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**Report Number R001906-1**

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**Emission Testing Report**  
**AGL Newcastle Gas Storage Facility, Tomago**

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## Document Information

Client Name: AGL Newcastle Gas Storage Facility  
 Report Number: R001906-1  
 Date of Issue: 12 February 2016  
 Attention: Brett Hayward  
 Address: 5 Old Punt Road  
 Tomago NSW 2322  
 Testing Laboratory: Ektimo (EML) ABN 98 006 878 342

## Report Status

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Amend Report	-	-	-	-	-

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## Amendment Record

Document Number	Initiator	Report Date	Section	Reason
Nil	-	-	-	-

## Report Authorisation



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Accredited for compliance with ISO/IEC 17025. NATA is a signatory to the ILAC mutual recognition arrangement for the mutual recognition of the equivalence of testing, calibration and inspection reports

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## 1 EXECUTIVE SUMMARY

Ektimo was engaged by AGL Newcastle Gas Storage Facility to perform emission to air sampling for EPA licence compliance purposes.

Results from the testing program indicate that AGL Newcastle Gas Storage Facility was within the requirements of the Licence during the sampling period.

Monitoring was performed as follows;

Location	Test Date	Test Parameters*
EPA ID 7-Gas Liquefaction System Stack (H-101)	7 January 2016	Metals & metal compounds(arsenic, lead, mercury) polycyclic aromatic hydrocarbons (expressed as benzo(a)pyrene equivalent), fine particulates (particulate matter <10 µm), solid particles, hydrogen sulfide, speciated volatile organic compounds, sulfuric acid mist and sulfur trioxide, sulfur dioxide, nitrogen oxides, carbon monoxide, carbon dioxide, oxygen
EPA ID 8-LNG Vaporiser Regasifier (F-501 A)	11 November 2015	Metals & metal compounds(arsenic, lead, mercury) polycyclic aromatic hydrocarbons (expressed as benzo(a)pyrene equivalent), fine particulates (particulate matter <10 µm), solid particles, hydrogen sulfide, speciated volatile organic compounds, sulfuric acid mist and sulfur trioxide, sulfur dioxide, nitrogen oxides, carbon monoxide, carbon dioxide, oxygen
EPA ID 8-LNG Vaporiser Regasifier (F-501 B)	11 November 2015	Metals & metal compounds(arsenic, lead, mercury) polycyclic aromatic hydrocarbons (expressed as benzo(a)pyrene equivalent), fine particulates (particulate matter <10 µm), solid particles, hydrogen sulfide, speciated volatile organic compounds, sulfuric acid mist and sulfur trioxide, sulfur dioxide, nitrogen oxides, carbon monoxide, carbon dioxide, oxygen
EPA ID 8-LNG Vaporiser Regasifier (F-501 C)	12 November 2015	Metals & metal compounds(arsenic, lead, mercury) polycyclic aromatic hydrocarbons (expressed as benzo(a)pyrene equivalent), fine particulates (particulate matter <10 µm), solid particles, hydrogen sulfide, speciated volatile organic compounds, sulfuric acid mist and sulfur trioxide, sulfur dioxide, nitrogen oxides, carbon monoxide, carbon dioxide, oxygen

\* Flow rate, velocity, temperature and moisture were determined unless otherwise stated

The methodologies chosen by Ektimo are those recommended by the NSW Office of Environment and Heritage (as specified in the Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales, January 2007).

All results are reported on a dry basis at STP. Unless otherwise indicated, the methods cited in this report have been performed without deviation.

Plant operating conditions have been noted in the report.

## 2 RESULTS SUMMARY

The following licence comparison table shows that all analytes highlighted in green are below the licence limit set by the NSW EPA as per licence 20130 (last amended on 08/07/2015).

EPA No.	Location Description	Pollutant	Units	100 percentile Concentration Licence Limit	Detected values	Detected values (corrected to 3% O <sub>2</sub> )
EPA No. 7	LNG Vaporiser Regasifier (F-501A)	Nitrogen oxides	mg/m <sup>3</sup>	250	64	-
		Volatile organic compounds as n-propane equivalent	mg/m <sup>3</sup>	5	<0.034	<0.039
		Solid particles	mg/m <sup>3</sup>	5	<0.96	-
		Sulfur oxides (reported as sulfuric acid mist and sulfur trioxide as SO <sub>3</sub> )	mg/m <sup>3</sup>	60	2.6	-
		Carbon monoxide	mg/m <sup>3</sup>	100	<2.5	<2.8
EPA No. 8	LNG Vaporiser Regasifier (F-501A)	Nitrogen oxides	mg/m <sup>3</sup>	190	110	-
		Volatile organic compounds as n-propane equivalent	mg/m <sup>3</sup>	20	<0.086	<0.097
		Solid particles	mg/m <sup>3</sup>	40	<0.59	-
		Sulfur oxides (reported as sulfuric acid mist and sulfur trioxide as SO <sub>3</sub> )	mg/m <sup>3</sup>	5	0.15	-
		Carbon monoxide	mg/m <sup>3</sup>	125	18	20
	LNG Vaporiser Regasifier (F-501B)	Nitrogen oxides	mg/m <sup>3</sup>	190	100	-
		Volatile organic compounds as n-propane equivalent	mg/m <sup>3</sup>	20	<0.083	<0.085
		Solid particles	mg/m <sup>3</sup>	40	<0.94	-
		Sulfur oxides (reported as Sulfuric acid mist and sulfur trioxide as SO <sub>3</sub> )	mg/m <sup>3</sup>	5	0.43	-
		Carbon monoxide	mg/m <sup>3</sup>	125	10	11
	LNG Vaporiser Regasifier (F-501C)	Nitrogen oxides	mg/m <sup>3</sup>	190	130	-
		Volatile organic compounds as n-propane equivalent	mg/m <sup>3</sup>	20	<0.086	<0.098
		Solid particles	mg/m <sup>3</sup>	40	<0.57	-
		Sulfur oxides (reported as sulfuric acid mist and sulfur trioxide as SO <sub>3</sub> )	mg/m <sup>3</sup>	5	0.17	-
		Carbon monoxide	mg/m <sup>3</sup>	125	<2.5	<2.8

### 3 RESULTS

#### 3.1 EPA ID 7-Gas Liquefaction System Stack (H-101)

<b>Date</b>	7/01/2016	<b>Client</b>	AGL Newcastle Gas Storage Facility	
<b>Report</b>	R001906	<b>Stack ID</b>	EPA ID 7 - Gas Liquefaction System Stack (H-101)	
<b>Licence No.</b>	20130	<b>Location</b>	Tomago	<b>State</b> NSW
<b>Ektimo Staff</b>	Swe/Zpa			
<b>Process Conditions</b>	Please refer to client records.			
<b>Reason for testing:</b>	Client requested testing to determine emissions to air			

<b>Sampling Plane Details</b>	
Sampling plane dimensions	610 mm
Sampling plane area	0.292 m <sup>2</sup>
Sampling port size, number & depth	4" Flange (x2)
Access & height of ports	Step ladder 3 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit cone 1.3 D
Upstream disturbance	Junction 2.2 D
No. traverses & points sampled	2 12
Compliance to AS4323.1	Compliant but non-ideal

<b>Comments</b>
The sampling plane is too near to the downstream disturbance but is greater than or equal to 1D
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D
The discharge is assumed to be composed of dry air and moisture

<b>Stack Parameters</b>	
Moisture content, %v/v	13
Gas molecular weight, g/g mole	28.3 (wet) 29.8 (dry)
Gas density at STP, kg/m <sup>3</sup>	1.26 (wet) 1.33 (dry)
<b>Gas Flow Parameters</b>	
Temperature, °C	195
Velocity at sampling plane, m/s	3.9
Volumetric flow rate, discharge, m <sup>3</sup> /s	1.1
Volumetric flow rate (wet STP), m <sup>3</sup> /s	0.66
Volumetric flow rate (dry STP), m <sup>3</sup> /s	0.57
Mass flow rate (wet basis), kg/hour	3000
Sampling time, min	60
Isokinetic rate, %	100
Velocity difference, %	<1

<b>Hydrogen Sulfide</b>	Sampling time	<b>Results</b>	
		1310-1410	
		Concentration mg/m <sup>3</sup>	Mass Rate g/min
Hydrogen sulfide		<0.0049	<0.00017

<b>Date</b>	7/01/2016	<b>Client</b>	AGL Newcastle Gas Storage Facility	
<b>Report</b>	R001906	<b>Stack ID</b>	EPA ID 7 - Gas Liquefaction System Stack (H-101)	
<b>Licence No.</b>	20130	<b>Location</b>	Tomago	<b>State</b> NSW
<b>Ektimo Staff</b>	Swe/Zpa			
<b>Process Conditions</b>	Please refer to client records.			
<b>Reason for testing:</b>	Client requested testing to determine emissions to air			

PAH's	Sampling time	Results	
		1400-1500	
		Concentration ng/m <sup>3</sup>	Mass Rate ng/min
Naphthalene		4200	140000
2-Methylnaphthalene		11000	370000
Acenaphthylene		64	2200
Acenaphthene		21	740
Fluorene		88	3000
Phenanthrene		230	8000
Anthracene		20	680
Fluoranthene		140	4900
Pyrene		63	2200
Benz(a)anthracene		<18	<610
Chrysene		29	1000
Benzo(b)fluoranthene		<18	<610
Benzo(k)fluoranthene		<18	<610
Benzo(e)pyrene		<18	<610
Benzo(a)pyrene		<18	<610
Perylene		25	860
Indeno(1,2,3-cd)pyrene		<18	<610
Dibenz(ah)anthracene		37	1300
Benzo(ghi)perylene		<18	<610
Total 16 PAH's		11000	390000
Total 19 PAH's		16000	540000
<b>BaP-TEQ</b>			
Lower Bound		15	530
Middle Bound		28	960
Upper Bound		40	1400

Date	7/01/2016	Client	AGL Newcastle Gas Storage Facility		
Report	R001906	Stack ID	EPA ID 7 - Gas Liquefaction System Stack (H-101)		
Licence No.	20130	Location	Tomago	State	NSW
Ektimo Staff	SWe/ZPa				
Process Conditions	Please refer to client records.				
Reason for testing:	Client requested testing to determine emissions to air				

<b>Sampling Plane Details</b>	
Sampling plane dimensions	610 mm
Sampling plane area	0.292 m <sup>2</sup>
Sampling port size, number & depth	4" Flange (x2)
Access & height of ports	Step ladder 3 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit cone 1.3 D
Upstream disturbance	Junction 2.2 D
No. traverses & points sampled	2 12
Compliance to AS4323.1	Compliant but non-ideal

**Comments**  
 The sampling plane is too near to the downstream disturbance but is greater than or equal to 1D  
 The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

<b>Stack Parameters</b>	
Moisture content, %v/v	13
Gas molecular weight, g/g mole	28.1 (wet) 29.7 (dry)
Gas density at STP, kg/m <sup>3</sup>	1.26 (wet) 1.33 (dry)
<b>Gas Flow Parameters</b>	
Temperature, °C	194
Velocity at sampling plane, m/s	3.9
Volumetric flow rate, discharge, m <sup>3</sup> /s	1.1
Volumetric flow rate (wet STP), m <sup>3</sup> /s	0.66
Volumetric flow rate (dry STP), m <sup>3</sup> /s	0.57
Mass flow rate (wet basis), kg/hour	3000
Sampling time, min	60
Isokinetic rate, %	100
Velocity difference, %	<1

<b>Isokinetic</b>	Sampling time	<b>Results</b>		
		1545-1645		
		Concentration	Corrected to 3% O <sub>2</sub>	Mass Rate
		mg/m <sup>3</sup>	mg/m <sup>3</sup>	g/min
Arsenic		<0.0018	<0.0021	<0.000063
Lead		0.00065	0.00074	0.000022
Mercury		<0.00046	<0.00053	<0.000016

<b>Gases</b>	Sampling time	<b>Average</b>			<b>Minimum</b>			<b>Maximum</b>		
		1545-1644			1545-1644			1545-1644		
		Corrected to 3% O <sub>2</sub>			Corrected to 3% O <sub>2</sub>			Corrected to 3% O <sub>2</sub>		
		Concentration	O <sub>2</sub>	Mass Rate	Concentration	O <sub>2</sub>	Mass Rate	Concentration	O <sub>2</sub>	Mass Rate
		mg/m <sup>3</sup>	mg/m <sup>3</sup>	g/min	mg/m <sup>3</sup>	mg/m <sup>3</sup>	g/min	mg/m <sup>3</sup>	mg/m <sup>3</sup>	g/min
Nitrogen oxides (as NO <sub>2</sub> )		64	73	2.2	49	56	1.7	70	80	2.4
Carbon monoxide		<2.5	<2.8	<0.084	<2.5	<2.8	<0.084	<2.5	<2.8	<0.084
		Concentration			Concentration			Concentration		
		%			%			%		
Carbon dioxide		8.7			8.4			8.8		
Oxygen		5.2			5.2			5.6		



Date	7/01/2016	Client	AGL Newcastle Gas Storage Facility		
Report	R001906	Stack ID	EPA ID 7 - Gas Liquefaction System Stack (H-101)		
Licence No.	20130	Location	Tomago	State	NSW
Ektimo Staff	SWe/ZPa				
Process Conditions	Please refer to client records.				
Reason for testing:	Client requested testing to determine emissions to air				

Total VOCs (as n-Propane)	Sampling time	Results 1434-1633 Corrected to 3%		
		Concentration mg/m <sup>3</sup>	O <sub>2</sub> mg/m <sup>3</sup>	Mass Rate g/min
Total		<0.034	<0.039	<0.0012

VOC's (speciated)	Sampling time	Results 1434-1633 Corrected to 3%		
		Concentration mg/m <sup>3</sup>	O <sub>2</sub> mg/m <sup>3</sup>	Mass Rate g/min
Detection limit <sup>(1)</sup>		<0.036	<0.041	<0.0012
Benzene		<0.036	<0.041	<0.0012

**(1) Unless otherwise reported, the following target compounds were found to be below detection:**

Ethanol, Isopropanol, Isobutanol, Butanol, 1-Methoxy-2-propanol, Cyclohexanol, 2-Butoxyethanol, Pentane, Hexane, Heptane, Octane, Nonane, Decane, Undecane, Dodecane, Tridecane, Tetradecane, Cyclohexane, 2-Methylhexane, 2,3-Dimethylpentane, 3-Methylhexane, Isooctane, Methylcyclohexane, alpha-Pinene, beta-Pinene, d-Limonene, 3-Carene, Acetone, Methyl ethyl ketone, Ethyl acetate, Isopropyl acetate, Propyl acetate, MIBK, 2-Hexanone, Butyl acetate, 1-Methoxy-2-propyl acetate, Cyclohexanone, Cellosolve acetate, 2-Butoxyethyl acetate, Ethyl diglycol acetate, Diacetone alcohol, Isophorone, Benzene, Toluene, Ethylbenzene, m-p-Xylene, Styrene, o-Xylene, Isopropylbenzene, Propylbenzene, 1,3,5-Trimethylbenzene, alpha-Methylstyrene, tert-Butylbenzene, 1,2,4-Trimethylbenzene, 1,2,3-Trimethylbenzene, m-Diethylbenzene, o-Diethylbenzene, p-Diethylbenzene, Dichloromethane, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Carbon tetrachloride, 1,1-Dichloroethene, cis-1,2-Dichloroethene, trans-1,2-Dichloroethene, Trichloroethene, Tetrachloroethene, 1,1,2-Trichloroethane, 1,1,2,2-Tetrachloroethane, Chlorobenzene, Fluorobenzene

<b>Date</b>	7/01/2016	<b>Client</b>	AGL Newcastle Gas Storage Facility	
<b>Report</b>	R001906	<b>Stack ID</b>	EPA ID 7 - Gas Liquefaction System Stack (H-101)	
<b>Licence No.</b>	20130	<b>Location</b>	Tomago	<b>State</b> NSW
<b>Ektimo Staff</b>	Swe/Zpa			
<b>Process Conditions</b>	Please refer to client records.			
<b>Reason for testing:</b>	Client requested testing to determine emissions to air			

**Sampling Plane Details**

Sampling plane dimensions	610 mm	
Sampling plane area	0.292 m <sup>2</sup>	
Sampling port size, number & depth	4" Flange (x2)	
Access & height of ports	Step ladder	3 m
Duct orientation & shape	Vertical	Circular
Downstream disturbance	Exit cone	1.3 D
Upstream disturbance	Junction	2.2 D
No. traverses & points sampled	2	12
Compliance to AS4323.1	Compliant but non-ideal	

**Comments**

The sampling plane is too near to the downstream disturbance but is greater than or equal to 1D  
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D  
The discharge is assumed to be composed of dry air and moisture

**Stack Parameters**

Moisture content, %v/v	12	
Gas molecular weight, g/g mole	28.3 (wet)	29.8 (dry)
Gas density at STP, kg/m <sup>3</sup>	1.26 (wet)	1.33 (dry)

**Gas Flow Parameters**

Temperature, °C	193	
Velocity at sampling plane, m/s	3.9	
Volumetric flow rate, discharge, m <sup>3</sup> /s	1.1	
Volumetric flow rate (wet STP), m <sup>3</sup> /s	0.66	
Volumetric flow rate (dry STP), m <sup>3</sup> /s	0.58	
Mass flow rate (wet basis), kg/hour	3000	
Sampling time, min	60	
Isokinetic rate, %	102	
Velocity difference, %	<1	

Isokinetic	Sampling time	Results	
		1700-1800	
		Concentration mg/m <sup>3</sup>	Mass Rate g/min
Solid particles		<0.96	<0.033
PM10*		<0.96	<0.033
Sulfur dioxide		0.4	0.014
Sulfuric acid mist and sulfur trioxide (as SO <sub>3</sub> )		2.6	0.091

\*PM10 assumed to be less than or equal to the solid particle result

### 3.2 EPA ID 8-LNG Vaporiser Regasifier (F-501 A)

Date	11/11/2015	Client	AGL Newcastle Gas Storage Facility		
Report	R001906	Stack ID	EPA ID 8- LNG Vaporiser Regasifier (F-501 A)		
Licence No.	20130	Location	Tomago	State	NSW
Ektimo Staff	DH/Swe				
Process Conditions	Please refer to client records.				
Reason for testing:	Client requested testing to determine emissions to air				

#### Sampling Plane Details

Sampling plane dimensions	875 mm			
Sampling plane area	0.601 m <sup>2</sup>			
Sampling port size, number & depth	4" Flange (x2)			
Access & height of ports	Elevated work platform	8 m		
Duct orientation & shape	Vertical	Circular		
Downstream disturbance	Exit	6 D		
Upstream disturbance	Junction	4 D		
No. traverses & points sampled	2	16		
Compliance to AS4323.1	Compliant but non-ideal			

#### Comments

The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

#### Stack Parameters

Moisture content, %v/v	13		
Gas molecular weight, g/g mole	28.2 (wet)	29.8 (dry)	
Gas density at STP, kg/m <sup>3</sup>	1.26 (wet)	1.33 (dry)	

#### Gas Flow Parameters

Temperature, °C	95		
Velocity at sampling plane, m/s	8		
Volumetric flow rate, discharge, m <sup>3</sup> /s	4.8		
Volumetric flow rate (wet STP), m <sup>3</sup> /s	3.6		
Volumetric flow rate (dry STP), m <sup>3</sup> /s	3.1		
Mass flow rate (wet basis), kg/hour	16000		
Sampling time, min	80		
Isokinetic rate, %	97		
Velocity difference, %	<1		

PAH's	Sampling time	Results		
		1440-1600		
		Corrected to 3% O <sub>2</sub>		
		Concentration ng/m <sup>3</sup>	ng/m <sup>3</sup>	Mass Rate ng/min
Naphthalene		2000	2200	370000
2-Methylnaphthalene		10000	11000	1900000
Acenaphthylene		130	150	24000
Acenaphthene		53	60	10000
Fluorene		380	420	71000
Phenanthrene		2000	2200	370000
Anthracene		31	35	5800
Fluoranthene		830	930	160000
Pyrene		450	500	83000
Benzo(a)anthracene		19	21	3600
Chrysene		71	80	13000
Benzo(b)fluoranthene		50	56	9500
Benzo(k)fluoranthene		18	21	3400
Benzo(e)pyrene		36	40	6700
Benzo(a)pyrene		<12	<13	<2200
Perylene		<12	<13	<2200
Indeno(1,2,3-cd)pyrene		<12	<13	<2200
Dibenz(ah)anthracene		18	20	3300
Benzo(ghi)perylene		<12	<13	<2200
Total 16 PAH's		14000	16000	2600000
Total 19 PAH's		16000	18000	3000000
BaP-TEQ				
Lower Bound		17	19	3100
Middle Bound		23	26	4300
Upper Bound		30	33	5600

Date	11/11/2015	Client	AGL Newcastle Gas Storage Facility		
Report	R001906	Stack ID	EPA ID 8- LNG Vaporiser Regasifier (F-501 A)		
Licence No.	20130	Location	Tomago	State	NSW
Ektime Staff	DH/Swe				
Process Conditions	Please refer to client records.				
Reason for testing:	Client requested testing to determine emissions to air				

Gases	Sampling time	Average 1535-1634 Corrected to 3%			Minimum 1535-1634 Corrected to 3%			Maximum 1535-1634 Corrected to 3%		
		Concentration mg/m <sup>3</sup>	O <sub>2</sub> mg/m <sup>3</sup>	Mass Rate g/min	Concentration mg/m <sup>3</sup>	O <sub>2</sub> mg/m <sup>3</sup>	Mass Rate g/min	Concentration mg/m <sup>3</sup>	O <sub>2</sub> mg/m <sup>3</sup>	Mass Rate g/min
Nitrogen oxides (as NO <sub>2</sub> )		110	120	20	72	80	13	150	170	28
Sulfur dioxide		12	14	2.3	11	13	2.1	14	16	2.7
Carbon monoxide		18	20	3.4	<2.5	<2.7	<0.46	30	34	5.6
		Concentration %			Concentration %			Concentration %		
Carbon dioxide		9.1			8.7			9.3		
Oxygen		4.9			4.6			5.5		

Total VOCs (as n-Propane)	Sampling time	Results 1535-1635 Corrected to 3%		
		Concentration mg/m <sup>3</sup>	O <sub>2</sub> mg/m <sup>3</sup>	Mass Rate g/min
Total		<0.086	<0.097	<0.016

VOC's (speciated)	Sampling time	Results 1535-1635 Corrected to 3%		
		Concentration mg/m <sup>3</sup>	O <sub>2</sub> mg/m <sup>3</sup>	Mass Rate g/min
Detection limit <sup>(1)</sup>		<0.09	<0.1	<0.017
Benzene		<0.09	<0.1	<0.017

(1) Unless otherwise reported, the following target compounds were found to be below detection:

Ethanol, Isopropanol, Isobutanol, Butanol, 1-Methoxy-2-propanol, Cyclohexanol, 2-Butoxyethanol, Pentane, Hexane, Heptane, Octane, Nonane, Decane, Undecane, Dodecane, Tridecane, Tetradecane, Cyclohexane, 2-Methylhexane, 2,3-Dimethylpentane, 3-Methylhexane, Isooctane, Methylcyclohexane, alpha-Pinene, beta-Pinene, d-Limonene, 3-Carene, Acetone, Methyl ethyl ketone, Ethyl acetate, Isopropyl acetate, Propyl acetate, MIBK, 2-Hexanone, Butyl acetate, 1-Methoxy-2-propyl acetate, Cyclohexanone, Cellosolve acetate, 2-Butoxyethyl acetate, Ethylidiglycol acetate, Diacetone alcohol, Isophorone, Benzene, Toluene, Ethylbenzene, m-p-Xylene, Styrene, o-Xylene, Isopropylbenzene, Propylbenzene, 1,3,5-Trimethylbenzene, alpha-Methylstyrene, tert-Butylbenzene, 1,2,4-Trimethylbenzene, 1,2,3-Trimethylbenzene, m-Diethylbenzene, o-Diethylbenzene, p-Diethylbenzene, Dichloromethane, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Carbon tetrachloride, 1,1-Dichloroethene, cis-1,2-Dichloroethene, trans-1,2-Dichloroethene, Trichloroethene, Tetrachloroethene, 1,1,2-Trichloroethane, 1,1,2,2-Tetrachloroethane, Chlorobenzene, Fluorobenzene

<b>Date</b>	11/11/2015	<b>Client</b>	AGL Newcastle Gas Storage Facility	
<b>Report</b>	R001906	<b>Stack ID</b>	EPA ID 8- LNG Vaporiser Regasifier (F-501 A)	
<b>Licence No.</b>	20130	<b>Location</b>	Tomago	<b>State</b> NSW
<b>Ektimo Staff</b>	DH/Swe			
<b>Process Conditions</b>	Please refer to client records.			
<b>Reason for testing:</b>	Client requested testing to determine emissions to air			

### Sampling Plane Details

Sampling plane dimensions	875 mm
Sampling plane area	0.601 m <sup>2</sup>
Sampling port size, number & depth	4" Flange (x2)
Access & height of ports	Elevated work platform 8 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 6 D
Upstream disturbance	Junction 4 D
No. traverses & points sampled	2 16
Compliance to AS4323.1	Compliant but non-ideal

### Comments

The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

### Stack Parameters

Moisture content, %v/v	14	
Gas molecular weight, g/g mole	27.9 (wet)	29.6 (dry)
Gas density at STP, kg/m <sup>3</sup>	1.25 (wet)	1.32 (dry)

### Results

### Gas Flow Parameters

Temperature, °C	95
Velocity at sampling plane, m/s	8.1
Volumetric flow rate, discharge, m <sup>3</sup> /s	4.8
Volumetric flow rate (wet STP), m <sup>3</sup> /s	3.6
Volumetric flow rate (dry STP), m <sup>3</sup> /s	3.1
Mass flow rate (wet basis), kg/hour	16000
Sampling time, min	80
Isokinetic rate, %	99
Velocity difference, %	<1

Isokinetic	Sampling time	Results	
		1530-1650	
		Concentration mg/m <sup>3</sup>	Mass Rate g/min
Arsenic		<0.0017	<0.00031
Lead		0.00084	0.00016
Mercury		<0.00042	<0.000078

<b>Date</b>	11/11/2015	<b>Client</b>	AGL Newcastle Gas Storage Facility
<b>Report</b>	R001906	<b>Stack ID</b>	EPA ID 8- LNG Vaporiser Regasifier (F-501 A)
<b>Licence No.</b>	20130	<b>Location</b>	Tomago <b>State</b> NSW
<b>Ektimo Staff</b>	DHi/Swe		
<b>Process Conditions</b>	Please refer to client records.		
<b>Reason for testing:</b>	Client requested testing to determine emissions to air		

<b>Sampling Plane Details</b>	
Sampling plane dimensions	875 mm
Sampling plane area	0.601 m <sup>2</sup>
Sampling port size, number & depth	4" Flange (x2)
Access & height of ports	Elevated work platform 8 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 6 D
Upstream disturbance	Junction 4 D
No. traverses & points sampled	2 16
Compliance to AS4323.1	Compliant but non-ideal

<b>Comments</b>
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

<b>Stack Parameters</b>		
Moisture content, %v/v	13	
Gas molecular weight, g/g mole	28.3 (wet)	29.8 (dry)
Gas density at STP, kg/m <sup>3</sup>	1.26 (wet)	1.33 (dry)
	<b>Results</b>	
<b>Gas Flow Parameters</b>		
Temperature, °C	96	
Velocity at sampling plane, m/s	8.1	
Volumetric flow rate, discharge, m <sup>3</sup> /s	4.8	
Volumetric flow rate (wet STP), m <sup>3</sup> /s	3.6	
Volumetric flow rate (dry STP), m <sup>3</sup> /s	3.1	
Mass flow rate (wet basis), kg/hour	16000	
Sampling time, min	80	
Isokinetic rate, %	97	
Velocity difference, %	<1	

<b>Isokinetic</b>	Sampling time	<b>Results</b>	
		1625-1745	
		Concentration mg/m <sup>3</sup>	Mass Rate g/min
Solid particles		<0.59	<0.11
PM10*		<0.59	<0.11
Sulfur dioxide		0.018	0.0034
Sulfuric acid mist and sulfur trioxide (as SO <sub>3</sub> )		0.15	0.029

\*PM10 assumed to be less than or equal to the solid particle result

<b>Hydrogen sulfide</b>	Sampling time	<b>Results</b>	
		1637-1737	
		Concentration mg/m <sup>3</sup>	Mass Rate g/min
Hydrogen Sulfide		<0.0029	<0.00055

### 3.3 EPA ID 8-LNG Vaporiser Regasifier (F-501 B)

Date	11/11/2015	Client	AGL Newcastle Gas Storage Facility	
Report	R001906	Stack ID	EPA ID 8- LNG Vaporiser Regasifier (F-501 B)	
Licence No.	20130	Location	Tomago	State NSW
Ektimo Staff	DH/Swe			
Process Conditions	Please refer to client records.			
Reason for testing:	Client requested testing to determine emissions to air			

Sampling Plane Details	
Sampling plane dimensions	875 mm
Sampling plane area	0.601 m <sup>2</sup>
Sampling port size, number & depth	4" Flange (x2)
Access & height of ports	Elevated work platform 8 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 6 D
Upstream disturbance	Junction 4 D
No. traverses & points sampled	2 16
Compliance to AS4323.1	Compliant but non-ideal

Comments
The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	12	
Gas molecular weight, g/g mole	28.4 (wet)	29.8 (dry)
Gas density at STP, kg/m <sup>3</sup>	1.26 (wet)	1.33 (dry)
Gas Flow Parameters		
Temperature, °C	92	
Velocity at sampling plane, m/s	7.8	
Volumetric flow rate, discharge, m <sup>3</sup> /s	4.7	
Volumetric flow rate (wet STP), m <sup>3</sup> /s	3.5	
Volumetric flow rate (dry STP), m <sup>3</sup> /s	3.1	
Mass flow rate (wet basis), kg/hour	16000	
Sampling time, min	80	
Isokinetic rate, %	100	
Velocity difference, %	<1	

PAH's	Sampling time	Results	
		1940-2100	
		Concentration ng/m <sup>3</sup>	Mass Rate ng/min
Naphthalene		4500	830000
2-Methylnaphthalene		2400	430000
Acenaphthylene		<19	<3500
Acenaphthene		<19	<3500
Fluorene		<19	<3500
Phenanthrene		120	23000
Anthracene		<19	<3500
Fluoranthene		76	14000
Pyrene		55	10000
Benz(a)anthracene		<19	<3500
Chrysene		<19	<3500
Benzo(b)fluoranthene		<19	<3500
Benzo(k)fluoranthene		<19	<3500
Benzo(e)pyrene		<19	<3500
Benzo(a)pyrene		<19	<3500
Perylene		<19	<3500
Indeno(1,2,3-cd)pyrene		<19	<3500
Dibenz(ah)anthracene		21	3800
Benzo(ghi)perylene		<19	<3500
Total 16 PAH's		2600	480000
Total 19 PAH's		7200	1300000
BaP-TEQ			
Lower Bound		8.3	1500
Middle Bound		22	4000
Upper Bound		35	6400

Hydrogen sulfide	Sampling time	Results	
		2140-2240	
		Concentration mg/m <sup>3</sup>	Mass Rate g/min
Hydrogen Sulfide		0.0033	0.00061

<b>Date</b>	11/11/2015	<b>Client</b>	AGL Newcastle Gas Storage Facility	
<b>Report</b>	R001906	<b>Stack ID</b>	EPA ID 8- LNG Vaporiser Regasifier (F-501 B)	
<b>Licence No.</b>	20130	<b>Location</b>	Tomago	<b>State</b> NSW
<b>Ektimo Staff</b>	DH/Swe			
<b>Process Conditions</b>	Please refer to client records.			
<b>Reason for testing:</b>	Client requested testing to determine emissions to air			

### Sampling Plane Details

Sampling plane dimensions	875 mm		
Sampling plane area	0.601 m <sup>2</sup>		
Sampling port size, number & depth	4" Flange (x2)		
Access & height of ports	Elevated work platform	8 m	
Duct orientation & shape	Vertical	Circular	
Downstream disturbance	Exit	6 D	
Upstream disturbance	Junction	4 D	
No. traverses & points sampled	2 16		
Compliance to AS4323.1	Compliant but non-ideal		

### Comments

The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

### Stack Parameters

Moisture content, %v/v	13	
Gas molecular weight, g/g mole	28.3 (wet)	29.8 (dry)
Gas density at STP, kg/m <sup>3</sup>	1.26 (wet)	1.33 (dry)

### Results

#### Gas Flow Parameters

Temperature, °C	92
Velocity at sampling plane, m/s	8
Volumetric flow rate, discharge, m <sup>3</sup> /s	4.8
Volumetric flow rate (wet STP), m <sup>3</sup> /s	3.6
Volumetric flow rate (dry STP), m <sup>3</sup> /s	3.1
Mass flow rate (wet basis), kg/hour	16000
Sampling time, min	80
Isokinetic rate, %	97
Velocity difference, %	<1

Isokinetic	Sampling time	Results	
		1935-2055	
		Concentration mg/m <sup>3</sup>	Mass Rate g/min
Arsenic		<0.0012	<0.00022
Lead		0.00058	0.00011
Mercury		<0.00035	<0.000065



Date	11/11/2015	Client	AGL Newcastle Gas Storage Facility		
Report	R001906	Stack ID	EPA ID 8- LNG Vaporiser Regasifier (F-501 B)		
Licence No.	20130	Location	Tomago	State	NSW
Ektimo Staff	DH/Swe				
Process Conditions	Please refer to client records.				
Reason for testing:	Client requested testing to determine emissions to air				

**Sampling Plane Details**

Sampling plane dimensions	875 mm
Sampling plane area	0.601 m <sup>2</sup>
Sampling port size, number & depth	4" Flange (x2)
Access & height of ports	Elevated work platform 8 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 6 D
Upstream disturbance	Junction 4 D
No. traverses & points sampled	2 16
Compliance to AS4323.1	Compliant but non-ideal

**Comments**

The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

**Stack Parameters**

Moisture content, %v/v	12	
Gas molecular weight, g/g mole	28.4 (wet)	29.8 (dry)
Gas density at STP, kg/m <sup>3</sup>	1.27 (wet)	1.33 (dry)

**Results****Gas Flow Parameters**

Temperature, °C	93
Velocity at sampling plane, m/s	7.8
Volumetric flow rate, discharge, m <sup>3</sup> /s	4.7
Volumetric flow rate (wet STP), m <sup>3</sup> /s	3.5
Volumetric flow rate (dry STP), m <sup>3</sup> /s	3.1
Mass flow rate (wet basis), kg/hour	16000
Sampling time, min	80
Isokinetic rate, %	100
Velocity difference, %	<1

Date	11/11/2015	Client	AGL Newcastle Gas Storage Facility		
Report	R001906	Stack ID	EPA ID 8- LNG Vaporiser Regasifier (F-501 B)		
Licence No.	20130	Location	Tomago	State	NSW
Ektimo Staff	DH/Swe				
Process Conditions	Please refer to client records.				
Reason for testing:	Client requested testing to determine emissions to air				

Isokinetic	Sampling time	Results		
		2115-2235		
		Concentration mg/m <sup>3</sup>	Corrected to 3%O <sub>2</sub> mg/m <sup>3</sup>	Mass Rate g/min
Solid particles		<0.94	<0.96	<0.17
PM10*		<0.94	<0.96	<0.17
Sulfur dioxide		<0.019	<0.02	<0.0036
Sulfuric acid mist and sulfur trioxide (as SO <sub>3</sub> )		0.43	0.45	0.08

\*PM10 assumed to be less than or equal to the solid particle result

Gases	Sampling time	Average			Minimum			Maximum		
		2040-2139			2040-2139			2040-2139		
		Concentration mg/m <sup>3</sup>	Corrected to 3% O <sub>2</sub> mg/m <sup>3</sup>	Mass Rate g/min	Concentration mg/m <sup>3</sup>	Corrected to 3%O <sub>2</sub> mg/m <sup>3</sup>	Mass Rate g/min	Concentration mg/m <sup>3</sup>	Corrected to 3% O <sub>2</sub> mg/m <sup>3</sup>	Mass Rate g/min
Nitrogen oxides (as NO <sub>2</sub> )		100	100	18	94	97	17	110	110	20
Sulfur dioxide		<5.7	<5.9	<1	<5.7	<5.9	<1	5.7	5.9	1.1
Carbon monoxide		10	11	1.9	8.7	9	1.6	14	14	2.5
Carbon dioxide		Concentration %			Concentration %			Concentration %		
Oxygen		9.7			9.2			10		
		3.5			3			3.9		

Total VOCs (as n-Propane)	Sampling time	Results		
		2040-2140		
		Concentration mg/m <sup>3</sup>	Corrected to 3%O <sub>2</sub> mg/m <sup>3</sup>	Mass Rate g/min
Total		<0.083	<0.085	<0.015

VOC's (speciated)	Sampling time	Results		
		2040-2140		
		Concentration mg/m <sup>3</sup>	Corrected to 3%O <sub>2</sub> mg/m <sup>3</sup>	Mass Rate g/min
Detection limit <sup>(1)</sup>		<0.086	<0.089	<0.016
Benzene		<0.086	<0.089	<0.016

(1) Unless otherwise reported, the following target compounds were found to be below detection:

Ethanol, Isopropanol, Isobutanol, Butanol, 1-Methoxy-2-propanol, Cyclohexanol, 2-Butoxyethanol, Pentane, Hexane, Heptane, Octane, Nonane, Decane, Undecane, Dodecane, Tridecane, Tetradecane, Cyclohexane, 2-Methylhexane, 2,3-Dimethylpentane, 3-Methylhexane, Isooctane, Methylcyclohexane, alpha-Pinene, beta-Pinene, d-Limonene, 3-Carene, Acetone, Methyl ethyl ketone, Ethyl acetate, Isopropyl acetate, Propyl acetate, MIBK, 2-Hexanone, Butyl acetate, 1-Methoxy-2-propyl acetate, Cyclohexanone, Cellosolve acetate, 2-Butoxyethyl acetate, Ethyldiglycol acetate, Diacetone alcohol, Isophorone, Benzene, Toluene, Ethylbenzene, m-p-Xylene, Styrene, o-Xylene, Isopropylbenzene, Propylbenzene, 1,3,5-Trimethylbenzene, alpha-Methylstyrene, tert-Butylbenzene, 1,2,4-Trimethylbenzene, 1,2,3-Trimethylbenzene, m-Diethylbenzene, o-Diethylbenzene, p-Diethylbenzene, Dichloromethane, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Carbon tetrachloride, 1,1-Dichloroethene, cis-1,2-Dichloroethene, trans-1,2-Dichloroethene, Trichloroethene, Tetrachloroethene, 1,1,2-Trichloroethane, 1,1,2,2-Tetrachloroethane, Chlorobenzene, Fluorobenzene

### 3.4 EPA ID 8-LNG Vaporiser Regasifier (F-501 C)

Date	12/11/2015	Client	AGL Newcastle Gas Storage Facility	
Report	R001906	Stack ID	EPA ID 8- LNG Vaporiser Regasifier (F-501 C)	
Licence No.	20130	Location	Tomago	State NSW
Ektimo Staff	DH/Swe			
Process Conditions	Please refer to client records.			
Reason for testing:	Client requested testing to determine emissions to air			

Sampling Plane Details	
Sampling plane dimensions	875 mm
Sampling plane area	0.601 m <sup>2</sup>
Sampling port size, number & depth	4" Flange (x2)
Access & height of ports	Elevated work platform 8 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 6 D
Upstream disturbance	Junction 4 D
No. traverses & points sampled	2 16
Compliance to AS4323.1	Compliant but non-ideal

#### Comments

The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

#### Stack Parameters

Moisture content, %v/v	18	
Gas molecular weight, g/g mole	27.6 (wet)	29.8 (dry)
Gas density at STP, kg/m <sup>3</sup>	1.23 (wet)	1.33 (dry)

#### Gas Flow Parameters

Temperature, °C	97
Velocity at sampling plane, m/s	8.9
Volumetric flow rate, discharge, m <sup>3</sup> /s	5.3
Volumetric flow rate (wet STP), m <sup>3</sup> /s	4
Volumetric flow rate (dry STP), m <sup>3</sup> /s	3.2
Mass flow rate (wet basis), kg/hour	18000
Sampling time, min	80
Isokinetic rate, %	108
Velocity difference, %	<1

PAH's	Sampling time	Results	
		1328-1448	
		Concentration ng/m <sup>3</sup>	Mass Rate ng/min
Naphthalene		1300	250000
2-Methylnaphthalene		750	150000
Acenaphthylene		<16	<3200
Acenaphthene		<16	<3200
Fluorene		<16	<3200
Phenanthrene		300	59000
Anthracene		<16	<3200
Fluoranthene		110	21000
Pyrene		58	11000
Benz(a)anthracene		<16	<3200
Chrysene		23	4400
Benzo(b)fluoranthene		<16	<3200
Benzo(k)fluoranthene		<16	<3200
Benzo(e)pyrene		<16	<3200
Benzo(a)pyrene		<16	<3200
Perylene		<16	<3200
Indeno(1,2,3-cd)pyrene		<16	<3200
Dibenz(ah)anthracene		21	4100
Benzo(ghi)perylene		<16	<3200
Total 16 PAH's		1200	240000
Total 19 PAH's		2600	500000
BaP-TEQ			
Lower Bound		8.7	1700
Middle Bound		20	3900
Upper Bound		32	6100

Date	12/11/2015	Client	AGL Newcastle Gas Storage Facility		
Report	R001906	Stack ID	EPA ID 8- LNG Vaporiser Regasifier (F-501 C)		
Licence No.	20130	Location	Tomago	State	NSW
Ektimo Staff	DH/Swe				
Process Conditions	Please refer to client records.				
Reason for testing:	Client requested testing to determine emissions to air				

**Sampling Plane Details**

Sampling plane dimensions	875 mm
Sampling plane area	0.601 m <sup>2</sup>
Sampling port size, number & depth	4" Flange (x2)
Access & height of ports	Elevated work platform 8 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Ext 6 D
Upstream disturbance	Junction 4 D
No. traverses & points sampled	2 16
Compliance to AS4323.1	Compliant but non-ideal

**Comments**

The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

**Stack Parameters**

Moisture content, %v/v	15	
Gas molecular weight, g/g mole	28.0 (wet)	29.8 (dry)
Gas density at STP, kg/m <sup>3</sup>	1.25 (wet)	1.33 (dry)

**Results****Gas Flow Parameters**

Temperature, °C	97
Velocity at sampling plane, m/s	8.8
Volumetric flow rate, discharge, m <sup>3</sup> /s	5.3
Volumetric flow rate (wet STP), m <sup>3</sup> /s	3.9
Volumetric flow rate (dry STP), m <sup>3</sup> /s	3.3
Mass flow rate (wet basis), kg/hour	18000
Sampling time, min	80
Isokinetic rate, %	109
Velocity difference, %	<1

Isokinetic	Sampling time	Results		
		1145-1305		
		Concentration	Corrected to 3% O <sub>2</sub>	
		mg/m <sup>3</sup>	Mass Rate	
		mg/m <sup>3</sup>	mg/m <sup>3</sup>	g/min
Arsenic		<0.0014	<0.0016	<0.00028
Lead		0.0007	0.0008	0.00014
Mercury		<0.00035	<0.0004	<0.00007

Date	12/11/2015	Client	AGL Newcastle Gas Storage Facility		
Report	R001906	Stack ID	EPA ID 8- LNG Vaporiser Regasifier (F-501 C)		
Licence No.	20130	Location	Tomago	State	NSW
Ektimo Staff	DH/Swe				
Process Conditions	Please refer to client records.				
Reason for testing:	Client requested testing to determine emissions to air				

Gases	Sampling time	Average 1056-1155 Corrected to 3% O2			Minimum 1056-1155 Corrected to 3% O2			Maximum 1056-1155 Corrected to 3% O2		
		Concentration mg/m <sup>3</sup>	Concentration mg/m <sup>3</sup>	Mass Rate g/min	Concentration mg/m <sup>3</sup>	Concentration mg/m <sup>3</sup>	Mass Rate g/min	Concentration mg/m <sup>3</sup>	Concentration mg/m <sup>3</sup>	Mass Rate g/min
Nitrogen oxides (as NO <sub>2</sub> )		130	150	26	110	130	23	150	170	29
Sulfur dioxide		<5.7	<6.5	<1.1	<5.7	<6.5	<1.1	8.6	9.7	1.7
Carbon monoxide		<2.5	<2.8	<0.49	<2.5	<2.8	<0.49	<2.5	<2.8	<0.49
		Concentration %			Concentration %			Concentration %		
Carbon dioxide		9			8.5			9.4		
Oxygen		5.1			4.2			5.8		

Total VOCs* (as n-Propane)	Sampling time	Results 1057-1157 Corrected to 3% O2		
		Concentration mg/m <sup>3</sup>	Concentration mg/m <sup>3</sup>	Mass Rate g/min
Total		<0.086	<0.098	<0.017

\*Total VOCs does not include methane

VOC's (speciated)	Sampling time	Results 1057-1157 Corrected to 3% O2		
		Concentration mg/m <sup>3</sup>	Concentration mg/m <sup>3</sup>	Mass Rate g/min
Detection limit <sup>(1)</sup>		<0.09	<0.1	<0.018
Benzene		<0.09	<0.1	<0.018

(1) Unless otherwise reported, the following target compounds were found to be below detection:

Ethanol, Isopropanol, Isobutanol, Butanol, 1-Methoxy-2-propanol, Cyclohexanol, 2-Butoxyethanol, Pentane, Hexane, Heptane, Octane, Nonane, Decane, Undecane, Dodecane, Tridecane, Tetradecane, Cyclohexane, 2-Methylhexane, 2,3-Dimethylpentane, 3-Methylhexane, Isooctane, Methylcyclohexane, alpha-Pinene, beta-Pinene, d-Limonene, 3-Carene, Acetone, Methyl ethyl ketone, Ethyl acetate, Isopropyl acetate, Propyl acetate, MIBK, 2-Hexanone, Butyl acetate, 1-Methoxy-2-propyl acetate, Cyclohexanone, Cellosolve acetate, 2-Butoxyethyl acetate, Ethyldiglycol acetate, Diacetone alcohol, Isophorone, Benzene, Toluene, Ethylbenzene, m-p-Xylene, Styrene, o-Xylene, Isopropylbenzene, Propylbenzene, 1,3-Trimethylbenzene, alpha-Methylstyrene, tert-Butylbenzene, 1,2,4-Trimethylbenzene, 1,2,3-Trimethylbenzene, m-Diethylbenzene, o-Diethylbenzene, p-Diethylbenzene, Dichloromethane, Chloroform, 1,1,1-Trichloroethane, 1,2-Dichloroethane, Carbon tetrachloride, 1,1-Dichloroethene, cis-1,2-Dichloroethene, trans-1,2-Dichloroethene, Trichloroethene, Tetrachloroethene, 1,1,2-Trichloroethane, 1,1,2,2-Tetrachloroethane, Chlorobenzene, Fluorobenzene

Date	12/11/2015	Client	AGL Newcastle Gas Storage Facility		
Report	R001906	Stack ID	EPA ID 8- LNG Vaporiser Regasifier (F-501 C)		
Licence No.	20130	Location	Tomago	State	NSW
Ektimo Staff	DH/Swe				
Process Conditions	Please refer to client records.				
Reason for testing:	Client requested testing to determine emissions to air				

Sampling Plane Details	
Sampling plane dimensions	875 mm
Sampling plane area	0.601 m <sup>2</sup>
Sampling port size, number & depth	4" Flange (x2)
Access & height of ports	Elevated work platform 8 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 6 D
Upstream disturbance	Junction 4 D
No. traverses & points sampled	2 16
Compliance to AS4323.1	Compliant but non-ideal

**Comments**  
 The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters		
Moisture content, %v/v	12	
Gas molecular weight, g/g mole	28.3 (wet)	29.8 (dry)
Gas density at STP, kg/m <sup>3</sup>	1.26 (wet)	1.33 (dry)
Results		
Gas Flow Parameters		
Temperature, °C	97	
Velocity at sampling plane, m/s	8.8	
Volumetric flow rate, discharge, m <sup>3</sup> /s	5.3	
Volumetric flow rate (wet STP), m <sup>3</sup> /s	3.9	
Volumetric flow rate (dry STP), m <sup>3</sup> /s	3.4	
Mass flow rate (wet basis), kg/hour	18000	
Sampling time, min	80	
Isokinetic rate, %	92	
Velocity difference, %	<1	

Isokinetic	Sampling time	Results		
		1150-1320		
		Concentration mg/m <sup>3</sup>	Corrected to 3% O <sub>2</sub> mg/m <sup>3</sup>	Mass Rate g/min
Solid particles		<0.57	<0.64	<0.12
PM10*		<0.57	<0.64	<0.12
Sulfur dioxide		0.024	0.027	0.005
Sulfuric acid mist and sulfur trioxide (as SO <sub>3</sub> )		0.17	0.19	0.035

\*PM10 assumed to be less than or equal to the solid particle result

Hydrogen sulfide	Sampling time	Results		
		1155-1310		
		Concentration mg/m <sup>3</sup>	Corrected to 3% O <sub>2</sub> mg/m <sup>3</sup>	Mass Rate g/min
Hydrogen Sulfide		0.006	0.0068	0.0012

## 4 PLANT OPERATING CONDITIONS

Unless otherwise stated, the plant operating conditions were normal at the time of testing. See AGL Newcastle Gas Storage Facility's records for complete process conditions.

## 5 TEST METHODS

All sampling and analysis was performed by Ektimo unless otherwise specified. Specific details of the methods are available upon request

Parameter	Test Method	Method Detection Limit	Uncertainty*	NATA Accredited	
				Sampling	Analysis
Sample plane criteria	NSW TM-1	NA	-	✓	NA
Velocity	NSW TM-2	2ms <sup>-1</sup>	7%	✓	NA
Moisture content	NSW TM-22	0.4%	8%	✓	✓
Temperature	NSW TM-2	0°C	2%	✓	NA
Sulfur dioxide and sulfuric acid mist (including sulfur trioxide)	NSW TM-3	0.01mg/m <sup>3</sup>	16%	✓	✓
Hydrogen sulfide	NSW TM-5	1.5mg/m <sup>3</sup>	19%	✓	✓
Nitrogen oxides (NO <sub>x</sub> )	NSW TM-11	4mg/m <sup>3</sup>	12%	✓	✓
Total (gaseous and particulate) metals and metallic compounds (As, Pb, Hg)	NSW TM-12, NSW TM-13, NSW TM-14	Analyte specific	15%	✓	✓ <sup>1</sup>
Solid particles	NSW TM-15	0.001g/m <sup>3</sup>	5%	✓	✓
Carbon dioxide	NSW TM-24	0.1%	13%	✓	✓
Oxygen	NSW TM-25	0.1%	13%	✓	✓
Carbon monoxide	NSW TM-32	0.0025g/m <sup>3</sup>	12%	✓	✓
Speciated volatile organic compounds (VOC's)	NSW TM-34	0.33mg/m <sup>3</sup>	19%	✓	✓
Particulate matter < 10µm (PM <sub>10</sub> )	NSW OM-5	0.0017g/m <sup>3</sup>	6%	✓	✓
Polycyclic aromatic hydrocarbons (PAH's)	NSW OM-6	Analyte	21%	✓	✓ <sup>2</sup>

\* Uncertainty values cited in this table are calculated at the 95% confidence level (coverage factor = 2)

1. Analysis was performed by Envirolab, NATA accreditation number 2901. Results were reported to Ektimo on 27 November 2015 and 19 January 2016 in report number 137822 and 139938.
2. Analysis was performed by Australian Government National Measurement Institute, NATA accreditation number 198. Results were reported to Ektimo on 15 December 2015 and 3 February 2016 in report number #ORG15\_150 and #ORG16\_001.

## 6 QUALITY ASSURANCE/ QUALITY CONTROL INFORMATION

Ektimo (EML) and Ektimo (ETC) are accredited by the National Association of Testing Authorities (NATA) for the sampling and analysis of air pollutants from industrial sources. Unless otherwise stated test methods used are accredited with the National Association of Testing Authorities. For full details, search for Ektimo at NATA's website [www.nata.com.au](http://www.nata.com.au).

Ektimo (EML) and Ektimo (ETC) are accredited by NATA (National Association of Testing Authorities) to ISO/IEC 17025. – General Requirements for the Competence of Testing and Calibration Laboratories. ISO/IEC 17025 requires that a laboratory have adequate equipment to perform the testing, as well as laboratory personnel with the competence to perform the testing. This quality assurance system is administered and maintained by the Compliance Manager.

NATA is a member of APLAC (Asia Pacific Laboratory Accreditation Co-operation) and of ILAC (International Laboratory Accreditation Co-operation). Through the mutual recognition arrangements with both of these organisations, NATA accreditation is recognised world –wide.

A formal Quality Control program is in place at Ektimo to monitor analyses performed in the laboratory and sampling conducted in the field. The program is designed to check where appropriate; the sampling reproducibility, analytical method, accuracy, precision and the performance of the analyst. The Laboratory Manager is responsible for the administration and maintenance of this program.

## 7 DEFINITIONS

The following symbols and abbreviations may be used in this test report:

STP	Standard temperature and pressure. Gas volumes and concentrations are expressed on a dry basis at 0°C, at discharge oxygen concentration and an absolute pressure of 101.325 kPa, unless otherwise specified.
Disturbance	A flow obstruction or instability in the direction of the flow which may impede accurate flow determination. This includes centrifugal fans, axial fans, partially closed or closed dampers, louvres, bends, connections, junctions, direction changes or changes in pipe diameter.
VOC	Any chemical compound based on carbon with a vapour pressure of at least 0.010 kPa at 25°C or having a corresponding volatility under the particular conditions of use. These compounds may contain oxygen, nitrogen and other elements, but specifically excluded are carbon monoxide, carbon dioxide, carbonic acid, metallic carbides and carbonate salts.
TOC	The sum of all compounds of carbon which contain at least one carbon to carbon bond, plus methane and its derivatives.
OU	The number of odour units per unit of volume. The numerical value of the odour concentration is equal to the number of dilutions to arrive at the odour threshold (50% panel response).
PM <sub>2.5</sub>	Atmospheric suspended particulate matter having an equivalent aerodynamic diameter of less than approximately 2.5 microns (µm).
PM <sub>10</sub>	Atmospheric suspended particulate matter having an equivalent aerodynamic diameter of less than approximately 10 microns (µm).
BSP	British standard pipe
NT	Not tested or results not required
NA	Not applicable
D <sub>50</sub>	'Cut size' of a cyclone defined as the particle diameter at which the cyclone achieves a 50% collection efficiency ie. half of the particles are retained by the cyclone and half are not and pass through it to the next stage. The D <sub>50</sub> method simplifies the capture efficiency distribution by assuming that a given cyclone stage captures all of the particles with a diameter equal to or greater than the D <sub>50</sub> of that cyclone and less than the D <sub>50</sub> of the preceding cyclone.
D	Duct diameter or equivalent duct diameter for rectangular ducts
<	Less than
>	Greater than
≥	Greater than or equal to
~	Approximately
CEM	Continuous Emission Monitoring
CEMS	Continuous Emission Monitoring System
DER	WA Department of Environment & Regulation
DECC	Department of Environment & Climate Change (NSW)
EPA	Environment Protection Authority
FTIR	Fourier Transform Infra Red
NATA	National Association of Testing Authorities
RATA	Relative Accuracy Test Audit
AS	Australian Standard
USEPA	United States Environmental Protection Agency
Vic EPA	Victorian Environment Protection Authority
ISC	Intersociety committee, Methods of Air Sampling and Analysis
ISO	International Organisation for Standardisation
APHA	American public health association, Standard Methods for the Examination of Water and Waste Water
CARB	Californian Air Resources Board
TM	Test Method
OM	Other approved method
CTM	Conditional test method
VDI	Verein Deutscher Ingenieure (Association of German Engineers)
NIOSH	National Institute of Occupational Safety and Health
XRD	X-ray Diffractometry