Stephenson
Environmental Management Australia

CO-GENERATION PLANT STACK EMISSION TESTING - ANNUAL, 2014

TOOHEYS PTY LTD

LIDCOMBE, NSW

PROJECT NO.: 5449/S23558/14

DATE OF SURVEY: 4 DECEMBER 2014

DATE OF ISSUE: 10 DECEMBER 2014

Stephenson
Environmental Management Australia

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P W STEPHENSON

A MCGHIE

A PRADHAN

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1 INTRODUCTION

Stephenson Environmental Management Australia (SEMA) was requested by Tooheys Pty Ltd to assess emissions from the stack serving their Co-generation Plant at their brewing facility at Lidcombe, New South Wales (NSW).

Tooheys operates under the NSW Office of Environment and Heritage (OEH) EPL No. 1167. Condition L3.4 specifies the emission concentration limits for the stack serving the Co-generation Plant (EPA Identification (ID) No. 7). The objectives of this were to meet the requirements for EPA ID No. 7 and to determine if the specified emission concentration limits were met.

The tests were undertaken on 4 December 2014.

TABLE 1-1 EPL ID NO. 7 – EMISSION CONCENTRATION LIMITS AND MONITORING REQUIREMENTS

Parameter	Units of measure	Frequency	OEH test method	100% conc. limit	Reference condition	Oxygen correction
Volatile Organic Compounds (as n-propane)	mg/m^3	Annual	TM-34	40	Dry, 273k, 101.3kPa,	5%
Nitrogen Oxides	mg/m^3	Annual	TM-11	250	Dry, 273k, 101.3kPa,	5%
Dry Gas Density	kg/m^3	Annual	TM-23	--	--	--
Moisture	%	Annual	TM-22	--	--	--
Molecular Weight	g/g mole	Annual	TM-23	--	--	--
Temperature	^oC	Annual	TM-2	--	--	--
Volumetric Flow Rate	m/s	Annual	TM-2	--	--	--
Velocity	m^3/s	Annual	TM-2	--	--	--

Key:

mg/m^3	=	milligrams per cubic metre
OEH	=	Office of Environment and Heritage
TM	=	Approved Test Method
mg/m^3	=	milligrams per cubic metre @ 0^oC and 1 atmosphere
kg/m^3	=	kilograms per cubic metre
%	=	percent
g/g mole	=	grams per gram mole
^oC	=	degrees Celsius
m/s	=	metres per second
m^3/s	=	cubic metres per second
conc.	=	concentration
--	=	no specified limit

2 PRODUCTION CONDITIONS

On the day of testing, the plant operating procedures and production rate were considered typical by Tooheys personnel. Refer to Appendix D for Screen Shots of Co-generation engine operating conditions for the day of testing.

In essence, the Co-generation Engine and associated waste heat boiler was producing of the order of 2.0 megawatts (MW) of power and steam on the day of testing.

Tooheys advise that this engine was designed by the manufacturer to meet an emission specification corrected to 5% Oxygen (O_2). This has been acknowledged by OEH because co-generation is considered by OEH to be best available technology and thus, has been confirmed in OEH Interim NO_x for Policy for Co-generation in Sydney and the Illawarra, which is presented in Appendix G.

This policy concept of 5% oxygen reference correction for co-generation plant emissions has now been incorporated into EPL 1167 for the Tooheys brewery site.

3 EMISSION TEST RESULTS AND DISCUSSION

3.1 INTRODUCTION

SEMA completed all the sampling and analysis for velocity, flow, dry gas density, molecular weight of stack gases, temperature, moisture, Volatile Organic Compounds (VOCs), Oxygen (O_2) and Nitrogen Oxides (NO_x). SEMA is NATA accredited to ISO17025 to complete the sampling and analysis for the above parameters. SEMA NATA accreditation number is 15043.

The VOC sample, collected by SEMA, was analysed by the NATA accredited Testsafe Australia, accreditation number 3726, Report No. 2014-2920.

The emission test results are summarised in table format in Table 3-1. Sections 3.2 and 3.3 provide a description of the results.

Refer to Appendix B for a graphical logged record of NO_x continuous emission analysis.

Appendix C presents SEMA's NATA endorsed Emission Test Report, No. 5449.

Details of the most recent calibration of each instrument used to take measurements is summarised in Appendix E, and the sample location is illustrated in Appendix F.

3.2 OXIDES OF NITROGEN (NO_X)

The one-hour average NO_x (expressed as NO_2) emission concentration during the sampling period was 80 parts per million (ppm) and when corrected to 5% O_2 was 238 mg/m^3. This emission concentration was in compliance with the Co-generation EPL NO_x concentration limit of 250 mg/m^3 at 5% O_2. Refer to Table 3-1 and Figure B-1 in Appendix B for detailed results in tabulated and graphical formats respectively.

3.3 VOLATILE ORGANIC COMPOUNDS

The sum of the total VOC emission concentrations in the suite of 73 analytes is reported as n-propane equivalent as required by the NSW OEH Approved Methods and POEO (Clean Air) Regulation 2010.

The measured total VOCs emission concentration (as n-propane) corrected to 5% O_2 was less than 6.19 mg/m^3 which was *in compliance* with EPL concentration emission limit of 40 mg/m^3. Refer to Table 3-1 and Appendix C for details.

TABLE 3-1 SUMMARY OF AVERAGE EMISSION TEST RESULTS

Parameter	Unit	EPL ID No.7 Average Result	EPL Concentration Limit
Temperature	°C	296	--
Pressure	kPa	101.0	--
Velocity	m/s	27.3	--
Volumetric Flow	m^3/s	2.16	--
Moisture	%	8.6	--
Molecular Weight Dry Stack Gas	g/g mole	29.425	--
Gas Density	kg/m^3	1.31	--
Nitrogen Oxides	mg/m^3 @ 5% O_2	238	250
Oxygen	%	9.9	--
Volatile Organic Compounds	mg/m^3 @ 5% O_2 as n-propane equiv.	< 6.19	40

Key:

°C	=	degrees Celsius
<	=	less than
*	=	reported as n-propane equivalent
%	=	percentage
EPA	=	Environment Protection Authority
EPL	=	Environment Protection Licence
kg/m^3	=	kilograms per cubic metre
kPa	=	kilo Pascals
g/g mole	=	grams per gram mole
m^3/s	=	dry cubic metre per second 0°C and 101.3 kilopascals (kPa)
m/s	=	metres per second
mg/m^3	=	milligrams per cubic metre at 0°C and 101.3 kilopascals (kPa)

4 CONCLUSIONS

From the data presented and test work conducted during typical production, the following conclusions were drawn for the stack emissions:

- The one-hour average NO_x emission concentration corrected to 5% O_2 was 238 mg/m^3, which was in compliance with the EPL NO_x emission limit of 250 mg/m^3.

- This NO_x emission concentration was also in compliance with the OEH Interim Co-generation Policy NO_x concentration limit corrected to 5% O_2.

- The VOC emission concentration corrected to 5% O_2 was less than 6.19 mg/m^3, which was in compliance with the EPL VOC emission limit of 40 mg/m^3 (expressed as n-propane).

5 TEST METHODS

5.1 EXHAUST GAS VELOCITY AND TEMPERATURE

(OEH NSW TM-1 & 2)

Velocity profiles were obtained across each stack utilising an Airflow Developments Ltd. S-type pitot tube and digital manometer. Where practicable, each sampling plane complied with AS4323.1.

The exhaust gas temperature was measured using a Digital thermometer (0-1200°C) connected to a chromel/alumel (K-type) thermocouple probe.

5.2 CONTINUOUS GASEOUS ANALYSIS

(OEH NSW TM-11, 24, 25 & 32)

Sampling and analysis of exhaust gas were performed using one of Stephenson Environmental Management Australia's mobile combustion and environmental monitoring laboratories. Emission gases were distributed to the analysers via a manifold. Flue gas from each stack was pumped continuously. The following components of the laboratory were relevant to this work:

Oxides of Nitrogen	Testo 350XL
Oxygen	Testo 350XL
Carbon Dioxide	Testo 350XL
Calibration	BOC / Air Liquide Special Gas Mixtures relevant for each analyser. Instrument calibrations were performed at the start and finish of sampling at each location.
QA/QC	Calibration (Zero/Span) checks Sample line integrity calibration check

5.3 VOLATILE ORGANIC COMPOUNDS (VOCS)

(OEH NSW TM-34)

A sample of stack air is drawn onto a carbon adsorption tube and analysed using Gas Chromatography/Mass Spectrometry (GC/MS) performed by the NATA accredited laboratory TestSafe Australia, accreditation number, 3726.

5.4 MEASUREMENT OF UNCERTAINTY

All results are quoted on a dry basis. SEMA has adopted the following (Table 5-1) uncertainties for various stack testing methods.

TABLE 5-1 MEASUREMENT OF UNCERTAINITY

Pollutant	Methods	Uncertainty
Moisture	AS4323.2, TM-22, USEPA 4	25%
Nitrogen Oxides	NSW TM-11, USEPA 7E	15%
Oxygen a	NSW TM-24, USEPA 3A	1% actual
Velocity	AS4323.1, TM-2, USEPA 2	5%
Volatile Organic Compounds (adsorption tube)	TM-34, USEPA M18	25%

Key:

Unless otherwise indicated the uncertainties quoted have been determined @ 95% level of Confidence level (i.e. by multiplying the repeatability standard deviation by a co-efficient equal to 1.96) (Source – Measurement Uncertainty)

Sources: *Measurement Uncertainty – implications for the enforcement of emission limits by Maciek Lewandowski (Environment Agency) & Michael Woodfield (AEAT) UK*

Technical Guidance Note (Monitoring) M2 Monitoring of stack emissions to air Environment Agency Version 3.1 June 2005.

APPENDIX A – EMISSION TEST RESULTS

Glossary:

%	=	percent
^oC	=	Degrees Celsius
am^3/min	=	cubic metre of gas at actual conditions per minute
Normal Volume (m^3)	=	cubic metre at 0°C and 760 mm pressure and 1 atmosphere
am^3	=	cubic metre of gas at actual conditions
g/g mole	=	grams per gram mole
g/s	=	grams per second
hrs	=	hours
kg/m^3	=	kilograms per cubic metre
kPa	=	kilo Pascals
m^2	=	square metre
m/s	=	metre per second
m^3/sec	=	cubic metre per second at 0^0C and 1 atmosphere
mg	=	milligrams
mg/ m^3	=	milligrams per cubic metre at 0^oC and 1 atmosphere
O_2	=	Oxygen
SEMA	=	Stephenson Environmental Management Australia
VOC	=	Volatile Organic Compounds

Abbreviations of Personnel

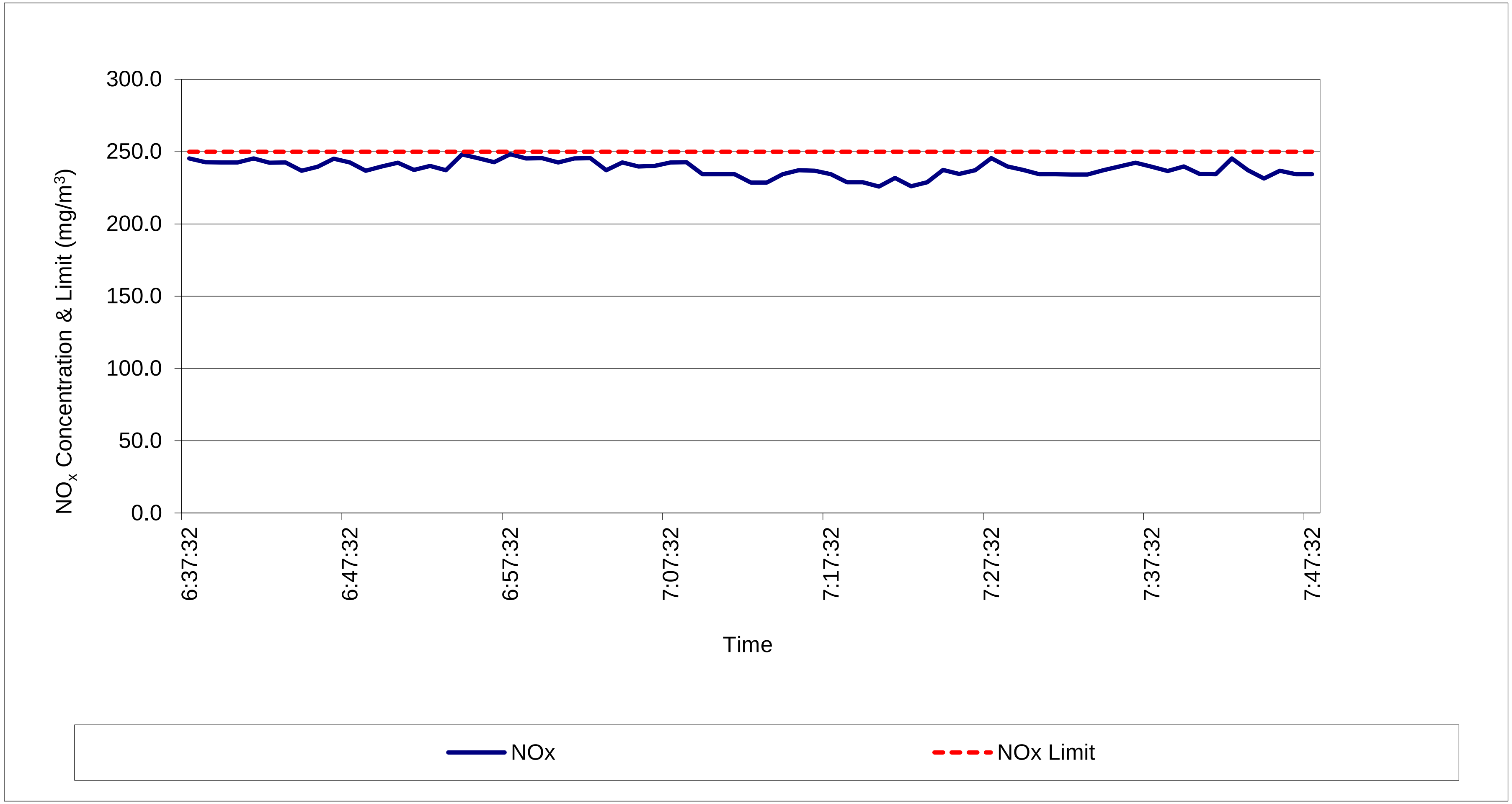
PWS	=	Peter Stephenson
AM	=	Argyll McGhie
AP	=	Alok Pradhan
AN	=	Ali Naghizadeh

TABLE A-1 EMISSION TEST RESULTS – EPL ID NO.7 – FLOW & VOCS

Emission Test Results	**Flow**
Project Number	5449
Project Name	Tooheys
Test Location	**EPA ID Point No.7 - Gas Engine**
Date	4 December 2014
RUN	1
Sample Start Time (hrs)	6:10
Sample Finish Time (hrs)	8:03
Sample Location (Inlet/Exhaust)	Exhaust
Stack Temperature (^oC)	296.0
Stack Cross-Sectional area (m^2)	0.181
Average Stack Gas Velocity (m/s)	27.3
Actual Gas Flow Volume (am^3/min)	296
Total Normal Gas Flow Volume (m^3/min)	130
Total Normal Gas Flow Volume (m^3/sec)	2.16
Total Stack Pressure (kPa)	101.0
Moisture Content (% by volume)	8.6
Molecular Weight Dry Stack Gas (g/g-mole)	29.425
Dry Gas Density (kg/m^3)	1.31
Oxygen (Grab Sample) (%)	9.89
Carbon Dioxide (Grab Sample) (%)	6.44
Sampling Performed by	PWS, AM, AP
Sample Analysed by (Laboratory)	SEMA
Calculations Entered by	AN
Calculations Checked by	AP
VOCs Sample Start Time:	7:03
VOCs Sample Finish Time:	8:03
Sampling Period (min):	60
SEMA Sample No.:	724370
Concentration (mg/m^3) @ 5% O_2	< 6.49
Concentration as n-prop. Equiv. (mg/m^3) @ 5% O_2	<6.19

APPENDIX B – CONTINUOUS LOGGED DATA

FIGURE B-1 CONTINUOUS LOG OF NITROGEN OXIDES EMISSIONS @ 5% O_2 4 DECEMBER 2014



APPENDIX C – NATA ENDORSED TEST REPORT

Test Safe AUSTRALIA 'Safety is no Accident'

CHEMICAL ANALYSIS BRANCH

WorkCover NEW SOUTH WALES

Alok Pradhan
Stephenson Environmental Management Australia
PO Box 6398
SILVERWATER NSW 1811

Lab. Reference: 2014-2920

SAMPLE ORIGIN: 5449

DATE OF INVESTIGATION: 04/12/2014 **DATE RECEIVED:** 5/12/14

ANALYSIS REQUIRED: VOC Screen

REPORT OF ANALYSIS

See attached sheet(s) for sample description and test results.

The results of this report have been approved by the NATA signatory whose signature appears below.

For all administrative or account details please contact Jeanine Wells.

E-MAILED
8/12

Martin Mazereeuw
Manager

Date: 8/12/14

WorkCover NSW Chemical Analysis Branch
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NSW GOVERNMENT | WorkCover | TestSafe AUSTRALIA

Analysis of Volatile Organic Compounds in Workplace Air by GC/MS

Client : Alok Pradhan
Sample ID : 724370 **Sample : 2014-2920-1**

No	Compounds	CAS No	Front (µg/section)	Back (µg/section)
	Aliphatic hydrocarbons (LOD = 5µg/compound/section)			
1	2-Methylbutane	78-78-4	ND	ND
2	n-Pentane	109-66-0	ND	ND
3	2-Methylpentane	107-83-5	ND	ND
4	3-Methylpentane	96-14-0	ND	ND
5	Cyclopentane	287-92-3	ND	ND
6	Methylcyclopentane	96-37-7	ND	ND
7	2,3-Dimethylpentane	565-59-3	ND	ND
8	n-Hexane	110-54-3	ND	ND
9	3-Methylhexane	589-34-4	ND	ND
10	Cyclohexane	110-8-27	ND	ND
11	Methylcyclohexane	108-87-2	ND	ND
12	2,2,4-Trimethylpentane	540-84-1	ND	ND
13	n-Heptane	142-82-5	ND	ND
14	n-Octane	111-65-9	ND	ND
15	n-Nonane	111-84-2	ND	ND
16	n-Decane	124-18-5	ND	ND
17	n-Undecane	1120-21-4	ND	ND
18	n-Dodecane	112-40-3	ND	ND
19	n-Tridecane	629-50-5	ND	ND
20	n-Tetradecane	629-59-4	ND	ND
21	α-Pinene	80-56-8	ND	ND
22	β-Pinene	127-91-3	ND	ND
23	D-Limonene	138-86-3	ND	ND
	Chlorinated hydrocarbons (LOD = 5µg/compound/section)			
24	Dichloromethane	75-09-2	ND	ND
25	1,1-Dichloroethane	75-34-3	ND	ND
26	1,2-Dichloroethane	107-06-2	ND	ND
27	Chloroform	67-66-3	ND	ND
28	1,1,1-Trichloroethane	71-55-6	ND	ND
29	1,1,2-Trichloroethane	79-00-5	ND	ND
30	Trichloroethylene	79-01-6	ND	ND
31	Carbon tetrachloride	56-23-5	ND	ND
32	Perchloroethylene	127-18-4	ND	ND
33	1,1,2,2-Tetrachloroethane	79-34-5	ND	ND
34	Chlorobenzene	108-90-7	ND	ND
35	1,2-Dichlorobenzene	95-50-1	ND	ND
36	1,4-Dichlorobenzene	106-46-7	ND	ND
	Miscellaneous (LOD #37= 5µg & #38=25µg/compound/section)			
37	Acetonitrile	75-05-8	ND	ND
38	n-Vinyl-2-pyrrolidinone	88-12-0	ND	ND
	Total VOCs (LOD =50µg/compound/section)		457	ND

No	Compounds	CAS No	Front (µg/section)	Back (µg/section)
	Aromatic hydrocarbons (LOD = 1µg/compound/section)			
39	Benzene	71-43-2	ND	ND
40	Ethylbenzene	100-41-4	ND	ND
41	Isopropylbenzene	98-82-8	ND	ND
42	1,2,3-Trimethylbenzene	526-73-8	ND	ND
43	1,2,4-Trimethylbenzene	95-63-6	ND	ND
44	1,3,5-Trimethylbenzene	108-67-8	ND	ND
45	Styrene	100-42-5	ND	ND
46	Toluene	108-88-3	ND	ND
47	p-Xylene &/or m-Xylene	[illegible]	ND	ND
48	o-Xylene	95-47-6	ND	ND
	Ketones (LOD #49, #54 & #55 =5µg/s/s, #50, #51, #52 & #53 =25µg/s/s)			
49	Acetone	67-64-1	ND	ND
50	Acetoin	513-86-0	ND	ND
51	Diacetone alcohol	123-42-2	ND	ND
52	Cyclohexanone	108-94-1	ND	ND
53	Isophorone	78-59-1	ND	ND
54	Methyl ethyl ketone (MEK)	78-93-3	ND	ND
55	Methyl isobutyl ketone (MIBK)	108-10-1	ND	ND
	Alcohols (LOD = 25µg/compound/section)			
56	Ethyl alcohol	64-17-5	ND	ND
57	n-Butyl alcohol	71-36-3	ND	ND
58	Isobutyl alcohol	78-83-1	ND	ND
59	Isopropyl alcohol	67-63-0	ND	ND
60	2-Ethyl hexanol	104-76-7	ND	ND
61	Cyclohexanol	108-93-0	ND	ND
	Acetates (LOD = 25µg/compound/section)			
62	Ethyl acetate	141-78-6	ND	ND
63	n-Propyl acetate	109-60-4	ND	ND
64	n-Butyl acetate	123-86-4	ND	ND
65	Isobutyl acetate	110-19-0	ND	ND
	Ethers (LOD = 25µg/compound/section)			
66	Ethyl ether	60-29-7	ND	ND
67	tert-Butyl methyl ether (MTBE)	1634-04-4	ND	ND
68	Tetrahydrofuran (THF)	109-99-9	ND	ND
	Glycols (LOD = 25µg/compound/section)			
69	PGME	107-98-2	ND	ND
70	Ethylene glycol diethyl ether	629-14-1	ND	ND
71	PGMEA	108-65-6	ND	ND
72	Cellosolve acetate	111-15-9	ND	ND
73	DGMEA	112-15-2	ND	ND
	Worksheet check		YES	YES

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TestSafe Australia – WorkCover NSW *Chemical Analysis Branch*
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Analysis of Volatile Organic Compounds in Workplace Air by GC/MS

Client : Alok Pradhan

Stephenson Environmental Management Australia

ND – Not Detected
VOCs – Volatile Organic Compounds
Method : Analysis of Volatile Organic Compounds in Workplace Air by Gas Chromatography/Mass Spectrometry
Method Number : WCA 207
Detection Limit : 5µg/section; 25µg/section for oxygenated hydrocarbons except acetone, MEK and MIBK at 5µg/section and aromatic hydrocarbon at 1µg/section.
Brief Description : Volatile organic compounds are trapped from the workplace air onto charcoal tubes by the use of a personal air monitoring pump. The volatile organic compounds are then desorbed from the charcoal in the laboratory with CS_2. An aliquot of the desorbant is analysed by capillary gas chromatography with mass spectrometry detection.

The Total Volatile Organic Compounds (TVOC) test result in µg/section is calculated by combining the determined values of the 73 compounds with other VOCs that have been identified by mass spectrometry in the sample. These extra VOCs were individually estimated by the response of the nearest internal standard to that compound. Therefore, the TVOC test result should be interpreted as a semi-quantitative guide to the amount of VOCs present. If the TVOC test result is greater than the addition of all the compounds quantified then this can indicate that there are additional compounds present other than the 73 quantified compounds reported.

PGME : Propylene Glycol Monomethyl Ether
PGMEA : Propylene Glycol Monomethyl Ether Acetate
DGMEA : Diethylene Glycol Monoethyl Ether Acetate

Measurement Uncertainty
The measurement uncertainty is an estimate that characterises the range of values within which the true value is asserted to lie. The uncertainty estimate is an expanded uncertainty using a coverage factor of 2, which gives a level of confidence of approximately 95%. The estimate is compliant with the "ISO Guide to the Expression of Uncertainty in Measurement" and is a full estimate based on in-house method validation and quality control data.

Quality Assurance
In order to ensure the highest degree of accuracy and precision in our analytical results, we undertake extensive intra- and inter-laboratory quality assurance (QA) activities. Within our own laboratory, we analyse laboratory and field blanks and perform duplicate and repeat analysis of samples. Spiked QA samples are also included routinely in each run to ensure the accuracy of the analyses. WorkCover Laboratory Services has participated for many years in several national and international inter-laboratory comparison programs listed below:-

- Workplace Analysis Scheme for Proficiency (WASP) conducted by the Health & Safety Executive UK;
- Quality Management in Occupational and Environmental Medicine QA Program, conducted by the Institute for Occupational, Social and Environmental Medicine, University of Erlangen – Nuremberg, Germany;
- Quality Control Technologies QA Program, Australia;
- Royal College of Pathologists QA Program, Australia.

TestSafe Australia – WorkCover NSW ***Chemical Analysis Branch***
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APPENDIX D – PRODUCTION DATA

Screenshot

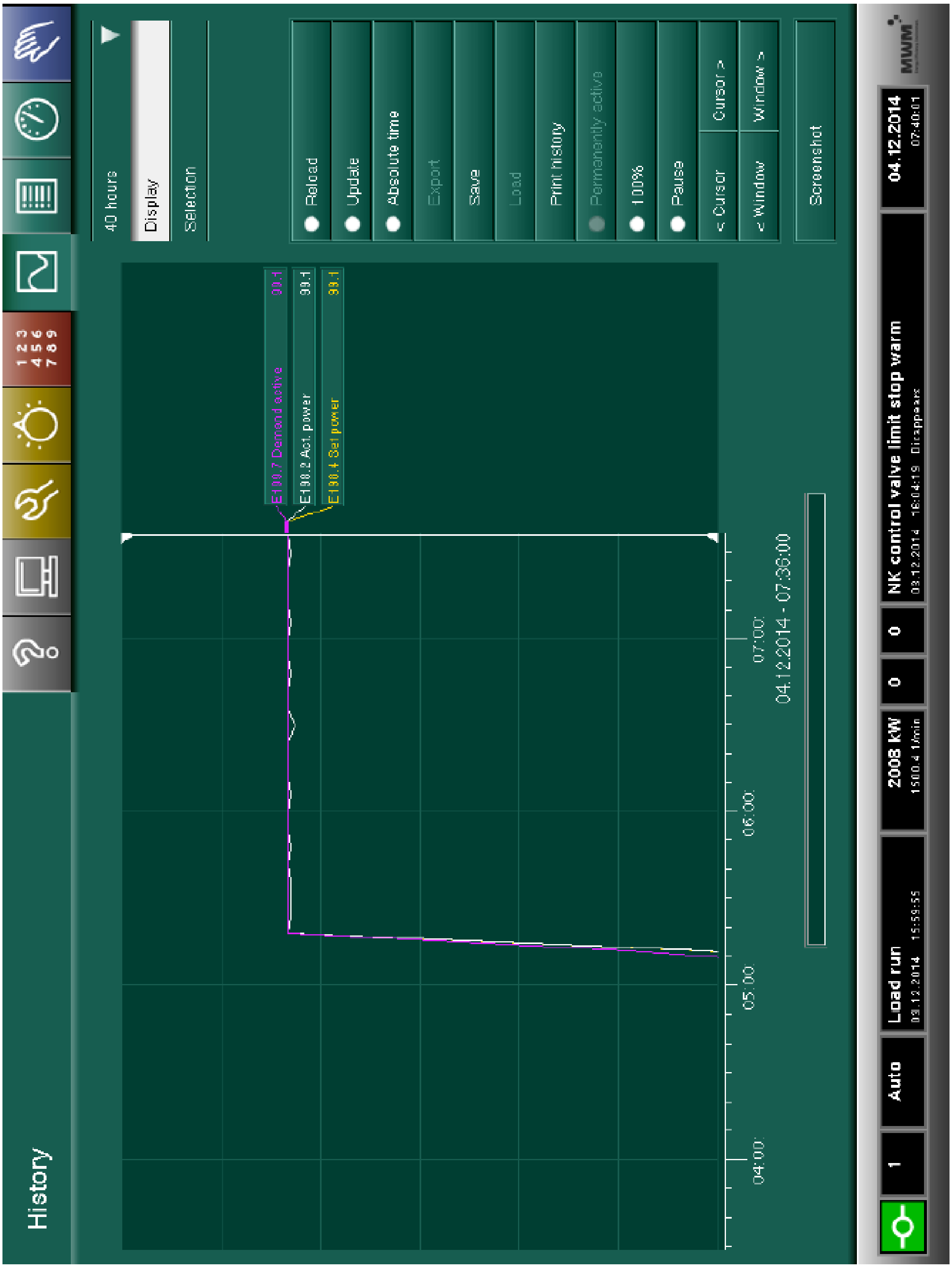
12/06/2010 - 2nd eng 09/2014
PLC-date = 04.12.2014 07:40:01

PLC release = 2.29.43
Comment: Toohey's

Number of faults = 0
Number of alarms = 0
Operation hours = 23354

Number: 9296876
Engine type: TCG2020V20

Actual load = 2008 kW
Actual speed = 1500.4 1/min
Starts = 1623



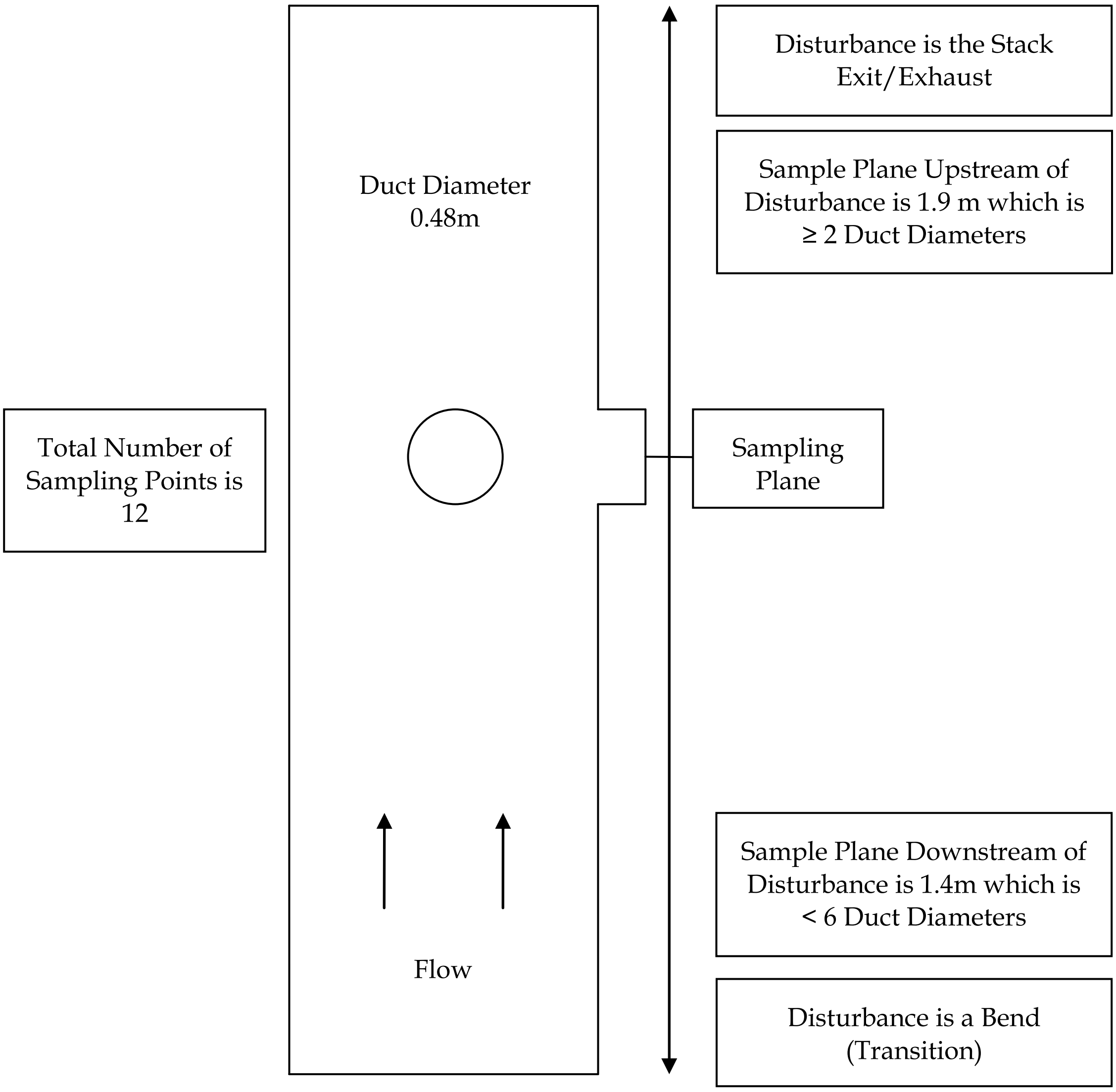
APPENDIX E – INSTRUMENT CALIBRATION DETAILS

TABLE E-1 INSTRUMENT CALIBRATION DETAILS

SEMA Asset No.	Equipment Description	Date Last Calibrated	Calibration Due Date
859	Digital Temperature Reader	20-Aug-2014	20-Feb-2015
863	Thermocouple	20-Aug-2014	20-Feb-2015
885	Digital Manometer	14-Mar-2014	14-Mar-2015
726	Pitot	19-Jun-2014	19-Jun-2015 Visually inspected On-Site before use
928	Balance	23-Apr-2014	Response Check with SEMA Site Mass
705	Field Mass For Calibration	20-Aug-2014	20-Aug-2015
932	Personal Sampler	16-Oct-2014	16-Oct-2015
846	Stopwatch	28-Mar-2014	28-Mar-2015
811	Flue Gas Analyser	11-Sep-2014	11-Mar-2015
Gas Mixtures used for Analyser Span Response			
Conc.	**Mixture**	**Cylinder No.**	**Expiry Date**
1080ppm 10.0% 10.2%	Carbon Monoxide Carbon Dioxide Oxygen In Nitrogen	454288	13-Jul-2016
441ppm 443ppm	Nitric Oxide Total Oxide Of Nitrogen In Nitrogen	437883	4-Apr-2017
243 ppm 247 ppm	Nitric Oxide Total Oxide Of Nitrogen In Nitrogen	ALTN1892	20-Aug-2019

APPENDIX F – STACK SAMPLING LOCATION

FIGURE F-1 CO-GENERATION ENGINE STACK – EPA ID NO. 7



In the absence of cyclonic flow activity ideal sampling plane conditions will be found to exist at 6-8 duct diameters downstream and 2-3 duct diameters upstream from a flow disturbance. The sampling plane does not meet this criterion. Additional sample points were used in compliance with AS4323.1 as the sampling plane was non-ideal.

However the sample plane does meet the minimum sampling plane position; sampling plane conditions will be found to exit at 2 duct diameters downstream and 0.5 duct diameters upstream from a flow disturbance.

The location of the sampling plane complies with AS4323.1 temperature, velocity and gas flow profile criteria for sampling.

APPENDIX G – OEH – CO-GENERATION AND TRI-GENERATION DOCUMENT

1. Cogeneration and tri-generation

Cogeneration is the simultaneous generation in one process of thermal energy and electrical and/or mechanical energy[1]. Cogeneration is also referred to as combined heat and power (CHP) and makes productive use of the heat that is normally rejected as waste in conventional generators.

Trigeneration is the simultaneous production of electrical and/or mechanical energy, heat and cooling from a single heat source. It can also be referred to as combined heat, cooling and power (CHCP).

[1] Source: *DIRECTIVE 2004/8/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 11 February 2004 on the promotion of cogeneration based on a useful heat demand in the internal energy market and amending Directive 92/42/EEC*

2. Interim NO_x policy for cogeneration

OEH released the Interim NO_X Policy for Cogeneration in Sydney and the Illawarra which sets out a framework for how we are currently dealing with emissions from cogeneration and tri-generation proposals.

One of the concepts introduced in the interim policy is best available techniques (BAT) emission performance. The interim policy does not define what emission performance is consistent with BAT for cogeneration and tri-generation.

3. What do we define as BAT?

BAT covers all aspects of a proposal including fuel source, technology selection and controls. The concept of BAT is a key principle in the European Union Directive on Integrated Pollution Prevention and Control.

Best available techniques shall mean the most effective and advanced stage in the development of activities and their methods of operation which indicate the practical suitability of particular techniques for providing in principle the basis for emission limit values designed to prevent and, where that is not practicable, generally to reduce emissions and the impact on the environment as a whole:

Best shall mean most effective in achieving a high general level of protection of the environment as a whole.

Available techniques shall mean those developed on a scale which allows implementation in the relevant industrial sector, under economically and technically viable conditions, taking into consideration the costs and advantages, whether or not the techniques are used or produced inside the Member State in question, as long as they are reasonably accessible to the operator.

Techniques shall include both the technology used and the way in which the installation is designed, built, maintained, operated and decommissioned.

Source: *DIRECTIVE 2008/1/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 15 January 2008 concerning integrated pollution prevention and control*

4. What do we define as BAT for natural gas fired reciprocating internal combustion engines?

The NO_x emission standard considered by OEH to be BAT for natural gas fired reciprocating internal combustion engines with a capacity to burn less than 7 mega joules of fuel per second are outlined in Table 1. A financial analysis of NO_x controls on gas fired reciprocating engines was used to develop the BAT emission standards[2].

[2] Source: *SKM 2009, Department of Environment and Climate Change (NSW) Financial Analysis of NOX Controls on Gas Fired Reciprocating Engines, Sinclair Knight Merz, June 2009*

5. Table 1: NO_x BAT emission standard for natural gas fired reciprocating internal combustion engines with a capacity to burn less than 7 mega joules of fuel per second

Activity or plant	Air impurity	Region	Emission standard
			mg/m³ *
Any natural gas fired stationary reciprocating internal combustion engine	Nitrogen dioxide (NO_2) or nitric oxide (NO) or both, as NO_2 equivalent	Sydney and Wollongong Metropolitan Area# and Wollondilly Local Government Area	250

* Reference conditions: *Dry, 273 K, 101.3kPa, 5% O_2*
# Defined in the *Protection of the Environment Operations (Clean Air) Regulation 2010*

6. Discussion of BAT emission standards

A NO_x emission standard of 250 mg/m^3 applies to all natural gas fired reciprocating internal combustion engines with a capacity to burn less than 7 mega joules of fuel per second in the Sydney and Wollongong Metropolitan Area and Wollondilly Local Government Area. Controlling NO_X emissions to 250 mg/m^3 has been found to have a minor impact on project financial performance and is unlikely to impact on project viability. The marginal reduction in financial performance is due to the slightly higher fuel consumption[2].

Outside of the Sydney and Wollongong Metropolitan Area and Wollondilly Local Government Area the NO_x emission standard is 450 mg/m^3, as defined in the *Protection of the Environment Operations (Clean Air) Regulation 2010*. A more stringent NO_x emission standard is only needed in the Sydney and Wollongong Metropolitan Area and Wollondilly Local Government Area as air quality in these regions currently exceeds the National Environment Protection Measure for Ambient Air Quality (Air NEPM) goal for ozone.

A NO_x emission standard for natural gas fired reciprocating internal combustion engines with a capacity to burn greater than or equal to 7 mega joules of fuel per second has not been proposed. This will be determined on a case by case basis.

In cogeneration and tri-generation applications, the financial viability of post combustion controls to reduce NO_x emissions to less than 250 mg/m^3 has been shown to improve as the capacity of the engine increases[2]. In cogeneration applications, post combustion controls are likely to be financially viable at approximately 1,000 kW of electrical output (or a capacity to burn approximately 3 mega joules of fuel per second) whereas in tri-generation applications the financially viable minimum size for post combustion controls is likely to be in excess of 10,000 kW of electrical output (or a capacity to burn greater than approximately 30 mega joules of fuel per second).

OEH should be contacted for the specific requirements for natural gas fired reciprocating internal combustion engines with a capacity to burn greater than or equal to 7 mega joules of fuel per second.

[2] Source: *SKM 2009, Department of Environment and Climate Change (NSW) Financial Analysis of NOX Controls on Gas Fired Reciprocating Engines, Sinclair Knight Merz, June 2009*

7. Why has BAT only been defined for natural gas fired reciprocating internal combustion engines?

OEH has firstly defined BAT for natural gas fired reciprocating internal combustion engines due to the significant interest in its installation in cogeneration and tri-generation applications. BAT will be developed for other technologies and industries on a case by case basis.

8. Do local air quality impacts still need to be considered?

Yes, local air quality impacts still need to be considered even if emissions performance is consistent with BAT.

Emission standards do not take into account site-specific features such as meteorology, background air quality, and other influences such as terrain and building downwash and therefore do not necessarily protect against adverse air quality impacts in the surrounding area. Depending on the sensitivity of the local receiving environment, an item of plant may need to meet emission standards tighter than BAT.

The impact of emissions from activities and plant is determined through an air quality impact assessment which is to be conducted in accordance with the Approved Methods for the Modelling and Assessment of Air Pollutants in NSW.

9. What's happening with the interim NO_x policy for cogeneration?

OEH is continuing to progress the broad framework introduced in the interim policy. Keep a look out for updates to the OEH website on progress with the interim policy and opportunities to provide comments.