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ENERGY

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# SHAWHOUSE, WHALLEY

September 2018

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## Noise Assessment

On behalf of Suncredit Energy

# SHARPS REDMORE

ACOUSTIC CONSULTANTS ▪ Established 1990



## Report

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**Shawhouse Farm, Whalley,  
Clitheroe.**  
Noise Impact Assessment for  
Standby Generator Facility

**Prepared by**  
Martin Court MIOA

**Date** 19th September 2018  
**Project No** 1818209

### Head Office

#### Sharps Redmore

The White House, London Road,  
Copdock, Ipswich, IP8 3JH

**T** 01473 730073

**E** [contact@sharpsredmore.co.uk](mailto:contact@sharpsredmore.co.uk)

**W** [sharpsredmore.co.uk](http://sharpsredmore.co.uk)

### Regional Locations

South England (Head Office),  
North England, Wales, Scotland

### Sharps Redmore Partnership Limited

Registered in England No. 2593855

#### Directors

TL Redmore BEng(Hons), MSc, PhD, MIOA;  
RD Sullivan BA(Hons), PhD, CEng, MIOA, MAAS, MASA;  
DE Barke MSc, MIOA;  
KJ Metcalfe BSc(Hons), MIOA



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## **1.0 Executive Summary**

- 1.1 Sharps Redmore has been instructed by Suncredit to carry out a noise assessment to accompany a planning application for the installation of a standby generator facility at Shawhouse Farm, Whalley, Clitheroe, which will include gas powered generators, transformers and cooling condensers for the generation of standby electricity to the National Grid.
- 1.2 The proposal consists of two compounds: One with 10 no. 2MW containerised gas generators with associated dry air cooling and transformers with a 33KV connection and the other consisting 2 no. 2MW containerised gas generators with associated dry air cooling and transformer with a 11KV connection. The compounds could each operate for approximately 2000 hours per year providing an energy output of 24MW. The development will operate for approximately 2 hours in the morning and similar times in the evening at peak demand times for electricity supplementing the National Grid.
- 1.3 The operation of the development will be intermittent and will be demand led. It is however, not envisaged that the development will operate at night time between the hours of 2300 and 0700.
- 1.4 A noise assessment has been undertaken to consider the impact (if any) on the nearest residential property outside of the development and considers the noise source data used, predicted levels and target levels using appropriate standards and methodology. This report provides an assessment to determine external noise limits for the proposed plant relative to that of the nearest noise sensitive property outside of the development. Consideration has also been given to the proximity of the Parish Council cemetery which is on the boundary of the proposal land.
- 1.5 A 24 hour noise survey has been undertaken at the site in a monitoring position representative of the nearest noise sensitive property to provide details of existing ambient and background noise levels.
- 1.6 It is concluded that the proposed standby generator facility, given the data supplied and with appropriate enclosure and exhaust attenuation can be developed and operate without causing impact from noise or detriment to the amenity.

## 2.0 Review of National Policy and Assessment Methodology

### National Policy

- 2.1 The National Planning Policy Framework (NPPF), revised in July 2018, sets out the Government's economic, environmental and social planning policies for England and "these policies articulate the Government's vision of sustainable development." In relation to noise, paragraph 180 states:

*"Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:*

- *a) mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life;*
- *b) Identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason."*

- 2.2 The NPPF reinforces the March 2010 DEFRA publication, "Noise Policy Statement for England" (NPSE), which states three policy aims, as follows:

*"Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:*

- *avoid significant adverse impacts on health and quality of life;*
- *mitigate and minimise adverse impacts on health and quality of life; and*
- *where possible, contribute to the improvement of health and quality of life."*

- 2.3 Together, the first two aims require that no significant adverse impact should occur and that, where a noise level which falls between a level which represents the lowest observable adverse effect and a level which represents a significant observed adverse effect, then according to the explanatory notes in the statement:

*"... all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life whilst also taking into consideration the guiding principles of sustainable development. This does not mean that such effects cannot occur."*

- 2.4 There is no specific technical guidance for the assessment of generator noise within the NPPF; however it is considered appropriate to base the assessment on current British Standards (BS) and national guidance. These are considered to be BS 4142:2014; BS 8233:2014 and World Health Organisation (WHO) guidelines for Community Noise and local policy aims.
- 2.5 BS 4142:2014 is the appropriate guidance for assessing commercial operations and fixed building services plant noise. It provides methods using 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. This is achieved by determining specific noise levels from fixed plant and comparing to existing background and ambient which are representative for the site, depending upon the context.
- 2.6 The updated British Standard BS 4142 2014 was published in November 2014 which gives methods for rating and assessing industrial and commercial sound and is the appropriate standard for this assessment. Amongst the changes to the Standard, the concepts of certainty in results and the consideration of context of measured values was introduced. In particular, the assessment of impacts reinforces and expands on the concept of context and a commentary is available in chapter 11 of the Standard, which is reproduced in part below. Further changes include the replacement of 'likelihood of complaint' with the 'likelihood of adverse impact or serious adverse impact'. This is consistent with the approach in the Noise Policy Statement for England (NPSE), also reproduced in part below. The character and level of the residual sound compared to the character and level of the specific sound has been considered, together with an assessment of uncertainty of the measured values.
- 2.7 The assessment of impacts is based on the subtraction of the measured background level from the rating level determined. The rating level is obtained by measuring or predicting the specific sound level and applying correction factors for on-time, and any acoustic feature corrections. The difference is compared to the following criteria to evaluate impact:
- 2.8 *A difference of around +10 dB or more is likely to be an indication of a significant adverse impact; A difference of around +5 dB indicates likely to be an indication of an adverse impact and; where the rating level does not exceed the background level then this is an indication of the noise source having a low impact. All these criteria consider the context in which the noise source is in.*
- 2.9 The WHO guideline values are appropriate to what are termed "critical health effects". This means that the limits are at the lowest noise level that would result in any psychological, physiological or sociological effect. They are, as defined by NPSE, set at the Lowest Observed Adverse Effect Level (LOAEL), but do not define the level above which effects are significant (the SOAEL). Compliance with the LOAEL should, therefore, be seen as a robust aim. The WHO LOAEL guideline values are summarised in the following table:

**Table 2.1 WHO Guidelines:**

Value	Guidance	Location
$L_{AeqT} = 55$ dB	Few seriously annoyed, Daytime and evening.	Continuous noise, outdoor living areas
$L_{AeqT} = 50$ dB	Few moderately annoyed, Daytime and evening.	Continuous noise, outdoor living areas
$L_{AeqT} = 35$ dB	Acceptable level to avoid speech interference, daytime and evening.	Continuous noise, Dwellings, indoors
$L_{AeqT} = 30$ dB	To avoid sleep disturbance at night.	Continuous noise, Bedrooms, indoors
$L_{AMAX} = 45$ dB	To avoid sleep disturbance at night.	Noise peaks, Bedrooms, indoors

2.10 The national interpretation of the WHO guidelines is contained in BS 8233: 2014 'Guidance on Sound Insulation & Noise Reduction for Buildings'. BS 8233: 2014 recommends the following which supersedes the 1999 version and removes the distinction between good and reasonable values, and now recommends a single standard as follows from table 4 of BS 8233:2014.

		0700-2300	2300-0700
Living Room	$L_{Aeq,T} =$	35 dB	
Dining	$L_{Aeq,T} =$	40 dB	
Bedrooms	$L_{Aeq,T} =$	35 dB	30 dB

2.11 Combining the two sets of guidance could give the following values which may be considered over the appropriate time base for which they are typically used:

Gardens	$L_{Aeq,T} =$	55 dB	T = 16 hours
Living rooms	$L_{Aeq,T} =$	35 dB	T= 16 hours
Bedrooms	$L_{Aeq,T} =$	30 dB	T= 8 hours
	$L_{Amax} =$	45 dB	

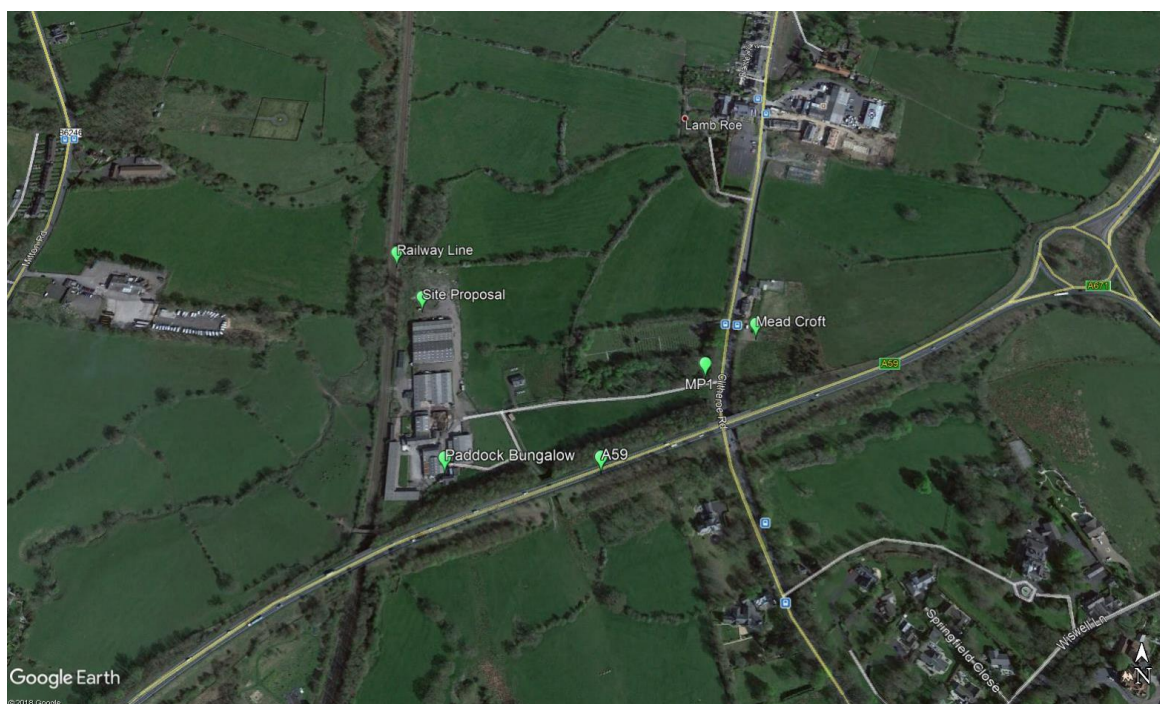
2.12 This is considered a robust but balanced view in the context of policy direction and could be considered as representing compliance with the robust LOAEL.

2.13 Consideration has also been given to the Core Strategy: A Local Plan for Ribble Valley 2008-2028 which states in Policy DMG1: General Considerations that all developments must not adversely affect amenities of surrounding areas and mitigate adverse impacts where possible.

### 3.0 Assessment of Impact

3.1 An environmental noise assessment of existing ambient and background noise levels was carried out over the 23rd-24th August 2018. The measurement location was chosen to be as close as possible and approximately representative of the nearest residential properties without financial interest in the scheme approximately 200m to the south of the proposed site and 350m to the east of the site on Clitheroe Road. The survey site was a similar distance from the main noise source for the area being the main A59 Clitheroe to Preston Road, shown below as Figure 3.1.

**Fig 3.1 Monitoring Location and noise sensitive premises:**



3.2 The sound level measurements were carried out over approximately a 24 hour period using a Norsonic 140 Type 1 precision sound level meter. The sound level meter was calibrated before and after the survey with no variation in accuracy noted. The weather conditions during the survey were generally dry, with some light drizzle and light winds (<5 m/s). The equipment used, and the measurement procedures employed, complied with the requirements of BS 4124:2014. The survey results are summarised for day and night and evening below in table 3.1. The results are shown in graphical form at Appendix C. Full survey data is available if required.

**Table 3.1: Survey Summary : MP1.**

dB Range	L <sub>Aeq</sub>	L <sub>A90</sub> range	Typical LA90	Lowest LA90
Day 0700-2300 (16hr)	*57	40-57	51	40
Night 2300-0700 (8hr)	*50	24-50	33	24

NB \* = logarithmic average

- 3.3 The noise climate at the nearest residential property is dominated by road traffic noise on the A59 and Clitheroe Road together with occasional train noise from the nearby Blackburn to Clitheroe line.
- 3.4 A short term manned measurement was undertaken at the boundary with the adjacent parish council cemetery. The noise climate in that area is similarly dominated by road traffic noise from the A59. It is considered that the use of the cemetery is generally restricted to daytime hours. The sample results can be summarised as follows. Given the relatively high levels, no significant impact is anticipated on visitors to the cemetery grounds.

**Table 3.2: Manned Cemetery Boundary Survey:**

Measurement Period	Measured Noise Level, dB			
	L <sub>Aeq,15m</sub> (range)	L <sub>Aeq</sub> (log average)	L <sub>A90,15m</sub> (range)	L <sub>Amax</sub> (range)
Daytime	53-56	55	50-54	60-69

**Predicted noise level at nearby receptors**

- 3.5 It is indicated that the generators will operate within containers. The likely source data for the proposed generators has been supplied by the manufacturers and is shown at Appendix B. The plant indicatively selected will have appropriate attenuation through enclosures and exhaust attenuation to provide the following likely individual SPL's of component noise sources at 1m at worst case scenario. These are outlined below and relevant data is shown at appendix B as supplied.

**Table 3.3 Typical Component SPL's for 12 Generator Proposal:**

Component	Exhaust	Condenser	Inlet	Outlet	Transformer
SPL @1m dB	65	65	65	65	70
Number	12	12	12	12	2
Total SPL dB	76	76	76	76	73

- 3.6 The total SPL @1m for the operation of all components added together representing simultaneous operation and worst case scenario gives a total of in the region of 83 dB. Noise propagation through distance attenuation ( $SPL_2 = SPL_1 - 20 \log r_2/r_1$ ) has been calculated to provide indicative levels at the nearest dwellings at Paddock Bungalow approximately 200m to the south and Mead Croft approximately 350m to the east. Levels from the proposal at any other residential properties further away in the area would be less than those indicated.
- 3.7 Distance attenuation over 200m to the nearest residential property provides in the region of 46 dB attenuation. The total SPL of the operation will be in the region of 83 dB at 1m given the data supplied and referred to in 3.6 above. This will result in a level in the region of 37 dB at the nearest residential property at 200m. This does not take into account the screening provided by the existing intervening agricultural buildings. This would account for further 5-10 dB attenuation to Paddock bungalow to around 27-32 dB.
- 3.8 Distance attenuation over 350m to Mead Croft provides in the region of 51 dB attenuation. This will result in a level in the region of 32 dB at the residential property.
- 3.8 The levels predicted at all dwellings, are well within the levels discussed in 2.10 and 2.11 above for BS 8233:2014 and WHO Guidelines for community noise. Levels are significantly below both typical and lowest background levels measured for daytime and evening and in the region of typical backgrounds for night time periods although above the lowest night time background measured.
- 3.9 BS 4142:2014 (Commentary on Clause 11, Paragraph 1, Page 17 of the Standard) considers the following when an initial estimate of the impact needs to include pertinent factors in relation to the context in which the sound is in. Clause 11 continues that where background levels are low, absolute levels, such as WHO guidance, might be as, or more relevant than the margin by which the rating level exceeds the background. This is especially true for night time or where daytime levels are also low. In essence, it is saying that where predicted levels are low, in absolute terms, then it is largely irrelevant what the margin is above background. The lowest background measured at night can be considered very low. The predicted levels of operation at around 32 dB are also low and well within any relevant standards such as WHO guidelines.

### **Conclusions**

- 3.10 It is concluded that the proposed standby generator facility would operate well below appropriate guidelines and below existing typical background and ambient levels as surveyed over approximately a 24 hour period providing day and night data. The rating level for the operation would be considered to have zero impact with reference to BS 4142:2014.

- 3.12 It is concluded, therefore that the proposed standby generator facility can be developed and operate without causing significant impact from noise or detriment to the amenity in accordance with the NPPF, NPSE relevant standards and criteria and local aims.

## **APPENDIX A**

### **BS 4142:2014 CALCULATIONS**

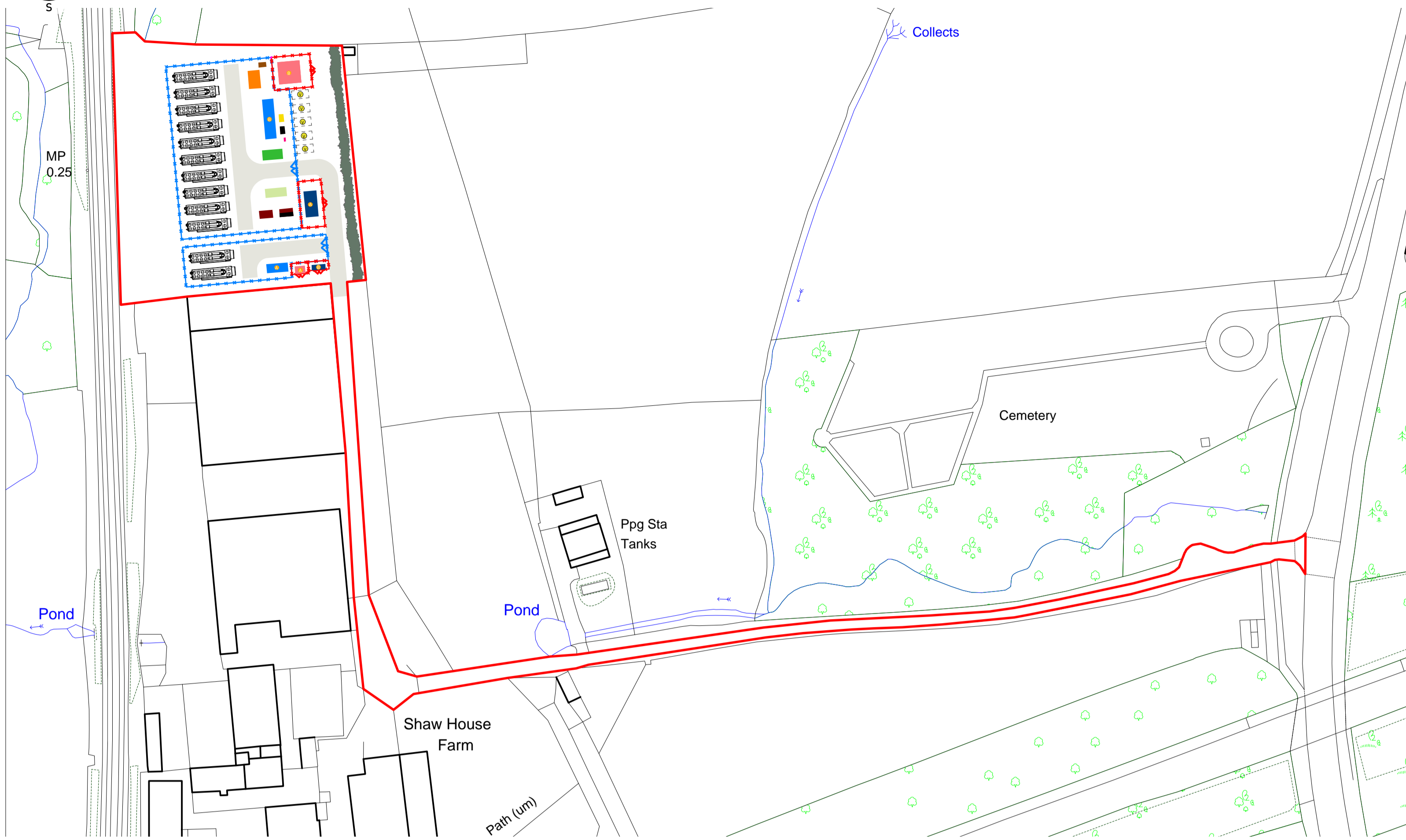
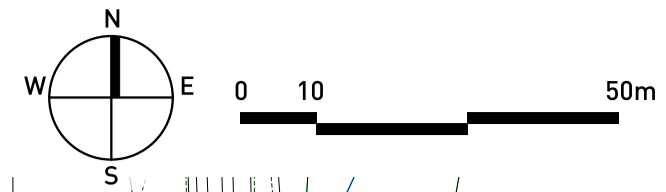
Results (DAY)	Receptor location		Relevant clause	Commentary
	Paddock Bungalow @ 200m	Mead Croft @350m		
Background sound level:	40 dB $L_{A90\ 15\ mins}$	40 dB $L_{A90\ 15\ mins}$	<b>8.1</b> <b>8.1.3</b>	The background sound level was derived from the measured noise levels at the likely times of proposed operation. To provide robust assessment, this is the <b>lowest</b> measured during the entire daytime survey period.
Specific sound level	37 dB $L_{Aeq\ 1\ hour}$	32 dB $L_{Aeq\ 1\ hour}$	<b>11</b>	Low absolute predicted levels from generator operations at the nearest noise sensitive premises. This is worst case scenario without consideration of barriers and is through distance attenuation alone.
Barrier attenuation	5 dB	-		Lowest likely attenuation due to intervening farm buildings. Likely to be 5-10dB
Acoustic feature correction	nil	nil	<b>9.2</b>	Given the low absolute levels and distance from the proposal (approx. 200/350m) there is not considered any feature correction. There is no intermittency as once started the plant will run for in the region of two hours
Ambient Level	57 dB $L_{Aeq\ 16hr}$	57 dB $L_{Aeq\ 16hr}$		$L_{Aeq\ 16hr}$ log average over daytime period.
Rating level	32 dB $L_{Aeq\ 1\ hour}$	32 dB $L_{Aeq\ 16hr}$	<b>9.2</b>	
Background level: daytime	40 dB $L_{A90,1\ hour}$	40 dB $L_{A90\ 1\ hour}$	<b>8.1</b> <b>8.1.3</b>	Lowest $L_{A90}$ measured
Excess of rating level over background level	= -8 dB	=-8 dB	<b>11</b>	Where the rating level is below background, the indication is that likelihood of impact is low.
Assessment indicates likelihood of low impact subject to context	<p><b>Relevant clause 11</b></p> <p>The context is:</p> <ol style="list-style-type: none"> <li>1. Predicted noise levels, <math>L_{Aeq\ 1hr}</math> are well below the WHO Day and night time Guideline values.</li> <li>2. How do the predicted activity sound levels compare to the existing ambient (<math>L_{Aeq\ T}</math>) noise climate? Predicted sound levels are significantly below the existing ambient noise climate during the likely times of operation.</li> <li>3. Predicted levels are significantly below the lowest background (<math>L_{A90}</math>) measured.</li> </ol>			

Results (NIGHT)	Receptor location		Relevant clause	Commentary
	Paddock Bungalow at 200m	Mead Croft at 350m		
Background sound level:	33 dB $L_{A90,15 \text{ mins}}$	33 $L_{A90,15 \text{ mins}}$	<b>8.1</b> <b>8.1.3</b>	The background sound level was derived from the measured noise levels overnight. To provide robust assessment, this is the typical measured during the night time period.
Specific sound level	37 dB $L_{Aeq,15 \text{ mins}}$	32 dB $L_{Aeq,15 \text{ mins}}$	<b>11</b>	Low absolute predicted levels from generator operations at the nearest noise sensitive premises. This is worst case scenario without consideration of barriers and is through distance attenuation alone.
Barrier attenuation	-5			Lowest likely attenuation through intervening farm buildings. Likely to be 5-10dB
Acoustic feature correction	nil		<b>9.2</b>	Given the low absolute levels and distance from the proposal (approx. 200/350m) there is not considered any feature correction. There is no intermittency correction as once started the plant will run for in the region of 2 hours.
Ambient Level	51 dB $L_{Aeq,15 \text{ mins}}$	51 dB $L_{Aeq,15 \text{ mins}}$		$L_{Aeq,8hr}$ measured over the night time survey period
Rating level	32 dB $L_{Aeq,15 \text{ mins}}$	32 dB $L_{Aeq,15 \text{ mins}}$	<b>9.2</b>	
Background level: Night time	33 dB $L_{A90,15 \text{ mins}}$	33 dB $L_{A90,15 \text{ mins}}$	<b>8.1</b> <b>8.1.3</b>	Typical background measured over the night time period
Excess of rating level over background level	= -1 dB		<b>11</b>	Rating level below background level indicates likelihood of low impact.
Assessment indicates likelihood of low impact subject to context	<p><b>Relevant clause 11</b></p> <p>The context is:</p> <ol style="list-style-type: none"> <li>1. Predicted noise levels, <math>L_{Aeq,T}</math> are well below the WHO Day and night time Guideline values.</li> <li>2. How do the predicted activity sound levels compare to the existing ambient (<math>L_{Aeq,T}</math>) noise climate? Predicted sound levels are significantly below the existing ambient noise climate.</li> <li>3. Predicted levels are significantly below lowest background level during the night time period.</li> </ol>			

**APPENDIX B**

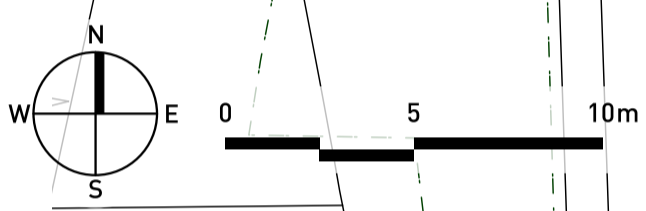
**PLAN SHOWING SITE OF GENERATOR PROPOSAL AND NEARBY  
NOISE SENSITIVE PREMISES**

# 1:1000 SCALE



KEY: SITE LAYOUT	
	APPLICATION BOUNDARY
	GAS KIOSK
	PRIVATE SUBSTATION
	WELFARE
	WORKSHOP
	NER
	33/11KW TX
	OIL STORAGE
	WASTE OIL
	DNO SUBSTATION
	11/0.4KW TX
	BT
	STBY GENERATOR
SURFACE MATERIALS:	
	TARMACADUM
ENCLOSURE DETAILS:	
	3M ACOUSTIC FENCE/2.4M SECURITY FENCE (COUPLED)
	2.4M SECURITY FENCING
	VISITOR PARKING
	ACOUSTIC ACCESS GATE
	SECURITY GATE
	PROPOSED SHRUB PLANTING

# 1:200 SCALE



MP  
0.25

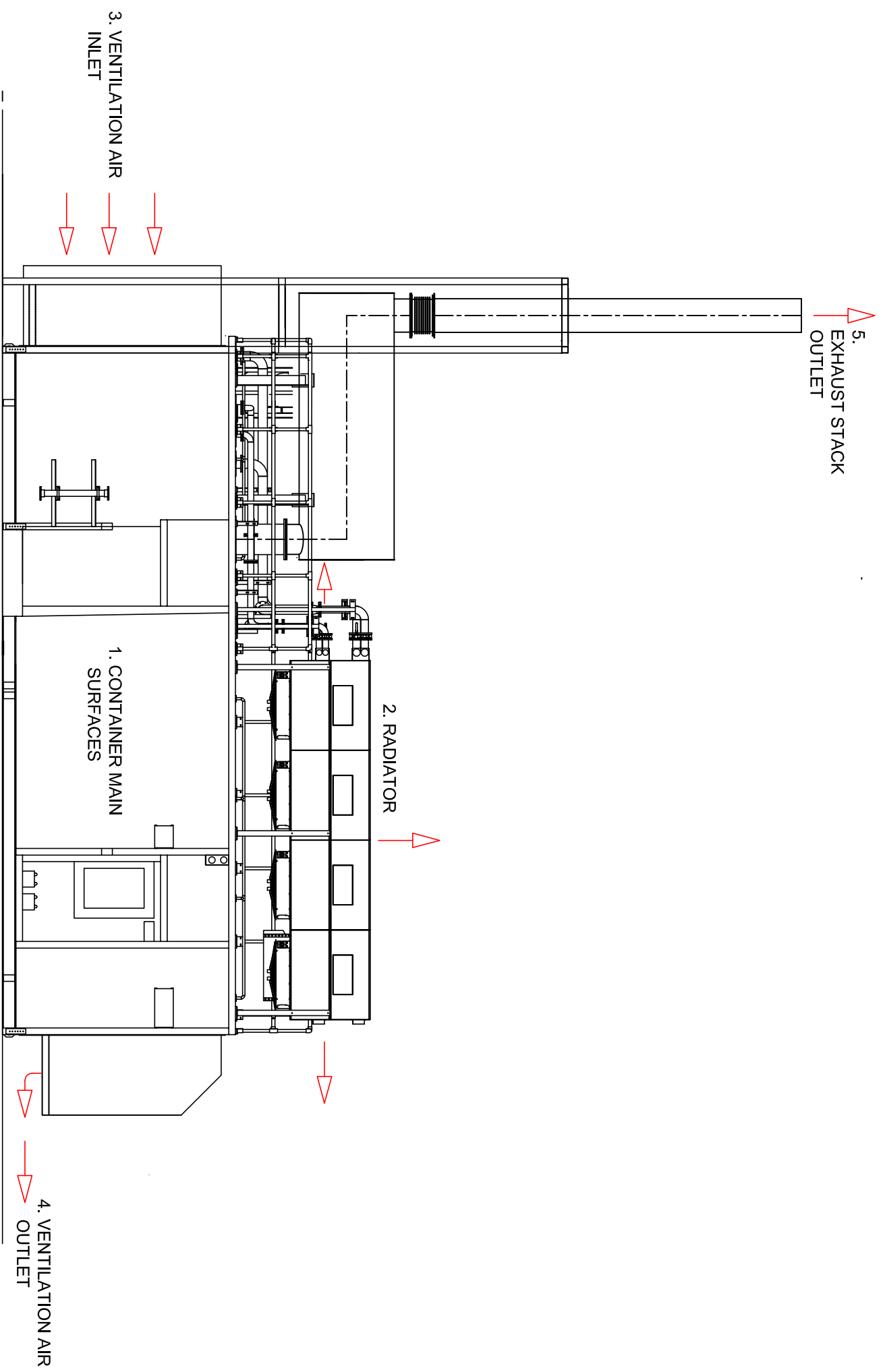
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## SHAWHOUSE, WHALLEY - SITE LAYOUT



## **APPENDIX C**

### **EXAMPLE GENERATOR INDICATIVE NOISE SOURCE DATA**



NOISE SOURCES (1-5) ALL DESIGNED TO 65 dB(A) @ 1M

REV	DATE	DESCRIPTION	DRN	CHK	APP
1.		NO DIMENSIONS ARE TO BE SCALED FROM THIS DRAWING			
2.		THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS ON SITE			



ENERG-G COMBINED POWER LIMITED  
EDISON HOUSE, 2 DANIEL ADAMSON ROAD,  
MANCHESTER, M50 1DT, UK  
TEL: 0161 745 7450  
FAX: 0161 745 7457  
WEB: WWW.ENERG.CO.UK

CLIENT	UNIT No.
PROJECT	TYPICAL

DRAWING TITLE  
NOISE SOURCES FROM  
CONTAINERISED GENSET

DRAWING No.	SHEET SIZE	REV
99999-M-0555	A3	P1

DATE	SCALE
06.09.17	1.75

DRAWN BY	CHECKED	APPROVED
KJS		

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## Significant Noise Sources and Levels - 2.0MWe Containerised Powergen Unit

Project: **Containerised Unit Projects**

Ref: **General**

<b><u>Noise Sources Genset Container</u></b>	SPL dB A @ 1m free field	Spectrum Available	Clarification	Data Sheet Reference 2.0 MWe Units
Acoustic Container	65	No		
Genset	105	Yes	Inside Container, with genset on full output	MTU 93800050454_V09
Genset exhaust outlet before silencer	122	Yes	Inside, undamped, with genset on full output	MTU 93800050454_V09
Dry Air Cooler - container roof mounted	65	Yes	Connection End in accordance with BS EN:13487	Transtherm E-28355
Container ventilation inlet	65	No		
Container ventilation outlet	65	No		
Genset exhaust flue outlet	65	Yes	Hemispherical Propogation	Aprovis AP-A172101

<b><u>Noise Sources on Site</u></b>	SPL dB A @ 1m free field	Spectrum Available	Clarification	Data Sheet Reference 2.0 MWe Units
Dry Air Cooler	65	Yes	Connection End in accordance with BS EN:13487	Container mounted
33 / 11 kV Transformer	70	No	With all gensets on full output	
11 / 0.4 kV Transformer	60	No	With all gensets on full output	

### Note

Noise levels quoted are for each individual unit or source and necessary allowance must be made for multiple sources *and* multiple units where applicable. See drawing number 9999-M-0555 for further information.



## 2.0 MW GENSETS RAD 01 DOUBLE BANK LOW NOISE DRY AIR LIQUID COOLER

Part No. E-28355-1 Date: 27/05/15  
Model Ref. TD90W/HB-23(4+3)/10D/4.0+2.0/36+81/DN80+DN100/S/B

Performance Data	HT	LT
Cooling Duty:	965.00 kW	127.00 kW
Water On Temperature:	90.00 °C	44.00 °C
Water Off Temperature:	78.00 °C	41.00 °C
Water Flow Rate:	22.18 l/s	11.89 l/s
Water Velocity:	1.43 m/s	1.72m/s
Water Pressure Drop:	47.00 kPa	86.00 kPa
Ethylene Glycol:	40.00 %	40.00 %
Total Airflow:	19.52 Sm <sup>3</sup> /s	19.52 Sm <sup>3</sup> /s
Air On Dry Bulb:	35.33 °C	30.00 °C
Air Off Dry Bulb:	76.12 °C	35.33 °C

Cooling duties stated are nominal values, cooler size includes the following tolerances; duty margin = 8%, surface margin = 10%.

### Construction – per Cooler

Fins HT / LT:	0.20mm Aluminium / 0.20m Aluminium
Tubes HT / LT:	P40-0.40mm / P60- 0.40mm Copper
Connections HT / LT:	PN16 DN100 / PN16 DN80
Weight:	1,969 kg dry / 2,337 kg operating
Hold Volumes HT / LT:	199 Litre / 169 Litre
Fans:	6 off at 0.90kW –1.83A (380-420V/50Hz/3Ph)
Casing:	Galv. Steel 3.0mm
Surface HT / LT:	974/599

### Noise Data – per Cooler

Frequency:	(Hz)	63	125	250	500	1000	2000	4000	8000	Total
Sound Power:	(L <sub>w</sub> A)	55	73	75	78	80	76	69	62	84
Sound Pressure:	(L <sub>p</sub> A)	64.5	(@ 1m calculated in accordance with BS EN:13487 Parallel Piped)							

Levels are quoted for single units – where multiple units are required due allowance must be made for the overall sound pressure level.

Reference: E-28355

Pos. 1 1 pc.

**EXHAUST GAS SILENCER**
**SDRA-1425-6501/4000-3-1H-1C**

working principle

 combined-reactive-absorptive silencer  
(horizontal / vertical version)

**DESIGN PARAMETERS**

engine type		16V4000L64	
number of cylinders		16	
rotating speed	rpm	1,500	
<b>sound pressure level engine outlet</b>	<b>dB(A)</b>	<b>109 @ 1 m</b>	<b>(open field conditions)</b>
<b>sound pressure level after silencer*</b>	<b>dB(A)</b>	<b>65 @ 1 m</b>	<b>(open field conditions)</b>
pressure drop	mbar	19	
flow rate (wet)	kg/hr	10,831	
inlet temperature	°C	412	
max. operating temperature	°C	550	
max. operating pressure	barg	0.1	

**DIMENSIONS**

outside diameter	mm	Ø 1,425	
total length	mm	4,010	
inlet connection	DN/PN	450/10	bottom
outlet connection	DN/PN	500/10	top
weight	kg	+/- 1,150	

**MATERIAL**

silencer	316Ti or 316L
flanges and support feet	steel
surface treatment	priming coat

**Important:**

**When the aforementioned design parameters are found to be inaccurate or require to be revised, we recommend recalculating the silencer. We do not accept any responsibility when our design is based on incorrect information.**

\*

To realise an optimal acoustic performance it is of great importance that vibration free mounting and correct installation of the complete air-intake or exhaust gas system is given, to avoid possible transfer of vibration and/or constructional borne noise. The given sound pressure level/ sound attenuation at open field conditions is a theoretical value, which could turn out to be higher in practice.

**Remark:**

The reactive part of this silencer is **without heat insulation**. Because of the radiated heat and the structure-borne noise we recommend urgently insulation on site.

**Remark:**

**To keep the requested noise level further downstream of the silencer, the ongoing piping has to be designed with DN500 or bigger to avoid additional flow noise.**

<b>Prognosis of Sound Level [Lp und Lw] at silencer outlet</b>					
Octave-frequency	Engine Lp in 1m	Transmission Loss	Lp behind silencer in 1m*	LpA behind silencer in 1m*	LwA behind silencer
31,5 Hz	dB	-78 dB	78 dB	39 dB(A)	
63 Hz	114 dB	29 dB	85 dB	59 dB(A)	
125 Hz	120 dB	45 dB	74 dB	58 dB(A)	
250 Hz	112 dB	46 dB	66 dB	57 dB(A)	
500 Hz	105 dB	46 dB	59 dB	56 dB(A)	
1.000 Hz	97 dB	42 dB	55 dB	55 dB(A)	
2.000 Hz	97 dB	43 dB	54 dB	55 dB(A)	
4.000 Hz	94 dB	45 dB	49 dB	50 dB(A)	
<b>Sum:</b>	<b>121 dB</b>		<b>86 dB</b>	<b>65 dB(A) in 1m</b>	<b>77 dB(A)</b>
			<b>Target:</b>	<b>65 dB(A) in 1m</b>	<b>77 dB(A)</b>

\* Measurement position at silencer outlet: If one considers flow direction 0°, then measurement angle is 90°

## **APPENDIX D**

**SURVEY DATA 23RD- 24TH AUGUST 2018**

