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Gist Ltd

Energy Centre, Barnsley

Noise Assessment of Proposed Development

First Draft Report - June 2008

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1 Introduction

1.1 Gist Ltd (Gist) is seeking planning permission to install a new Energy Centre at their Barnsley depot. Accordingly RPS has been commissioned by Gist to undertake a noise assessment of the proposed development.

1.2 The proposed Energy Centre is a new stand alone unit to the west of the current store room and is an ammonia-based cooling system for the depot. The unit is two storeys high and will contain compressors on the ground floor and condensers on the first floor.

1.3 The closest noise sensitive receptors (NSRs) to the proposed Energy Centre are residential properties at the end of Blakeley Close and St Helen's School.

2 Noise Units, Standards, Guidance and Consultation

2.1 Noise is defined as unwanted sound. The range of audible sound is from 0 dB to 140 dB. The frequency response of the ear is usually taken to be about 18 Hz (number of oscillations per second) to 18000 Hz. The ear does not respond equally to different frequencies at the same level. It is more sensitive in the mid-frequency range than the lower and higher frequencies and because of this, the low and high frequency components of a sound are reduced in importance by applying a weighting (filtering) circuit to the noise measuring instrument. The weighting which is most widely used and which correlates best with subjective response to noise is the dB (A) weighting. This is an internationally accepted standard for noise measurements.

2.2 For variable noise sources such as traffic, a difference of 3 dB is just distinguishable. In addition, a doubling of traffic flow will increase the overall noise by 3 dB. The 'loudness' of a noise is a purely subjective parameter, but it is generally accepted that an increase/decrease of 10 dB corresponds to a doubling/halving in perceived loudness.

2.3 External noise levels are rarely steady, but rise and fall according to activities within an area. In an attempt to produce a figure that relates this variable noise level to subjective response, a number of noise indices have been developed. These include:

i) The L_{Amax} noise level;

This is the maximum noise level recorded over the measurement period and provides an indication of the highest noise levels registered during the measurement period.

ii) The $L_{Aeq,T}$ noise level;

This is the 'equivalent continuous A-weighted sound pressure level, in decibels' and is defined in British Standard (BS) 7445 [1] as the 'value of the A-weighted sound pressure level of a continuous, steady sound that, within a specified time interval, T, has the same mean square sound pressure as a sound under consideration whose level varies with time'.

It is a unit commonly used to describe construction noise, noise from industrial premises and is the most suitable unit for the description of other forms of environmental noise.

iii) The L_{A90} noise level;

This is the noise level that is exceeded for 90% of the measurement period and gives an indication of the noise level during quieter periods. It is often referred to as the background noise level and is used in the assessment of disturbance from industrial noise.

2.4 In addition, the term 'ambient noise' is often referred to. Ambient noise is defined in BS 4142 [2] as the '*totally encompassing sound in a given situation at a given time usually composed of sound from many sources near and far*'. It is commonly measured in terms of $L_{Aeq,T}$.

2.5 Planning Policy Guidance: Planning and Noise (PPG 24) [3] states that:

> *'The likelihood of complaints about noise from industrial development can be assessed, where the Standard is appropriate, using guidance in BS 4142: 1990. Tonal or impulsive characteristics of the noise are likely to increase the scope for complaints and this is taken into account by the "rating level" defined in BS 4142.'*

2.6 Accordingly, noise effects from the proposed development have been assessed in accordance with BS 4142. The 1990 version of BS 4142 has now been superseded by the 1997 version.

Method for Assessing Noise From Fixed Installations (BS 4142:1997)

2.7 BS 4142 provides a method for rating industrial noise affecting mixed residential and industrial areas and advocates the use of $L_{Aeq,T}$, a level that is directly measurable, and termed the specific noise level when corrected for the duration of the noise. The specific noise level is then corrected for character, if appropriate (see paragraph 2.8), and termed the rating level. When used to assess industrial noise, the rating level is determined and the L_{A90} background level is subtracted from it. A difference of around 10 dB or higher indicates that complaints are likely. A difference of around 5 dB is of marginal significance. A difference of –10 dB is a positive indication that complaints are unlikely.

2.8 BS 4142 requires a +5 dB correction to be applied to the specific noise level if the noise contains a distinguishable, discrete, continuous note (whine, hiss, screech, hum etc), or if there are distinct impulses in the noise (bangs, clicks, clatters, or thumps), or if the noise is irregular enough in character to attract attention. The specific noise level then becomes the rating level.

2.9 BS 4142 requires that the assessment location should be free-field noise levels (at least 3.5 m from any reflecting façades apart from the ground) at ground floor level and façade noise levels (1 m from the façade) at first floor and above.

2.10 Table 2.1 below provides the BS 4142 significance criteria for rating level compared to background level.

Table 2.1 : BS 4142 Significance Criteria

BS 4142 Assessment Level, dB(A) (Rating level relative to background noise level)	BS 4142 Semantic (As described in the Standard)
< -10	*'If the rating level is more than 10 dB below the measured background level then this is a positive indication that complaints are unlikely'*
-10 to +5	No BS 4142 description but the more negative the difference, the less the likelihood of complaints.
+ 5	*'A difference of around +5 dB is of marginal significance'*
+5 to +10	No BS 4142 description but the more positive the difference, the greater the likelihood of complaints.
> +10	*'A difference of around 10 dB or more indicates that complaints are likely'*

Guidelines for Community Noise (GCN)

2.11 The World Health Organisation (WHO) published GCN [4] in 2000, which contains guidance on the desirable levels of environmental noise. GCN contains noise levels that, the authors suggest, are commensurate with the onset of measurable effects.

2.12 With regards to noise during the daytime, GCN states:

'To protect the majority of people from being seriously annoyed during the daytime, the outdoor sound level from steady, continuous noise should not exceed 55 dB L_{Aeq} on balconies, terraces, and outdoor living areas. To protect the majority of people from being moderately annoyed during the daytime, the outdoor sound level should not exceed 50 dB L_{Aeq}. Where it is practical and feasible, the lower outdoor sound level should be considered the maximum desirable sound level for new development.'

2.13 With regards to noise during the night-time, the authors of GCN consider that sleep disturbance criteria should be taken as an internal noise level of 30 dB $L_{Aeq,8hr}$ or an external level of 45 dB $L_{Aeq,8hr}$, measured at 1 m from the façade. It is also suggested that internal L_{Amax} levels of 45 dB and external L_{Amax} levels of 60 dB, should not be exceeded.

2.14 With regards to noise in schools , GCN states:

'For schools, the critical effects of noise are on speech interference, disturbance of information extraction (e.g. comprehension and reading acquisition), message communication and annoyance. To be able to hear and understand spoken messages in classrooms, the background sound pressure level should not exceed 35 dB LAeq during teaching sessions. For hearing impaired children, an even lower sound pressure level may be needed.

...

For outdoor playgrounds, the sound pressure level of the noise from external sources should not exceed 55 dB LAeq, the same value given for outdoor residential areas in daytime.'

Consultation with Barnsley Metropolitan District Council

2.15 An Environmental Health Officer (EHO) from Barnsley Metropolitan Borough Council (BMBC) was consulted by RPS on 27th May 2008. The following assessment methodology was agreed:

- a 7-day baseline noise survey should be carried out in a location representative of the nearest NSRs;
- the significance of effects should be assessed in accordance with BS 4142 but, other assessment methodologies should be applied where appropriate, i.e. noise change and GCN;
- the assessment should address daytime and night-time periods; and
- the assessment should address any other potential changes in site activity not directly related to noise from the Energy Centre.

3 Proposed Energy Centre, Site Activity and Noise Sensitive Receptors

Energy Cente Layout

3.1 The proposed Energy Centre is a two-storey block approximately 21.5 m wide and 7.3 m deep situated to the west of the current store room at the location indicated in Figure 1.

3.2 The ground floor comprises three rooms: a control room; a large room containing three compressor units; and a store room. The ground floor of the unit is enclosed by a 140 mm solid blockwork wall, with a louvred double door on the east side and a louvred single door on the west side. The first floor comprises two condenser units on a concrete plinths enclosed on all sides by louvred walls.

3.3 The Energy Centre ground and first floor plans are provided in Figure 2.

Site Activity

3.4 It is unlikely that the implementation of the new energy centre will cause any significant changes on site other than the operation of the unit itself. All current plant buildings will continue to operate as normal and there will be no significant changes in traffic movements on site. Therefore it is considered that the only significant noise change will be due to the operation of the plant unit.

Noise Sensitive Receptors

3.5 The nearest NSRs to the proposed Energy Centre are the houses at the end of Blakeley Close, which are directly opposite the site entrance, and St. Helen's school, which is directly opposite the western boundary of the site. The proposed Energy Centre would be approximately 90 m from the closest house on Blakeley Close and closest school building.

4 Baseline Noise Survey

4.1 In accordance with the BS 4142 methodology, the likelihood of a complaint is partly dependent upon the background noise level at the nearest NSR. The background noise levels during the day and night have been monitored for 6-days, including a weekend. As the proposed plant would be running 24-hours a day, a long-term noise measurement was considered appropriate.

4.2 The background noise level was measured to the west of the existing buildings on the site boundary close to the school and representative of the nearest residential NSRs. The survey was undertaken from Friday 30th May to Friday 6th June 2008. The measurement was undertaken at a freefield location at a height of 1.5 m above local ground level. The measurement was made with an 01dB 'SOLO' Sound Level Meter (SLM), which was calibrated prior to and after the measurements with an 01dB calibrator. No significant drift occurred whilst the measurements were taken. Calibration certificates are available on request from RPS. The survey location is provided in Figure 1.

4.3 The meteorological conditions during the survey period have been checked from archive data on Metcheck.com and were considered satisfactory for noise monitoring.

4.4 The background noise level was measured with all existing plant operating. Data were recorded in hourly periods and then averaged for the daytime and night-time periods. The background noise levels are summarised in Table 4.1. Full survey results are shown in Appendix A.

Table 4.1 : Background Noise Level Summary

	Daytime (07:00 – 23:00 hours) $L_{A90, 16h}$	**Night-time (23:00 – 07:00 hours) $L_{A90, 8h}$**
Weekend	52	46
Weekday	55	54
Minimum 1 hour	-	44

5 Assessment

Plant Noise Levels

Ground Floor

5.1 The proposed compressor unit is an Agilium 610. This produces a sound pressure level (L_p) of 92 dB(A) at a distance of 1 m when measured in a free-field location. Calculations were made of the sound power level (L_w) of the enclosure façade facing west toward the nearest NSRs. Typical properties for sound attenuation and absorption of the materials described in the plans have been used to predict the reverberation time and sound reduction of the facade. The results of the calculations are provided in Table 5.1. Full calculations can be found in Appendix B.

Table 5.1 : Calculation of Sound Power Level of Ground Floor Facade

L_p of single compressor dB(A)	92
L_p of 3 compressor units dB(A)	97
L_w of 3 compressors dB(A)	105
Reverberant L_p in enclosure dB(A)	100
L_w of enclosure facade dB(A)	85

First Floor

5.2 The proposed condenser unit is a BAC VCL 285-0 evaporative condenser. This is available from the supplier either with or without acoustic HS attenuation. Calculations have been made of the sound power level of the first floor façade facing west toward the nearest NSRs for both units with attenuation and with no attenuation. A façade correction has been applied to compensate for reflections to the unit east of the proposed plant. The results of the calculations are provided in Table 5.2. Full calculations can be found in Appendix B.

Table 5.2 : Calculation of Sound Power Level of First Floor Facade

	Without Acoustic attenuation	With Acoustic HS attenuation
L_w of Single unit dB(A)	98	83
L_w of 2 units dB(A)	101	86
L_w of 2 units with façade correction	104	89

Noise Level at NSR

5.3 The noise level produced by the ground floor, first floor and combined plant at the closest NSR has been calculated for two options: Option 1 with no acoustic attenuation for the condensers on first floor and option 2, using condensers with HS acoustic attenuation. The results are provided in Table 5.3. Full calculations can be found in Appendix B.

Table 5.3 : Calculated Noise levels at 90 m

Option	Floor	Contributing plant	Noise Level at closest NSR
	GF	Compressors	35
	FF	Condensers	54
Option 1	**GF & FF**	**Compressors and Condensers**	**54**
	GF	Compressors	35
	FF	Condensers with HS attenuation	39
Option 2	**GF & FF**	**Compressors and Condensers with HS attenuation**	**41**

BS 4142 Assessment

5.4 A BS 4142 assessment has been undertaken to assess the likelihood of complaints arising from the operation of the proposed plant from the nearest NSR at Blakeley Close. The two options referred to in Paragraph 5.3 have been assessed for day and night, and weekend and weekdays. A façade correction has been made to the rating level in accordance with BS 4142 for the night-time assessments to account for a position 1 m in front of the façade. The results of the assessments are provided in Table 5.4 below. Full calculations are shown in Appendices C and D.

Table 5.4 : BS 4142 Assessment Summary

Option	Weekend / Weekday	Daytime / Night-time	Background Noise Level $L_{A90,T}$ (dB)	Rating Level $L_{Ar,Tr}$ (dB)	Rating / Background Level Difference (dB)
Option 1	Weekend	Daytime	52	54	+ 2
Option 1	Weekend	Night-time	46	57	+ 11
Option 1	Weekday	Daytime	55	54	- 1
Option 1	Weekday	Night-time	54	57	+ 3
Option 2	Weekend	Daytime	52	41	- 11
Option 2	Weekend	Night-time	46	44	- 2
Option 2	Weekday	Daytime	55	41	- 14
Option 2	Weekday	Night-time	54	44	- 10

5.5 The results of the assessments indicate that, with option 1, complaints would be likely during weekend night-time operation. At all other times with option 1 the plant would be audible above the existing background noise and could give rise to complaints.

5.6 With the extra HS attenuation installed, option 2, the plant would not be likely to cause complaints at any time during the week or during the daytime at the weekend. During the night at the weekend a rating above background level of -2 dB indicates that the plant is approaching a level where complaints would be unlikely and is a less than marginal significance.

5.7 Therefore, with the existing background levels the new plant would require the additional HS attenuation specified by the supplier to meet reasonable BS 4142 criteria.

GCN Criteria

5.8 The GCN specifies that a steady continuous noise should not exceed 55 dB L_{Aeq} in outdoor areas for both residential and schools. Internally for residential dwellings at night a level of 30 dB L_{Aeq} should not be exceeded. The GCN states that this is equivalent to a noise level of 45 dB 1 m in front of the façade. For internal levels in school classrooms the GCN states that the noise level should not exceed 35 dB. Using the same assumptions for inside to outside corrections as night-time noise levels in residential dwellings the external level should not exceed 50 dB LAeq 1 m from the façade.

5.9 Table 5.5 below shows the measured ambient noise level compared to the GCN criteria.

Table 5.5 : Existing Measured Background Noise Levels Compared to GCN Criteria

Scenario	Existing Measured Ambient Noise Level, L_{Aeq}	GCN Criteria, L_{Aeq}	Criteria Achieved?
Residential Weekend Daytime Outdoor	63 dB	55 dB	No
Residential Weekend Night-time External	60 dB	45 dB	No
Residential and School Weekday Daytime Outdoor	64 dB	55 dB	No
School Weekday Daytime External	64 dB	50 dB	No
Residential Weekday Night-time External	66 dB	45 dB	No

5.10 The comparison between the existing measured ambient noise levels and the GCN criteria shows that the existing noise climate currently does not meet the GCN criteria and therefore a noise change assessment would be more suitable to assess the impacts of the proposed plant.

Noise Change

5.11 A noise change assessment has been undertaken to indicate the significant effects of the proposed plant. Table 5.6 below shows the noise change assessment. The assessment has been carried out for a distance 90 m away from the proposed plant, the distance to both nearest NSRs. The noise level for the plant has been assumed to be

Table 5.6 : Noise Change Assessment

Scenario	Existing Ambient Noise Level, L_{Aeq}	Proposed Plant Noise Level, L_{Aeq}	Combined Existing Ambient and Proposed Plant Noise Level, L_{Aeq}	Noise Change	Significance
Weekend Daytime	63 dB	41 dB	63 dB	0 dB	Not significant
Weekend Night-time	60 dB	41 dB	60 dB	0 dB	Not significant
Weekday Daytime	64 dB	41 dB	64 dB	0 dB	Not significant
Weekend Night-time	66 dB	41 dB	66 dB	0 dB	Not significant

5.12 The noise change assessment shows that no significant noise change will occur at the nearest NSRs as a result of the proposed plant.

6 Summary and Conclusions

6.1 Gist Ltd (Gist) is seeking planning permission to install a new Energy Centre at their Barnsley depot. Accordingly RPS has been commissioned by Gist to undertake a noise assessment of the proposed development.

6.2 It was agreed with a BMBC EHO that the assessment should be undertaken in accordance with BS 4142 but that criteria contained within GCN and noise change should also be considered, where necessary.

6.3 A long-term survey was carried out on the site boundary in order to determine the background noise level at a location that was representative of the nearest NSRs.

6.4 Predictions of noise from the proposed plant have been undertaken for the nearest NSR. These predictions indicate that the new plant will achieve a BS 4142 rating level of 54 dB for option 1 and 41 dB for option 2 (which includes the additional HS attenuation). With option 2 for the plant in place the rating over background levels are at least -10 dB at any time during the week and daytime during the weekend. This indicates that complaints are unlikely. During weekend nights the rating over background level is -2 dB which is of less than marginal significance.

6.5 Comparison of existing ambient levels to the GCN criteria show that the local noise environment currently exceeds the criteria and so a noise change assessment was carried out to indicate any significant effects of the proposed plant. The assessment shows that no ambient noise change will occur and therefore there are no significant noise change effects.

6.6 On the above basis, operation of the proposed plant at this location will not be significant. Therefore, it is considered that there are no reasons, with regards to noise, why planning permission should not be granted.

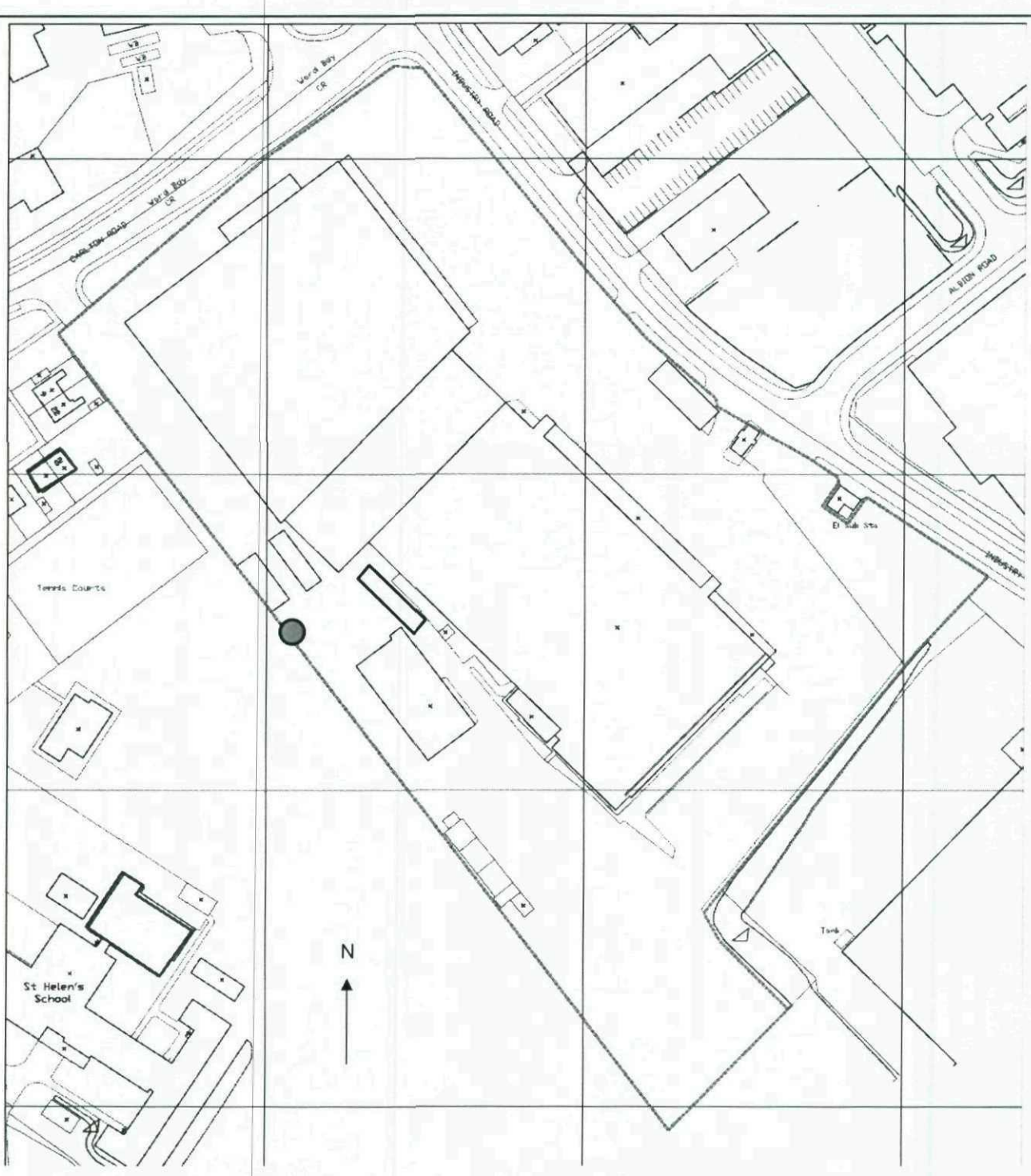
References

1. British Standards Institution. British Standard 7445: Description and Measurement of Environmental Noise, Part 1. Guide to Quantities and Procedures, 2003.
2. British Standards Institution. British Standard 4142: Method for Rating industrial noise affecting mixed residential and industrial areas, 1997.
3. Department of the Environment. Planning Policy Guidance 24: Planning and Noise, September 1994.
4. World Health Organisation. Guidelines for Community Noise. 2000.

Figures

Figure 1

Plan Showing Proposed Energy Centre, Survey Location and NSRs



- Long-term survey location
- Site boundary
- Approximate location of new Energy Centre
- Nearest NSRs

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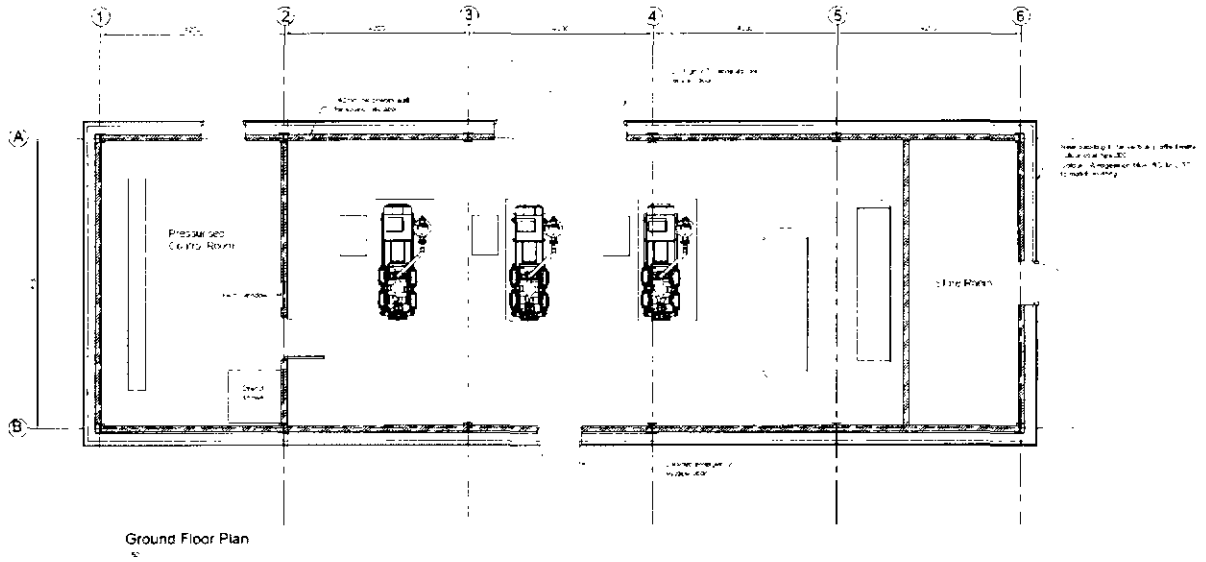
Plan showing Proposed Energy Centre, Survey Location and NSRs

Figure 1

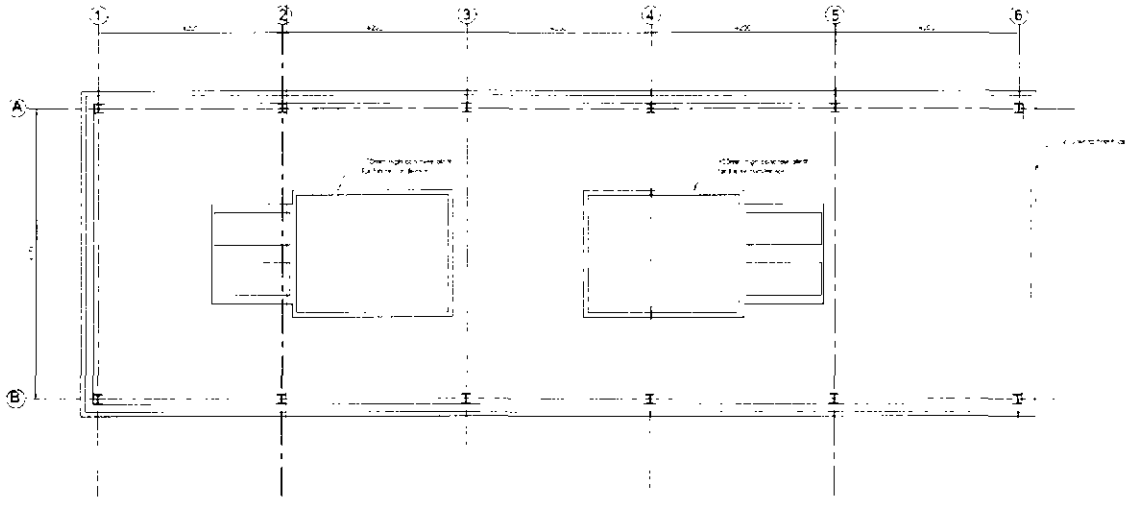
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Figure 2

Proposed Energy Centre Floor Plans



Ground Floor Plan



First Floor Plan

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Proposed Energy Centre Floor Plans

Figure 2

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Appendices

Appendix A

Long-term Noise Survey Data

Appendix A - Long-term Noise Survey Data

Hourly Survey Data

Date	Time	Daytime 07:00 - 23:00		Night-time 23:00 - 07:00	
		$L_{Aeq, 1h}$	$L_{A90, 1h}$	$L_{Aeq, 1h}$	$L_{A90, 1h}$
30/05/2008	14:00	63.2	55.5		
30/05/2008	15:00	63.5	55.6		
30/05/2008	16:00	60.0	54.3		
30/05/2008	17:00	59.3	54.4		
30/05/2008	18:00	61.1	56.1		
30/05/2008	19:00	62.6	57.0		
30/05/2008	20:00	64.9	54.5		
30/05/2008	21:00	62.8	52.4		
30/05/2008	22:00	59.8	47.3		
30/05/2008	23:00			60.5	48.4
31/05/2008	00:00			61.1	46.7
31/05/2008	01:00			60.4	48.1
31/05/2008	02:00			60.0	49.9
31/05/2008	03:00			67.2	53.3
31/05/2008	04:00			66.7	55.5
31/05/2008	05:00			62.6	54.1
31/05/2008	06:00			56.5	51.7
31/05/2008	07:00	59.1	53.4		
31/05/2008	08:00	58.6	53.5		
31/05/2008	09:00	62.6	53.8		
31/05/2008	10:00	66.3	57.5		
31/05/2008	11:00	63.9	57.7		
31/05/2008	12:00	65.0	51.0		
31/05/2008	13:00	61.3	52.1		
31/05/2008	14:00	57.5	52.2		
31/05/2008	15:00	59.4	53.4		
31/05/2008	16:00	57.1	49.9		
31/05/2008	17:00	54.6	49.0		
31/05/2008	18:00	53.7	50.7		
31/05/2008	19:00	56.9	53.1		
31/05/2008	20:00	57.5	53.6		
31/05/2008	21:00	55.4	49.1		
31/05/2008	22:00	54.9	46.4		
31/05/2008	23:00			68.4	46.3
01/06/2008	00:00			60.0	45.6
01/06/2008	01:00			53.5	44.4
01/06/2008	02:00			52.2	44.1
01/06/2008	03:00			55.2	45.4
01/06/2008	04:00			54.5	46.3
01/06/2008	05:00			55.6	46.2
01/06/2008	06:00			53.2	43.8
01/06/2008	07:00	58.4	46.6		
01/06/2008	08:00	57.2	47.2		
01/06/2008	09:00	69.9	57.3		
01/06/2008	10:00	68.1	58.4		
01/06/2008	11:00	68.2	58.5		
01/06/2008	12:00	68.1	51.8		
01/06/2008	13:00	68.5	57.9		
01/06/2008	14:00	67.0	53.3		
01/06/2008	15:00	64.5	52.0		

Date	Time	Daytime 07:00 - 23:00		Night-time 23:00 - 07:00	
		$L_{Aeq, 1h}$	$L_{A90, 1h}$	$L_{Aeq, 1h}$	$L_{A90, 1h}$
01/06/2008	16:00	55.6	51.0		
01/06/2008	17:00	59.6	51.2		
01/06/2008	18:00	57.3	45.0		
01/06/2008	19:00	60.4	51.1		
01/06/2008	20:00	66.6	46.4		
01/06/2008	21:00	54.9	44.7		
01/06/2008	22:00	62.7	46.6		
01/06/2008	23:00			64.4	48.0
02/06/2008	00:00			56.6	47.0
02/06/2008	01:00			59.4	47.6
02/06/2008	02:00			54.9	46.6
02/06/2008	03:00			61.2	49.8
02/06/2008	04:00			59.0	46.4
02/06/2008	05:00			56.5	45.9
02/06/2008	06:00			56.5	46.4
02/06/2008	07:00	56.6	46.0		
02/06/2008	08:00	59.7	53.3		
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02/06/2008	12:00	64.6	57.7		
02/06/2008	13:00	64.6	55.4		
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02/06/2008	17:00	59.2	54.6		
02/06/2008	18:00	61.1	56.0		
02/06/2008	19:00	69.0	58.0		
02/06/2008	20:00	64.1	55.7		
02/06/2008	21:00	65.7	55.0		
02/06/2008	22:00	61.8	53.3		
02/06/2008	23:00			68.1	56.6
03/06/2008	00:00			63.7	51.5
03/06/2008	01:00			65.8	53.7
03/06/2008	02:00			64.8	53.0
03/06/2008	03:00			72.3	54.6
03/06/2008	04:00			68.1	53.7
03/06/2008	05:00			62.1	52.6
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03/06/2008	08:00	62.8	53.7		
03/06/2008	09:00	63.6	53.4		
03/06/2008	10:00	66.8	53.9		
03/06/2008	11:00	67.5	56.6		
03/06/2008	12:00	66.2	55.8		
03/06/2008	13:00	65.6	52.8		
03/06/2008	14:00	65.6	54.0		
03/06/2008	15:00	62.2	55.5		
03/06/2008	16:00	63.6	55.3		
03/06/2008	17:00	61.5	55.2		
03/06/2008	18:00	63.7	51.6		
03/06/2008	19:00	60.8	54.2		
03/06/2008	20:00	65.2	54.8		
03/06/2008	21:00	64.1	54.4		

Date	Time	Daytime 07:00 - 23:00		Night-time 23:00 - 07:00	
		$L_{Aeq, 1h}$	$L_{A90, 1h}$	$L_{Aeq, 1h}$	$L_{A90, 1h}$
03/06/2008	22:00	62.5	54.0		
03/06/2008	23:00			63.4	53.6
04/06/2008	00:00			65.2	52.8
04/06/2008	01:00			64.4	54.5
04/06/2008	02:00			57.8	52.4
04/06/2008	03:00			66.8	55.2
04/06/2008	04:00			68.7	54.8
04/06/2008	05:00			62.7	53.9
04/06/2008	06:00			61.9	54.0
04/06/2008	07:00	63.2	53.3		
04/06/2008	08:00	62.4	54.1		
04/06/2008	09:00	65.2	53.7		
04/06/2008	10:00	66.9	53.4		
04/06/2008	11:00	64.7	55.1		
04/06/2008	12:00	64.7	55.8		
04/06/2008	13:00	64.6	55.8		
04/06/2008	14:00	62.8	53.9		
04/06/2008	15:00	60.6	56.7		
04/06/2008	16:00	62.7	56.3		
04/06/2008	17:00	59.8	54.3		
04/06/2008	18:00	61.5	55.9		
04/06/2008	19:00	63.7	54.1		
04/06/2008	20:00	63.6	52.6		
04/06/2008	21:00	63.4	51.6		
04/06/2008	22:00	64.4	54.9		
04/06/2008	23:00			63.8	54.1
05/06/2008	00:00			61.1	52.6
05/06/2008	01:00			64.6	53.9
05/06/2008	02:00			62.8	52.6
05/06/2008	03:00			69.0	53.9
05/06/2008	04:00			69.6	54.8
05/06/2008	05:00			61.7	53.8
05/06/2008	06:00			61.5	52.6
05/06/2008	07:00	59.1	53.2		
05/06/2008	08:00	63.3	53.8		
05/06/2008	09:00	63.7	55.6		
05/06/2008	10:00	66.1	57.7		
05/06/2008	11:00	65.7	55.6		
05/06/2008	12:00	64.0	57.9		
05/06/2008	13:00	63.7	56.8		
05/06/2008	14:00	63.3	56.4		
05/06/2008	15:00	62.0	53.7		
05/06/2008	16:00	60.9	57.5		
05/06/2008	17:00	58.9	54.3		
05/06/2008	18:00	63.4	55.2		
05/06/2008	19:00	63.4	57.0		
05/06/2008	20:00	67.1	57.4		
05/06/2008	21:00	63.7	56.3		
05/06/2008	22:00	62.4	54.4		
05/06/2008	23:00			63.9	54.2
06/06/2008	00:00			68.1	53.1
06/06/2008	01:00			65.5	54.3
06/06/2008	02:00			61.2	52.6
06/06/2008	03:00			65.3	55.3

Date	Time	Daytime 07:00 - 23:00		Night-time 23:00 - 07:00	
		$L_{Aeq, 1h}$	$L_{A90, 1h}$	$L_{Aeq, 1h}$	$L_{A90, 1h}$
06/06/2008	04:00			67.8	54.7
06/06/2008	05:00			61.4	53.8
06/06/2008	06:00			62.1	52.3
06/06/2008	07:00	60.8	53.8		
06/06/2008	08:00	63.5	54.6		
06/06/2008	09:00	64.0	56.2		
06/06/2008	10:00	66.3	55.6		
06/06/2008	11:00	66.8	54.8		

Summary

Date	Daytime 07:00 - 23:00		Night-time 23:00 - 07:00	
	$L_{Aeq, 16h}$	$L_{A90, 16h}$	$L_{Aeq, 8h}$	$L_{A90, 8h}$
Saturday 31/05/2008	60.7	52.3	60.7	45.3
Sunday 01/06/2008	65.4	51.2	59.7	47.2
Monday 02/06/2008	64.3	53.8	67.2	53.4
Tuesday 03/06/2008	64.5	54.3	64.9	53.9
Wednesday 04/06/2008	63.7	54.5	65.5	53.5
Thursday 05/06/2008	63.7	55.8	65.2	53.8
Weekend Mean	**63.1**	**51.7**	**60.2**	**46.2**
Weekday Mean	**64.1**	**54.6**	**65.7**	**53.7**

Appendix B

Proposed Plant Noise Levels at the Nearest NSRs

Appendix B - Proposed Plant Noise Levels at the Nearest NSRs

Note - all dimensions measured from CAD plans 15777_0003.dwg and 15777_0004.dwg

Sound Power Level	104.753	*from RPS standard spreadsheet, hemispherical source
Room dimenisions		
Enclosure length (m)	14.05	
Enclosure width (m)	6.5	
Enclosure height (m)	4.3	
Enclosure volume (m^3)	392.6975	

	w	h	area
small door dimensions	1	2	2
large door dimensions	3	3	9

Surface Areas		
total surface area	359.38	
surface area louvres	11	
surface area concrete	91.325	
surface area blockwork walls	257.055	*includes internal walls and door
Absorption Coefficients		
Absorption coefficient louvres	0.6	*taken from BB93 abs coeff data air vent
Absorption coefficient concrete	0.02	*taken from BB93 abs coeff data
Absorption coefficient blockwork	0.02	*taken from BB93 abs coeff data
Reverberation Time	4.659947	
Reverberant SPL	99.49624	*Noise Control in Building Services, Sound Research Laboratories Ltd, formula 5.4

Sound Reduction Indices Total			for whole building	for facades facing NSR
louvred doors	0		0.03060827	0.00556514
concrete roof	49	*taken from BB93 SRI data 100mm concrete slab	3.19916E-06	
140mm dense blockwork	45	*estimate from BB93 SRI data for 150mm blockwork (-2dB)	2.26189E-05	2.45939E-06
			0.030634088	0.005567599

Total sound reduction	22.54332	
Sound Level at facade	85.41674	
Lw at facade	85.41674	

Summary

	Noise Level
Lp of single compressor dB(A)	92
Lp of 3 compressor units dB(A)	96.8
Lw of 3 compressors dB(A)	104.8
Reverberant Lp in enclosure dB(A)	99.5
Lw at enclosure facade dB(A)	85.4

Without Attenuation

Sound Power Level	98
2 units	101.0103

With attenuation

Sound Power Level	83
2 units	86.01029996

Distance to NSR	90	
Correction for building reflections	3	
Noise levels at NSR		
Compressor	35	3413.412
Condenser	54	246913.6
Condensor with acoustic attenuation	39	7808.093
Compressor and condenser	54	250327
Compressor and condenser with acoustic	41	11221.51

Option	Floor	Contributing plant	Noise Level at closest NSR
	GF	Compressors	35
	FF	*Condensers*	54
Option 1	GF and FF	Compressors and Condensors	54
	GF	Compressors	35
	FF	Condensers with HS attenuaation	39
Option 2	GF and FF	Compressors and Condensors with HS a	41

Appendix C

BS 4142 Assessment with Plant Option 1

Appendix C - BS 4142 Assessment with Plant Option 1

BS 4142 Assessment - New Plant @ Nearest NSR Weekend Daytime		
Predicted Noise Level from HVAC	L_{Aeq}	54.0
Residual Noise Level	$L_{Aeq,\ 16\ h}$	63.1
Background Level	$L_{A90,\ 16\ h}$	51.7
Assessment to be made during the daytime thus the reference time period is 1 h.		
Correction from BS 4142 table 1 is		0
Specific noise level	$L_{Aeq,\ 16\ h}$	54
Acoustic Feature Correction		0
Rating Level		54
Background Level	$L_{A90,\ 16\ h}$	52
Excess of rating over background level.		2
Assessment indicates:		**Less than marginal significance.**

BS 4142 Assessment - New Plant @ Nearest NSR Weekend Night-time		
Predicted Noise Level from HVAC	L_{Aeq}	54.0
Residual Noise Level	$L_{Aeq,\ 8\ h}$	60.2
Background Level	$L_{A90,\ 8\ h}$	46.2
Assessment to be made during the daytime thus the reference time period is 1 h.		
Correction from BS 4142 table 1 is		0
Specific noise level	$L_{Aeq,\ 5\ mins}$	54
Acoustic Feature Correction		0
Rating Level		54
Background Level	$L_{A90,\ 8\ h}$	46
Excess of rating over background level.		8
Assessment indicates:		**Marginal significance.**

BS 4142 Assessment - New Plant @ Nearest NSR Weekday Daytime		
Predicted Noise Level from HVAC	L_{Aeq}	54.0
Residual Noise Level	$L_{Aeq,\ 3\ h}$	64.1
Background Level	$L_{A90,\ 3\ h}$	54.6
Assessment to be made during the daytime thus the reference time period is 1 h.		
Correction from BS 4142 table 1 is		0
Specific noise level	$L_{Aeq,\ 1\ h}$	54
Acoustic Feature Correction		0
Rating Level		54
Background Level	$L_{A90,\ 3\ h}$	55
Excess of rating over background level.		-1
Assessment indicates:		**Less than marginal significance.**

BS 4142 Assessment - New Plant @ Nearest NSR Weekday Night-time		
Predicted Noise Level from HVAC	L_{Aeq}	54.0
Residual Noise Level	$L_{Aeq,\ 8\ h}$	65.7
Background Level	$L_{A90,\ 8\ h}$	53.7
Assessment to be made during the daytime thus the reference time period is 1 h.		
Correction from BS 4142 table 1 is		0
Specific noise level	$L_{Aeq,\ 5\ mins}$	54
Acoustic Feature Correction		0
Rating Level		54
Background Level	$L_{A90,\ 8\ h}$	54
Excess of rating over background level.		0
Assessment indicates:		**Less than marginal significance.**

Appendix D

BS 4142 Assessment with Plant Option 2

Appendix D - BS 4142 Assessment with Plant Option 2

BS 4142 Assessment - New Plant @ Nearest NSR Weekend Daytime		
Predicted Noise Level from HVAC	L_{Aeq}	41.0
Residual Noise Level	$L_{Aeq,\ 16\ h}$	63.1
Background Level	$L_{A90,\ 16\ h}$	51.7
Assessment to be made during the daytime thus the reference time period is 1 h.		
Correction from BS 4142 table 1 is		0
Specific noise level	$L_{Aeq,\ 16\ h}$	41
Acoustic Feature Correction		0
Rating Level		41
Background Level	$L_{A90,\ 16\ h}$	52
Excess of rating over background level.		-11
Assessment indicates:	**Complaints are unlikely.**	

BS 4142 Assessment - New Plant @ Nearest NSR Weekend Night-time		
Predicted Noise Level from HVAC	L_{Aeq}	41.0
Residual Noise Level	$L_{Aeq,\ 3\ h}$	60.2
Background Level	$L_{A90,\ 3\ h}$	46.2
Assessment to be made during the daytime thus the reference time period is 1 h.		
Correction from BS 4142 table 1 is		0
Specific noise level	$L_{Aeq,\ 1\ h}$	41
Acoustic Feature Correction		0
Rating Level		41
Background Level	$L_{A90,\ 3\ h}$	46
Excess of rating over background level.		-5
Assessment indicates:	**Less than marginal significance.**	

BS 4142 Assessment - New Plant @ Nearest NSR Weekday Daytime		
Predicted Noise Level from HVAC	L_{Aeq}	41.0
Residual Noise Level	$L_{Aeq,\ 16\ h}$	64.1
Background Level	$L_{A90,\ 16\ h}$	54.6
Assessment to be made during the daytime thus the reference time period is 1 h.		
Correction from BS 4142 table 1 is		0
Specific noise level	$L_{Aeq,\ 16\ h}$	41
Acoustic Feature Correction		0
Rating Level		41
Background Level	$L_{A90,\ 16\ h}$	55
Excess of rating over background level.		-14
Assessment indicates:	**Complaints are unlikely.**	

BS 4142 Assessment - New Plant @ Nearest NSR Weekday Night-time		
Predicted Noise Level from HVAC	L_{Aeq}	41.0
Residual Noise Level	$L_{Aeq,\ 8\ h}$	65.7
Background Level	$L_{A90,\ 8\ h}$	53.7
Assessment to be made during the daytime thus the reference time period is 1 h.		
Correction from BS 4142 table 1 is		0
Specific noise level	$L_{Aeq,\ 5\ mins}$	41
Acoustic Feature Correction		0
Rating Level		41
Background Level	$L_{A90,\ 8\ h}$	54
Excess of rating over background level.		-13
Assessment indicates:	**Complaints are unlikely.**	