

DESIGN AND ACCESS STATEMENT
FOR
INCORPORATION OF AN EXTERNAL STAND-BY
GENERATOR AND FUEL TANK

UNIT 5, CARLTON INDUSTRIAL ESTATE
SHAWFIELD ROAD, BARNSELY

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Design and Access Statement

Incorporation of an external stand-by generator and fuel tank

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Design and Access Statement

Incorporation of an external stand-by generator and fuel tank

1.0 Introduction

- 1.1 The Telecoms Switch site is located in the outskirts of Barnsley in South Yorkshire. The site address is, Unit 5, Carlton Industrial Estate, Shawfield Road, Barnsley, South Yorkshire S71 3HS.

The building is a warehouse style, which was developed into a Switch by T Mobile in 2000, now called Everything Everywhere Ltd.

The site contains six Switch Rooms, a Transmission Room and OMC/Data Room. A security room is located at the entrance, with office and meeting room spaces on two floors, together with welfare facilities. There are two Power Rooms. The Power Room for the main building is located on the ground floor adjacent to Transmission Room 1; the Power Room for the extension building is located in the basement below Switch Room 5.

The Generator upgrade relates to the electrical infrastructure for the extension building; the DC upgrade is specific to Switch Room 2 in the Main Building.

- 1.2 Barnsley is an existing Switch Site which is being integrated into the Everything Everywhere technical estate. The project comprises an upgrade of the power infrastructure to meet the increasing load requirements of the site.

It is intended to develop the electrical infrastructure into a concurrently maintainable site. This upgrade aims to provide EE with the flexibility for future expansion. Under this project, a third 720kVA Generator set will be integrated into the Generator Synchronisation system to provide N+1 redundancy.

There are two generator sets and two day tanks located within the Generator Room, adjacent to the Power room in the basement of the extension building. In the event of a disruption or loss to the mains supply the site is equipped with prime rated AVK/SDMO generators to provide back-up power to the site. The generator sets have the capacity of 825kVA/660kW running at N+1 which is capable of supporting the measured site load.

Each generator set has a day tank of 1000 litres located within the Generator room. There is a buried bulk fuel tank with a capacity of 30,000 litres located underground outside the generator room where the fuel for the day tanks and generators are supplied from. Fuel is fed to the generator sets via a duty/standby pump located within the Power Room.

In the event of a fire, a SQR fire drop valve and 3 N° flameguard fire detection will drop, stop the flow of fuel to the engine and send the remaining fuel back to the fuel dump via the return pipes.

2.0 Scale and appearance

The existing building is a large 2/3 storey portal framed industrial unit with integral offices. (Refer to Photographs in Appendix A)

There are presently 32 N° parking bays to the front of the building which includes 2 N° disabled parking bays.

As part of their strategic plan Everything Everywhere are consolidating their technical estate to provide both operational and efficiency benefits. The infrastructure on key sites therefore needs to be reinforced.

A new emergency power generator is proposed at Barnsley ASC. The new generator will serve the existing extension building to provide greater capacity and resilience. With the exception of a 1 hour monthly test, the generator will usually only run in the event of a mains power failure to the site.

The new generator will be a containerised set located external to the building, but will operate in parallel with the 2 N° existing internal units. The existing buried fuel tank will be removed and replaced with an overground tank, which will be internally banded. All of the supply fuel pipe work from the tank will be doubled skinned. (Refer to details in Appendix B for the containerised generator and Appendix C for the fuel tanks).

A new flue will be fixed to the face of the building and extended to high level and discharge adjacent to the existing flues.

The generator will be housed in a proprietary acoustically lined container. A site acoustic assessment has been carried out and the new emergency generator system will be designed to meet the anticipated planning requirements.

The incorporation of an additional emergency stand-by generator will not significantly increase the noise levels arising from site. (Refer to the acoustic report in Appendix D)

Refer to Clive Adams Associates Ltd drawings 7131/01, 02, 03 and 04.

3.0 Accessibility

The generator and fuel tank are fully accessible for any long term maintenance from outside the building, via the existing access roadway.

4.0 **Environmental sustainability**

The generator and fuel tank should not need any maintenance for at least 20 years.

The existing oil storage tank will be emptied, cleaned and removed from site.

In terms of air quality please refer to the Power Generation details in Appendix E

We would also confirm the following:

Monthly test is 1 hour running off load

Annual test is 1 hour running full load

Engine Model	KTA50-C1675 D5e	
	Monthly	Annual (standby)
BHP	792	3830
PM₁₀ (kg/s)	14.5E-05	2.8E-04
NO₂ (kg/s)	11.8-E04	0.0072

5.0 **Community Safety**

The generator and fuel tank are securely fixed in position. There is no public access on to the site.

APPENDIX A

Photographs 01 - 10



Photograph No. 1 – (North East Elevation)



Photograph No. 2 – (North East Elevation)



Photograph No. 3 – (North East Elevation)



Photograph No. 4 – (North East Elevation)



Photograph No. 5 – (North East Elevation)



Photograph No. 6 – (South East Elevation)



Photograph No. 7 – (South East Elevation)



Photograph No. 8 – (South West Elevation)



Photograph No. 9 – (South West Elevation)



Photograph No.10 – (South West Elevation)

APPENDIX B

Typical details of Stand-by Generator

APPENDIX C

Typical details of Fuel Tank

APPENDIX D

Acoustic report as prepared by Norman Disney & Young

Acoustic Consultancy Report

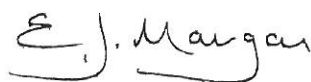
56895/3/1/2

Acoustic Planning Report and Plant Assessment

Report Prepared For

Norman Disney And Young Ltd
Everything Everywhere (Ee) Site Upgrades
13 April 2012

Report Author



Ted Mangan MIOA

Checked By



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i) Executive Summary

It is proposed to install a new emergency power generator which will operate in parallel with two existing generator sets at the Everything Everywhere site, located on the Carlton Industrial Estate, Shawfield Road Barnsley.

LCP has been commissioned by Norman Disney & Young to carry out a background noise survey and to use the obtained data to assess the noise impact of the plant installation on surrounding noise sensitive receptors.

The lowest background noise level measured was 30 dB $L_{A90, 5 \text{ mins}}$.

Following our discussion with the local authority, Mr Steve Billcliffe EHO for Barnsley Council has agreed the following design rating level for the new emergency plant at the nearest affected residential property: Existing Background Noise Level ($L_{A90, 5 \text{ mins}}$) + 5dB.

The residential design criterion is as follows:

35 dB $L_{Aeq, T}$ at 269m.

The commercial design criterion is:

55 dB $L_{Aeq, T}$ at 58m.

Noise emission criteria for the new equipment has been determined at both the nearest residential and commercial premises based on the measured existing background noise levels.

Provided the new generator plant does not exceed a noise level of 75 dB(A) at 1.0 metre, the noise emission criteria outlined above will be achieved.

ii) Document History

Issue	Date	Issue Details	Issued By	Checked By
1	13 th April 2012	Initial Issue	E J Mangan MIOA	M Balsom BSc MIOA

1 Introduction

It is proposed to install a new emergency power generator which will operate in parallel with two existing generator sets at the Everything Everywhere site, located on the Carlton Industrial Estate, Shawfield Road Barnsley.

LCP has been commissioned by Norman Disney & Young to carry out a background noise survey and to use the obtained data to set design noise limits for the operational plant installation on surrounding noise sensitive receptors.

The Everything Everywhere site operates 24 hours per day 7 days per week. Any acoustic impact will therefore be when the ambient and background noise levels are at their lowest which will occur during the night time period. Night periods are defined in BS4142:1997 as between 23:00 and 07:00.

Therefore, an attended noise survey was made during the night period only, as compliance during these times will result in compliance during the less stringent daytime requirements.

The emergency generator proposed will provide increased resilience to the site. We understand that the two existing generators will be operate in conjunction with the new generator set under emergency situations when external power supply to the site is cut off. Under these conditions the emergency generators will provide electrical power to the site.

The guidance in this report is on the basis that the generator will operate under emergency conditions and occasional brief daytime testing periods only (monthly load test runs)

The details of the new generator set have not been finalised, however, the following report sets out design noise limits to be applied at the nearest residential and commercial premises due to the operation the set.

Noise levels contained in this report have been rounded to the nearest decibel, as fractions of a decibel are not perceptible to human hearing.

A brief glossary of acoustic terminology is shown in Appendix E

2 Site Description

An aerial view of the building, including surrounding areas, noise monitoring positions, together with the proposed location of the new generator and the nearest noise sensitive premises are shown in Appendix A.

The site is located on the Carlton Industrial Estate, off Shawfield Road, Barnsley and is surrounded by other industrial and commercial units.

There are distant residential areas to the North West, West, and South of the industrial estate. To the North and North West of the building there is a dense foliage zone known as Spring Wood which borders the site.

The nearest noise sensitive premises are located along Aldbury Close to the North West of the site, approximately 270metres from the proposed generator location.

The nearest commercial unit is located to the East of the site at Oakleaf Coaches approximately 59 metres from the proposed new generator set.

3 Local Noise Climate

The predominant local noise sources were as follows:

- MP1: Shawfield Road, Occasional vehicular movement around the industrial estate, distant traffic noise with the occasional emergency vehicle siren, existing mechanical plant noise from neighbouring industrial units on the estate.
- MP2: Aldbury Close, Distant traffic noise.

4 Measurements

The noise monitoring took place from 21:51 to 02:30 on Monday 2nd & Tuesday 3rd April 2012. The measurement period was considered sufficient to establish the lowest background noise levels corresponding to the operational period of the plant.

The weather conditions during the survey were considered to be suitable for environmental noise monitoring being predominantly cloudy and dry.
Temperature 7deg C, Wind Speed $\leq$ 5m/s

The measurement system was calibrated at the beginning and end of the survey utilising a portable acoustic calibrator, no calibration drift occurred.

5 Results

The measured statistical broad-band sound pressure levels are shown within Appendix C. The lowest representative background noise level(s) obtained being as follows:

Table 1: Lowest measured background noise levels, dB re 2×10^{-5} Pa

Measurement Position	L _{A90, 5 mins} Night*
MP1: Shawfield Road	38
MP2: Aldbury Close	30

* Night periods are defined in BS4142:1997 as between 23:00 and 07:00.

The noise levels at MP1 were generally higher due to plant noise associated with neighbouring industrial units on the estate and vehicular movements around the site. The ambient noise level varied from 56dB L_{Aeq} to 39dB L_{Aeq}.

The background noise level at MP2 was significantly lower as it was further from the industrial area and shielded by the dense foliage associated with Spring Wood.

6 Evaluation of Design Criteria

6.1 Recommended Rating Level (Residential)

Emergency Generator

We have not received finalised details of the standby generator; however, we understand the set will operate under emergency conditions and brief testing periods only. It would normally be inappropriate to impose standard noise conditions on emergency generators, although some restrictions should be imposed to prevent excessive use or nuisance.

Our recommended condition is for emergency generator plant to increase the existing background noise level by no more than 5dB(A) during brief testing periods and emergency use. Although this level will not comply with the usual requirement to be 5dB(A) or 10dB below background levels it is nevertheless a high standard of noise reduction for such items of plant.

The standby generation plant will only be used during a mains power failure or other emergency.

Test periods should be restricted to typically one period of not more than 1 hour per month between the hours of 09.00 and 17.00 on Mondays to Fridays excluding bank holidays. The emergency generator should be installed so that noise levels do not cause nuisance at any time during its operation.

On the basis of the above the recommended rating level at the nearest affected residential premises shall therefore be:

Design Rating Level

Existing lowest $L_{A90, 5 \text{ mins}} + 5 \text{ dB}$

6.2 Recommended Commercial Design Criterion (BS8233:1999)

Design criteria for non-residential buildings have been derived from BS8233:1999.

For typical office environments, the rating level would be typically $L_{Aeq, T} 50 \text{ dB}$ at 1m from the façade of the receiver premises; again we would suggest a relaxation of 5dB for the emergency operation of the generators.

Design Rating level

$L_{Aeq, T} 55 \text{ dB}$

The standard states that an open or partially open window provides a weighted sound reduction index of 10-15 dB. Based on the guidance of BS8233, the resultant noise level, even with windows to office space open and the generator set operational is 40-45 dB L_{Aeq}

6.3 Local Authority Requirements

Following our discussion with the local authority, Mr Steve Billcliffe EHO for Barnsley Council would concur with the design rating level outlined above for the new emergency generator.

6.4 Design Rating Levels

The design levels to be adopted for this project are therefore set out in the table below.

Table 2: Design rating levels, dB re 2×10^{-5} Pa

Receiver Premises	Approximate Distance (m)	Design Level $L_{A,T}$
Residential on Aldbury Close	269	35
Commercial at Oakleaf Coaches	58	55

These noise limits apply to the night period. The day time background noise levels are expected to be significantly higher, and therefore compliance with the above noise limits will necessarily mean compliance with day time noise criteria.

7 Review of Plant Installation

Although finalised generator plant selections are yet to be determined, provisional calculations based on a maximum of 75 dB(A) at 1.0 metre have been carried out with the appropriate corrections for geometric attenuation, barrier effect, reflective surfaces and multiple source addition.

The design rating levels to be adopted for this project, together with the predicted noise levels, are set out in the table below.

Table 3: Predicted and design noise levels, dB re 2×10^{-5} Pa

Receiver Premises	Approximate Distance (m)	Design Level (Night) $L_{Aeq, 8 \text{ hr}}^*$	Predicted Level $L_{Aeq, 8 \text{ hr}}$
Residential: Aldbury Close	269	35	31
Commercial: Carlton Industrial Estate	58	55	54

* For the purposes of this assessment, the design period is from 23:00 to 07:00

The estimated generator noise level data used in this assessment are contained within Appendix C. Confirmation of finalised plant selection to be verified by Lee Cunningham Partnership.

Calculations are shown within Appendix D.

8 Conclusion

Lee Cunningham Partnership have been engaged by Norman Disney & Young Consulting Limited to carry out an environmental noise survey in order to establish the existing background noise levels local to the site and determine appropriate noise limits based on local authority criteria.

The nearest residential premises are located on Aldbury Close to the North West of the site approximately 270 metres from the proposed location of the new generator set.

Noise emission criteria for the new equipment has been determined at both the nearest residential and commercial premises based on the measured existing background noise levels.

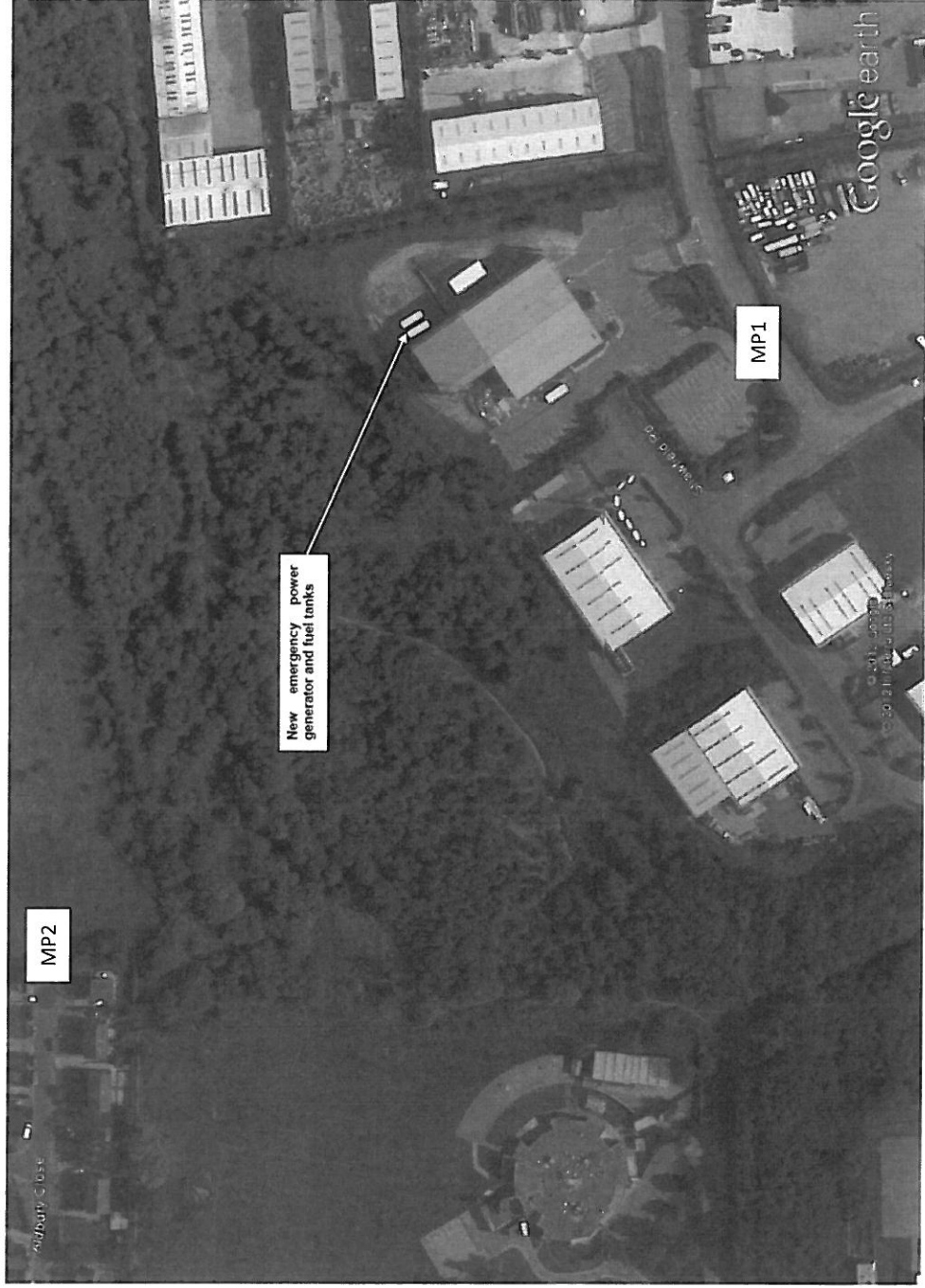
The design levels provided, should be applied to ensure the new generator plant complies with the relevant guidelines.

A review of noise levels from the final generator set selection including relevant octave band data to be approved by LCP.

Provided the new generator plant does not exceed a noise level of 75 dB(A) at 1.0 metre, the noise emission criteria outlined in Table 3 above will be achieved.



Appendix A: Site Plan



Appendix B: Measurement Data

MP	Date & time	Elapsed time	63Hz	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz	8000Hz	L _{A90}
MP1	02/04/2012 21:51:08	00:05:00	49	46	40	40	37	30	19	14	42
MP1	02/04/2012 21:56:08	00:05:00	49	46	39	39	36	30	19	14	41
MP1	02/04/2012 22:01:08	00:05:00	48	46	39	39	36	29	18	14	41
MP1	02/04/2012 22:06:08	00:05:00	49	46	38	39	36	29	18	13	41
MP1	02/04/2012 22:11:08	00:05:00	49	46	38	39	36	29	18	13	41
MP1	02/04/2012 22:16:08	00:05:00	49	46	39	39	36	30	18	14	41
MP1	02/04/2012 22:21:08	00:05:00	49	46	39	39	37	30	19	14	41
MP1	02/04/2012 22:26:08	00:05:00	49	46	39	39	36	29	18	14	41
MP1	02/04/2012 22:31:08	00:05:00	49	45	38	39	36	29	18	14	40
MP1	02/04/2012 22:36:08	00:05:00	48	45	38	38	35	28	18	13	40
MP1	02/04/2012 22:41:08	00:05:00	49	46	39	38	34	27	17	13	40
MP1	02/04/2012 22:46:08	00:05:00	49	45	38	38	34	27	18	13	40
MP1	02/04/2012 22:51:08	00:05:00	48	45	38	37	34	27	18	13	39
MP1	02/04/2012 22:56:08	00:05:00	49	45	38	38	34	27	19	14	39
MP1	02/04/2012 23:01:08	00:05:00	48	45	39	38	34	26	18	13	39
MP1	02/04/2012 23:06:08	00:05:00	48	45	37	37	34	26	17	13	39
MP1	02/04/2012 23:11:08	00:05:00	48	45	38	38	35	27	18	13	40
MP1	02/04/2012 23:16:08	00:05:00	49	45	38	38	34	27	18	13	39
MP1	02/04/2012 23:21:08	00:05:00	48	45	37	37	33	26	18	13	39
MP1	02/04/2012 23:26:08	00:05:00	48	44	37	38	34	26	17	13	39
MP1	02/04/2012 23:31:08	00:05:00	48	45	39	40	36	28	18	13	41
MP1	02/04/2012 23:36:08	00:05:00	48	45	38	38	34	27	18	13	39
MP1	02/04/2012 23:41:08	00:05:00	48	44	37	38	33	26	18	13	39
MP1	02/04/2012 23:46:08	00:05:00	48	45	36	37	32	26	18	13	38
MP1	02/04/2012 23:51:08	00:05:00	48	44	36	37	32	26	18	13	38
MP1	02/04/2012 23:56:08	00:05:00	49	45	38	38	33	26	18	13	39
MP1	03/04/2012 00:01:08	00:05:00	48	44	38	40	35	29	18	13	41
MP1	03/04/2012 00:06:08	00:05:00	48	44	37	37	33	26	17	13	39
MP1	03/04/2012 00:11:08	00:05:00	48	45	37	37	33	26	17	13	39
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MP1	03/04/2012 00:26:08	00:05:00	48	44	36	37	33	26	18	13	38
MP1	03/04/2012 00:31:08	00:05:00	49	44	39	40	36	29	18	13	41
MP1	03/04/2012 00:36:08	00:05:00	49	44	37	37	34	28	19	13	39
MP1	03/04/2012 00:41:08	00:05:00	49	44	37	37	33	27	18	13	38
MP1	03/04/2012 00:46:08	00:05:00	49	44	38	38	35	28	18	13	40
MP1	03/04/2012 00:51:08	00:05:00	49	44	38	38	34	27	18	13	39
MP1	03/04/2012 00:56:08	00:05:00	49	44	38	38	34	27	18	13	39
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MP1	03/04/2012 01:06:08	00:05:00	49	44	38	38	33	26	17	13	39
MP1	03/04/2012 01:11:08	00:05:00	48	44	38	39	33	26	18	13	39
MP1	03/04/2012 01:16:08	00:05:00	49	44	37	38	33	26	18	13	39
MP1	03/04/2012 01:21:08	00:05:00	49	45	38	39	34	26	18	13	39
MP1	03/04/2012 01:26:08	00:05:00	49	45	38	39	35	28	18	13	40
MP1	03/04/2012 01:31:08	00:05:00	49	45	38	39	35	28	18	13	40
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MP1	03/04/2012 01:41:08	00:05:00	49	44	38	39	34	27	18	13	39
MP1	03/04/2012 01:46:08	00:05:00	49	44	37	39	34	27	18	13	39
MP1	03/04/2012 01:51:08	00:05:00	48	44	38	39	34	27	18	13	40
MP1	03/04/2012 01:56:08	00:05:00	49	44	37	39	34	27	18	13	40
MP1	03/04/2012 02:01:08	00:05:00	48	44	37	39	34	27	18	13	40
MP1	03/04/2012 02:06:08	00:05:00	49	44	38	39	35	28	18	13	40
MP2	03/04/2012 02:21:46	00:05:00	46	34	29	29	27	17	13	13	31
MP2	03/04/2012 02:26:46	00:05:00	46	33	27	28	26	16	13	13	30

Sound pressure level measurements were obtained using the following instrumentation complying with the Class 1 specification of BS EN 61672:2003

- Svantek 959 Sound Level Meter S/N: 11258
- Svantek pre-amplifier SV12L S/N: 13111 with GRAS microphone capsule 40AE S/N: 86548

Calibration checks were made prior to and after completion of measurements using a Svantek SV30A calibrator, S/N: 10890 complying with Class 1 specification of BS EN 60942:2003, calibration level 94.0 dB @ 1.0 kHz. All acoustic instrumentation carried current manufacturer's certificates of conformance.

Appendix C: Plant Data

Estimated plant noise data used in the preceding assessment follow.

Table 4: Estimated generator sound pressure data, dB re 2×10^{-5} Pa

Plant	Distance (m)	Octave Band Centre Frequency (Hz)								L _{PA} *
		63	125	250	500	1k	2k	4k	8k	
Emergency Generator	1.0	89	82	76	72	68	66	64	62	75

* The sound pressure spectrum for this unit has been estimated based upon a typical manufacturer's single figure broadband value.

Appendix D: Calculations

Project Information:

Project Number	56895 : Everything Everywhere - Barnsley
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Calculation Information:

Source Description	Emergency Generator Set
Receiver Description	Residential

Source Dimensions:

Description	Value	Units	
Source height (dimension a) (1)	2.5	m	
Source length (dimension b) (1)	9.0	m	Dimensions Of Generator Set TBC
Source depth	2.4	m	

Barrier Loss:

Description	Value	Units
Source height (2)		m
Receiver height		m
Barrier height		m
Source to barrier distance		m
Barrier to receiver distance		m
Calculated path difference		m

Distance to Receiver:

Description	Value	Units
Barrier Present	N	
Distance to Receiver (no barrier) (3)	269	m

Calculated Noise Level at Receiver:

Description				Octave Band Centre Frequency (Hz)								A	Units	Ref
				63	125	250	500	1000	2000	4000	8000			
Source Noise Data (Lp) (5)	Reference distance	1.0	m	89	82	76	72	68	66	64	62	75	dB	
Calculated Source Lw (6)				104	97	91	87	83	81	79	77	90	dB	1
Distance Attenuation (from Lw)	Distance to receiver	269.0	m	-57	-57	-57	-57	-57	-57	-57	-57		dB	1
Net Barrier Loss				0	0	0	0	0	0	0	0		dB	2,3
Reflections (7)		0		0	0	0	0	0	0	0	0		dB	3
Number of sources		3		5	5	5	5	5	5	5	5		dB	3
Façade Correction (3dB) (8)				3	3	3	3	3	3	3	3		dB	
Noise Level at Receiver (Lp)				55	48	42	38	34	32	30	28	41	dB	

Required Criteria:

Description	Criteria Type	Value	Octave Band Centre Frequency (Hz)									A	Units	Ref
			63	125	250	500	1000	2000	4000	8000				
Limiting Noise Criteria	dBA	35	54	43	36	30	26	23	21	19		35	dB	
Excess			1	4	6	8	8	9	9	9		6	dB	

Additional Attenuation: Due to dense foliage ISO9613-2 (9)

Additional Noise Reduction (e.g. enclosure)		Octave Band Centre Frequency (Hz)									A	Units	Ref
		63	125	250	500	1000	2000	4000	8000				
Noise Reduction Loss (10)	Manual	-4	-6	-8	-10	-12	-16	-18	-24			dB	
Resultant Noise Level		28	42	34	28	22	16	12	4		31	dB	
Remaining Excess												dB	

Reference 1	"Note on two common problems of sound propagation"	E. J. Rathe	Journal of Sound and Vibration	1969
Reference 2	"Calculation of Road Traffic Noise"		Department of Transport	1988
Reference 3	IOA Diploma Formula Sheet Edition 5			2003

Note 1	Rathe method only uses height and length - depth is not used. This assumes that the receiver is perpendicular to the source surface defined by a and b.
Note 2	Heights should be specified relative to the reference level shown in the sheet.
Note 3	Distance from receiver should be entered when a barrier is not present. This cell will clear if a barrier is present.
Note 4	Barrier attenuation derivation is based on the logarithmic addition of noise over and through the barrier.
Note 5	Enter a reference distance of 0 to input a sound power level.
Note 6	Source is assumed to be on a solid ground plane.
Note 7	Allow 3 dB for each reflective surface that influences the site conditions (excluding ground plane).
Note 8	3dB is added for increase at façade.
Note 9	Reference ISO9613-2.
Note 10	Reduction should be entered as negative values. 200metres of dense foliage (Spring Wood).

Project Information:

Project Number	56895 : Everything Everywhere - Barnsley
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Calculation Information:

Source Description	Emergency Generator Set
Receiver Description	Commercial

Source Dimensions:

Description	Value	Units
Source height (dimension a) (1)	2.5	m
Source length (dimension b) (1)	9.0	m
Source depth	2.4	m

Dimensions Of Generator Set TBC

Barrier Loss:

Description	Value	Units
Source height (2)		m
Receiver height		m
Barrier height		m
Source to barrier distance		m
Barrier to receiver distance		m
Calculated path difference		m

Distance to Receiver:

Description	Value	Units
Barrier Present	N	
Distance to Receiver (no barrier) (3)	58	m

Calculated Noise Level at Receiver:

Description				Octave Band Centre Frequency (Hz)								A	Units	Ref	
				63	125	250	500	1000	2000	4000	8000				
Source Noise Data (Lp) (5)		Reference distance	1.0	m	89	82	76	72	68	66	64	62	75	dB	
Calculated Source Lw (6)					104	97	91	87	83	81	79	77	90	dB	1
Distance Attenuation (from Lw)		Distance to receiver	58.0	m	-43	-43	-43	-43	-43	-43	-43	-43		dB	1
Net Barrier Loss					0	0	0	0	0	0	0	0		dB	2,3
Reflections (7)			0		0	0	0	0	0	0	0	0		dB	3
Number of sources			3		5	5	5	5	5	5	5	5		dB	3
Façade Correction (3dB) (8)					3	3	3	3	3	3	3	3		dB	
Noise Level at Receiver (Lp)					68	61	55	51	47	45	43	41	55	dB	

Required Criteria:

Description	Criteria Type	Value	Octave Band Centre Frequency (Hz)									A	Units	Ref
			63	125	250	500	1000	2000	4000	8000				
Limiting Noise Criteria	dBA	55	72	63	56	51	48	45	43	42	55	dB		
Excess												dB		

Additional Noise Reduction (e.g. enclosure)			Octave Band Centre Frequency (Hz)								A	Units	Ref
			63	125	250	500	1000	2000	4000	8000			
Noise Reduction Loss (10)	None	▼	0	0	0	0	0	0	0		dB		
Resultant Noise Level			51	61	55	51	47	45	43	41	54	dB	
Remaining Excess												dB	

Reference 1	"Note on two common problems of sound propagation"	E. J. Rathe	Journal of Sound and Vibration	1969
Reference 2	"Calculation of Road Traffic Noise"		Department of Transport	1988
Reference 3	IOA Diploma Formula Sheet Edition 5			2003

Note 1	Rathe method only uses height and length - depth is not used. This assumes that the receiver is perpendicular to the source surface defined by a and b
Note 2	Heights should be specified relative to the reference level shown in the sheet
Note 3	Distance from receiver should be entered when a barrier is not present. This cell will clear if a barrier is present
Note 4	Barrier attenuation derivation is based on the logarithmic addition of noise over and through the barrier
Note 5	Enter a reference distance of 0 to input a sound power level
Note 6	Source is assumed to be on a solid ground plane
Note 7	Allow 3 dB for each reflective surface that influences the site conditions (excluding ground plane)
Note 8	3dB is added for increase at façade
Note 9	
Note 10	Reduction should be entered as negative values

Appendix E: Glossary

The list below details the major acoustical terms and descriptors, with brief definitions:

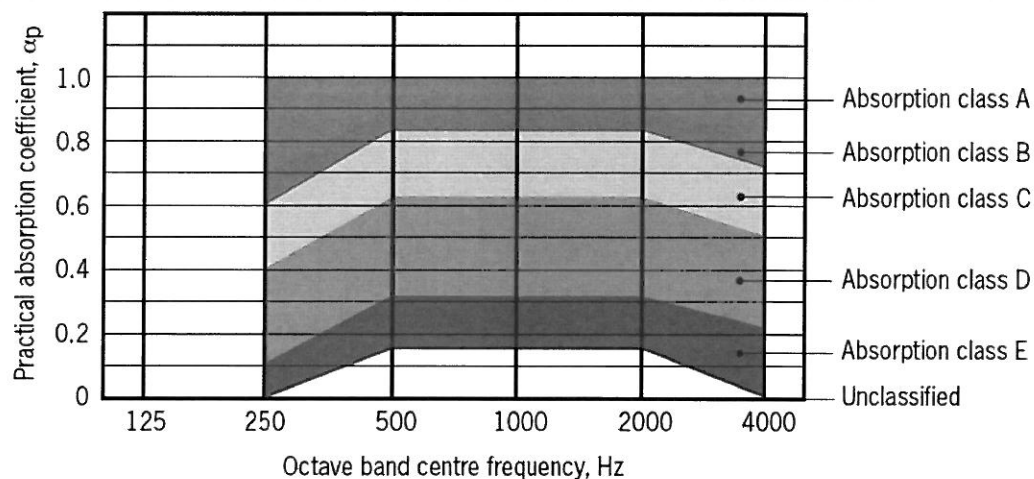
'A' Weighting

Weighting applied to the level in each stated octave band by a specified amount, in order to better represent the response of the human ear. The letter 'A' will follow a descriptor, indicating the value has been 'A' weighted. An 'A' weighted noise level may also be written as dB(A).

Absorption Class

In order to categorise the absorptive effects of different elements (such as ceiling tiles), classes from A to E were derived, as per BS EN ISO 11654:1997. A class 'A' absorber would be very acoustically absorptive, a Class 'E' absorber would be less absorptive and more reflective. A product that is highly reflective may not be classified.

The chart shown below has been extracted from BB93, and demonstrates the characteristics of each class according to BS EN ISO 11654:1997.



Absorption Coefficient (α)

A value usually between 0 and 1 assigned to a material to indicate how acoustically absorptive it is. 0 indicates a material is entirely reflective (and therefore not absorptive), and 1 indicates a material is entirely absorptive (and therefore not reflective). Absorption coefficients are usually given for each octave band between 125Hz and 4kHz, or as an overall 'practical' coefficient.

Airborne Noise

Noise transmitted through air.

Ambient Noise

The total noise level including all 'normally experienced' noise sources.

dB or Decibel

Literally meaning 'a tenth of a bel', the bel being a unit devised by the Bell Laboratory and named after Alexander Graham Bell. A logarithmically based descriptor to compare a level to a reference level. Decibel arithmetic is not linear, due to the logarithmic base. For example:

$$30 \text{ dB} + 30 \text{ dB} \neq 60 \text{ dB}$$

$$30 \text{ dB} + 30 \text{ dB} = 33 \text{ dB}$$

$D_{nTw} + C_{tr}$

The weighted, normalised difference in airborne noise levels measured in a source room (L1) and a receive room (L2) due to a separating partition.

D Is simply $L1 - L2$.

D_{nT} Is the normalisation of the measured level difference to the expected (in comparison to the measured) reverberation time in the receiving room.

D_{nTw} Is the weighted and normalised level difference. This value is the result of applying a known octave band weighting curve to the measured result.

C_{tr} Is a correction factor applied to the D_{nTw} to account for the known effects of particular types of noise, such as loud stereo music or traffic noise.

Frequency (Hz)

Measured in Hertz (after Heinrich Hertz), and represents the number of cycles per second of a sound or tone.

Impact Noise

Re-radiated noise as a result of impact(s) on a solid medium, such as footfalls on floors. Measured in L'_{nTw} .

Insertion Loss, dB

The amount of sound reduction offered by an attenuator or louvre once placed in the path of a noise level.

$L_{A90, T}$

The 'A' weighted noise level exceeded for 90% of the time period T, described or measured. The '90' can be substituted for any value between 1 and 99 to indicate the noise level exceeded for the corresponding percentage of time described or measured.

$L_{Aeq, T}$

The 'A' weighted 'equivalent' noise level, or the average noise level over the time period T, described or measured.

L_{Amax}

The 'A' weighted maximum measured noise level. Can be measured with a 'slow' (1 sec) or 'fast' (0.125 sec) time weighting.

L_{Amin}

The 'A' weighted minimum measured noise level.

L'_{nTw}

The weighted, normalised impact sound pressure level measured in a receive room below a source room.

L

Is the spatially averaged impact sound pressure level measured in a receive room.

L'_{nT}

Is the normalisation of the measured impact sound pressure level to the expected (in comparison to the measured) reverberation time in the receiving room.

L'_{nTw}

Is the weighted and normalised impact sound pressure level. This value is the result of applying a known octave band weighting curve to the measured result.

NR

Noise Rating (NR) level. A frequency dependent system of noise level curves developed by the International Organisation for Standardisation (ISO). NR is used to categorise and determine the acceptable indoor environment in terms of hearing preservation, speech communication and annoyance in any given application as a single figure level. The US predominantly uses the Noise Criterion (NC) system.

Octave

The interval between a frequency in Hz (f) and either half or double that frequency (0.5f or 2f).

Pa

Pascals, the SI unit to describe pressure, after physicist Blaise Pascal.

Reverberation Time, T_{mf} , RT60, RT30 or RT20

The time taken in seconds for a sound to diminish within a room by 1,000 times its original level, corresponding to a drop in sound pressure of 60 dB. When taking field measurements and where background noise levels are high, the units RT20 or RT30 are used (measuring drops of 20 or 30 dB respectively). Sometimes given as a mid-frequency reverberation time, T_{mf} which is the average of reverberation time values at 500Hz, 1kHz and 2kHz.

R_w

The sound reduction value(s) of a constructional element such as a door, as measured in a laboratory, with a known octave band weighting curve applied to the result.

Sound Power Level

A noise level obtained by calculation from measurement data, given at the face of an item of plant or machinery. Referenced to 10^{-12} W or 1pW.

Sound Pressure Level

A noise level measured or given at a distance from a source or a number of sources. Referenced to 2×10^{-5} Pa.

Speech Intelligibility, Speech Transmission Index (STI)

Speech intelligibility is the measure of how well a speaker's voice can be heard within a given space. Speech intelligibility within a room depends on a number of factors, including reverberation time and background noise.

The Speech Transmission Index or STI has emerged as the favoured method of describing speech intelligibility.

Subjective Effect of Changes in Sound Pressure Level

A basic example to illustrate the assessment of difference in noise levels follows.

A background noise survey is undertaken that yields a lowest background noise level of L_{A90} 30 dB.

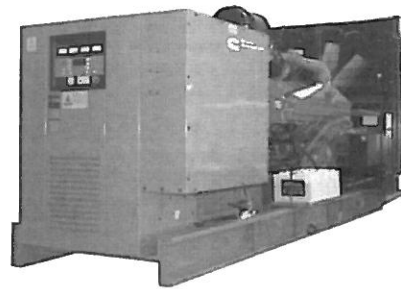
As the existing background noise level is low, a rating level for new plant noise of $L_{Aeq, T}$ 30 dB is set.

APPENDIX E

Power Generation details of the proposed low emissions
technology

Power Generation details for the proposed KTA38 generator
engine.

Diesel Generator set KTA38 series engine



> Specification sheet

750kVA - 1132kVA 50Hz

1046kW - 1276kW 60Hz

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Description

This Cummins® Power Generation commercial generator set is a fully integrated power generation system, providing optimum performance, reliability, and versatility for stationary standby, prime power, and continuous duty applications.



This generator set is available with CE certification.

2000/14/EC

All enclosed products are designed to meet or exceed EU noise legislation 2000/14/EC step 2006.

ISO8528

This generator set has been designed to comply with ISO8528 regulation.



This generator set is designed in facilities certified to ISO9001 and manufactured in facilities certified to ISO9001 or ISO9002.

Features

Cummins® Heavy-Duty Engine - Rugged 4-cycle industrial diesel delivers reliable power, low emissions and fast response to load changes.

Permanent Magnet Generator (PMG) - Offers enhanced motor starting and fault clearing short circuit capability.

Alternator - Several alternator sizes offer selectable motor starting capability with low reactance 2/3 pitch windings; low waveform distortion with non-linear loads, fault clearing short-circuits capability, and class H insulation.

Control System - Standard PowerCommand® electronic control provides total system integration including remote start/stop, precise frequency and voltage regulation, alarm and status message display, AmpSentry protection, output metering, auto-shutdown.

Cooling System - Standard integral set-mounted radiator system, designed and tested for rated ambient temperatures, simplifies facility design requirements for rejected heat.

Enclosures - Optional weather-protective and sound-attenuated enclosures are available.

Warranty and Service - Backed by a comprehensive warranty and worldwide distributor network.

Model	Standby Rating		Prime Rating		Emissions Compliance	Datasheet	
	50Hz kVA (kW)	60Hz kW (kVA)	50Hz kVA (kW)	60Hz kW (kVA)		60Hz	50Hz
C825 D5e	825 (660)	N/A	750 (600)	N/A	2g TA Luft	DS37-CPGK	N/A
C900 D5	900 (720)	N/A	820 (656)	N/A	2g TA Luft	DS38-CPGK	N/A
C1000 D5e	1000 (800)	N/A	910 (728)	N/A	2g TA Luft	DS39-CPGK	N/A
832 DFJC	1040 (832)	N/A	936 (748)	N/A	N/A	DS40-CPGK	N/A
906 DFJD	1132 (906)	N/A	1029 (823)	N/A	N/A	DS41-CPGK	N/A
921 DFJC	N/A	921 (1151)	N/A	837 (1046)	N/A	N/A	DS81-CPGK
1020 DFJD	N/A	1020 (1276)	N/A	928 (1160)	N/A	N/A	DS83-CPGK

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Generator Set Specifications

Governor Regulation Class	ISO8528 G2
Voltage Regulation, No Load to Full Load	± 1%
Random Voltage Variation	± 1%
Frequency Regulation	Isochronous
Random Frequency Variation	±0.25%
EMC Compatibility	BS EN 61000-6-4 / BS EN 61000-6-2

Engine Specifications

Design	4 cycle, in line, turbo Charged and after-cooled
Bore	159mm (6.25in.)
Stroke	159mm (6.25in.)
Displacement	38 liter (2300in.3)
Cylinder Block	Twelve-cylinder vee formation, direct injection, four-cycle diesel engine
Battery Capacity	890 amps at ambient temperature 32°F (0°C)
Battery Charging Alternator	55 amps
Starting Voltage	24-volt, negative ground
Fuel System	Direct injection
Fuel Filter	Dual spin on paper element fuel filters with standard water separator.
Air Cleaner Type	Dry replaceable element
Lube Oil Filter Type(s)	Spin-on paper element full flow and bypass lube oil filters.
Standard Cooling System	122°F (50°C) ambient radiator

Alternator Specifications

Design	Brushless, 4 pole, drip proof revolving field
Stator	2/3 pitch
Rotor	Direct coupled by flexible disc
Insulation System	Class H
Standard Temperature Rise	150°C Standby
Exciter Type	PMG (Permanent Magnet Generator)
Phase Rotation	A (U), B (V), C (W)
Alternator Cooling	Direct drive centrifugal blower fan
AC Waveform Total Harmonic Distortion	No load < 1.5%. Non distorting balanced linear load < 5%
Telephone Influence Factor (TIF)	<50 per NEMA MG1-22.43
Telephone Harmonic Factor (THF)	<3%

Available Voltages

50Hz Line - Neutral / Line - Line	60Hz Line - Neutral / Line - Line
<ul style="list-style-type: none"> • 110/190 • 115/200 • 120/208 • 127/220 	<ul style="list-style-type: none"> • 110/190 • 115/200 • 120/208 • 127/220 • 139/240 • 220/380 • 230/380 • 240/416 • 255/440 • 277/480 • 347/600

Generator Set Options

Engine

- Heavy Duty air filter
- Water jacket heater 220/240 v

Cooling

- Antifreeze 50/50 (Ethylene glycol)

Enclosure

- High-Cube 40ft Container

Alternator

- Alternator heater

Control Panel

- 3 pole Main Circuit Breaker
- 4 pole Main Circuit Breaker

Warranty

- 5 years for Standby application
- 2 years for Prime application

Silencer

- 9 dB attenuation critical silencer
- 25 dB residential - delivered loose

*Note: Some options may not be available on all models – consult factory for availability.

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Control System – PCC3100

The PowerCommand™ 3100 Control is a microprocessor-based generator set monitoring, and control system. The control provides an operator interface to the genset, digital voltage regulation, digital governing and generator set protective functions.

The PowerCommand™ 3100 generator set control is suitable for use on a wide range of generator sets in nonparalleling and paralleling applications.

The PowerCommand™ Control can be configured for any frequency, voltage and power connection configuration from 120 to 13,800 VAC for 50Hz or 60Hz operation.

Power for the control is derived from the generator set starting batteries. The control functions over a voltage range from 8VDC to 35VDC.

Major Features

- Digital Governing and Voltage Regulation, including digital overcurrent fault regulation.
- Digital Voltage Regulation with 3-phase sensing.
- AmpSentry™ Protection for true alternator overcurrent protection.
- Analog and Digital AC Output Metering.
- Battery Monitoring System to sense and warn against a weak battery condition.
- Digital Alarm and Status Message Display.
- Generator set Monitoring: Displays status of all critical engine and alternator generator set functions.
- Smart Starting Control System: Integrated fuel ramping to limit black smoke and frequency overshoot.
- Advanced Serviceability using InPower™, a PC-based software service tool.

Control System

Includes all functions to locally or remotely start and stop, and protect the generator set.

Control Switch - RUN/OFF/AUTO

OFF Mode - the generator set is shut down and cannot be started

RUN mode the generator set will execute its start sequence

AUTO mode, the generator set can be started with a start signal from a remote device

LED Indicating Lamps – includes LED indicating lamps for the following functions:

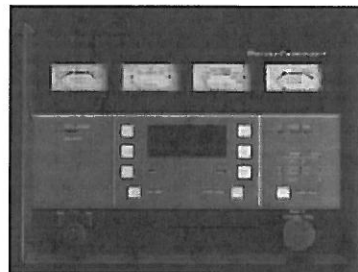
- Not-in-auto mode
- Common wiring
- Shutdown
- Phase and scale indication
- Fault reset switch. Allows the operator to reset the control after warning or shutdown
- Emergency stop switch - immediately shuts down the generator set operation

Base Engine Protection

- Overspeed shutdown
- Low Oil Pressure Warning / Shutdown
- High Engine Temperature Warning / Shutdown
- Underspeed / Sensor Fail Shutdown
- Fail to Start / Fail to Crank
- Low / high battery voltage

Options

Integrated PowerCommand Digital Paralleling Controls
Key Type Mode Selector Switch
Exhaust Temperature Monitoring
PowerCommand Network
Refer to the PowerCommand Controls Technical Bulletin (S1025C-Non-Paralleling / S1005c-Paralleling)



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Ratings Definitions

Emergency Standby Power (ESP):

Applicable for supplying power to varying electrical load for the duration of power interruption of a reliable utility source. Emergency Standby Power (ESP) is in accordance with ISO 8528. Fuel Stop power in accordance with ISO 3046, AS 2789, DIN 6271 and BS 5514.

Limited-Time running Power (LTP):

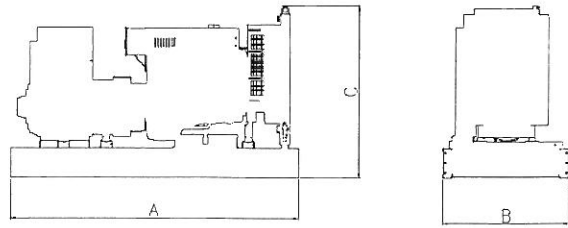
Applicable for supplying power to a constant electrical load for limited hours. Limited Time Running Power (LTP) is in accordance with ISO 8528.

Prime Power (PRP):

Applicable for supplying power to varying electrical load for unlimited hours. Prime Power (PRP) is in accordance with ISO 8528. Ten percent overload capability is available in accordance with ISO 3046, AS 2789, DIN 6271 and BS 5514.

Base Load (Continuous) Power (COP):

Applicable for supplying power continuously to a constant electrical load for unlimited hours. Continuous Power (COP) in accordance with ISO 8528, ISO 3046, AS 2789, DIN 6271 and BS 5514.



This outline drawing is to provide representative configuration details for Model series only.

See respective model data sheet for specific model outline drawing number.

Do not use for installation design.

Model	Dim "A" mm	Dim "B" mm	Dim "C" mm	Set weight* dry kg	Set weight* wet kg
C825 D5e	4375	2033	2856	7362	7752
C900 D5	4375	2033	2856	7512	7902
C1000 D5e	4375	2033	2856	7512	7902
832 DFJC	4375	1785	2229	7667	8054
906 DFJD	4470	1785	2229	7960	8350
921 DFJC	4470	1785	2229	7667	8057
1020 DFJD	4470	1785	2229	7960	8350

*Note: Weights represent a set with standard features. See outline drawings for weights of other configurations

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Low-emissions
technology
The power to exceed global clean air standards



No-one's putting more energy into creating a cleaner world

Cummins Inc. is a world leader in the design and manufacture of power generation equipment. For countless industrial and commercial operations across the globe, we're providing more than reliable, efficient and easy-to-use power systems; we're proving we're committed to meet, and exceed, regulatory air quality standards worldwide.

In fact, since 2004, as strict schedules of increasingly stringent European and international regulations have come into force, our integrated technological innovations have always lived up to them. More importantly, we're in a position to guarantee they will continue to do so through 2017 and beyond.

As a recognised leader in developing innovative low-emission technologies and the first engine manufacturer to offer a complete range of EU Stage IIIA compliant products, our fresh approach to power generation is as important in today's world as it will be in tomorrow's.

The environment comes first

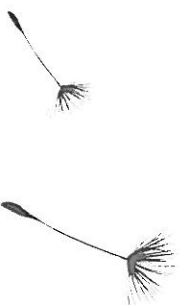
To protect public health and conserve our planet's natural resources, legislation from the U.S. Environmental Protection Agency (EPA) and regulatory agencies in the European Union (EU) has, for the past decade, required that pollutants produced by diesel engines - such as nitrogen oxides (NOx), hydrocarbons (HC) and particulate matter (PM) - be reduced.

Throughout this time, Cummins Inc. has been at the forefront of the move to meet these new standards, becoming:

- the first manufacturer to introduce EPA Tier-2 and Tier-3 products to the market - ahead of the regulatory deadline;
- the first manufacturer to introduce EU Stage IIIA compliant generator-drive diesel engines to Europe;
- the leader in innovative emissions solutions that focus predominantly on in-cylinder design improvements to eliminate most of the NOx, HC and PM before they are formed.

As a result, our diesel engines are not only very clean, but also retain all of their performance advantages without exhaust aftertreatment strategies that add cost and complicate maintenance for end users.

This is truly - Our Energy Working For You.



Contents

The environment comes first
Meeting and exceeding emissions regulations
Timetables for compliance
The Cummins Quantum system
Optimising combustion efficiencies
Powering the widest range of equipment
Strategic emissions leadership for Tier 4 and beyond

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4 & 5
6 & 7
8 & 9
10 & 11
12 & 13
14

Award-winning diesel technology

In recognition of our continued advancements and market leadership in emissions technology, and on top of our award in 2006, Frost & Sullivan have named Cummins Power Generation the recipient of the 2008 North American Diesel Engine Technology Leadership of the Year Award.

2008

Meeting and exceeding emissions regulations

Right now, emissions regulations vary from country to country. But it is acknowledged that working towards harmonised global standards will not only simplify the choice of cost-efficient power systems for manufacturers and customers, but also minimise the impact on air quality.

To assure end-users of the best solution for their application, regardless of country or continent, it's long been a fundamental part of our strategy to design engines that meet or exceed the world's most stringent requirements - those of the EU and U.S.

Allowable emissions set by the EU and U.S.

Categories of allowable emissions are set out as Tiers 1-4 in the U.S. and Stages I-IIIa in the EU. Each increasing Tier or Stage specifies lesser amounts of NOx, HC, CO and PM based on the number of grams per kilowatt-hour of the compounds present in diesel exhaust.

To meet the 2011 target - for NOx and PM levels to have dropped 98% below unregulated levels - requires a phase-on-phase emissions reduction of around 40%.

Whilst in the U.S. both nonroad (portable diesel generator sets and other industrial engines) and stationary applications (generator sets used primarily for peak shaving, load shedding and standby power) are regulated, the EU (with the exception of Germany's TA Luft and France's Directive 2910) regulates only nonroad applications.

Taking into account the broad power range of nonroad diesel engines (and the fact that in the EU, only those producing 18 kWm to 560 kWm are regulated), emissions standards for this class are phased in by power categories, for example:

100-174 hp (75-130 kWm)
174-750 hp (130-560 kWm)

TA Luft and Directive 2910

Under existing legislation, limits for stationary applications within Europe apply to applications above the following:

1 MW (thermal) in Germany
2 MW (thermal) in France

Standby applications (in use <500 hours/year in France and <300 hours/year in Germany) also benefit from less stringent requirements as Germany's TA Luft mainly controls NOx and PM, while France's Directive 2910 controls emissions of NOx, CO, SO₂, non methane organic compounds (NMOC) and PM.

For continuous or prime power applications, TA Luft also regulates NOx and CO emissions according to application size, whilst Directive 2910 limits NOx to 1500 mg/m³. (Variations of these two rules also apply in Austria, Switzerland, Belgium and Luxembourg).

Developing natural compliance

By ensuring all our engines already meet, and very often exceed, the world's toughest emissions regulations, we're helping accelerate the move towards global standards and a cleaner world.

Existing legislation in the rest of the world

China

Legislation exists for all nonroad engines up to 560 kWm. Within this classification, mobile generator sets powered by 37 kWm - 560 kWm engines have, since 2007, had to comply with China Tier I, and from 2009, diesel generator sets powered by engines 18 kWm - 560 kWm will have to comply with China Tier II.

India

Regulations are currently divided into two categories - engines below 800 kWm and engines above the figure. Engines smaller than 19 kWm must comply with U.S. Tier 1. The next level of regulations, based on EU Stage II, is likely to come into effect in 2011.

Japan

Japan does not regulate emissions from very small or very large engines. Current permissible levels (with some exceptions) are similar to EU Stage I and the U.S. EPA Tier 1.

Singapore

Off-highway diesel engines (including portable generators) must meet either EU Stage I or U.S. Tier 1.

Central and South America

As yet, Mexico, Argentina and Brazil have no controls on nonroad power generation engines, although local authorities may institute emissions regulations if warranted by air quality. Chile is adopting its own version of the TA Luft standard.

Timetables for compliance

With the timeframe for the introduction of new global air quality standards in place, our innovative technology is already producing cleaner, quieter, more efficient diesel engines to ensure you have the power to comply.

U.S. EPA nonroad emissions regulations schedule

Emergency standby generators need only comply with Tier 3 and are exempt from Tier 4 Interim and Tier 4 Final regulations that require aftertreatment.

kW	(HP)	2009	2010	2011	2012	2013	2014	2015	2016	2017
0 - 7	(0 - 10)	(7.5) / 6.6 / 0.40								
8 - 18	(11 - 24)									
19 - 36	(25 - 48)	(7.5) / 5.5 / 0.30								
37 - 55	(49 - 74)	Opt T4d 0.30 PM, 37-55 kW								
56 - 74	(75 - 99)	(4.7) / 5.0 / 0.40 37-74 kW								
75 - 129	(100 - 173)	3.4 / 0.19 / 5.0 / 0.02								
130 - 224	(174 - 301)	(4.0) / 3.5 / 0.20								
225 - 449	(302 - 602)	(4.0) / 3.5 / 0.20								
450 - 560	(603 - 751)	(4.0) / 3.5 / 0.20								
>560*	(>751)*	(6.4) / 3.5 / 0.20								

Tier 2 ■ Tier 3 ■ Tier 4 Interim ■ Tier 4 Final ■
 a. Applies to portable power gen engines <300kW (<407hp).
 b. Applies to portable power gen engines >300kW (>407hp).

EU nonroad emissions regulations schedule

Portable nonroad generator sets (i.e. rental) are required to meet Stage II and Stage IIIa where indicated by red bars. The EU does not regulate stationary prime or emergency standby installations.

kW	(HP)	2009	2010	2011	2012	2013	2014	2015	2016	2017
18 - 36	(24 - 48)	8.0 / 5.5 / 0.3								
37 - 55	(49 - 74)	7.0 / 5.0 / 0.4								
56 - 74	(75 - 99)	(4.7) / 5.0 / 0.4								
75 - 129	(100 - 173)	(4.0) / 3.5 / 0.20								
130 - 560	(174 - 751)	(4.0) / 3.5 / 0.2								

Stage II ■ Stage IIIa ■

U.S. EPA stationary emissions regulations schedule

Non-emergency engine requirements shown in black; emergency engine requirements shown in red. All 2009+ requirements are the same as prevailing nonroad requirements except > 3000 hp T4 for 2009-2010, and when emergency engine requirements become unique by not forcing aftertreatment.

kW	(HP)	2009	2010	2011	2012	2013	2014	2015	2016
0 - 18	(0 - 24)	T4 / T4							
19 - 36	(25 - 48)	T4d / T4d							
37 - 55	(49 - 74)	T4d / T4d							
56 - 74	(75 - 99)	T4d / T4d							
75 - 129	(100 - 173)	T4 / T4							
130 - 560	(174 - 751)	T4 / T4							
561 - 900	(752 - 1207)	T4 / T4							
901 - 2237	(1208 - 3000)	T4 / T4							
>2237	>3000	T4 / T4 (nonroad is T2)							

Tier 1 ■ Tier 2 ■ Tier 3 ■ Tier 4 Interim ■ Tier 4 Final ■

Compliance with optional Option 1 0.30g/kWh PM limit in 2008 allows 1-year delay of T4 until 2013.
 Option 1 engines in 2008 are T4 engines not T3 engines.

Key

NOx / HC / CO / PM (g/kWh-hr)
 (NOx + HC) / CO / PM (g/kWh-hr)
 Conversion: (g/kWh-hr) x 0.7457 = g/bhp-hr
 Separate NOx and HC standards separated by a slash.
 Combined NOx and HC standards denoted in parenthesis (').

Notes

- Generally, effect dates of standards are for engines built on or after 1 January of the respective year, except where noted.
- All standards are based upon ISO 8178 C1 8-mode test for variable-speed engines and D2 5-mode test for constant-speed engines. Transient test required beginning with 2011 phase-in.
- Smoke requirements: US - On-highway federal test procedure; Europe - None, but some OEMs require R24.03 certification.
- Nonroad generator sets in Europe are required to meet Stage IIIa standards beginning 1 January 2011 or 2012, based on power band.

Leading the way ahead

Combustion chemistry

NOx - Gases composed of nitrogen and oxygen that react together during combustion. The EPA estimates that diesel engines emit 25% of all NOx in the U.S.

HC - React with NOx in sunlight to form ground-level ozone, involved in the formation of smog and acid rain.

CO - Produced by the incomplete combustion of fossil fuels and present at very low levels in diesels.

PM - A non-gaseous material consisting of soot, carbon and other combustion by-products.

The EPA estimates that diesel engines emit 15% of all PM in the U.S.

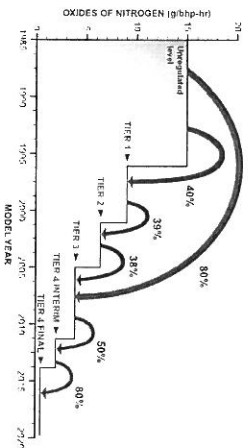
The advantages of Cummins Quantum technology

By relying on analysis-led design rather than prototype testing, the Cummins Quantum system brings together a series of integrated technologies using proven base-engine platforms.

As well as meeting stringent regulations up to U.S. Tier 3/EU Stage IIIa, predominantly without the use of exhaust aftertreatments or other power-consuming strategies, the system reduces primary pollutants by 60% compared to Tier 1 levels, without sacrificing engine performance or reliability.

Percent reduction of NOx + HC (typical 250 kW/60Hz and 275 kVA/50 Hz generator set).

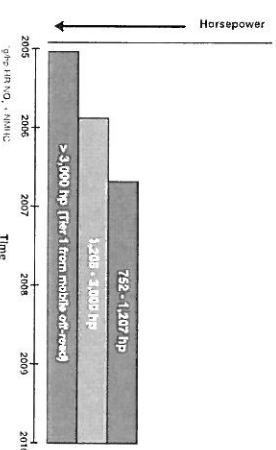
Since U.S. EPA emissions regulations for nonroad diesel engines came into effect in 1996, Cummins Power Generation has, through in-cylinder design improvements and precise control of the combustion process, developed technologies that reduce the primary pollutants in diesel engine exhausts by approximately 80%.



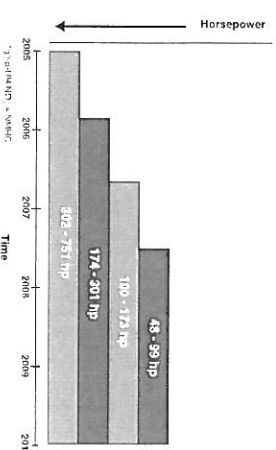
With the power to cut pollutants not engine performance, our intelligent Quantum system represents more than a step forward in low-emission technology; it's internationally acknowledged as a giant leap.

Integrating innovative developments

Tier 2 regulation phase-in (752 hp to >3000 hp)
Large generator engines of >3000 hp must comply with Tier 2 if used in nonroad or non-emergency stationary applications. Stationary emergency generator sets powered by engines of >3000 hp will remain at Tier 1 until Tier 4 regulations take effect in 2011.

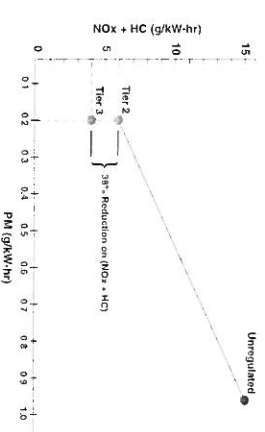


Tier 3 regulation phase-in (48 hp to 751 hp)
Small to medium generator engines have also been phased in to Tier 3 regulations based on horsepower because different size engines require different control strategies.

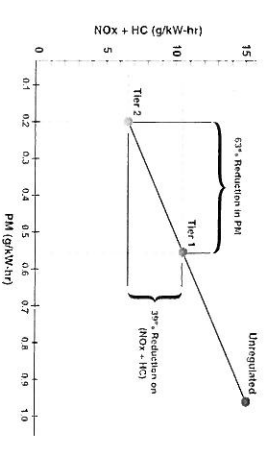


Charting the move to clean air
Under the current legislative timetable, by 2010 the move from U.S. Tier 1 regulations to Tiers 2 and 3 will have reduced diesel engine NOx emissions by 1.2 million tons, HC emissions by 163,000 tons, and PM emissions by 140,000 tons.

(NOx + HC) reduction medium-hp engines
(NOx + HC) emissions from medium-horsepower engines are reduced 39% from Tier 2 to Tier 3 levels.



(NOx + HC) + PM reduction high-hp engines
(NOx + HC) + PM emissions from high-horsepower engines are reduced 39% from Tier 1 to Tier 2 levels. PM emissions are reduced 63%.



Designed to minimise emissions and maximise performance

By controlling NOx and PM during combustion while producing the highest possible power output, the Cummins Quantum system delivers real benefits to the end-user and the environment, ensuring:

- Compliance with EPA Tier 2 and Tier 3 regulations
- Lowest-cost installation
- Generator set footprints that are virtually identical with those of Tier 1
- High fuel efficiency with only a minor increase in heat rejection

Optimising combustion efficiencies

The key components of the Quantum system
With advanced in-cylinder combustion control and optimised fuel delivery, the Quantum system has the technology to meet global emissions standards through to 2017.

Advanced electronic engine controls

With new electronic sensors and microprocessor-based engine controls to compensate for load, temperature, fuel energy content, barometric pressure and even engine wear, fuel efficiency and power output are improved while production of both NOx and PM are decreased.

The advantages of advanced in-cylinder combustion control > 751 hp

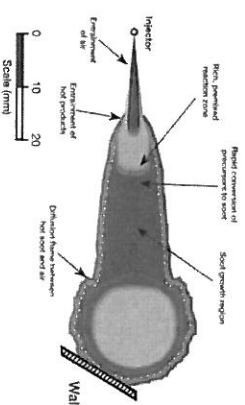
- Uses proven engine platforms with no displacement or base-engine changes
- Avoids complicated engineering such as exhaust gas recirculation (EGR) or major changes to turbocharging or cooling
- Tolerates high-sulphur fuel

Meticulous research and development has enabled our engineers to design one of the world's most advanced combustion systems: one that delivers both increased fuel efficiency and reduced emissions.

Taking greater control

Improved combustion chamber geometry

Using computer simulation of the combustion event, Cummins' engineers have altered the combustion chamber geometry to improve the compression ratio and fuel and air mixing. As a result, the production of emissions is significantly reduced, as is mechanical stress through the lowering of piston temperatures and cylinder pressures.



- Fuel-rich, premixed flame
- Initial soot formation
- Thermal NO production zone
- Soot growth region

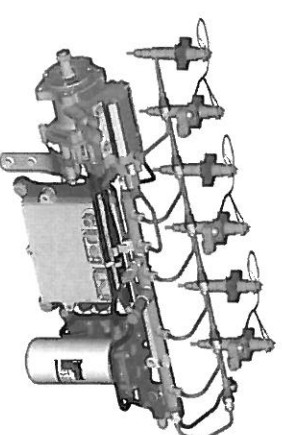
Enhanced 'FCD' cast iron pistons

With a new ferrous cast ductile (FCD) single-piece, cast iron piston in all our high-horsepower engines to permit expansion and contraction during thermal cycles, we've increased power cylinder durability by up to 15%. Our tier-compliant designs also include piston-cooling nozzles for a higher oil flow rate, a nitrided cylinder liner for reduced oil consumption and wear, and a simplified valve train to minimise loading on crankshafts and gear train.



Optimised fuel injection systems

Enhanced injection timing, injection pressure and nozzle design ensure greater control of both NOx and PM. In addition, the high-pressure common rail fuel system (used on engine platforms QSB5, QSB7 and QSL9) reduces engine noise and stress on engine parts for greater durability, whilst the modular common rail system (for QSK19, QSK38, QSK50 and QSK60) does much the same for the higher-horsepower engines.



High-pressure common rail

Higher injection pressures from new fuel injection systems improve fuel atomization, assist combustion chamber penetration (for better cold starting and response to transient loads), and enhance engine performance effectively:

- Reducing noise and smoke
- Improving idle stability
- Improving low-end torque
- Producing cleaner combustion



Proven emissions-compliant engine platforms

¹to be refilled emissions compliant late 2009

Designed to meet U.S. Tier 2/Tier 3 and EU Stage II/Stage IIIA regulations, our products offer everything from prime power to standby systems for offices, data centres, telecoms, hospitals and a wide variety of other applications.

X1.3*  <ul style="list-style-type: none"> • EPA Tier 2/ EU Stage II • 10 kW 60 Hz standby power • 11 kW 60 Hz standby power • 1.2L displacement 	X1.7*  <ul style="list-style-type: none"> • EPA Tier 2/ EU Stage II • 2 kW 60 Hz standby power • 1.5 kW 60 Hz standby power • 1.7L displacement 	X2.5*  <ul style="list-style-type: none"> • EPA Tier 2/ EU Stage II • 25 kW 60 Hz standby power • 27.5 kW 60 Hz standby power • 2.5L displacement 	X3.3*  <ul style="list-style-type: none"> • EPA Tier 2/ EU Stage II • 35 kW 60 Hz standby power • 38 kW 60 Hz standby power • 3.3L displacement 	B3.3  <ul style="list-style-type: none"> • EPA Tier 2/ EU Stage II • 60 kW 60 Hz standby power • 70 kW 60 Hz standby power • 3.3L displacement 	QSB5  <ul style="list-style-type: none"> • EPA Tier 3/ EU Stage IIIA • 60-125 kW 60 Hz standby power • 10-150 kW 50 Hz standby power • High-pressure common rail fuel system • Dual speed • 4.5L displacement 	QSB7  <ul style="list-style-type: none"> • EPA Tier 3/ EU Stage IIIA • 100-200 kW 60 Hz standby power • 110-220 kW 50 Hz standby power • High-pressure common rail fuel system • Dual speed • 6.7L displacement 	QSL9  <ul style="list-style-type: none"> • EPA Tier 3/ EU Stage IIIA • 200-275 kW 60 Hz standby power • 220-300 kW 50 Hz standby power • Full-authority electronic engine system • High-pressure common rail fuel system • Dual speed • 8.9L displacement
QSK15  <ul style="list-style-type: none"> • EPA Tier 2/ EU Stage II • 500 kW 60 Hz standby power • 400-550 kW 50 Hz standby power • High-pressure fuel system • 15L displacement 	QSK19  <ul style="list-style-type: none"> • EPA Tier 2 • 550-600 kW 60 Hz standby power • 600-715 kW 50 Hz standby power • Modular common rail fuel system • Dual speed • 19L displacement 	QSK23  <ul style="list-style-type: none"> • EPA Tier 2 at 1500/1800 rpm • 650-800 kW 60 Hz standby power • 825-900 kW 50 Hz standby power • High-pressure injection fuel system • Dual speed • 23L displacement 	QST30  <ul style="list-style-type: none"> • Tier 2 • 750-1000 kW 60 Hz standby power • 825-1100 kW 50 Hz standby power • 30L displacement 	QSK38  <ul style="list-style-type: none"> • Tier 2 • 900-1250 kW 60 Hz standby power • 1000-1400 kW 50 Hz standby power • Modular common rail fuel system • 38L displacement 	QSK50  <ul style="list-style-type: none"> • Tier 2 • 1100-1600 kW 60 Hz standby power • 1250-1700 kW 50 Hz standby power • Modular common rail fuel system • 50L displacement 	QSK60  <ul style="list-style-type: none"> • Tier 2 • 1750-2000 kW 60 Hz standby power • 1875-2250 kW 50 Hz standby power • Modular common rail fuel system • 60L displacement 	QSK78  <ul style="list-style-type: none"> • Tier 1 • 2500-2750 kW 60 Hz standby power • 2750-3000 kW 50 Hz standby power • High pressure injection fuel system • 78L displacement

Matching every application

With the broadest product line in the world, and a range of power ratings to match, Cummins' engines already power more types of equipment in more markets than those made by any other manufacturer.

G-drive engines
Purpose-designed for high load factors, high usage in a variety of applications and reliability, our G-drive engines are used extensively by original equipment manufacturers. Capabilities include:

- Mid-range (1.3 - 9L) medium-horsepower engines (16 to 476 hp), providing the broadest Tier 3 range which further reduce Tier 2 NOx levels by 38%
- Heavy duty (11 - 15L) 415 to 755 hp engines powering commercial operations
- High-horsepower (19 - 78L) 675 to 3700 hp at both 1500 and 1800 rpm, designed to meet Tier 2/Stage II emissions requirements for electronics and diagnostics, base engine and turbocharging, power cylinder and fuel systems



Strategic emissions leadership for Tier 4 and beyond

By developing advanced regenerative filters and selective catalyst reduction (SCR) systems, we're already in a position to help you gear up for the 15-ppm ultra low-sulphur fuel, PM filter and high-efficiency NOx aftertreatment requirements of the Tier 4 nonroad generator set emissions standards.

In fact, by designing, installing and servicing these aftertreatment strategies, we'll be able to provide you with compatible, high-performance systems that assure maximum reliability and durability not just for 2011, but way beyond.

Get our energy working for you

With trusted local relationships, innovative solutions and dedicated customer service, Cummins Inc. is committed to understanding and meeting customers' needs worldwide. It's this promise that enables us to deliver power wherever, whenever and however it is needed.

For more information on global emissions standards, visit:

www.cumminspower.com
www.cumminsgdrive.com
www.epa.gov
www.dieselnr.com/standards/eu/offroad.html
www.cleanairworld.org

Or, contact your Cummins distributor.

Product Reliability

- Digital control systems and pre-integrated power system components
- Fewer components and higher reliability with in-cylinder emissions solutions
- Proven emissions technology through hundreds of millions of hours of use



Value

- Best performance, service and support
- Value-added engineering to help you select cost-effective power solutions
- Full low-emissions product portfolio for correct sizing and application

Customer Support

- Prompt local response, 24/7 - 365 days of the year
- 170 worldwide service locations
- Local application engineering support to develop the low-emissions power solution for your needs

Cummins is the only manufacturer to offer dual-speed diesel G-Drive engines from 4.5L - 9L. These not only boast the most advanced technology, but also represent compliance with the most stringent EPA Tier 3 and EU Stage IIIA norms at both speeds (50 & 60 Hz). The ability of our engines to meet these strict emissions norms ensures our products represent a cost effective and versatile power solution for rental and mobile applications.

With our commitment to low-emission technology, we're continuing to prove we have the power to make the air cleaner. So if you have the will to make our environment healthier and safer, we have the way.

