Appendix 21

Acoustic Appendices

Glossary of Terminology

In order to assist the understanding of acoustic terminology and the relative change in noise, the following background information is provided.

The human ear can detect a very wide range of pressure fluctuations, which are perceived as sound. In order to express these fluctuations in a manageable way, a logarithmic scale called the decibel, or dB scale is used. The decibel scale typically ranges from 0dB (the threshold of hearing) to over 120dB. An indication of the range of sound levels commonly found in the environment is given in the following table.

Table A12.1.1
Sound Levels Commonly Found in the Environment

Sound Level	Location
0dB(A)	Threshold of hearing
20 to 30dB(A)	Quiet bedroom at night
30 to 40dB(A)	Living room during the day
40 to 50dB(A)	Typical office
50 to 60dB(A)	Inside a car
60 to 70dB(A)	Typical high street
70 to 90dB(A)	Inside factory
100 to 110dB(A)	Burglar alarm at 1m away
110 to 130dB(A)	Jet aircraft on take off
140dB(A)	Threshold of Pain

Acoustic Terminology

dB (decibel) The scale on which sound pressure level is expressed. It is defined as 20 times the logarithm of the ratio between the root-mean-square pressure of the sound field and a reference pressure (2x10-5Pa).

dB(A) A-weighted decibel. This is a measure of the overall level of sound across the audible spectrum with a frequency weighting (i.e. 'A' weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies.

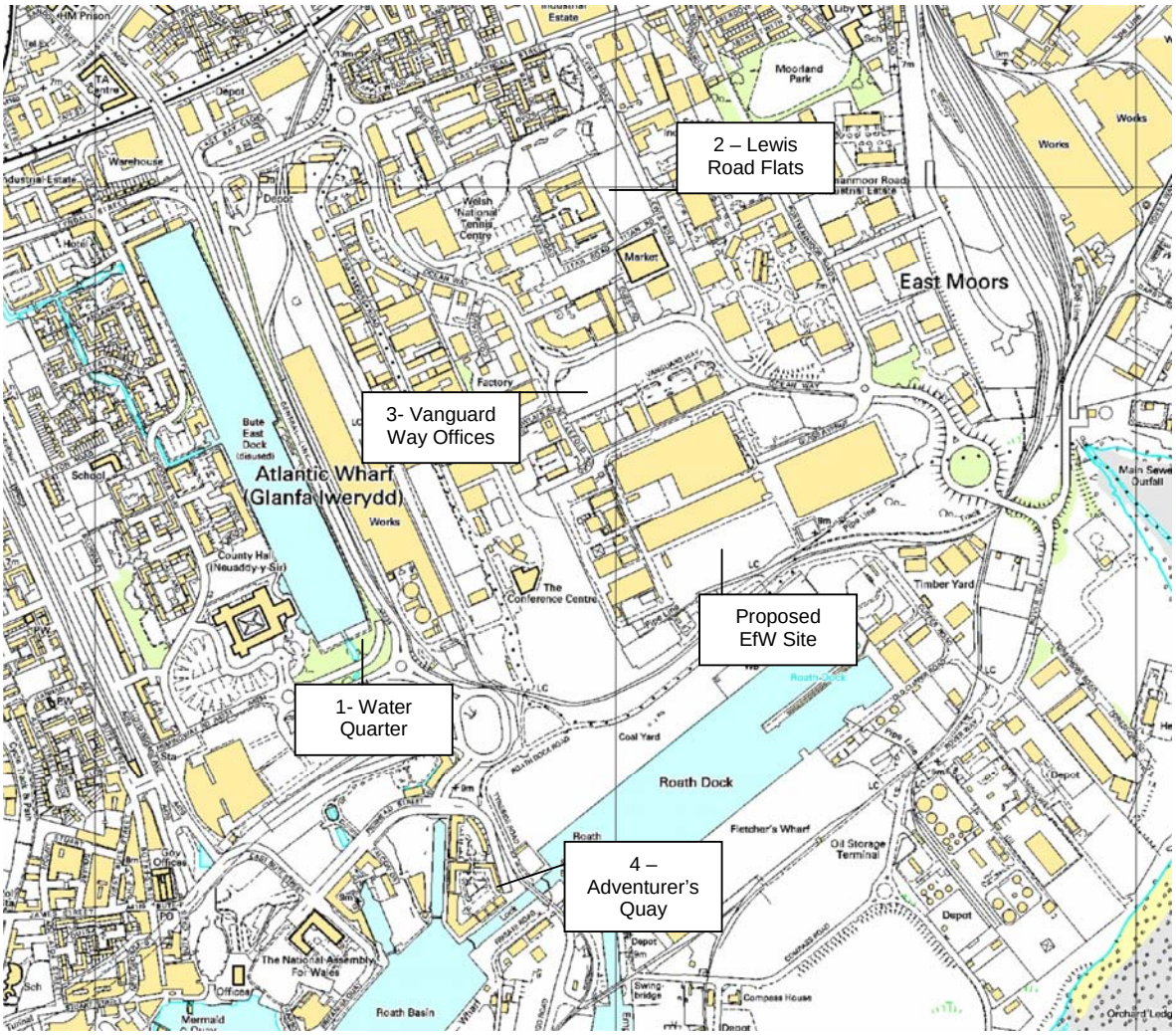
L_{Aeq} L_{Aeq} is defined as the notional steady sound level which, over a stated period of time, would contain the same amount of acoustical energy as the A-weighted fluctuating sound measured over that period.

L_{10} & L_{90} If a non-steady noise is to be described it is necessary to know both its level and the degree of fluctuation. The Ln indices are used for this purpose, and the term refers to the level exceeded for n% of the time. Hence L_{10} is the level exceeded for 10% of the time and as such can be regarded as the 'average maximum level'. Similarly, L_{90} is the 'average minimum level' and is often used to describe the background noise. It is common practice to use the L_{10} index to describe traffic noise.

L_{Amax} L_{Amax} is the maximum A-weighted sound pressure level recorded over the period stated. L_{Amax} is sometimes used in assessing environmental noise where occasional loud noises occur, which may have little effect on the overall L_{eq} noise level but will still affect the noise environment.

Unless described otherwise, it is measured using the 'fast' sound level meter response.

Monitoring Locations



Noise Survey Results

Table A12.3.1
Full Background Noise Survey Results, free-field dB

Position	Period	$L_{Aeq,30minutes}$	L_{A90}	L_{A10}	L_{AFmax}
1 – Water Quarter	14:36-14:51	64.7	62.9	66.4	68.7
1 – Water Quarter	14:51-15:06	65.0	63.5	66.4	69.6
1 – Water Quarter	15:06-15:21	64.5	62.7	66.1	73.0
1 – Water Quarter	15:21-15:36	64.0	62.3	65.5	69.5
1 – Water Quarter	13:01-13:16	64.6	61.9	65.1	85.0
1 – Water Quarter	13:16-13:31	64.0	61.9	65.6	71.7
1 – Water Quarter	00:48-01:03	60.6	59.3	61.9	66.9
1 – Water Quarter	01:03-01:18	60.0	58.8	61.4	69.7
2 – Lewis Road Flats	13:53-14:08	53.6	51.6	55.3	66.8
2 – Lewis Road Flats	14:08-14:23	53.6	51.7	55.2	69.0
2 – Lewis Road Flats	14:23-14:38	55.4	52.1	57.2	71.8
2 – Lewis Road Flats	14:38 – 14:53	54.5	52.0	56.5	66.2
2 – Lewis Road Flats	00:06-00:21	50.8	48.7	52.3	61.0
2 – Lewis Road Flats	00:21-00:36	50.7	48.3	52.7	63.1
3 – Vanguard Way Offices	10:54-11:09	56.0	52.5	58.2	71.6
3 – Vanguard Way Offices	11:09-11:24	56.3	53.1	58.5	67.5
3 – Vanguard Way Offices	11:24-11:39	56.8	52.9	58.9	74.9
3 – Vanguard Way Offices	11:39-11:54	58.1	52.9	60.0	77.5

Table A12.3.2
Full Background Noise Survey Results at Adventurer's Quay, free-field dB

Date	Time	Duration (hh:mm)	$L_{Aeq,T}$	L_{A90}	L_{A10}	L_{AFMax}
26/03/2007	20:30	00:30	57.0	51.0	57.9	78.4
	21:00	01:00	56.1	50.5	56.4	83.2
	22:00	01:00	57.6	50.6	56.1	83.3

	23:00	01:00	57.0	48.3	54.8	88.7
27/03/2007	00:00	01:00	54.4	46.9	52.7	79.2
	01:00	01:00	58.1	48.8	56.2	87.3
	02:00	01:00	54.2	48.1	52.6	77.7
	03:00	01:00	55.6	49.1	54.5	78.4
	04:00	01:00	57.3	49.1	57.6	80.3
	05:00	01:00	61.0	49.3	63.9	84.7
	06:00	01:00	64.3	53.3	66.8	90.3
	07:00	01:00	65.9	56.8	69.4	86.1
	08:00	01:00	66.1	55.9	69.0	88.3
	09:00	01:00	66.7	54.9	70.7	86.5
	10:00	01:00	67.2	54.3	70.9	89.7
	11:00	01:00	67.4	54.2	71.2	90.2
31/03/2007	20:30	00:30	56.6	52.8	56.8	78.0
	21:00	01:00	57.0	52.9	56.4	82.1
	22:00	01:00	54.5	52.2	55.6	73.4
	23:00	01:00	57.4	52.8	57.2	81.8
01/04/2007	00:00	01:00	56.0	52.1	56.3	81.5
	01:00	01:00	55.1	51.8	55.6	75.5
	02:00	01:00	55.9	52.7	57.2	78.3
	03:00	01:00	57.4	52.9	57.8	84.4
	04:00	01:00	57.3	52.5	58.9	77.0
	05:00	01:00	58.5	52.7	61.2	79.6
	06:00	01:00	58.3	53.1	58.6	80.4
	07:00	01:00	59.8	54.0	61.4	83.8
	08:00	01:00	61.4	55.5	62.8	84.4
	09:00	01:00	60.2	55.7	61.8	80.0
	10:00	01:00	61.1	55.9	61.6	86.9
	11:00	01:00	61.4	56.7	62.2	98.0

References

The Town and Country Planning (Environmental Impact Assessment) (England and Wales) Regulations, as amended by the Town and Country Planning (Environmental Impact Assessment)(England and Wales)(Amendment) regulations 2000

British Standard 4142:1997 *Method for: Rating industrial noise affecting mixed residential and industrial areas*

British Standard 8233:1999 *Sound insulation and noise reduction for buildings – Code of practice*

ISO 9613-2:1996 *Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation*

British Standard 5228:1997 Part 2 *Noise and vibration control on construction and open sites*

Source Data
Table A12.4.1
Description of the Main Sources of Noise and Vibration –Operation (EIA)

Area	Sources of noise	Frequency of activities	Fixed / mobile source	Operating hours	Number of plant items	Location and elevation of noise source (int/ext)	Percentage on time of a typical hour for intermittent plant	Sound Power level/sound pressure level data of plant Lp at 1m from equipment (all in dB(A))	Attenuation measures utilised
1. Tipping Hall	Trucks manoeuvring, unloading waste into the bunker	Intermittent	Mobile	12				Lp=80	Doors closed once tipping completed. South façade – translucent polycarbonate. Roof/east/west façade – metal cladding. Interior walls – 4m high concrete push walls
2. Bunker Hall	Crane movements	Intermittent	Mobile	24	1 in operation	Internal of tipping hall	100	Lp=70	Roof/east/west façade – metal cladding 1 in stand by
	Unloading of waste into hoppers	Intermittent	Fixed	16		Level 20 (average)	20	Lp=80	
3. Boiler	Ash transport	Continuous	Fixed	24	4	Internal boiler house	100	Lp=70	Thermal/acoustic insulation on FGT residues screws
	Rappers	Intermittent	Fixed	1	12	Internal Internal boiler house	2	Lp=95	
	Combustion fans	Continuous	Fixed	24	2		100	Lp=85	
4. Bottom ash	Conveyors	Continuous	Fixed	24	6	Internal boiler house/ from	100	Lp=85	Concrete floor and pushwalls. Conveyors on specialist mounts. Roof/east/west façade – metal cladding

Area	Sources of noise	Frequency of activities	Fixed / mobile source	Operating hours	Number of plant items	Location and elevation of noise source (int/ext)	Percentage on time of a typical hour for intermittent plant	Sound Power level/sound pressure level data of plant Lp at 1m from equipment (all in dB(A))	Attenuation measures utilised
5. Flue gas cleaning	ID fans	Continuous	Fixed	24	2	Internal boiler house	100	Lp=85	Roof/east/west façade – metal and acoustic cladding.
	Residue and ash conveyors	Continuous	Fixed	24	12	Internal boiler house/ from	100	Lp=85	
6. Steam cycle and compressors	Feedwater pumps	Continuous	Fixed	24	2 in service		100	Lp=90	Enclosed in main building in turbine room (concrete)
	Condensate pumps	Continuous	Fixed	24	1 in service		100	Lp=85	Enclosed in main building in turbine room (concrete)
	Vacuum ejectors	Continuous	Fixed	24	1		100	Lp=95	Silencer at steam exhaust In turbine concrete room
	Deaerator	Continuous	Fixed	24	1			Lp=80	In boiler hall
	Compressors	Continuous	Fixed	24	1			Lp=85	Acoustic enclosure in concrete room
7. Turbine room	Turbine	Continuous	Fixed	24	1			Lp=105	Turbine table on specialist mounts
	Gearbox	Continuous	Fixed	24	1			Lp=105	Walls – concrete/noise attenuating material
	Generator	Continuous	Fixed	24	1			Lp=105	Roof – concrete/noise attenuating material
8. Flue gas chimneys	ID fan and chimney	Continuous	Fixed	24	2		100	Lp=85	Silencers as necessary
10. Air cooled condenser and ducting	Air cooled condenser	Continuous	Fixed	24	4 fans		100	PWL = 92 Per fan	Low noise fans, mesh roofing only

Area	Sources of noise	Frequency of activities	Fixed / mobile source	Operating hours	Number of plant items	Location and elevation of noise source (int/ext)	Percentage on time of a typical hour for intermittent plant	Sound Power level/sound pressure level data of plant Lp at 1m from equipment (all in dB(A))	Attenuation measures utilised
11. Air cooling system	Air-water cooler	Continuous	Fixed	24	6 fans		80	PWL= 92 per fan	Small low noise fans, mesh roofing only
12 Conveyor drive units	Gearbox and drive unit	Continuous	Fixed	24	16		100	Lp=85	Use of oil gearbox with low rotation speed
13 conveyor runs	Wheel movement and clatter along the belt run	Continuous	Fixed	24	4	Internal boiler house	100	Lp=70	Use of rubber materials
14	Shredder	Intermittent	Fixed	8	1	Internal of tipping hall	100	Lp=85	Hydraulically unit to be installed in a concrete closed room.

Certificate of Calibration

Certificate No.: 1400310

Object	Sound Analyser Nor-140
Supplier	Norsonic AS
Type	Nor140
Serial number	1403009
Client	SLR Consulting ENGLAND

Calibration complies with the following standard(s)

IEC 61672-1:2002 class 1
IEC 60651 type 1
IEC 60804 type 1
IEC 61260 class 1
ANSI S1.4-1983 (R2001) with amd. S1.4A-1985 class 1
ANSI S1.43-1997 (R2002) class 1
ANSI S1.11-2004 class 1
DIN 45 657, Applicable parts
Norsonic production standard set for the Nor-140

Instrumentation used for calibration traceable to

Electrical Parameters: MT, Norway
Acoustical Parameters: PTB, Germany
Environmental Parameters: IKM, Norway. Justervesenet. Norway

Adjustments None

Comments None

Date of calibration	**Calibration interval recommended**
26.10.2007	2 years

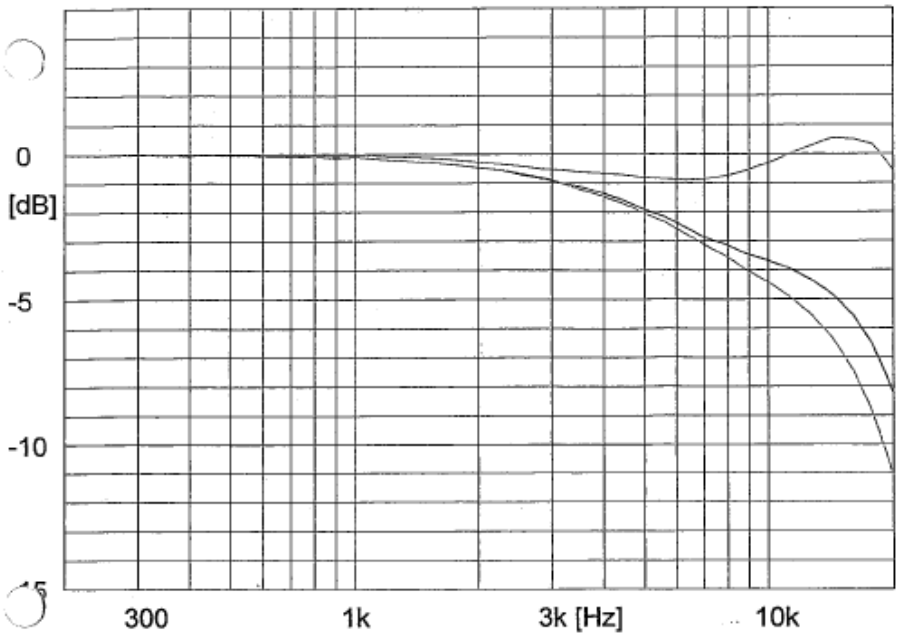
The environmental parameters applicable to this calibration are kept well within limits ensuring negligible deviation on obtained measurement results.

Calibrated by
Hien Van Le Thanh

Sign. Hien Van

Norsonic AS, P.B 24, 3421 Lierskogen. Visitor address: Gunnersbråtan 2, Tranby, Norway.
Phone +47 32858900 Fax.: +47 32852208. email: norsonic@online.no

Microphone Calibration Certificate



Norsonic
Type : 1225

Serial no : 91777

Sensitivity : 54,0 mV/Pa
-25,3 dB re. 1 V/Pa
Capacitance : 24,2 pF
Date : 2007-10-23
Signature :

Measurement conditions :

Polarization voltage :	200,0 V
Pressure :	99,99 kPa
Temperature :	23,2 °C
Relative humidity :	40,7 %RH

Results are normalised to the reference conditions.

Free field response
Diffuse field response
Pressure (Actuator) response

Norsonic AS
www.norsonic.com

Microphone Specifications

Calibration of your microphone cartridge has been made with utmost care to meet all your needs for a high quality measurement device. The calibration is traceable to PTB in Germany.

Nominal Specifications

Ambient temperature coeffecient: 0.01 dB/°C
Ambient pressure coeffecient: -1×10^{-5} dB/Pa
Temperature range: -30 to +70°C
Diameter: 13.2 mm with protection grid on,
12.7 mm without protection grid
Thread for preamp mounting: 11.7 mm 60 UNS

Reference Values

Temperature: 20°C
Relative humidity: 50%
Ambient pressure: 101.325 kPa
Test frequency for sensitivity: 250 Hz

Norsonic Warranty Statement

The warranty period for microphones is 36 months after the time of delivery.
The warrenty does not include damage due to improper handling, overload, force majeur, or normal wear and tear. The warranty is not granted if the buyer make modifications or repairs without our written consent.
Norsonic can choose either to repair or replace microphones having defects due to material or workmanship. Defective goods should be returned to our factory or one of our distributors, and shipments are to be paid and insured by the buyer unless otherwise agreed.

Norsonic

Certificate of Calibration

Certificate No.: CAL 022-2007-0403

Test object :

Manufacturer:	Norsonic
Type :	1251
Serial no:	31875

	Level	Level Stability	Frequency	Frequency Stability	Distortion
Measurement Results:	114,01 dB	0,05 dB	1000,20 Hz	0,00 %	0,15 %
Expanded Uncertainty:	0,10 dB	0,02 dB	0,10 %	0,01 %	0,20 %

The stated level is relative to 20µPa.
The stated level is valid at reference conditions.The following correction factors have been applied during the measurement:
Pressure : 0,0005 dB/kPa Temperature : 0,000 dB/°C Relative humidity : 0,000 dB/%RH Load volume : 0,0003 dB/mm3
The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k, which for a t-distribution with the reported effective degree of freedom corresponds to coverage probability of approximately 95%. The standard uncertainty of measurement has been determined in accordance with EA publication EA-4/02.
Records : L:\PROJECTS\CALLAB\PROGRAM\Cal\2007\NOR1251_31875_M1.nmf

Environmental conditions:	Pressure :	Temperature :	Relative humidity :
Reference conditions:	101,325 kPa	23,0 °C	50 %RH
Measurement conditions :	97,828 ± 0,01 kPa	23,8 ± 1,0 °C	44,5 ± 2,0 %RH

Date of calibration: 2007-09-24
Date of issue: 2007-09-24
Engineer Terje Hansen

Terje Hansen

Acoustic Calibration Services Limited,
Unit 6F, Diamond Industrial Centre,
Works Road, Letchworth Garden City,
Hertfordshire SG6 1LW

Tel: 01462-610085/87 Fax: 01462-610087
e-mail: cal@acousticcalibration.co.uk
web: www.acousticcalibration.co.uk

ACSL
Acoustic Calibration Services Limited

CERTIFICATE OF CALIBRATION

Model: CR:513A **Serial No:** 32327

Organisation: SLR Consulting Limited, Meadowbank Way, Eastwood Nottingham.NG16 3SR

Job Number: 1429 **Customer Order Reference:** 403/6078

The acoustic calibrator was run for a period of time until a stable level was measured. The output level was compared to the certified level of the laboratory measurement references. The measurements were repeated 5 times and the average value calculated.

The ambient temperature during calibration was 24.2 ± 1°C
The barometric pressure was 100.1 to 100.3 kPa.
The relative humidity was 30 to 42 %.

The output of the acoustic calibrator when applied to the **BK 4188** was
94.1dB. on the 94dB setting and ***104.2dB*** on the 104dB setting.
The signal output frequency of the acoustic calibrator operates at 1000Hz.

All ACSL's calibration instrumentation is fully traceable to National Standards. The acoustic references are calibrated by laboratories which are UKAS accredited for the purpose.

Certificate No: **12495**
Date of Issue: **29th November, 2007**

Signature:
Print Name: **Trevor Lewis**

Certificate of Calibration

Cirrus Research plc

Equipment Details

Instrument Manufacturer	Cirrus Research plc
Instrument Type	Acoustic Calibrator
Model Number	CR:513A
Serial Number	032327

Calibration Procedure

The instrument detailed above has been calibrated to the published test and calibration data as detailed in the instrument handbook, using the techniques recommended in the latest revisions of the International Standards IEC 60651:1989, IEC 60804:1985, IEC 225:1966, IEC 61260:1995 and IEC 60942:1988 where applicable.

Sound Level Meters: All Calibration procedures were carried out by substituting the microphone capsule with a suitable electrical signal, apart from the final acoustic calibration.

Sound Calibrators: The output level of the Sound Calibrator was adjusted to the reference level of 94.0dB where this is the specified reference output level.

Calibration Traceability

In equipment detailed above was calibrated against the calibration laboratory standards held by Cirrus Research plc. which are traceable to the appropriate National Standards.

The Cirrus Research plc calibration laboratory standards are:

Microphone Type	B&K4180	Serial Number 1893453	Calibration Ref. S4699
Pistonphone Type	B&K4220	Serial Number 613843	Calibration Ref. 00069

Calibrated By

Calibration Date 16 June 2003

Calibration Certificate Number 121491

This Calibration Certificate is valid for one year from the date above.

Cirrus Research plc Acoustic House Bridlington Road Hunmanby North Yorkshire YO14 0PH
Telephone 01723 891655 Fax 01723 891742
email support@cirrusreseach.co.uk

Acoustic Calibration Services Limited,
Unit 6F, Diamond Industrial Centre,
Works Road, Letchworth Garden City,
Hertfordshire SG6 1LW

Tel: 01462-610085/87 Fax: 01462-610087
e-mail: cal@acousticcalibration.co.uk
web: www.acousticcalibration.co.uk

ACSL
Acoustic Calibration Services Limited

CERTIFICATE OF CALIBRATION

Model: Cirrus CR:511E **Serial No:** 036342

Organisation: SLR Consulting Limited, Meadowbank Way, Eastwood Nottingham.NG16 3SR

Job Number: 1429 **Customer Order Reference:** 403/6078

The acoustic calibrator, which was fitted with a Q3 adaptor for half inch microphones, was run for a period of time until a stable level was measured. The output level was compared to the certified level of the laboratory measurement references. The measurements were repeated 5 times and the average value calculated.

The ambient temperature during calibration was 24.0 ± 1°C
The barometric pressure was 100.2 to 100.4 kPa.
The relative humidity was 30 to 42 %.

The output of the acoustic calibrator when applied to the **BK 4188** was
93.8dB. on the 94dB setting and ***103.8dB*** on the 104dB setting.
The signal output frequency of the acoustic calibrator operates at 1000Hz.

All ACSL's calibration instrumentation is fully traceable to National Standards. The acoustic references are calibrated by laboratories which are UKAS accredited for the purpose.

Certificate No: **12496**
Date of Issue: **29th November, 2007**

Signature: T J Lewis
Print Name: **Trevor Lewis**

Certificate of Calibration

Cirrus Research plc

Equipment Details

Instrument Manufacturer	Cirrus Research plc
Instrument Type	Sound Level Meter
Model Number	CR:704B
Serial Number	B11587F

Calibration Procedure

The instrument detailed above has been calibrated to the published test and calibration data as detailed in the instrument handbook, using the techniques recommended in the latest revisions of the International Standards IEC 60651:1989, IEC 60804:1985, IEC 225:1966, IEC 61260:1995 and IEC 60942:1988 where applicable.

Sound Level Meters: All Calibration procedures were carried out by substituting the microphone capsule with a suitable electrical signal, apart from the final acoustic calibration.

Sound Calibrators: The output level of the Sound Calibrator was adjusted to the reference level of 94.0dB where this is the specified reference output level.

Calibration Traceability

In equipment detailed above was calibrated against the calibration laboratory standards held by Cirrus Research plc. which are traceable to the appropriate National Standards.

The Cirrus Research plc calibration laboratory standards are:

Microphone Type	B&K4180	Serial Number 1893453	Calibration Ref. S4699
Pistonphone Type	B&K4220	Serial Number 613843	Calibration Ref. 00069

Calibrated By

Calibration Date 16 June 2003

Calibration Certificate Number 121490

This Calibration Certificate is valid for one year from the date above.

Cirrus Research plc Acoustic House Bridlington Road Hunmanby North Yorkshire YO14 0PH
Telephone 01723 891655 Fax 01723 891742
email support@cirrusreseach.co.uk

ENERGY FROM WASTE FACILITY
TRIDENT PARK, CARDIFF

Assessment of Existing Noise

September 2008
SLR REPORT REF.: 402.0036.00306.002

CONTENTS

APPENDICES

1.0 INTRODUCTION

Viridor Waste Management Limited has appointed SLR Consulting Limited to carry out an environmental noise assessment of the existing industrial noise sources affecting the site of the proposed administrative complex of the proposed Trident Park Energy from Waste Facility.

This assessment supplements the Environmental Statement and has been undertaken in accordance with the appropriate British Standard and is intended to inform the design of this part of the development.

Whilst every effort has been made to ensure that this report is easy to understand, it is technical in nature; to assist the reader, a glossary of terminology is included in Appendix A.

2.0 SITE DESCRIPTION

The site is currently disused, with proposals to redevelop the site as an Energy from Waste Facility.

To the south of the site boundary is a BoC oxygen plant serving the Tremorfa Steelworks complex and concern has been expressed regarding the noise generated by the oxygen plant and the subsequent suitability of the location of the proposed Trident Park administrative offices.

Plans for the Trident Park site, showing the currently proposed layout are included in the Environmental Statement, SLR Ref 402.0036.00306.0001.

3.0 GUIDANCE

3.1 British Standard 8233

The scope of British Standard 8223: 1999: *Sound Insulation and Noise Reduction for Buildings – Code of Practice* is the provision of recommendations for the control of noise in and around buildings. It suggests appropriate criteria and limits for different situations, which are primarily intended to guide the design of new or refurbished buildings undergoing a change of use rather than to assess the effect of changes in the external noise climate.

The standard suggests suitable internal noise levels within different types of buildings, including offices, as shown in Table 3.3.

Table 3.3
Indoor Ambient Noise Levels In Spaces When They Are Unoccupied, dB

Criterion	Typical Situations	Design Range $L_{Aeq, T}$ dB	
		Good	Reasonable
Reasonable conditions for study and work requiring concentration	Cellular Office	40	50
	Meeting Room, Executive Office	35	40

4.0 ENVIRONMENTAL NOISE SURVEY

A noise survey was undertaken on Wednesday 27th and Thursday 28th August 2008. The survey was undertaken at the closest point on the build line of the proposed office façade to the BoC plant, approximately 45 metres away.

4.1 Survey Methodology

The equipment used during the survey comprised a Norsonic 140 type 1 sound level meter (serial number 1403009), coupled to a Norsonic type 1209 pre-amplifier (serial number 12449) and a Norsonic type 1225 microphone (serial number 91777), which was in turn fitted with a windshield suitable for environmental noise measurements. The sound level meter was calibrated before the measurements, and its calibration checked after, using a Norsonic type 1251 calibrator (serial number 31875). No calibration drifts were found to have occurred. The sound level meter and the acoustic calibrator were calibrated by a UKAS laboratory within the 12 months preceding the survey.

The sound level meter was located in free-field conditions at the measurement location, with the microphone approximately 1.5 metres above ground level. The measurement spanned a total period of approximately 19.5 hours in order to gain a statistically robust sample showing any variability in the primary noise source.

4.2 Survey Results

The background noise climate was dominated by noise from the neighbouring BoC plant. The noise was aerodynamic in nature, caused by the processing and passage of gases through the plant.

The trace of the survey contained in Appendix C shows the variability of the noise source as processes within the BoC plant come on and off-line.

The weather throughout the survey was suitable for noise measurement, it being dry with virtually no wind.

The survey results are summarised in Table 4.1.

Table 4.1
Summary of Measured Noise Levels, free-field dB

Position		Period	L_{Aeq}	L_{A90}	L_{A10}	$L_{Amax, F}$
Proposed Facade	Office	Day - mean	64.9	58.2	69.1	85.0
		Night - mean	63.5	57.7	67.7	81.9
		Day – worst 1 hour	70.6	67.8	72.6	80.9

5.0 ASSESSMENT

As set out in Section 3 of this report, the appropriate criteria for assessing this scenario is that set out in BS8233, in order to determine the level of required mitigation in order to achieve recommended internal noise levels.

The worst 1-hour figure quoted in Table 4.1 represents that period during which activity at the BoC plant is at its peak, this figure has been used for designing the building façade and formulating a glazing specification.

It is important to note that during this assessment the external levels generated by the EfW plant itself, detailed in the Environmental Statement, have been considered through interrogating the Cadna/A model. The predicted noise levels are considered to be insignificant in comparison to those generated by the BoC plant at this location and have been discounted accordingly.

Regarding these noise levels and their suitability for natural ventilation; noise passing through a partially open window is normally reduced by between 10 and 15dB. In this scenario, that would result in sustained internal noise levels of 55 to 60dB, which is substantially in excess of the recommended maxima for the building's proposed use. As a result, the possibility of natural ventilation via openable windows is reduced and an alternative means of ventilation needs to be considered in order to achieve the appropriate air changeover rates.

6.0 MITIGATION MEASURES

The overall sound reduction performance of a building façade is normally determined by the glazing or ventilation components as these are typically the weakest links. It is therefore considered appropriate to explore the protection that could be afforded by the sound insulation performance of the glazing elements. The following sound insulation performance values would be required to achieve the target internal noise levels. Note that the measured noise levels have all been rounded up to the nearest decibel.

Table 6.1
Required Sound Insulation Performances, dB

Location	Use	Measured Noise Level	Target Value	Required Sound Insulation Performance
Proposed southern office façade	Cellular Office	71	40 to 50	21 to 31
	Meeting Room or Executive Office	71	35 to 40	31 to 36

It can be seen from the above table that a window capable of reducing the external noise level by 36dB would be sufficient to ensure that the “good” criteria are met within meeting rooms or executive offices overlooking the BoC plant achieve the recommendations set out by in BS8233. The requirement will reduce to 31dB in order to achieve the same rating should cellular offices occupy the worst affected part of the façade.

As an example of a glazing unit that could achieve such a performance requirement, the glazing manufacturer Pilkington states that its 6/12/7 Audioscreen double glazed window unit has an R_W of 36dB. The 6/12/7 notation refers to a glazing unit comprising two panes of glass, one 6mm thick and one 7mm thick, separated by a 12mm air gap.

Other units may be suitable and it is the responsibility of the glazing manufacturer to recommend and provide appropriate systems. The above analysis is provided to demonstrate that a design solution is feasible at the site for the purposes of a planning application and not for the purposes of detailed design or glazing procurement.

The detailed design of the proposed offices will affect both the required sound reduction performance and the appropriate selection of glazing units. The aspects of the detailed design that are important are the room dimensions, room finishes, window dimensions and the sound reduction performance of non-glazing elements. Further detailed consideration of the glazing components will be required once the detailed design is confirmed.

Internal noise levels should be considered in the context of room ventilation requirements. The target internal noise levels will only be achieved when windows are closed. An alternative means of ventilation will therefore be required to comply with the requirements of the Building Regulations Approved Document F.

The Building Research Establishment (BRE) has published an Information Paper on the acoustic performance of such passive ventilation systems. IP4/99: *Ventilators: Ventilation and Acoustic Effectiveness* (October 1999) details a study into the sound reduction performance of fourteen different window mounted trickle ventilators and seven different through-wall passive ventilators. The measured sound reduction performance, after taking into account flanking sound paths (i.e. sound paths that do not travel directly through the vent) and the effective area of the ventilator, ranged from 14 to 46dB.

Passive vents are available that meet or exceed the sound reduction required by the glazing elements.

7.0 CONCLUSION

Viridor Waste Management Limited has appointed SLR Consulting Limited to carry out an assessment of existing industrial noise affecting the proposed office complex at its proposed Energy from Waste Facility in Cardiff. The site neighbours a BoC oxygen plant, which generates moderate to high levels of noise and quantification of these noise levels at the proposed façade were required in order to inform the design of the offices.

Noise measurements were undertaken at the proposed facade location, in order to obtain noise levels representative of the area, which would be suitable for deriving a glazing and ventilation specification for this element of the scheme.

The results show that for prolonged periods the proposed office façade will be exposed to noise levels in excess of 70dB generated by operations at the BoC plant. As a result, a system of acoustic glazing and ventilation has been suggested in order to achieve the recommended internal noise levels quoted within BS8233.

8.0 CLOSURE

This report has been prepared by SLR Consulting Limited with all reasonable skill, care and diligence, and taking account of the manpower and resources devoted to it by agreement with the client. Information reported herein is based on the interpretation of data collected and has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of Viridor Waste Management Limited; no warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the client and others in respect of any matters outside the agreed scope of the work.

Appendix A - Glossary of Terminology

In order to assist the understanding of acoustic terminology and the relative change in noise, the following background information is provided.

The human ear can detect a very wide range of pressure fluctuations, which are perceived as sound. In order to express these fluctuations in a manageable way, a logarithmic scale called the decibel, or dB scale is used. The decibel scale typically ranges from 0dB (the threshold of hearing) to over 120dB. An indication of the range of sound levels commonly found in the environment is given in the following table.

Table A.1
Sound Levels Commonly Found in the Environment

Sound Level	Location
0dB(A)	Threshold of hearing
20 to 30dB(A)	Quiet bedroom at night
30 to 40dB(A)	Living room during the day
40 to 50dB(A)	Typical office
50 to 60dB(A)	Inside a car
60 to 70dB(A)	Typical high street
70 to 90dB(A)	Inside factory
100 to 110dB(A)	Burglar alarm at 1m away
110 to 130dB(A)	Jet aircraft on take off
140dB(A)	Threshold of Pain

Acoustic Terminology

dB (decibel) The scale on which sound pressure level is expressed. It is defined as 20 times the logarithm of the ratio between the root-mean-square pressure of the sound field and a reference pressure ($2x10^{-5}$Pa).

dB(A) A-weighted decibel. This is a measure of the overall level of sound across the audible spectrum with a frequency weighting (i.e. 'A' weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies.

L_{Aeq} L_{Aeq} is defined as the notional steady sound level which, over a stated period of time, would contain the same amount of acoustical energy as the A-weighted fluctuating sound measured over that period.

L_{10} & L_{90} If a non-steady noise is to be described it is necessary to know both its level and the degree of fluctuation. The Ln indices are used for this purpose, and the term refers to the level exceeded for n% of the time. Hence L_{10} is the level exceeded for 10% of the time and as such can be regarded as the 'average maximum level'. Similarly, L_{90} is the 'average minimum level' and is often used to describe the background noise. It is common practice to use the L_{10} index to describe traffic noise.

L_{Amax} L_{Amax} is the maximum A-weighted sound pressure level recorded over the period stated. L_{Amax} is sometimes used in assessing environmental noise where occasional loud noises occur, which may have little effect on the overall L_{eq} noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response.

Appendix B – Noise Survey Results