emissiontestingconsultants
Environmental Partners

VIC
Unit 2, 160 New Street,
Ringwood, VIC 3134

QLD
Unit 7, 10 Fortune Street,
Geebung QLD 4034

NSW
Unit 1, 19 Ralph Black Drive
Wollongong, NSW 2500

WA
Unit 3, 4 Monash Gate,
Jandakot, WA 6164

Freecall 1300 782 007
www.emission.com.au
ABN 74 474 273 172

Date: 6 March 2014

Report No: 140047r

Terminals Pty Ltd
Gate 38B
45 Friendship Rd Port Botany NSW

Emission Testing – February 2014
EPA 7 – Bitumen Combustor

Dear Mr W Cook,

Tests were performed 7 February 2014 to determine emissions to air from the Bitumen Combustor at the Port Botany plant of Terminals Pty Ltd.

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Yours faithfully
Emission Testing Consultants

Aaron Davis BSc, LLB (Hons)
State Manager

ad@emission.com.au

LICENCE COMPARISON

EPA No.	Location Description	Pollutant	Unit of measure	Licence limit	Detected Values	Detected Values (corrected to 3% O_2)
7	Bitumen Combustor	Nitrogen oxides (as NO_2)	milligrams per cubic meter (mg/m^3)	350	73	170
		Volatile organic compounds (VOCs)	milligrams per cubic meter (mg/m^3)	40	<0.8	<2

Note: All analytes are below the Licence Limit set by the NSW EPA as per licence 1048 (last amended on 13-Sep-2013). Results have also been corrected to 3% Oxygen as stipulated in Schedule 5 of the *Protection of the Environment Operations (Clean Air) Regulation, (NSW)* 2010.

EXECUTIVE SUMMARY

Emission Testing Consultants (ETC) was engaged by Terminals Pty Ltd to perform emission monitoring as required by NSW EPA Environment Protection Licence 1048. Monitoring was performed on EPA Point 7 – Bitumen Combustor during ship discharge for the following parameters:

- Flow rate
- Velocity
- Temperature
- Moisture
- Dry gas Density
- Molecular weight
- Carbon dioxide (CO_2)
- Oxygen (O_2)
- Nitrogen oxides (NO_x) as NO_2
- Hydrogen sulphide (H_2S)
- Volatile organic compounds (VOC)

The methodologies chosen by ETC are those stipulated by Terminals Pty Ltd Licence (1048). There were no technical issues in terms of sampling on the days of testing. Plant operating conditions have been noted in the report.

RESULTS

EPA 7 – Bitumen Combustor

7 February 2014

Flow Results	Measured MW	Bitumen Combustor 140047	
Date and time of flow test		7/2/14 1345	
Date and time of flow test		7/2/14 1455	
Stack dimensions at sampling plane		980	mm
Velocity at sampling plane		6.2	m/s
Average temperature		819	°C
Moisture content	Alt008	12	% v/v
Flow rate at discharge conditions		4.7	m³/sec
Flow rate at wet NTP conditions		1.2	m³/sec
Flow rate at dry NTP conditions		1.0	m³/sec

Continuous Analyser Results	Bitumen Combustor 140047 62	Sampling Times	Concentration at NTP		Concentration at 3% O2		Mass rate	
Oxygen (dry basis)		1350-1450	13.0	% v/v	-		-	
Carbon dioxide (dry basis)		1350-1450	4.1	% v/v	-		300	kg/hour
Dry gas density		1350-1450	1.3	kg/m3	-		-	
Molecular weight of stack gas, dry basis		1350-1450	29	g/g-mole	-		-	
Nitrogen oxides as NO_2		1350-1450	73	mg/m3	170	mg/m3	4.5	g/min

Volatile Organic Compound (VOC) Results	Bitumen Combustor 140047 62	Sampling Times	Concentration at NTP		Concentration at 3% O2		Mass rate	
Total VOC as n-propane		1350-1450	< 0.8	mg/m3	< 2	mg/m3	< 0.05	g/min

Note: If not listed above, the following compounds were not detected above the analytical range of the instrument. Please contact ETC should you wish to discuss detection limits of specific undetected compounds; Acetone (2-propanone), Propylene Oxide, Acrylonitrile, Methylene Chloride, MEK (2-butanone), Hexane, Ethyl Acetate, 1,2-dichloroethane, Benzene, Carbon tetrachloride, Cyclohexane, Ethyl Acrylate, Trichloroethene (Trichloroethylene,TCE), 1,4-Dioxane, Epichlorohydrin, MIBK (4-methyl-2-pentanone), Toluene, Tetrachloroethene (Perchloroethylene,PCE), n-Butyl Acetate, Chlorobenzene, Ethylbenzene, m/p-xylene, Styrene (Vinyl benzene), o-xylene, Cyclohexanone, Nonane, Isopropylbenzene (Cumene), DIBK (Diisobutyl Ketone), α-Methylstyrene, Decane, Benzyl Chloride (α-chlorotolune), Benzoyl Chloride, Naphthalene, Dodecane

Manual Sampling Results	Bitumen Combustor 140047 62	Sampling Times	Concentration at NTP		Concentration at 3% O2		Mass rate	
Hydrogen sulphide		1350-1450	< 2	mg/m3	< 5	mg/m3	< 0.1	g/min

Refer to "SAMPLING PLANE OBSERVATIONS" on page 4.

SAMPLING PLANE OBSERVATIONS

EPA 7 – Bitumen Combustor

The sampling plane had 2 x 4 inch flange ports. The location was determined to be "ideal" as per AS4323.1. It was more than the required 2 duct diameters upstream from the exit. It was more than the required 6 duct diameters downstream from a junction. The sampling plane passed the flow assessment (items (a) to (f) of AS4323.1) and was therefore "compliant".

PLANT OPERATING CONDITIONS

Plant operating conditions were supplied by Terminals Pty Ltd personnel.

Plant operating conditions were representative of typical operation for the duration of sampling. Testing was performed during a bitumen ship loading operation to provide peak load rate between 1345PM to 1445PM on 7 February 2014.

TEST METHODS

The following methods are accredited with the National Association of Testing Authorities (NATA) and are approved for the sampling and analysis of gases unless otherwise stated. Specific details of the methods are available on request.

All sampling and analysis will be conducted in accordance with the test methods (TM) prescribed in NSW EPA's *Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales,* Jan 2007 and in accordance with the *Protection of the Environment Operations (Clean Air) Regulation* 2010 unless otherwise specified.

All parameters are reported adjusted to dry NTP conditions unless otherwise stated.

Parameter	Sampling			Analysis			
	NATA	NSW TM Method	Sampling Method	NATA	Analytical Laboratory	Analytical Method	Analytical Laboratory Report Number(s)
Selection of sampling positions	Yes	TM-1	AS4323.1	Yes	NA	NA	140047r
Flow rate	Yes	TM-2	USEPA 2	Yes	NA	NA	140047r
Velocity	Yes	TM-2	USEPA 2	Yes	NA	NA	140047r
Temperature	Yes	TM-2	USEPA 2	Yes	NA	NA	140047r
Moisture	Yes	TM-22	USEPA 4	Yes	NA	NA	140047r
Dry gas Density	Yes	TM-23	USEPA 3A	Yes	Emission Testing Consultants	USEPA 3A	140047r
Molecular weight	Yes	TM-23	USEPA 3A	Yes	Emission Testing Consultants	USEPA 3A	140047r
Carbon dioxide (CO_2)	Yes	TM-24	USEPA 3A	Yes	Emission Testing Consultants	USEPA 3A	140047r
Oxygen (O_2)	Yes	TM-25	USEPA 3A	Yes	Emission Testing Consultants	USEPA 3A	140047r
Nitrogen oxides (NO_x) as NO_2	Yes	TM-11	USEPA 7E	Yes	Emission Testing Consultants	USEPA 7E	140047r
Hydrogen sulphide (H_2S)	Yes	TM-5	USEPA 11	Yes	SGS Australia Pty Ltd	AN513	SE124696 R0
Volatile organic compounds (VOC)	Yes	TM-34	USEPA 18	Yes	SGS Australia Pty Ltd	AN467	SE124696 R0

DEFINITIONS

The following symbols and abbreviations are used in test reports:

BSP	British standard pipe.
Concentration	Mass of analyte per cubic metre expressed at NTP dry conditions (ng, µg or mg/m^3).
Dioxins & furans	2,3,7,8-substituted polychlorinated dibenzo-*p*-dioxins (PCDD) and polychlorinated dibenzofurans) PCDF
Dioxin & furan TEQ values	Toxic equivalent. The TEQ values have been calculated using the toxicity equivalence factors (TEF) according to the World Health Organisation (2005)
Flow rate at discharge conditions	Volume of gas flow per unit time expressed at discharge temperature, pressure and moisture content (m^3/min).
Flow rate at wet NTP conditions	Volume of gas flow per unit time expressed at 0°C, an absolute pressure of 101.325 kPa and discharge moisture content (m^3/min).
Flow rate at dry NTP conditions	Volume of gas flow per unit time expressed at 0°C, an absolute pressure of 101.325 kPa and 0% moisture content (m^3/min).
Lowerbound	(Lower) results do not include any limit of detection values (< values).
Mass rate	Mass of analyte per unit time (µg, mg or g/min).
Mediumbound	(Medium) results include half limit of detection values (< values).
Moisture content	Percentage of gaseous moisture in the gas expressed on a volume / volume percentage basis. This does not include moisture in the gas stream that is in the liquid phase (free moisture).
NA	Not applicable.
NTP	Normal temperature and pressure. Gas volumes and concentrations are expressed on a dry **(wet in the case of odour only)** basis at 0°C, at discharge oxygen concentration and an absolute pressure of 101.325 kPa, unless otherwise specified.
Odour concentration	Number of odour units (ou).
Odour flux rate	Odour emission rate per unit surface area per unit time (ou/m^2/min).
Odour mass	Odour emission rate per unit time (ou/min).

rate	
Odour unit	One odour unit (ou) is that concentration of odorant(s) at standard concentrations that elicits a physiological response from a panel (detection threshold) equivalent to that elicited by one Reference Odour Mass (ROM), evaporated in one cubic metre of neutral gas at standard conditions.
PAH's	Polycyclic aromatic hydrocarbons.
PAH's TEQ values	The TEQ values have been calculated using the toxicity equivalence factors (TEF's) relative to Benzo(a)pyrene, as reported by Larsen & Larsen (1998) (TEF factors reported in the 2003 World Health Organisation (WHO) report E78963 - HEALTH RISKS OF PERSISTENT ORGANIC POLLUTANTS FROM LONG-RANGE TRANSBOUNDARY AIR POLLUTION).
ppm	Parts per million expressed on a volume / volume wet basis.
Sampling plane	Location at which measurements were conducted.
TOC	Total Organic Compounds. Total gaseous organic concentration of vapours consisting primarily of alkanes, alkenes, and/or arenes (aromatic hydrocarbons) The concentration can be expressed in terms of propane, hexane (or other appropriate organic calibration gas) or in terms of methane.
Velocity	Gas velocity expressed at discharge temperature, pressure and moisture content (m/s)
VOC	Any chemical compound based on carbon in the boiling range 36 to 126°C, with a vapour pressure of at least 0.010kPa at 25°C (or having a corresponding volatility under the particular conditions of use) that adsorb onto activated charcoal and desorb into CS_2, or that can be collected in a tedlar bag and be quantitatively recovered, and that are detected by GCMS. These compounds may contain oxygen, nitrogen and other elements, but specifically excluded are CO, CO_2, carbonic acid, metallic carbides and carbonate salts.
>	Greater than.
<	Less than the minimum limit of detection using the specified method.
~	Approximately.

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