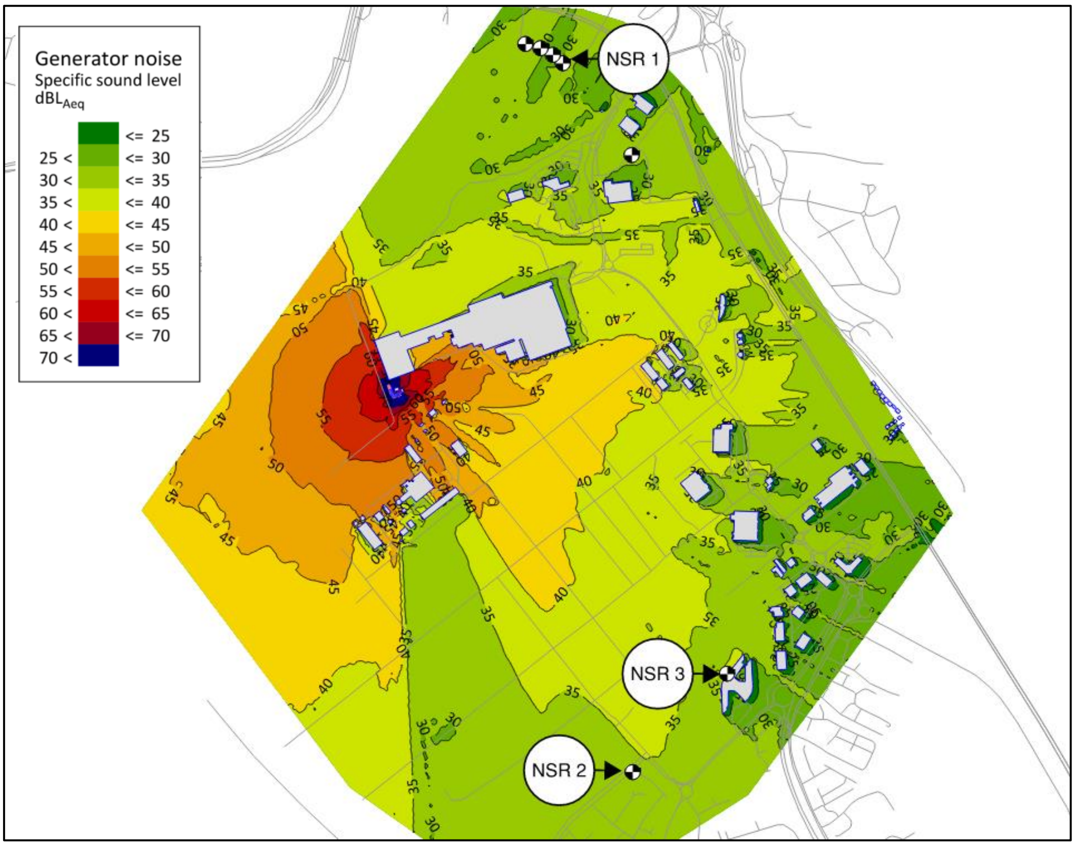

Figure 4: Noise map showing the predicted specific sound level in the surrounding area

6 Uncertainty

Some uncertainty is present in the measured background sound levels, due to the effects of meteorological conditions. Although the conditions during measurements were good, different conditions may be more or less favourable for the propagation of noise from the M4 motorway, and therefore influence the background sound levels at the NSRs.

The prediction of the specific sound levels may also include some uncertainty, as the near-field measurement locations of the generators were constrained, due to the proximity to the site boundary. Furthermore, the prediction method used to calculate the propagation of noise assumes moderately downwind conditions, and therefore in different wind conditions, the specific sound levels could vary at the NSRs. The prediction method used is considered to be a reasonable worst-case assumption.

The magnitude of the above uncertainties are not considered to be significant, and therefore the overall uncertainty in the outcome of the assessment will be low.

7 Noise impact assessment

The assessment and its results are detailed in Table 3.

Based on the BS 4142 assessment methodology, the likelihood of adverse impacts is low at all identified NSRs. The rating level for the operational generators is significantly below the measured background sound level, and therefore the contribution to the overall site noise is negligible.

Listening tests were carried out near to NSR 2, with and without the generators operating. Noise from the Sofidel site was inaudible in both cases, and the overall noise climate was assessed to be the same.

No character corrections relating to the BS 4142 assessment method have been applied to the specific sound level, as it was found to be not audible at the NSRs during listening tests. Furthermore, when in the near-field the specific sound was subjectively assessed to show no acoustically distinguishing characteristics, i.e. tonality, impulsivity, intermittency, and therefore it would not be necessary to include a penalty when calculating the rating level.

7.1 BS 4142 assessment table

Location	Background sound level, $dBL_{A90,T}$		Specific sound level, dBL_{Aeq}	Acoustic feature correction	Rating level, $dBL_{Ar,Tr}$	Excess of rating level over background sound level		Assessment outcome (in BS 4142 terms)
	Daytime (07:00 – 23:00) T = 16hr	Night-time (23:00 – 07:00) T = 8hr				Daytime (07:00 – 23:00)	Night-time (23:00 – 07:00)	
NSR 1	58	43	31	0	31	-15	-8	The likelihood of adverse impacts is low
NSR 2	41	38	33	0	33	-8	-5	
NSR 3	41	38	34	0	34	-7	-4	

Table 3: Noise impact assessment table (following BS 4142)

8 Conclusion

The noise impact assessment has shown that adverse impacts at the NSRs due to the operation of the proposed generators are unlikely, according to the BS 4142 standard.

Therefore, no further mitigation is required or recommended to reduce the noise levels at the NSRs.

Appendix A

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.

Frequency

Frequency is the rate of repetition of a sound wave. The subjective equivalent in music is pitch. The unit of frequency is the hertz (Hz), which is identical to cycles per second. A 1000Hz is often denoted as 1kHz, eg 2kHz = 2000Hz. Human hearing ranges approximately from 20Hz to 20kHz. For design purposes the octave bands between 63Hz to 8kHz are generally used. The most commonly used frequency bands are octave bands, in which the mid frequency of each band is twice that of the band below it. For more detailed analysis, each octave band may be split into three one-third octave bands or in some cases, narrow frequency bands.

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 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$L_{A90,\ 8hr}$.

Typical levels

Some typical dBA noise levels are given below:

Noise Level, dBA	Example
130	Threshold of pain
120	Jet aircraft take-off at 100m
110	Chain saw at 1m
100	Inside disco
90	Heavy lorries at 5m
80	Kerbside of busy street
70	Loud radio (in typical domestic room)
60	Office or restaurant
50	Domestic fan heater at 1m
40	Living room
30	Theatre
20	Remote countryside on still night
10	Sound insulated test chamber

Appendix B

Full sound level survey measurement data

B1 Sound level survey measurement data

Location (see Figure 5 and Figure 6)	Start Time	Elapsed Time	Notes	dBL_{AFmax}	dBL_{AFmin}	dBL_{Aeq}	dBL_{AF90}
1	15:09:00	00:05:00	Daytime, representative of NSR 1. M4 dominant. Sofidel site not audible. Generators not running	61.6	55.5	57.9	56.9
1	15:18:00	00:05:00		66.9	55.7	58.3	57.0
1	15:25:00	00:05:00		60.3	55.7	58.1	57.1
2	15:40:00	00:05:00	Daytime, NSR 2. Handel Road dominant when active, sea noise dominant when no traffic. Some occasional children activity noise from local school playground/playing fields. Sofidel site not audible. Generators not running	58.8	40.0	44.7	41.6
2	15:48:00	00:05:00		61.8	39.9	47.0	42.2
2	15:57:00	00:05:00		68.7	39.7	52.3	41.5
2	16:13:00	00:05:00		64.2	38.1	48.7	40.0
2	16:20:00	00:05:00		61.4	39.7	50.6	40.9
2	16:26:00	00:05:00		65.7	39.0	51.4	40.4
1	02:10:00	00:05:00	Night-time, representative of NSR 1. M4 dominant. Sofidel site not audible. Generators not running	59.4	40.6	49.5	44.4
1	02:18:00	00:05:00		56.0	37.0	48.1	40.1
1	02:24:00	00:05:00		57.2	42.6	50.8	45.6
2	02:38:00	00:05:00	Night-time, NSR 2. M4 dominant, some low-level plant noise from SE direction. Sofidel site not audible. Generators not running	57.8	35.3	38.3	36.8
2	02:45:00	00:05:00		45.2	36.9	39.9	38.3
2	02:51:00	00:05:00		41.7	36.8	39.0	38.1
G1	10:21:00	00:01:00	Near-field generator measurement 1	72.8	70.5	71.3	70.9
G2	10:22:00	00:01:00	Near-field generator measurement 2	76.6	74.1	75.4	74.9
G3	10:23:00	00:01:00	Near-field generator measurement 3	77.8	74.9	76.2	75.4
G4	10:24:00	00:01:00	Near-field generator measurement 4	76.8	74.7	75.7	75.3
G5	10:25:00	00:01:00	Near-field generator measurement 5	63.2	60.5	61.9	61.2
G6	10:26:00	00:01:00	Near-field generator measurement 6	68.1	64.1	66.1	65.1
3	10:51:00	00:05:00	Closest point to site on southern side. Generators running, but not audible	55.7	44.9	48.2	46.4

2	10:59:00	00:05:00	Daytime, NSR 2. Generators running, but not audible. Handel Rd dominant. Sofidel site not audible	66.9	39.1	53.3	42.1
3	11:08:00	00:05:00	Closest point to site on southern side. Sofidel site not audible. Generators not running	58.5	43.6	48.2	45.7
1	11:21:00	00:05:00	Daytime, representative of NSR 1. M4 dominant, Sofidel site not audible. Generators not running	64.9	57.5	60.0	58.9
1	11:28:00	00:05:00		63.2	57.1	59.9	58.8
1	11:35:00	00:05:00		63.5	56.9	59.5	58.2

Table 4: Table of full sound level survey measurement data

B2 Measurement locations

Figure 5: Measurement locations

B3 Photographs of measurement locations


Measurement location 1


Measurement location 2

Measurement location 3

B4 Generator compound layout and operational measurement locations

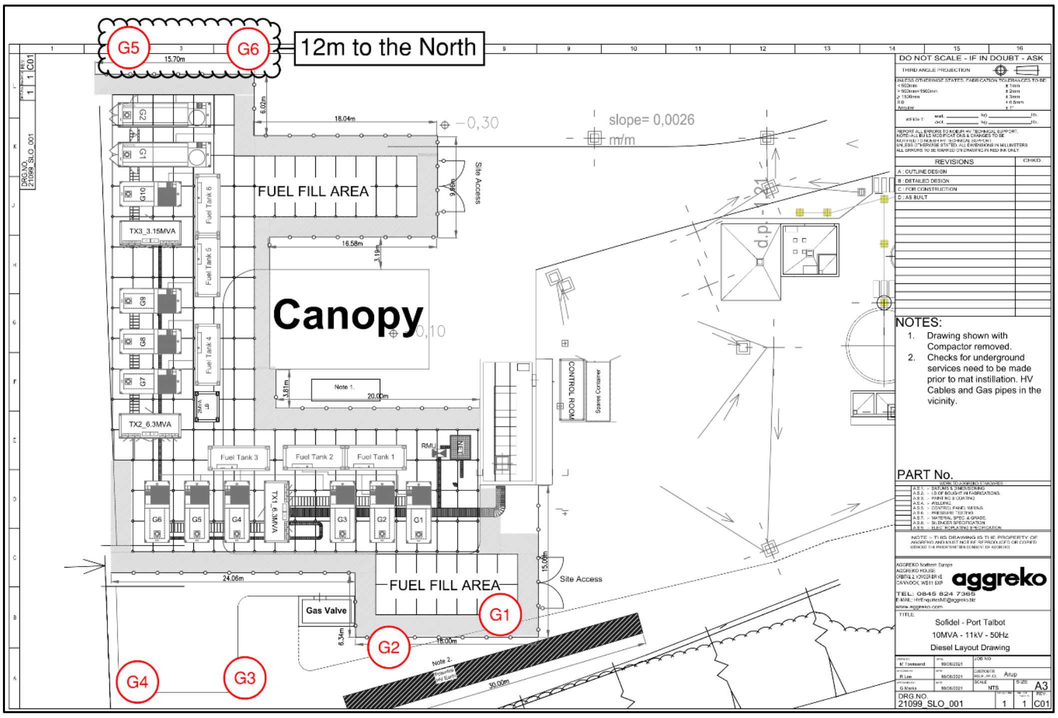

Figure 6: Generator compound layout and measurement locations