Air Quality Report

Prepared For

Fuel Plus International Pty Ltd

Report No. J 1609081

29 September 2016

BELL LABORATORIES PTY LTD

ABN 22 150 195 734

PO Box 6064, Hawthorn West, VIC 3122
T 1800 878 262

Air Sampling & Analysis Consulting Chemists

MELBOURNE | SYDNEY | BRISBANE

CLIENT	Fuel Plus International Pty Ltd Paynesville, Vic 3880
CONTACT	Jonathan L Kranz
PROJECT	Diesel Generator Emissions
REPORT No.	J 1609081
REPORT DATE	29 September 2016
AUTHORISED BY	Wayne Anderson Air Quality Specialist

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BACKGROUND

Fuel Plus International Pty Ltd is the co-developer, marketer and Australian agent for the diesel fuel additive, 'ENERGEN'. Energen is claimed to reduce diesel fuel consumption and emission of diesel particulate matter.

Fuel Plus International engaged BELL Laboratories to carry out emission testing of a diesel generator using both untreated and Energen treated diesel fuel.

TEST UNIT

Generator Details	Specification
Make	Kipor
Model	KDE20SS3
Serial No.	34511100404
Rated frequency	50 Hz
Rated output	17 kVA
Rated voltage	240/416 V
Rated current	23.6 A
Rated speed	1500 rpm
Power factor	0.8 (lag)
Engine type	4 cylinder, four stroke, in-line, direct injection
Displacement	2.19L
Fuel tank capacity	65 L

TEST SCHEDULE

The diesel generator emissions were first tested using untreated diesel (Mobil) at two settings: full load and 80% load. 80% load was selected following discussion with Macfarlane Generators who advised that most generators operate at 65 - 90% load with the majority operating at 75-80% load.

The generator emissions were tested again, fifty hours later, at the same settings, with the same batch of diesel treated with Energen additive.

Location	Date	Test Parameters
22 Station St, Dandenong	08/09/16	Full load: Carbon dioxide, carbon monoxide, nitrogen oxides, diesel particulate matter
22 Station St, Dandenong	08/09/16	80% load: Carbon dioxide, carbon monoxide, nitrogen oxides, diesel particulate matter
22 Station St, Dandenong	10/09/16	Full load: Carbon dioxide, carbon monoxide, nitrogen oxides, diesel particulate matter
22 Station St, Dandenong	10/09/16	80% load: Carbon dioxide, carbon monoxide, nitrogen oxides, diesel particulate matter

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TEST METHODS

Combustion gases (carbon monoxide, carbon dioxide, nitrogen oxides, sulphur dioxide) were measured using a portable combustion analyser (MRU). Diesel particulate matter was collected onto quartz filters for subsequent laboratory analysis.

All sampling was performed by BELL Laboratories. All analytical work performed by BELL Laboratories and/or the third party laboratories indicated below.

Parameter	Test Method
Carbon dioxide	USEPA 3A
Carbon monoxide	USEPA 10
Nitric oxide	USEPA 7E
Nitrogen dioxide	USEPA 7E
Sulphur dioxide	USEPA 6C
Diesel particulate matter (elemental carbon)[1]	NIOSH 5040

1. Analysis performed by Coal Services; NATA accreditation No. 10782

AS – Australian Standard
ISO – International Standards Organisation
NIOSH – National Institute of Occupational Safety & Health
USEPA – United States Environmental Protection Agency

TEST OUTCOME

A synopsis of the outcome for each test parameter is given below. Please refer to the tabulated test results on pages 6 and 7.

Carbon monoxide mass rates (g/min) were found to decrease at full load and 80% load with treated diesel.

Nitrogen oxides mass rates (g/min) were found to decrease at full load and 80% load with treated diesel.

Sulphur dioxide mass rates (g/min) were found to decrease at full load but increase slightly at 80% load with treated diesel.

Diesel Particulate matter mass rates (g/min) decreased approximately 30% at full load and decreased approximately 50% at 80% load.

Fuel Consumption data (supplied by the Fuel Plus International) showed that fuel usage decreased on average by approximately 30% for the combined full/80% load tests with treated diesel.

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PHOTOGRAPHS

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TEST RESULTS – UNTREATED DIESEL

Date	8/09/2016	Client	Fuel Plus International P/L		
Report	J 1609081	Stack ID	Kipor KDE20SS3 Generator		
Licence No.	NA	Location	22 Station St, Dandenong	State	VIC
Field Staff	WA				
Test Conditions	Untreated Diesel: Test 1 - Full Load, Test 2 - 80% Load				
Fuel Consumption	5.3 L/hour				

Sampling Plane Details		
Sampling plane dimensions (mm) & area	60	0.00283 m²
Sampling port size, number & depth	Sampled at exit	
Access & height of ports	Ground level	1.5 m
Duct orientation & shape	Vertical	Circular
Downstream disturbance	Exit	0 D
Upstream disturbance	Bend	4 D
No. traverses & points sampled	1	2
Traverse method & compliance	AS4323.1	Non-compliant

Exhaust Parameters	Wet	Dry
Moisture content, %v/v	10	
Gas molecular weight, g/g mole	28.6 (wet)	29.9 (dry)
Gas density at 0°C, kg/m³	1.28 (wet)	1.33 (dry)
	Test 1	Test 2
Temperature, °C	135	120
Velocity at sampling plane, m/s	12	10.4
Volumetric flow rate, discharge, m³/min	2.04	1.76
Volumetric flow rate (wet at 0°C), m³/min	1.37	1.23
Volumetric flow rate (dry at 0°C), m³/min	1.23	1.1

Diesel Particulate Matter		Test 1		Test 2	
Sampling time		1010-1012		1230-1232	
		Concentration mg/m³	Mass Rate g/min	Concentration mg/m³	Mass Rate g/min
Elemental carbon		95.5	0.112	23.3	0.0273

Gases		Test 1		Test 2	
Sampling time		0957-1002		1219-1224	
		Concentration ppm	Mass Rate g/min	Concentration ppm	Mass Rate g/min
Nitric oxide		988	2.37	393	0.942
Nitrogen dioxide		33	0.0791	79.3	0.19
Nitrogen oxides		1020	2.44	472	1.13
Sulfur dioxide		<2	<0.0067	3	0.01
Carbon monoxide		336	0.49	298	0.435
		Concentration %		Concentration %	
Carbon dioxide		8.9		6.2	

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TEST RESULTS – TREATED DIESEL

Date	10/09/2016	Client	Fuel Plus International P/L		
Report	J 1609081	Stack ID	Kipor KDE20SS3 Generator		
Licence No.	NA	Location	22 Station St, Dandenong	State	VIC
Field Staff	WA				
Test Conditions	Energen treated diesel: Test 3 - Full Load, Test 4 - 80% Load				
Fuel Consumption	3.7 L/hour				

Sampling Plane Details		
Sampling plane dimensions (mm) & area	60	0.00283 m²
Sampling port size, number & depth	Sampled at exit	
Access & height of ports	Ground level	1.5 m
Duct orientation & shape	Vertical	Circular
Downstream disturbance	Exit	0 D
Upstream disturbance	Bend	4 D
No. traverses & points sampled	1	2
Traverse method & compliance	AS4323.1	Non-compliant

Exhaust Parameters	Wet	Dry
Moisture content, %v/v	10	
Gas molecular weight, g/g mole	28.3 (wet)	29.5 (dry)
Gas density at 0°C, kg/m³	1.26 (wet)	1.32 (dry)
	Test 3	Test 4
Temperature, °C	130	120
Velocity at sampling plane, m/s	8.97	8.04
Volumetric flowrate, discharge, m³/min	1.52	1.37
Volumetric flowrate (wet at 0°C), m³/min	1.03	0.952
Volumetric flowrate (dry at 0°C), m³/min	0.927	0.853

Diesel Particulate Matter		Test 3		Test 4	
Sampling time		1540-1542		1737-1739	
		Concentration mg/m³	Mass Rate g/min	Concentration mg/m³	Mass Rate g/min
Elemental carbon		85.8	0.0764	16.1	0.0144

Gases		Test 3		Test 4	
Sampling time		1529-1534		1729-1734	
		Concentration ppm	Mass Rate g/min	Concentration ppm	Mass Rate g/min
Nitric oxide		959	1.75	284	0.519
Nitrogen dioxide		56	0.102	100	0.183
Nitrogen oxides		1020	1.86	384	0.702
Sulfur dioxide		<2	<0.0051	4.7	0.012
Carbon monoxide		277	0.308	383	0.426
		Concentration %		Concentration %	
Carbon dioxide		9.7		6.5	

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QUALITY ASSURANCE

BELL Laboratories operates to ISO 17025 – General Requirements for the Competence of Testing and Calibration Laboratories. ISO 17025 requires that laboratories have an ISO 9002 compliant quality system. More importantly, it requires that testing laboratories have adequate equipment, as well as laboratory personnel with the technical competence to perform the analytical procedures. The quality assurance system is administered and maintained by the Quality Assurance Manager.

A formal Quality Control program is in place at BELL Laboratories to monitor field sampling activities as well as laboratory analyses. The program is designed to check sampling reproducibility as well as analytical precision & accuracy. The Laboratory Manager is responsible for administration and maintenance of this program.

STATEMENT OF LIMITATIONS

This report has been prepared in accordance with the agreement between BELL Laboratories Pty Ltd and Fuel Plus International Pty Ltd. Within the limitations of the agreed scope of services, this work has been performed in a professional manner, in accordance with generally accepted practices, using a degree of skill and care ordinarily exercised by members of its profession and consulting practice. No other warranty, expressed or implied, is made.

Any reliance on this report by third parties shall be at such parties sole risk and may not contain sufficient information for purposes of other parties or for other uses. This report shall only be presented in full and may not be used to support any other objective than those set out in the report, except where written approval with comments are provided by BELL Laboratories Pty Ltd.

DEFINITIONS

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

<	Less than
NA	Not applicable
NS	Not specified
STP	Standard Temperature & Pressure (25°C, 101.325 kPa)
STEL	Short Term Exposure Limit
TWA	Time Weighted Average, SafeWork Australia
TSP	Total suspended particulate matter
PM_{10}	Particulate matter less than 10 micron
NEPM	National Environment Protection Measure
RH	Relative humidity
CO	Carbon monoxide
CO_2	Carbon dioxide
BP	Barometric pressure
$\mu g/m^3$	Micrograms per cubic metre
mg/m^3	Milligrams per cubic metre
ppb	Parts per billion
ppm	Parts per million
µm	Micrometre
hPa	Hectopascals

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