

MEMORANDUM

To	Kate Sinai, kate.sinai@eriasgroup.com
From	Ricky Gellatly, ricky.gellatly@katestone.com.au
Client name	Erias Group
Deliverable No.	D21049-1
Subject	Generator Emissions Concentration Review
Date	25 October 2021

Dear Kate,

Katestone Environmental Pty Ltd (Katestone) conducted an air quality and greenhouse gas assessment for the Fountain Head Gold Project in March 2021. The Northern Territory Environmental Protection Agency (NTEPA) has reviewed the assessment and has requested that the emissions from the proposed diesel generators be demonstrated to comply with the relevant concentration limits specified in the *Protection of the Environment Operation (Clean Air) Regulation 2010 (NSW)*.

PNX Metals is proposing to install 4 x Aggreko QSK50G4 diesel engines at the mine site (3 x 1,500 kW diesel generators and 1 x 1,500 kW standby unit). Katestone has used emissions data from the technical datasheet for the Aggreko QSK50G4 engine (see Appendix A) to inform emissions calculations assuming stoichiometric combustion of the input diesel fuel to derive pollutant emissions concentrations in the exhaust gas.

These emission concentrations have been compared to the Group 6 emission limits specified in Schedule 4 Standards of Concentration for Scheduled Premises: General Activities and Plant specified in the *Clean Air Regulation*. The table below summarises the emission concentrations of the proposed engines. The key assumptions used to calculate the emission concentrations from the proposed engines are presented in Table 2.

Table 1 A comparison of emission concentrations for proposed engines to the *Clean Air Regulation* Standards of Concentration

Air impurity	Activity of Plant	Concentration ¹	
		Clean Air Regulation	Proposed engines
Nitrogen dioxide (NO ₂) or nitric oxide (NO) or both, as NO ₂ equivalent	Stationary reciprocating internal combustion engines	450 mg/Nm ³	2,520 mg/Nm ³
Volatile organic compounds (VOCs), as n-propane	Stationary reciprocating internal combustion engine using a liquid fuel	1140 mg/Nm ³ VOCs or 5880 mg/Nm ³ CO	39.2 mg/Nm ³ VOCs or 208 mg/Nm ³ CO
Solid particles (Total)	Any activity or plant	50 mg/Nm ³	13 mg/Nm ³
Table note: ¹ Reference conditions are dry, 273K, 101,3kPa, 3% O ₂			

Table 2 Engine Characteristics

Parameter	Units	Value
Diesel fuel consumption	litres/hour	393
Net fuel input	kW	3,903
Gross fuel input	kW	4,166
Electrical output efficiency	%	31.21
Electrical output power	kW	1,300
	kVA	1,625
NOx emission rate	mg/kWh	7,772
Particulate matter emission rate	mg/kWh	40
CO emission rate	mg/kWh	643
VOC emission rate ¹	mg/kWh	121
Table note: ¹ Emission rate of "Unburnt Hydrocarbons" given on technical datasheet		

Table 1 demonstrates that, while the emission concentrations for particulate matter, VOCs and CO will be well below the standard specified in the *Clean Air Regulation*, the emission concentration of NO_x exceeds the limit by more than a factor of five. The proposed engines do not, therefore, adhere to the emissions requirements of the regulation.

Katestone therefore recommends either that an alternative generator model is installed that meets the NO_x emission standard, or that dispersion modelling is carried out to establish whether NO_x emissions from the proposed generators have the potential to result in exceedances of the ambient air quality objectives at nearby sensitive receptors. For any diesel generator to meet the Group 6 NO_x emission limit, it is likely to require secondary abatement technology to be fitted, such as selective catalytic reduction (SCR).

If you have any questions please do not hesitate to contact the undersigned.

Kind regards,

Ricky Gellatly

ATTACHMENT A – ENGINE TECHNICAL DATA SHEET

Generator
QSK50G4 Tier 2 / TPEM Emissions
Regulated (C2 Injectors)

Document No: G080358
 Revision: E
 Created By: A. Stewart
 Approved By: C. Shrive
 Approval Date: 28/11/2013
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Model

Model reference	GN1500GHPEMM; GN1500GHPCON
Model size and rating	1500kVA / 1500kW
Bill of Material reference number	602129, 602141, 602142, 602145, 602154

Manufacturer

Model Reference	NHC20/QSK50G4
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Electrical Output

Electrical Output	Hz (Hz)	50.0	(50)	60.0	(60)
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Performance Data

Maximum Ambient	°C (°F)	45.0	(113)	44.0	(111.2)
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Electrical (ISO 8528-1) *

Continuous Power (COP)	kW (kVA)	1030.0	(1287.5)	1131.0	(1413.75)
Prime Power (PRP)	kW (kVA)	1120.0	(1400)	1300.0	(1625)
Permissible Average of PRP		70%		70%	

Electrical (ISO 3046-1) **

Single Step Load Application		56%		56%	
Fuel Stop Power/Standby	kW (kVA)	1220.0	(1525)	1455.0	(1818.75)

Alternator

Class F Temp Rise (105°C) Three Phase	kW (kVA)	1156.0	(1445)	1380.0	(1725)
Ends Out				6	
Make & Type				Cummins Generator Technologies PE 734C2	
AVR				MX321	
Regulation	%			±0.5	

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ISO references apply to Aggreko Manufacturing built equipment only

* ISO 8528-1 Reciprocating Internal Combustion Engine Driven Alternating Current Generating Sets:

Part 1 - Application, Ratings and Performance

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Generator
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Circuit Breaker

Make & Type	Schneider NW25		
Number of Poles	4		
Rating	Amp (Amp)	2500.0	(2500)
Trip Unit Type	Micrologic 5.0 or Micrologic 6.0		
Overload Protection Range	1000 – 2500 (Adjustable by selector)		
Short Circuit Protection Range	1500 – 25000 (Adjustable by selector)		

Load Terminals

Type	Busbar M12
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Engine

Make & Type	Cummins Diesel QSK50G4 CPL		
Cylinders & Form	V16 60°		
Aspiration	Turbocharged & Low Temperature Aftercooled		
Fuel Pump	Cummins MCRS		
Governor Make & Type	Electronic	Cummins CM2150	
Steady State Frequency	%	±0.25	
Battery Voltage	Volts (Volts)	24.0	(24)

Fuel Consumption as per ISO3046-1

Standby/Fuel Stop (*C2 Injector)	L/hr (US gal/hr)	331.0	(87.384)	393.0	(103.752)
Continuous Power (COP) (*C2 Injector)	L/hr (US gal/hr)	281.0	(74.184)	314.0	(82.896)
100% Prime Power (*C2 Injector)	L/hr (US gal/hr)	304.0	(80.256)	349.0	(92.136)
75% Prime Power (*C2 Injector)	L/hr (US gal/hr)	233.0	(61.512)	278.0	(73.392)
50% Prime Power (*C2 Injector)	L/hr (US gal/hr)	166.0	(43.824)	202.0	(53.328)
Standby/Fuel Stop (C3 Injector)	L/hr (US gal/hr)	325.0	(85.8)	387.0	(102.168)

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	gal/hr)				
Continuous Power (COP) (C3 Injector)	L/hr (US gal/hr)	275.0	(72.6)	306.0	(80.784)
100% Prime Power (C3 Injector)	L/hr (US gal/hr)	299.0	(387.0)	347.0	(91.608)
75% Prime Power (C3 Injector)	L/hr (US gal/hr)	229.0	(60.456)	267.0	(70.488)
50% Prime Power (C3 Injector)	L/hr (US gal/hr)	159.0	(41.976)	186.0	(49.104)
Standby/Fuel Stop (*C2 Injector)	L/kWhe (US gal/kWhe)	0.271	(0.072)	0.270	(0.071)
Continuous Power (COP) (*C2 Injector)	L/kWhe (US gal/kWhe)	0.273	(0.072)	0.278	(0.073)
100% Prime Power (*C2 Injector)	L/kWhe (US gal/kWhe)	0.271	(0.072)	0.68	(0.18)
75% Prime Power (*C2 Injector)	L/kWhe (US gal/kWhe)	0.277	(0.073)	0.285	(0.075)
50% Prime Power (*C2 Injector)	L/kWhe (US gal/kWhe)	0.96	(0.254)	0.311	(0.082)
Standby/Fuel Stop (C3 Injector)	L/kWhe (US gal/kWhe)	0.266	(0.07)	0.266	(0.07)
Continuous Power (COP) (C3 Injector)	L/kWhe (US gal/kWhe)	0.267	(0.071)	0.270	(0.071)
100% Prime Power (C3 Injector)	L/kWhe (US gal/kWhe)	0.267	(0.071)	0.267	(0.071)
75% Prime Power (C3 Injector)	L/kWhe (US gal/kWhe)	0.273	(0.072)	0.274	(0.072)
50% Prime Power (C3 Injector)	L/kWhe (US gal/kWhe)	0.284	(0.075)	0.286	(0.076)

Running Hours

Continuous Power (COP) (*C2 Injector)	Hours (Hours)	4.0	(4.0)	3.6	(3.6)
100% Prime Power (*C2 Injector)	Hours (Hours)	3.7	(3.7)	3.2	(3.2)
75% Prime Power (*C2 Injector)	Hours (Hours)	4.8	(4.8)	4.1	(4.1)
50% Prime Power (*C2 Injector)	Hours (Hours)	6.8	(6.8)	5.6	(5.6)
Continuous Power (COP) (C3 Injector)	Hours (Hours)	4.1	(4.1)	3.7	(3.7)
100% Prime Power (C3 Injector)	Hours (Hours)	3.8	(3.8)	3.3	(3.3)

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75% Prime Power (C3 Injector)	Hours (Hours)	4.9 (4.9)	4.2 (4.2)
50% Prime Power (C3 Injector)	Hours (Hours)	7.1 (7.1)	6.1 (6.1)
*C2 injectors replaced with C3 at first service interval			-

Exhaust Emissions

Measurement Method	Cummins Exhaust Emissions Data Sheet		
Specific Load	100% Prime \pm 2% CPL		
NOx - Oxides of Nitrogen	5.762 g/kWh	7.772 g/kWh	
PM - Particulate Matter	0.054 g/kWh	0.040 g/kWh	
CO - Carbon Monoxide	0.724 g/kWh	0.643 g/kWh	
HC - Unburnt Hydrocarbons	0.147 g/kWh	0.121 g/kWh	
O2 - Oxygen	%	-	

Exhaust Silencer

Make & Type	Industrial & Marine Silencers Box Type
Certificate Number	M-12346
Permissible Back Pressure	6.35 (0.25) mm (ins) Hg

Noise Data

Sound Power - EEC	111 dBA (Lw)	
Certificate Number	R020162	
Sound Pressure at 1m/3ft	85.8 dBA	89.7 dBA
Sound Pressure at 7m/21ft	79.2 dBA	83.3 dBA

Other Capacities and Dimensions

External Fuel Supply - Max Above Base	m (ft)	2.4 (7.874)
External Fuel Supply - Max Below Base	m (ft)	1.5 (4.921)

Physical Characteristics

Length	6.06 m	19.88 ft
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Width	2.44 m	8.01 ft
Height	2.6 m	8.53 ft
Gross Weight	20370 kg	44908.16 lbs
Net Weight	19242 kg	42421.35 lbs
Gross Fuel	1290 lit	340.78 US gal
Net Fuel	1131 lit	298.78 US gal

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