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Report Number R002974

**Emission Testing Report
GX Energy Pty Ltd, Mascot**

Document Information

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 Attention: Chris Smith
 Address: Building TG1, 10 Bourke Rd
 Mascot NSW 2020
 Testing Laboratory: Ektimo (ETC) ABN 74 474 273 172

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Report Authorisation



Aaron Davis
Operations Manager

NATA Accredited Laboratory
No. 14601

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1 EXECUTIVE SUMMARY

Ektimo was engaged by GX Energy Pty Ltd to perform emission testing at the trigeneration facility located at Mascot NSW to satisfy conditions within NSW Environment Protection licence 20246.

Monitoring was performed for the following parameters:

Location	Test Date	Test Parameters*
DP1 – Unit 1	14 July 2016	Nitrogen oxides, oxygen, volatile organic compounds (VOC's) includes n-propane equivalent
DP2 – Unit 2	14 July 2016	Nitrogen oxides, oxygen, volatile organic compounds (VOC's) includes n-propane equivalent

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

The sampling 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 LICENCE 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 20246 (last amended on 02/12/15).

EPA No.	Pollutant	Units	Licence limit	Detected values	
				14/07/2016	(Corrected to 3% O ₂)
DP 1-Unit 1	Nitrogen Oxides	mg/m ³	250	150	240
	Volatile Organic Compounds (as n-propane)	mg/m ³	40	<0.2	<0.3
DP 2-Unit 2	Nitrogen Oxides	mg/m ³	250	140	230
	Volatile Organic Compounds (as n-propane)	mg/m ³	40	<0.2	<0.3

3 RESULTS

3.1 DP 1 – Unit 1

Date	14/07/2016	Client	GX Energy Pty Ltd		
Report	R002974	Stack ID	DP1 - Unit 1		
Licence No.	20246	Location	Mascot	State	NSW
Ektimo Staff	Aaron Davis / Scott Woods				
Process Conditions	Plant operating at 85% load, chilling unit off				

Sampling Plane Details

Sampling plane dimensions	900 mm
Sampling plane area	0.636 m ²
Sampling port size, number	1" BSP (x2)
Access & height of ports	Stairs 25 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 10 D
Upstream disturbance	Junction 2 D
No. traverses & points sampled	2 16
Compliance of sample plane to AS4323.1	Compliant but non-ideal



The sampling plane is deemed to be non-ideal or non-compliant due to the following reasons:
 The sampling plane is too near to the upstream disturbance but is greater than or equal to 2D

Stack Parameters

Moisture content, %v/v	7.9	
Gas molecular weight, g/g mole	27.7 (wet)	28.5 (dry)
Gas density at STP, kg/m ³	1.24 (wet)	1.27 (dry)
% Oxygen correction & Factor	3 %	1.64

Gas Flow Parameters

Measurement time (hh:mm)	1035
Temperature, °C	409
Velocity at sampling plane, m/s	20
Volumetric flow rate, discharge, m ³ /s	13
Volumetric flow rate (wet STP), m ³ /s	5
Volumetric flow rate (dry STP), m ³ /s	4.6
Mass flow rate (wet basis), kg/hour	22000
Velocity difference, %	<1

Gases	Sampling time	Average 1036-1135 Corrected to 3%			Minimum 1036-1135 Corrected to 3%			Maximum 1036-1135 Corrected to 3%		
		Concentration mg/m ³	O ₂ mg/m ³	Mass Rate g/min	Concentration mg/m ³	O ₂ mg/m ³	Mass Rate g/min	Concentration mg/m ³	O ₂ mg/m ³	Mass Rate g/min
Nitrogen oxides (as NO ₂)		150	240	41	120	190	33	180	300	51
Oxygen		10			9.9			10		

Total VOCs (as n-Propane)	Sampling time	Results 1040-1140 Corrected to 3%		
		Concentration mg/m ³	O ₂ mg/m ³	Mass Rate g/min
Total		<0.2	<0.3	<0.05

VOC's (speciated)	Sampling time	Results 1040-1140 Corrected to 3%		
		Concentration mg/m ³	O ₂ mg/m ³	Mass Rate g/min
Detection limit ⁽¹⁾		<0.4	<0.6	<0.1

(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, Tetradecane, Cyclohexane, 2-Methylhexane, 2,3-Dimethylpentane, 3-Methylhexane, Isooctane, Methylcyclohexane, alpha-Pinene, beta-Pinene, d-Limonene, 3-Carene-3-Carene, Acetone, Methyl ethyl ketone, Ethyl acetate, Isopropyl acetate, Propyl acetate, MIBK, 2-Hexanone, Butyl acetate, 1-Methoxy-2-propyl acetate, Cyclohexanone, 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, 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, Tetrachloroethene, 1,1,2-Trichloroethane, 1,1,2,2-Tetrachloroethane, Chlorobenzene, Fluorobenzene

3.2 DP 2 – Unit 2

Date	14/07/2016	Client	GX Energy Pty Ltd		
Report	R002974	Stack ID	DP2 - Unit 2		
Licence No.	20246	Location	Mascot	State	NSW
Ektimo Staff	Aaron Davis / Scott Woods				
Process Conditions	Plant operating at 85% load, chilling unit off				

Sampling Plane Details

Sampling plane dimensions	900 mm
Sampling plane area	0.636 m ²
Sampling port size, number	1" BSP (x2)
Access & height of ports	Stairs 25 m
Duct orientation & shape	Vertical Circular
Downstream disturbance	Exit 10 D
Upstream disturbance	Junction 2 D
No. traverses & points sampled	2 16
Compliance of sample plane to AS4323.1	Compliant but non-ideal



The sampling plane is deemed to be non-ideal or non-compliant due to the following reasons:

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

Stack Parameters

Moisture content, %v/v	8.1	
Gas molecular weight, g/g mole	27.7 (wet)	28.5 (dry)
Gas density at STP, kg/m ³	1.24 (wet)	1.27 (dry)
% Oxygen correction & Factor	3 %	1.65

Gas Flow Parameters

Measurement time (hhmm)	850
Temperature, °C	400
Velocity at sampling plane, m/s	19
Volumetric flow rate, discharge, m ³ /s	12
Volumetric flow rate (wet STP), m ³ /s	4.9
Volumetric flow rate (dry STP), m ³ /s	4.5
Mass flow rate (wet basis), kg/hour	22000
Velocity difference, %	1

Gases	Sampling time	Average 915-1014 Corrected to 3%			Minimum 915-1014 Corrected to 3%			Maximum 915-1014 Corrected to 3%		
		Concentration mg/m ³	O ₂ mg/m ³	Mass Rate g/min	Concentration mg/m ³	O ₂ mg/m ³	Mass Rate g/min	Concentration mg/m ³	O ₂ mg/m ³	Mass Rate g/min
Nitrogen oxides (as NO ₂)		140	230	38	110	190	31	180	300	50
Oxygen		10.1			10			10.2		

Total VOCs (as n-Propane)	Sampling time	Results 0910-1010 Corrected to 3%		
		Concentration mg/m ³	O ₂ mg/m ³	Mass Rate g/min
Total		<0.2	<0.3	<0.05

VOC's (speciated)	Sampling time	Results 0910-1010 Corrected to 3%		
		Concentration mg/m ³	O ₂ mg/m ³	Mass Rate g/min
Detection limit ⁽¹⁾		<0.4	<0.6	<0.1

(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, 3-Carene, Acetone, Methyl ethyl ketone, Ethyl acetate, Isopropyl acetate, Propyl acetate, MIBK, 2-Hexanone, Butyl acetate, 1-Methoxy-2-propyl acetate, Cyclohexanone, 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, 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, Tetrachloroethene, 1,1,2-Trichloroethane, 1,1,2,2-Tetrachloroethane, Chlorobenzene, Fluorobenzene

4 PLANT OPERATING CONDITIONS

Testing was conducted on DP1 and DP 2 under 85% load conditions. The Chilling Unit was 'off' for DP 1 and DP2. See GX Energy'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	Sampling Method	Analysis Method	Method Detection Limit	Uncertainty*	NATA Accredited	
					Sampling	Analysis
Sample plane criteria	NSW TM-1	NA	NA	-	✓	NA
Moisture content	NSW TM-22	NSW TM-22	0.4%	8%	✓	✓
Temperature	NSW TM-2	NA	0°C	2%	✓	NA
Flow rate	NSW TM-2	NA	Location specific	8%	✓	NA
Velocity	NSW TM-2	NA	2ms ⁻¹	7%	✓	NA
Nitrogen oxides (NO _x)	NSW TM-11	NSW TM-11	4mg/m ³	12%	✓	✓
Oxygen	NSW TM-25	NSW TM-25	0.1%	13%	✓	✓
Speciated volatile organic compounds (VOC's)	NSW TM-34	USEPA SW-846 8260	0.33mg/m ³	19%	✓	✓ ¹

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

1. Analysis performed by Ektimo (EML Air), NATA accreditation number 2732. Results were reported to Ektimo on 3 August 2016 in report number R002974_SVOCs

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.

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 _{2.5}	Atmospheric suspended particulate matter having an equivalent aerodynamic diameter of less than approximately 2.5 microns (µm).
PM ₁₀	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 ₅₀	'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 ₅₀ 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 ₅₀ of that cyclone and less than the D ₅₀ 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