

Report for the Periodic Monitoring of Emissions to Atmosphere

Asgard Renewables Ltd

A1 - 2G Engine

Permit No: EPR/AB3097FU
Installation: Asgard Renewables Cardigan
Monitoring Dates: 16th August 2022
Site Address: Unit 2 Crugmore Farm, Penparc, Cardigan, SA43 1RD

Report Number:	ES-0984	Version:	1	Visit:	1 in 2022
Date of Report:	16th September 2022				
Report Author:	Toby Cambell				
MCERTS No:	MM 03 155	MCERTS Level:	2 (TE1, TE2, TE3, TE4)		
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Executive Summary

Monitoring Objectives

Envirocare Technical Consultancy were contracted by Asgard Renewables Ltd to carry out emissions monitoring, to determine the compliance of A1 - 2G Engine with the conditions specified in the operators permit (EPR/AB3097FU) for emissions to atmosphere. The methodologies utilised and the results obtained form the basis of this report.

The substances requested for monitoring are listed below.

Emission Point Identification

Substances to be Monitored	A1 - 2G Engine
Carbon Monoxide	✓
Oxides of Nitrogen (as NO ₂)	✓
Total VOC	✓
Oxygen	✓
Sulphur Dioxide	✓

Special requirements: none

Opinions and interpretations expressed within this report are outside the scope of Envirocare Technical Consultancy's MCERTS and UKAS accreditation. Envirocare accepts no responsibility for information in this report that was provided by the client, the client's representative or employees of the client. Where such information has been provided by external sources this is identified in footnotes of the respective tables.

Executive Summary

Monitoring Results

where MU = Measurement Uncertainty associated with the result (95% Confidence)

Substance		Concentration			Reference Conditions	Mass Emission			Sampling Date	Sampling Times
		Limit (mg/m³)	Result (mg/m³)	Measurement Uncertainty (MU) +/-		Limit (g/hr)	Result (g/hr)	Measurement Uncertainty (MU) +/-		
Carbon Monoxide	R1	1400	513	5.5	273k, 101.3kPa, Dry, 5% O ₂ .	-	-	-	16/08/2022	10:26-11:26
Oxides of Nitrogen (as NO ₂)	R1	500	987	14.0	273k, 101.3kPa, Dry, 5% O ₂ .	-	-	-	16/08/2022	10:26-11:26
Total VOC	R1	1000	731	13.6	273k, 101.3kPa, Dry, 5% O ₂ .	-	-	-	16/08/2022	10:26-11:26
Oxygen	R1	-	7.8%	0.14	273k, 101.3kPa, Dry, 5% O ₂ .	-	-	-	16/08/2022	10:26-11:26
Sulphur Dioxide	R1	350	206	16.0	273k, 101.3kPa, Dry, 5% O ₂ .	-	-	-	16/08/2022	10:27-11:27

Reference conditions (REF) are: 273k, 101.3kPa, Dry Gas, 5% Oxygen.

Supporting Information

Appendix 1: General Information

Operating Information

Parameter	Process Details
Process Type	Engine
Continuous or Batch Process	Continuous
Operating Status	Normal
Feedstock	Bio Gas
Normal Load, Throughput or Continuous Rating	Normal 500kWhr
Abatement System	None
Abatement System Status	None
Process Fuel	Bio Gas
Plume Appearance	None

Monitoring Deviations

Parameter	Run	Deviation
All Parameters	Run 1	There are no deviations associated with the monitoring undertaken.

Monitoring Organisation Staff Details

Personnel	Position	MCERTS Level	MCERTS Number
Mr R Bromwell	Team Leader	2 (TE1, TE4)	MM 20 1592
Mr T Campbell	Director	2 (TE1, TE2, TE3, TE4)	MM 03 155
Mr M Knapton	Technician	Trainee	TBC

Monitoring Methods

Pollutant Species	Standard	Technical Procedure	Testing MCERTS	Analysis Laboratory	Analytical Procedure	Analytical Technique	Analysis MCERTS
Sulphur Dioxide	BS EN 14791	ETC-SE-14	Yes	RPS	C27(U)	IC	Yes
Carbon Monoxide	BS EN 15058	ETC-SE-10 (a/b)	Yes	NDIR by Horiba PG-250 or PG350E			
Oxides of Nitrogen	BS EN 14792	ETC-SE-10 (a/b)	Yes	Chemiluminescence by Horiba PG-250 or Horiba PG-350			
Oxygen	BS EN 14789	ETC-SE-10 (a/b)	Yes	Dry Zirconia Cell by Horiba PG-250 or Dry Paramagnetic by Horiba PG-350E			
Total VOC	BS EN 12619	ETC-SE-04	Yes	Flame Ionisation Detector by M&C Thermo FID or Sick 3006 FID			

RPS Laboratories Ltd (RPS) - Accreditation Number: 0605 | Marchwood Scientific Services - Accreditation Number: 1668 | Olfasense - Accreditation Number: 2430

Equipment Checklist

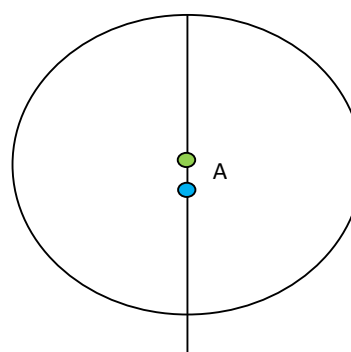
Extractive Sampling		Instrumental Analysers		Miscellaneous Items	
Equipment Type	Equipment I.D.	Equipment Type	Equipment I.D.	Equipment Type	Equipment I.D.
Control Box DGM	ETC-S8.03 /8.05(b)	Horiba PG-250	-	Tape Measure	ETC-S17.02
Box Thermocouples	ETC-S2.03a	Horiba PG-250 SRM	ETC-S12.05	Bevel Box	-
Box Thermocouple In	ETC-S3.21	Horiba PG-350	ETC-S12.03	Stopwatch	ETC-S10.03/10.11
Box Thermocouple Out	ETC-S3.24	JCT JCC Cooler	-	Barometer	ETC-S11.04
Control Box Timer	ETC-S10.03	MAK10 Cooler	-	Digital Manometer	ETC-S24.a/b
Umbilical	ETC-S2.3	Horiba PS200 Cooler	-	Digital Temperature Meter	ETC-S24.a/b
Oven Box	ETC-S9.04	M&C PSS Gas Preparation	ETC-S3.42b	Dual Channel Heat Controller	-
Heated Probe (1)	ETC-S4.05	Gasmet DX4000 FTIR	-	1m Heated Line	-
Heated Probe (2)	ETC-S4.06	Gasmet Sampling System	-	3m Heated Line	-
Stack Thermocouple (1)	ETC-S4670	SK-Thermo FID	ETC-S13.02	5m Heated Line	ETC-S5.09
Stack Thermocouple (2)	ETC-S4.05	Bernath 3006 FID	-	10m Heated Line	ETC-S5.02
S-Type Pitot (1)	ETC-S4670	Testo 350XL	-	20m Heated Line	ETC-S5.11
S-Type Pitot (2)	ETC-S10-17-19-4	M&C PSP 4000	ETC-S7.03	30m Heated Line	-
L-Type Pitot	ETC-SL-Type 03	Easylogger EN-EL-12 Bit	-	Impinger Arm Thermocouple (1)	ETC-S3.05
Site Balance	ETC-S18.06	Hioki 5043 (V)	-	Impinger Arm Thermocouple (2)	ETC-S3.09
500g Check Weight	ETC-S18.06 500g	Analyser Temperature Logger	-	Dioxins Kit Thermocouple	-
1KG Check Weight	ETC-S18.06 1kg	-	-	Sample Temperature Logger	-

Appendix 2: A1 - 2G Engine Results and Calculations

Picture of the sampling location



Sampling Points Diagram



Sampling Line

- = Isokinetic sampling point
- = Isokinetic point not sampled
- = Non-Isokinetic sampling point
- = Combustion Gases, VOC Sampling point

Duct Characteristics

Parameter	Units	Value
Type	-	Circular
Depth	m	-
Width	m	-
Area	m ²	-
Port Depth	cm	5.0
Orientation of Stack / Duct	-	Angled
Sampling Port Size	-	1" BSP
Number of Ports	-	1

Manual Sampling Points	Used / Required
Number of Sampling Lines	1 / 1
Number of Sampling Points	1 / 1
Instrumental Sampling Points	Used / Required
Number of Sampling Lines	1 / 1
Number of Sampling Points	1 / 1

Platform Type and Location	
Platform Type - Permanent / Temporary	Permanent
Location - Inside / Outside	Inside

EA Technical Guidance Note M1 Platform Requirements		
Load Baring Capacity	Load bearing capacity of platform sufficient to fulfil the measurement objective	N/A
Position & Work Space	Sufficient work area to manipulate probe & operate the measurement instruments	Yes
	Depth of work area > internal diameter of stack and wall thickness plus 1.5m	N/A
	Ports on vertical ducts 1.2m to 1.5m above platform floor	N/A
	Platform has chains / self closing gates at top of ladders	N/A
Fall Prevention	Platform has adequate drainage to prevent accumulation of free-standing water	N/A
	Platform has 2 levels of handrails (approx. 0.5m & 1.0m high)	N/A
	Gaps between handrails not >0,5m	N/A
Access	Platform has vertical base boards (approx. 0.25m high)	N/A
	Access to sampling ports unhindered by obstructions	Yes
	Easy & safe access and egress available	Yes

Sampling Location / Platform Recommendations

All sampling platforms should be designed in accordance with the requirements specified in Environment Agency Guidance Note M1 and BS EN 15259.

Instrumental Gas Analyser Calibrations

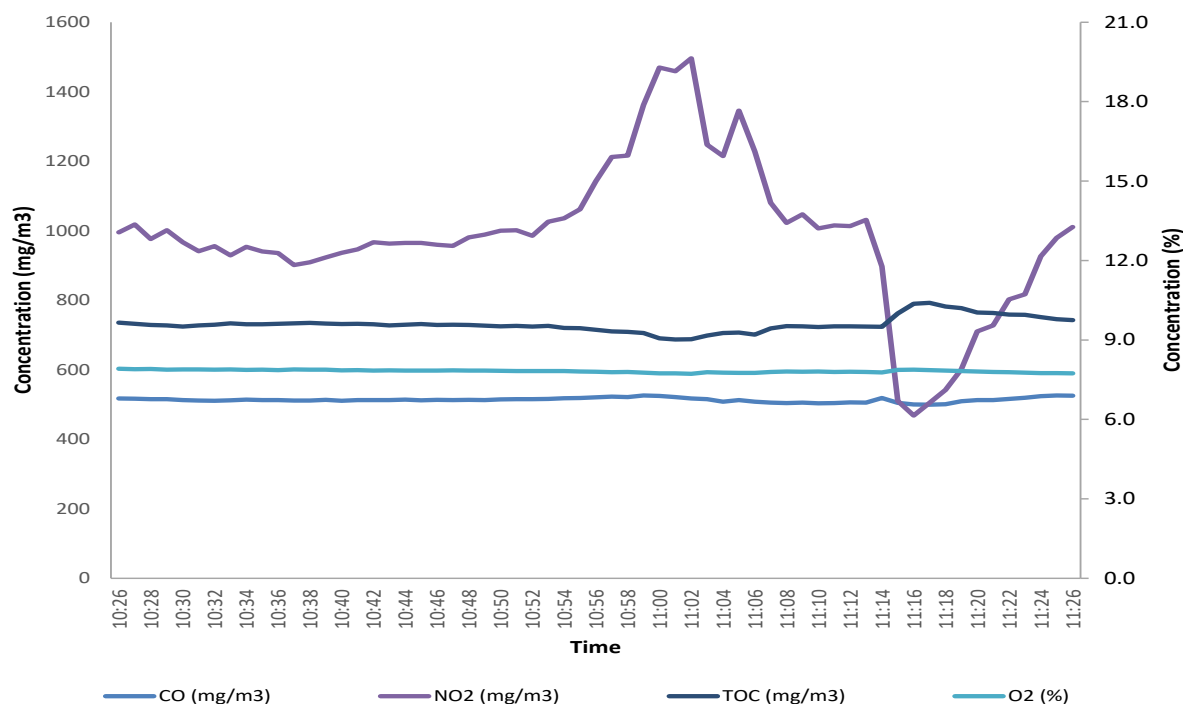
Date	Operators	Combustion Gas Analyser	Flame Ionisation Detector
16/08/2022	IB/RB	ETC-S12.03	ETC-S13.02

Calibration Gas	Certified Concentration	Analyser Range	T90 Time	Analyser Span	Pre-sample Cal		Post-sample Cal		Zero Drift	Span Drift	Drift Acceptable
					Zero	Span	Zero	Span			
Carbon Monoxide	158.94ppm	200ppm	70	159.1	0.30	159.1	0.10	158.2	0.07	-0.64	Yes
Nitrogen Monoxide	198.28ppm	250ppm	70	198.38	0.30	198.38	0.30	195.1	0.15	-1.8	Yes
Propane	79.94ppm	1000ppm	65	79.9	0.06	78.6	-0.03	78.8	-0.06	-1.3	Yes
Oxygen	20.9%	25%	50	20.91	-0.03	20.91	-0.01	20.81	-0.05	-0.4	Yes

Instrumental Gas Analyser Results

Substance	Run	Corrected Concentration			Units	Basis	O ₂ Correction
		Average	Max	Min			
Carbon Monoxide	1	513.3	526.0	499.4	mg/m ³	-	5%
Oxides of Nitrogen (as NO ₂)	1	986.73	1496.20	467.96	mg/m ³	NO _x as NO ₂	5%
Total VOC	1	730.6	792.6	686.8	mg/m ³	VOC as C	5%
Oxygen	1	7.82	7.91	7.72	%	-	-

Instrumental Gas Analyser Chart - Run 1



Sulphur Dioxide - Run 1 Calculations

Sampling Details		
Meter Box Number	S8.04	-
Gas Meter Coefficient	0.975	-
Pitot Coefficient	-	-
Stack Gas Molecular Weight	29.44	g/mole
Static Pressure in Stack	-0.13	cmH ₂ O

Analysis Details		
Collection Media	H2O2	
1st Collector Reference	Imp A&B	
1st Collector Concentration	14509.28	µg
2nd Collector Reference	Imp C	
2nd Collector Concentration	6320.82	µg
Blank Concentration	<0.14	mg/Nm ³
Has breakthrough occurred?	Yes	-

Isokineticity Details		
Nozzle Diameter	-	mm
Average Gas Meter Temperature	19.1	°C
Average Stack Temperature	400	°C
Average Stack Velocity	-	m/s
Isokineticity	-	%

Date	Operators
16/08/2022	RB/MK

Parameter	Before	After	Unit
Barometric Pressure	1011	1011	mbar
Ambient Temperature	16.0	16.0	°C
Leak Check	0.00	-	L/min
Time	10:27	11:27	-

Emissions Calculations		
Total Sampling Time	60.0	min
Gas Meter Difference	135.0	L
Corrected Gas Meter Volume	131.6	L
Mean Sampling Rate	2.19	L/min
Gas Meter Volume (STP Dry)	0.123	Nm ³
Gas Meter Volume (REF)	0.101	Nm ³
Stack Gas Water Vapour Content	13.0	% v/v
Stack Gas Oxygen Content	7.9	% v/v
Emission Limit Value	350	mg/Nm ³
SO ₂ Concentration (REF)	206	mg/Nm ³
SO ₂ Mass Emissions (REF)	-	g/hr

Reference conditions (REF) are: 273k, 101.3kPa, Dry, 5% O₂.

Uncertainty

Uncertainty of Carbon Monoxide by Horiba Analyser

Parameter	Value	Unit
Emission Limit Value (ELV)	1400	mg/m ³
Reading	410.6	ppm
Span Gas Certified Value	158.9	ppm
Range	200	ppm

Cal Gas
CO

Source of Uncertainty	Uncertainty Criteria	Probability Distribution	Divisor	Source Uncertainty u	Combined Uncertainty u ²
Zero Drift/Lower limit of detection (ppm)	-0.20	Rectangular	1.7	-0.12	0.01
Span Drift (ppm)	0.90	Rectangular	1.7	0.52	0.27
Linearity (% of value)	0.46	Rectangular	1.7	1.1	1.2
Setting Gas Divider (% of value)	0.35	Normal	1.0	1.4	2.1
Interference (% of value)	-0.48	Rectangular	1.7	-1.1	1.3
Standard deviation of repeatability at zero point (% of range)	0.10	Rectangular	-	0.20	0.04
Standard deviation of repeatability at span point (% of range)	0.20	Rectangular	-	0.40	0.16
Total					5.0
Combined Standard Uncertainty [(sum u²)^{0.5}]					2.2
Expanded Total Uncertainty (ppm) (95% confidence)					4.4
Expanded Total Uncertainty as a % of emission conc. (95% confidence)					1.1
Expanded Total Uncertainty (mg/m³) (95% confidence)					5.5
Expanded Total Uncertainty as a % of emission limit value (95% confidence)					0.39

Uncertainty of Oxides of Nitrogen by Horiba gas Analyser

Parameter	Value	Unit
Emission Limit Value (ELV)	500	mg/m ³
Reading	480.7	ppm
Span Gas Certified Value	198.3	ppm
Range	250	ppm

Cal Gas
NO

Source of Uncertainty	Uncertainty Criteria	Probability Distribution	Divisor	Source Uncertainty u	Combined Uncertainty u ²
Zero Drift/Lower limit of detection (ppm)	-0.20	Rectangular	1.7	-0.1	0.0
Span Drift (ppm)	3.3	Rectangular	1.7	1.9	3.6
Linearity (% of value)	0.58	Rectangular	1.7	1.6	2.6
Setting Gas Divider (% of value)	0.35	Normal	1.0	1.7	2.8
Interference (% of value)	0.63	Rectangular	1.7	1.7	3.1
Standard deviation of repeatability at zero point (% of range)	0.00	Rectangular	-	0.00	0.00
Standard deviation of repeatability at span point (% of range)	0.10	Rectangular	-	0.25	0.06
Total					12.1
Combined Standard Uncertainty [(sum u²)^{0.5}]					3.5
Expanded Total Uncertainty (ppm) (95% confidence)					6.8
Expanded Total Uncertainty as a % of emission conc. (95% confidence)					1.4
Expanded Total Uncertainty (mg/m³) (95% confidence)					14.0
Expanded Total Uncertainty as a % of emission limit value (95% confidence)					2.8

Uncertainty of Total VOC by SK - Run 1

Parameter	Value	Unit
Emission Limit Value (ELV)	1000	mg/m ³
Reading	454.5	ppm
Span Gas Certified Value	79.9	ppm
Range	1000	ppm

Cal Gas
C ₃ H ₈

Source of Uncertainty	Uncertainty Criteria	Probability Distribution	Divisor	Source Uncertainty u	Combined Uncertainty u ²
Zero Drift/Lower limit of detection (ppm)	0.09	Rectangular	1.7	0.05	0.003
Span Drift (ppm)	-0.20	Rectangular	1.7	-0.12	0.01
Linearity (% of value)	0.41	Rectangular	1.7	1.1	1.2
Setting Gas Divider (% of value)	0.35	Normal	1.0	1.6	2.5
Noise (ppm)	0.10	Rectangular	1.7	0.06	0.003
Temperature Drift (% of value)	1.0	Rectangular	1.7	2.6	6.9
Standard deviation of repeatability at zero point (% of range)	0.20	Rectangular	-	2.0	4.0
Standard deviation of repeatability at span point (% of range)	0.20	Rectangular	-	2.0	4.0
Total					18.6
Combined Standard Uncertainty [(sum u²)^{0.5}]					4.3
Expanded Total Uncertainty (ppm) (95% confidence)					8.5
Expanded Total Uncertainty as a % of emission conc. (95% confidence)					1.9
Expanded Total Uncertainty (mg/m³) (95% confidence)					13.6
Expanded Total Uncertainty as a % of emission limit value (95% confidence)					1.4

Uncertainty of Oxygen by Horiba Analyser

Parameter	Value	Unit
Reading	7.82	%
Span Gas Certified Value	20.90	%
Range	25	%

Cal Gas
O ₂

Source of Uncertainty	Uncertainty Criteria	Probability Distribution	Divisor	Source Uncertainty u	Combined Uncertainty u ²
Zero Drift/Lower limit of detection (%vol)	0.05	Rectangular	1.7	0.03	0.001
Span Drift (%vol)	0.10	Rectangular	1.7	0.06	0.003
Linearity (% of value)	0.24	Rectangular	1.7	0.01	0.0001
Setting Gas Divider (% of value)	0.35	Normal	1.0	0.03	0.001
Interference (% of value)	0.00	Rectangular	1.7	0.00	0.00
Standard deviation of repeatability at zero point (% of range)	0.02	Rectangular	-	0.01	0.00003
Standard deviation of repeatability at span point (% of range)	0.02	Rectangular	-	0.01	0.00003
Total					0.01
Combined Standard Uncertainty [(sum u²)^{0.5}]					0.07
Expanded Total Uncertainty (%) (95% confidence)					0.14
Expanded Total Uncertainty as a % of emission conc. (95% confidence)					1.8

Uncertainty of Sulphur Dioxide - Run 1

Parameter	Value	Unit
Emission Limit Value (ELV)	350	mg/m ³
Mean Sampling Rate	2.2	L/min
Leak Rate	0.00	L/min
Barometric Pressure	1011	mbar
Average Stack Temperature	400	°C
Sampled Stack Gas Volume	135.0	L

Parameter	Value	Unit
Mean Emission Concentration	206.40	mg/m ³
Monitoring Duration	60	min
Console ID	S8.04	-
Temperature Uncertainty	0.24	°C
Gas Meter Uncertainty	0.37	%
Barometer Uncertainty	1.0	mbar

Source of Uncertainty	ASD*	BS EN 14791		Envirocare Certified Value	Units	% Actual Value	Source Uncertainty u	Combined Uncertainty u ²
		Uncertainty Criteria	Max. Value					
Analysis Procedure	Std	<2.5% of measured value	-	7.7	%	3.9	8.1	65.7
Leak Rate	Rect	<2% of sampling rate	0.04	0.00	L/min	0.00	0.00	0.00
Time	Std	1sec in 1hour = 0.028%	2.0	1.0	sec	0.03	0.06	0.003
Gasmeter Volume	Std	<2.5% volume of gas	3.4	0.50	L	0.37	0.76	0.58
Temperature	Std	<1% absolute temperature	6.7	0.24	°C	0.04	0.07	0.01
Pressure	Std	<1% absolute pressure	10.1	1.0	mbar	0.10	0.20	0.04
Total								66.4
Combined Standard Uncertainty [(sum u²)^{0.5}]								8.1
Expanded Total Uncertainty as a % of emission conc. (95% confidence)								7.7
Expanded Total Uncertainty (mg/m³) (95% confidence)								16.0
Expanded Total Uncertainty as a % of emission limit value (95% confidence)								4.6

Document Version Number	Record of change within different version numbers
V1	Original version of the document issued to client.