Element, Unit C6, Emery Court, The Embankment Business Park, Heaton Mersey, Stockport, SK4 3GL
Your Element Contact: David Guy (+44 (0)7827 156 007)
E: david.guy@element.com

Stack Emissions Testing Report Commissioned by
Asgard Renewables Ltd

Installation Name & Address
Asgard Renewables Ltd
Unit 2
Crugmore Farm
Penparc
Cardigan
SA43 1RD

EPR Permit: EPR/AB3097FU

Stack Reference
A1 Engine 1 500kWe

Dates of the Monitoring Campaign
19th March 2025

Job Reference Number
EMT12532

Report Written by
Craig Harley Senior Team Leader MCERTS Level 2 MM 05 670 TE1 TE2 TE3 TE4

Report Approved by
Darragh Long Reporting Manager MCERTS Level 2 MM 18 1494 TE1 TE2 TE3 TE4

Report Date
2nd April 2025

Version
Version 1

Signature of Report Approver


CONTENTS

Opinions and interpretations expressed herein are outside the scope of Element's ISO 17025 accreditation.

MONITORING OBJECTIVES

Asgard Renewables Ltd, Cardigan
A1 Engine 1 500kWe
19th March 2025

Overall Aim of the Monitoring Campaign

Element were commissioned by Asgard Renewables Ltd to carry out stack emissions testing on the A1 Engine 1 500kWe at Cardigan.

The aim of the monitoring campaign was to demonstrate compliance with a set of emission limit values (ELVs) as specified in the Site's Permit.

Special Requirements

There were no special requirements.

Target Parameters

Sulphur Dioxide, Total VOCs (as Carbon), Oxides of Nitrogen (as NO_2), Carbon Monoxide

MONITORING RESULTS

Asgard Renewables Ltd, Cardigan
A1 Engine 1 500kWe
19th March 2025

where MU = Measurement Uncertainty associated with the Result

		Concentration		
Parameter	**Units**	**Result**	**MU +/-**	**Limit**
Sulphur Dioxide [1]	mg/m³	71.6	4.2	350
Total VOCs (as Carbon) [1]	mg/m³	948	56.2	1000
Oxides of Nitrogen (as NO_2) [1]	mg/m³	241	12.6	500
Carbon Monoxide [1]	mg/m³	561	30.7	1400
Oxygen	% v/v	**Dry** 8.3	0.36	
Water Vapour	% v/v	16.9	0.70	

[1] Reference Conditions (REF) are: 273K, 101.3kPa, dry gas, 5% oxygen.

MONITORING DATE(S) & TIMES

Asgard Renewables Ltd, Cardigan
A1 Engine 1 500kWe
19th March 2025

Parameter		Units	Concentration		Sampling Date(s)	Sampling Times	Duration mins
Sulphur Dioxide	R1	mg/m³	71.6		19/03/2025	10:55 - 11:55	60
Total VOCs (as Carbon)	R1	mg/m³	948		19/03/2025	10:55 - 11:55	60
Oxides of Nitrogen (as NO_2)	R1	mg/m³	241		19/03/2025	10:55 - 11:55	60
Carbon Monoxide	R1	mg/m³	561		19/03/2025	10:55 - 11:55	60
Oxygen	R1	% v/v	8.3		19/03/2025	10:55 - 11:55	60

All results are expressed at the respective reference conditions.

PROCESS DETAILS

Asgard Renewables Ltd, Cardigan
A1 Engine 1 500kWe
19th March 2025

Standard Operating Conditions

Parameter	Value
Process Status	Operational
Capacity (of 100%) and Tonnes / Hour	100% ~ 500Kw/h
Continuous or Batch Process	Continuous
Feedstock (if applicable)	N/A
Abatement System	None
Abatement System Running Status	N/A
Fuel	Bio-Gas
Plume Appearance	None Visible

MONITORING & ANALYTICAL METHODS

Asgard Renewables Ltd, Cardigan
A1 Engine 1 500kWe
19th March 2025

	Monitoring				Analysis					
Parameter	**Standard**	**Technical Procedure**	**Sampling Status**	**Testing Lab**	**Analytical Procedure**	**Analytical Technique**	**Analysis Status**	**Analysis Lab**	**Overall Status**	**LOD (Average)**
Sulphur Dioxide	EN 14791	MD 009	MCERTS	EET	MD 101	IC	MCERTS	EET	MCERTS	0.36 mg/m³
Water Vapour	EN 14790	MD 005	MCERTS	EET	MD 005	Gravimetric	MCERTS	EET	MCERTS	0.10 % v/v
Total VOCs (as Carbon)	EN 12619:2013	MD 020	MCERTS	EET	Flame Ionisation Detection by Sick 3006				MCERTS	0.32 mg/m³
Oxides of Nitrogen (as NO_2)	EN 14792	MD 039	MCERTS	EET	Chemiluminescence by Horiba PG-350E				MCERTS	0.41 mg/m³
Carbon Monoxide	EN 15058	MD 039	MCERTS	EET	NDIR by Horiba PG-350E				MCERTS	0.35 mg/m³
Oxygen	EN 14789	MD 039	MCERTS	EET	Dry Paramagnetic Cell by Horiba PG-350E				MCERTS	0.1 %

ANALYSIS LABORATORIES

(with short name reference as appears in the table above)

Element (Stockport Lab - EET)	ISO 17025 Accreditation Number: UKAS 4279

SUMMARY OF SAMPLING DEVIATIONS

Parameter	Run	Deviation
All	All Runs	There are no deviations associated with the sampling employed.

SUITABILITY OF SAMPLING LOCATION

Duct Characteristics

Parameter	Units	Value
Type	-	Circular
Depth	m	0.30
Width	m	-
Area	m^2	0.07
Port Depth	cm	9
Orientation of Duct	-	Vertical
Number of Ports	-	2
Sample Port Size	-	2" BSP

Location of Sampling Platform

General Platform Information	Value
Permanent / Temporary Platform	On Ground
Inside / Outside	Inside

Platform Details

EA Technical Guidance Note M1 / EN 15259 Platform Requirements	Value
Sufficient working area to manipulate probe and operate the measuring instruments	Yes
Platform has 2 levels of handrails (approx. 0.5m & 1.0m high)	N/A
Platform has vertical base boards (approx. 0.25m high)	N/A
Platform has chains / self closing gates at top of ladders	N/A
There are no obstructions present which hamper insertion of sampling equipment	Yes
Safe Access Available	Yes
Easy Access Available	Yes

Sampling Location / Platform Improvement Recommendations

Due to the nature of the access into the duct, it is not possible to conduct a full velocity profile, however no particulate phase sampling was required and all gaseous species were considered to be mixed sufficiently for the purposes of these tests. There is also no requirement to undertake a homogeneity test as per EN 15259 and as such the location cannot be compared against that or the criteria within TGN M1. The sampling location used in this instance has been approved for use by the Environment Agency.

EN 15259 Homogeneity Test Requirements

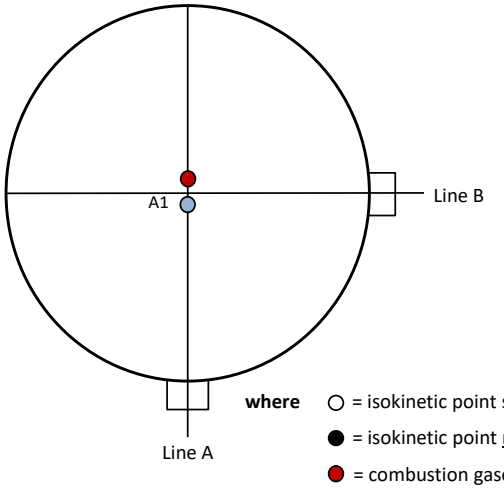
There is no requirement to perform a EN 15259 Homogeneity Test on this Stack.

PLANT PHOTOS

Photo 1

Photo 2

SAMPLE POINTS



where
○ = isokinetic point sampled at
● = isokinetic point not sampled at
● = combustion gases sample point
● = non-isokinetic sample point

APPENDIX CONTENTS

STACK EMISSIONS MONITORING PERSONNEL

Position	Name	MCERTS Accreditation	MCERTS Number	Technical Endorsements
Team Leader	Craig Harley	MCERTS Level 2	MM 05 670	TE1 TE2 TE3 TE4
Technician	Samuel Summers	MCERTS Level 1	MM 23 1795	TE1 TE2 & TE3

LIST OF EQUIPMENT

Extractive Sampling	
Equipment Type	**Equipment I.D.**
Control Box DGM (1)	-
Control Box DGM (2)	-
Box Thermocouples (1)	-
Box Thermocouples (2)	-
Umbilical (1)	-
Umbilical (2)	-
Oven Box (1)	-
Oven Box (2)	-
Heated Probe (1)	-
Heated Probe (2)	-
Heated Probe (3)	-
S-Pitot (1)	-
S-Pitot (2)	-
L-Pitot	-
Site Balance	CAT 17.111
500g / 1Kg Check Weights	CAT 17.111
Last Impinger Arm	CAT 4.1130
Callipers	CAT 23.50
Tubes Kit Thermocouple	-

Instrumental Analysers	
Equipment Type	**Equipment I.D.**
Horiba PG-350E	CAT 39.25
Horiba PG-250 SRM	-
Servomex 5200 MP	-
Eco Physics CLD 822Mh	-
ABB AO2020-URAS26	-
Testo 350 XL	-
JCT JCC P1 Cooler	CAT 4.44
Gasmet DX4000	-
Gasmet Sampling System	-
Sick 3006	CAT 8.13
M&C PSS	-
Mass Flow Controller (1)	CAT 6.34
Mass Flow Controller (2)	CAT 6.35
Mass View (1)	CAT 25.13
Mass View (2)	CAT 25.14
Hioki 5043 (V)	CAT 11.99
Hioki 5043 (V)	-
Bioaerosols Temperature Logger	-
Electronic Refrigerator	-

Miscellaneous Items	
Equipment Type	**Equipment I.D.**
Digital Manometer (1)	CAT 3.228
Digital Manometer (2)	CAT 3.177
Digital Temperature Meter	CAT 3.228
Stopwatch	-
Barometer	CAT 13.46
Stack Thermocouple (1)	CAT 4.1661
Stack Thermocouple (2)	-
Stack Thermocouple (3)	-
1m Heated Line (1)	-
1m Heated Line (2)	-
1m Heated Line (3)	-
5m Heated Line (1)	-
15m Heated Line (1)	CAT 20.83
20m Heated Line (1)	-
20m Heated Line (2)	-
Dual Channel Heater Controller	-
Single Channel Heater Controller	-
Laboratory Balance	
Tape Measure	CAT 16.22

METHODS & TECHNICAL PROCEDURES USED

Parameter	Standard	Technical Procedure
Sulphur Dioxide	EN 14791	MD 009
Water Vapour	EN 14790	MD 005
Total VOCs (as Carbon)	EN 12619:2013	MD 020
Oxides of Nitrogen (as NO_2)	EN 14792	MD 039
Carbon Monoxide	EN 15058	MD 039
Oxygen	EN 14789	MD 039

SULPHUR DIOXIDE: RESULTS SUMMARY

Asgard Renewables Ltd, Cardigan

A1 Engine 1 500kWe

Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m³	71.6		71.6
Uncertainty	±mg/m³	4.2		4.2

Parameter	Units	Run 1		Mean
Water Vapour	% v/v	16.9		16.9
Uncertainty	±% v/v	0.70		0.70

Blank Runs

Parameter	Units	Blank 1		Maximum
Concentration	mg/m³	< 0.24		< 0.24

General Sampling Information

Parameter	Value	
Standard	EN 14791	
Technical Procedure	MD 009	
Name of Analytical Laboratory	EET	
Analytical Laboratory's Procedure	MD 101	
ISO 17025 Accredited Analysis?	MCERTS	
Date of Sample Analysis	26/03/2024	
Probe Material	Titanium	
Filter Housing Material	Titanium	
Impinger Material	Polyethylene	
Absorption Solution	0.3% Hydrogen Peroxide	
Positioning of Filter	Out Stack Heated Head	
Filter Size and Material	0.1µm Glass Fibre	
Number of Sampling Lines Used	1/1	FORMAT: Number Used / Number Required
Number of Sampling Points Used	1/1	FORMAT: Number Used / Number Required
Sample Point I.D.'s	A1	

Reference Conditions

Reference Conditions are: 273K, 101.3kPa, dry gas, 5% oxygen.

SULPHUR DIOXIDE: SAMPLING DETAILS

Sample Runs

Parameter	Units	Run 1
Sampling Times	-	10:55 - 11:55
Sampling Dates	-	19/03/2025
Sampling Device	-	MFC / MV
Duration	mins	60
Volume Sampled (STP, Dry)	m^3	0.0785
Volume Sampled (STP, Wet)	m^3	0.0945
Volume Sampled (REF)	m^3	0.0625
Sample Flow Rate	l/min	1.29
Laboratory Result for Front Impingers	µg/ml	14.56
Laboratory Result for Back Impinger	µg/ml	< 0.05
Volume in Front Impingers	ml	306.6
Volume in Back Impinger	ml	143.7
Mass in Front Impingers	µg	4464.1
Mass in Back Impinger	µg	< 7.2
Total Mass Collected	µg	4471.3
Calculated Concentration	mg/m^3	71.57
Liquid Trap Start Mass	g	1552.3
Liquid Trap End Mass	g	1564.0
Silica Trap Start Mass	g	1631.4
Silica Trap End Mass	g	1632.5
Total Mass Of Water Vapour	g	12.8
Calculated Water Vapour	% v/v	16.88

Where: MFC stands for Mass Flow Controller, MV stands for Mass View Flowmeter

Blank Runs

Parameter	Units	Blank 1
Blank Dates	-	19/03/2025
Average Volume Sampled (REF)	m^3	0.0625
Laboratory Result for Impingers	µg/ml	< 0.05
Volume in Impingers	ml	298.9
Total Mass Collected	µg	< 14.9
Calculated Concentration	mg/m^3	< 0.24

SULPHUR DIOXIDE: QUALITY ASSURANCE

Sample Runs

Leak Test Results	Units	Run 1
Mean Sampling Rate	l/min	1.3
Pre-Sampling Leak Rate	l/min	0.00
Post-Sampling Leak Rate	l/min	0.00
Allowable Leak Rate	l/min	0.03
Leak Test Acceptable	-	Yes

Absorption Efficiency	Units	Run 1
Absorption Efficiency	%	100.0
Allowable Absorption Efficiency	%	N/A [2]
Absorption Efficiency Acceptable	-	Yes [2]

[2] The concentration is less than 30% of the ELV, therefore no assessment against an allowable efficiency is required.

Water Droplets	Units	Run 1
Are Water Droplets Present	-	No

MU (Concurrent Water Vapour)	Units	Run 1
Measurement Uncertainty (MU)	%	4.1
Allowable MU	%	20.0
MU Acceptable	%	Yes

Silica Gel (Concurrent Water Vapour)	Units	Run 1
Less than 50% Faded	%	Yes

Test Conditions	Units	Run 1
Ambient Temperature Recorded?	-	Yes

Blank Runs

Leak Test Results	Units	Blank 1
Expected Sampling Rate	l/min	1.5
Pre-Sampling Leak Rate	l/min	0.00
Post-Sampling Leak Rate	l/min	0.00
Allowable Leak Rate	l/min	0.03
Leak Test Acceptable	-	Yes

Validity of Blank vs ELV	Units	Blank 1
Allowable Blank	mg/m³	35.0
Blank Acceptable	-	Yes

Method Deviations

Nature of Deviation (x = deviation applies to the associated run, wx = deviation also applies to the concurrent water vapour run)	Run Number 1
There are no deviations associated with the sampling employed.	wx

SULPHUR DIOXIDE: MEASUREMENT UNCERTAINTY CALCULATIONS

	Value			Standard uncertainty			
Measured Quantities	**Symbol**	**Run 1**		**Symbol**	**Units**	**Run 1**	
Sampled Volume (STP)	V_m	0.0785		uV_m	m^3	0.0016	
Leak	L	0.00		uL	%	-	
Laboratory Result	L_r	0.90		uL_r	%	-	

	Uncertainty as a Percentage			
Measured Quantities	**Units**	**Run 1**		**Requirement of Standard**
Sampled Volume (STP)	%	2.00		≤2%
Leak	%	0.00		≤2%
Laboratory Result	%	0.90		No Requirement

	Uncertainty in Measurement Units				Sensitivity Coefficient	
Measured Quantities	**Symbol**	**Units**	**Run 1**		**Run 1**	
Sampled Volume (STP)	V_m	m^3	0.0785		911.34	
Leak	L	mg/m^3	0.000		1.00	
Laboratory Result	L_r	mg/m^3	0.644		1.00	

	Uncertainty in Result		
Measured Quantities	**Units**	**Run 1**	
Sampled Volume (STP)	mg/m^3	1.431	
Leak	mg/m^3	0.0000	
Laboratory Result	mg/m^3	0.6441	

	Oxygen Correction Part of MU Budget		
Measured Quantities	**Units**	**Run 1**	
O_2 Correction Factor	-	1.26	
Stack Gas O_2 Content	% v/v	8.27	
MU for O_2 Correction	-	0.05	
Overall MU For O_2 Measurement	%	3.93	

Parameter	**Units**	**Run 1**
Combined uncertainty	mg/m^3	1.57
Expanded uncertainty (95% confidence), without Oxygen Correction	mg/m^3	3.08
Expanded uncertainty (95% confidence), with Oxygen Correction	mg/m^3	4.17
Expanded uncertainty (95% confidence), estimated with Method Deviations	mg/m^3	4.17
Reported Uncertainty	mg/m^3	4.17
Expanded uncertainty (95% confidence), without Oxygen Correction	%	4.3
Expanded uncertainty (95% confidence), with Oxygen Correction	%	5.8
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	5.8
Reported Uncertainty	%	5.8
Reported Uncertainty as % of ELV	%	1.2

TOTAL VOCs (as CARBON): RESULTS SUMMARY

Asgard Renewables Ltd, Cardigan
A1 Engine 1 500kWe

Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m³	948		948
Uncertainty	±mg/m³	56.2		56.2

General Sampling Information

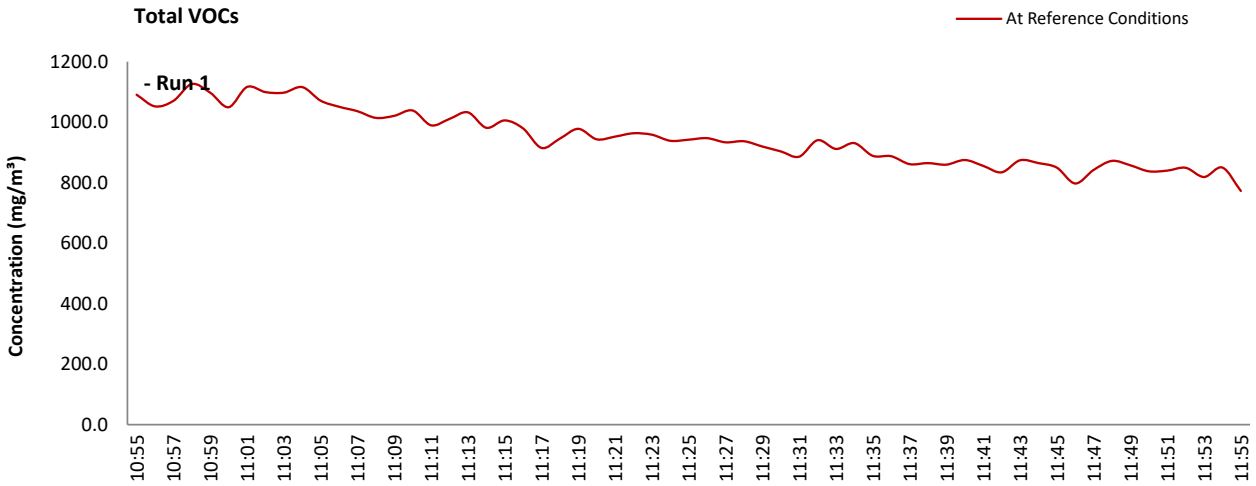
Parameter	Value	
Standard	EN 12619:2013	
Technical Procedure	MD 020	
Probe Material	Stainless Steel	
Filtration Type / Size	0.1µm Glass Fibre	
Heated Head Filter Used	Yes	
Heated Line Temperature	180°C	
Span Gas Type	Propane in 8% O_2 in N_2 (5 Grade)	
Span Gas Reference Number	12.0593 in N_2 | 1.0442a in AIR	
Span Gas Expiry Date	28/02/2026 | 23/04/2026	
Span Gas Start Pressure (bar)	140 | 40	
Gas Cylinder Concentration (ppm)	819.11 | 802.35	
Span Gas Set Point (ppm)	812.73	This is the blended concentration of both propane cylinders
Span Gas Uncertainty (%)	2 | 2	
Zero Gas Type	8% O_2 in N_2 (5 Grade)	
Number of Sampling Lines Used	1 / 1	FORMAT: Number Used / Number Required
Number of Sampling Points Used	1 / 1	FORMAT: Number Used / Number Required
Sample Point I.D.'s	A1	

Reference Conditions

Reference Conditions are: 273K, 101.3kPa, dry gas, 5% oxygen.

TOTAL VOCs (as CARBON): DATA TREND

Graphical Trend of Data



TOTAL VOCs (as CARBON): SAMPLING DETAILS & QUALITY ASSURANCE

Sampling Details

Parameter	Units	Run 1
Sampling Times	-	10:55 - 11:55
Sampling Dates	-	19/03/2025
Instrument Range	ppm	1000
Span Gas Value	ppm	812.7

Quality Assurance

	Zero Drift	Units	Run 1
CAL 1	Zero Down Sampling Line (Pre)	ppm	0.00
CAL 1	Zero Down Sampling Line (Post)	ppm	4.00
CAL 1	Zero Drift	ppm	4.00
CAL 1	Zero Drift	%	0.49
CAL 1	Drift Correction Applied	2-5%	No
	Allowable Zero Drift	± ppm	40.64
	Zero Drift Acceptable	-	Yes

	Span Drift	Units	Run 1
CAL 1	Span Down Sampling Line (Pre)	ppm	810.00
CAL 1	Span Down Sampling Line (Post)	ppm	821.10
CAL 1	Span Drift	ppm	11.10
CAL 1	Span Drift	%	1.37
CAL 1	Drift Correction Applied	2-5%	No
	Allowable Span Drift	± ppm	40.64
	Span Drift Acceptable	-	Yes

Test Conditions	Units	Run 1
Run Ambient Temperature Range	°C	14 / 10

Method Deviations

Nature of Deviation	Run Number	
(x = deviation applies to the associated run)	1	
There are no deviations associated with the sampling employed.	x	

TOTAL VOCs (as CARBON): MEASUREMENT UNCERTAINTY CALCULATIONS

Performance characteristics	RUN 1		Units
Limit value	1000.0		mg/m³ (REF)
Allowable MU	15.0		%
Measured concentration	754.41		mg/m³ (STP, dry)
Range Used	1000.0		ppm
Range Used [A]	1606.1		mg/m³
Cal gas conc.	812.7		ppm
Conversion	1.61		ppm to mg/m³
MCERTS Range [B]	15.0		mg/m³
Lower of [A] or [B]	15.0		mg/m³
Cal gas conc.	1305.3		mg/m³

Performance characteristics	RUN 1		Units
Response time	45		seconds
Number of readings in measurement	60		-
Repeatability at zero	2.00		% full scale
Repeatability at span level	0.00		% full scale
Deviation from linearity	0.33		% of value
Zero drift	0.49		% full scale
Span drift	1.37		% full scale
Volume or pressure flow dependence	1.60		% of full scale
Atmospheric pressure dependence	0.30		% of value/kPa
Ambient temperature dependence	1.40		% full scale/10K
Combined interference	0.45		% range
Dependence on voltage	0.50		% full scale/10V
Losses in the line (leak)	0.25		% of value
Uncertainty of calibration gas	2.83		% of value

Performance characteristic	RUN 1		Units
Standard deviation of repeatability at zero	use rep at span		mg/m³
Standard deviation of repeatability at span level	0.00		mg/m³
Lack of fit	0.03		mg/m³
Drift	9.69		mg/m³
Volume or pressure flow dependence	0.00		mg/m³
Atmospheric pressure dependence	0.01		mg/m³
Ambient temperature dependence	0.20		mg/m³
Combined interference (from MCERTS Certificate)	0.04		mg/m³
Dependence on voltage	0.06		mg/m³
Losses in the line (leak)	1.07		mg/m³
Uncertainty of calibration gas	12.32		mg/m³

			RUN 1		Units
Measurement uncertainty		**Result**	754.41		mg/m³
Combined uncertainty			15.71		mg/m³
Expanded uncertainty	k =	1.96	30.80		mg/m³
Uncertainty corrected to std conds. (O_2)			38.71		mg/m³ (REF)

	RUN 1		Units
Expanded uncertainty (no O_2) - at 95% Confidence	4.08		% of Value
Expanded uncertainty (no O_2) - at 95% Confidence	3.08		% at ELV
Overall Allowable uncertainty (no O_2) - at 95% Confidence	15.0		% at ELV
Result of Compliance with Uncertainty Requirement	**N/A**		-

	RUN 1		Units
Expanded uncertainty (with O_2) - at 95% Confidence	5.93		% of Value
Expanded uncertainty (with O_2) - at 95% Confidence	5.79		% at ELV
Overall Allowable uncertainty (with O_2) - at 95% Confidence	15.6		% at ELV
Result of Compliance with Uncertainty Requirement	**COMPLIANT**		-

Requirement for SRM is that Uncertainty should be <15% of the value at the ELV, on a dry gas basis, or if O_2 correction is applied less than 15% + the uncertainty associated with the O_2 correction (using sqrt of sum squares to add uncertainty components).

OXIDES OF NITROGEN (as NO_2): RESULTS SUMMARY

Asgard Renewables Ltd, Cardigan
A1 Engine 1 500kWe

Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m³	241		241
Uncertainty	±mg/m³	12.6		12.6

General Sampling Information

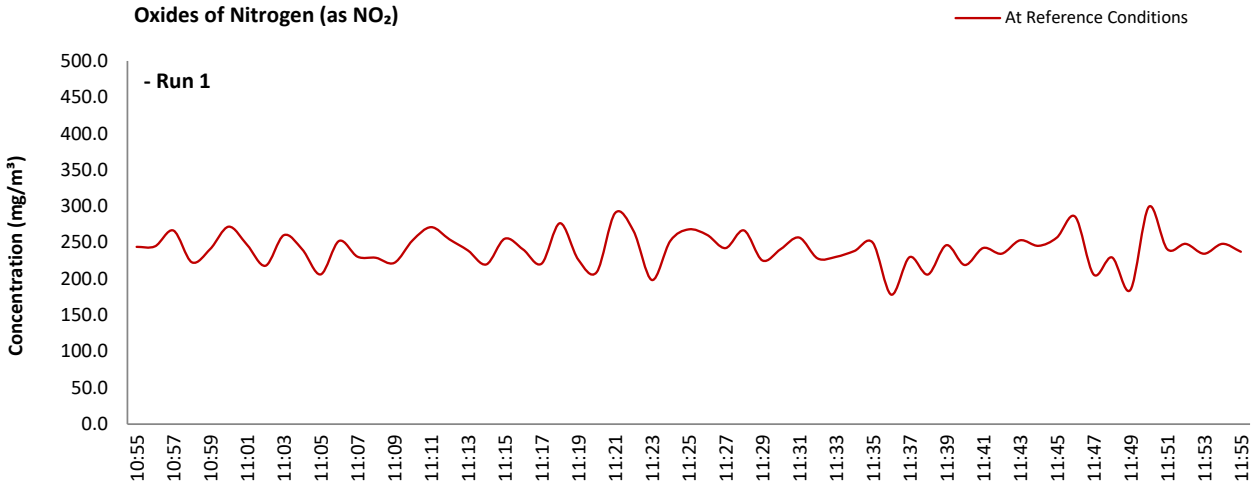
Parameter	Value	
Standard	EN 14792	
Technical Procedure	MD 039	
Probe Material	Stainless Steel	
Filtration Type / Size	0.1µm Glass Fibre	
Heated Head Filter Used	Yes	
Heated Line Temperature	180°C	
Date & Result of Last Converter Check	13/12/2024 - 95.5%	
Span Gas Type	Nitrogen Monoxide	
Span Gas Reference Number	12.0593	
Span Gas Expiry Date	28/02/2026	
Span Gas Start Pressure (bar)	180	
Gas Cylinder Concentration (ppm)	2108.8	NOTE: Dilution performed to achieve correct span value
Span Gas Uncertainty (%)	2	
Zero Gas Type	Nitrogen (5 Grade)	
Number of Sampling Lines Used	1 / 1	FORMAT: Number Used / Number Required
Number of Sampling Points Used	1 / 1	FORMAT: Number Used / Number Required
Sample Point I.D.'s	A1	

Reference Conditions

Reference Conditions are: 273K, 101.3kPa, dry gas, 5% oxygen.

OXIDES OF NITROGEN (as NO_2): DATA TREND

Graphical Trend of Data



OXIDES OF NITROGEN (as NO_2): SAMPLING DETAILS & QUALITY ASSURANCE

Sampling Details

Parameter	Units	Run 1
Sampling Times	-	10:55 - 11:55
Sampling Dates	-	19/03/2025
Instrument Range	ppm	500
Span Gas Value	ppm	243.6

Quality Assurance

Conditioning Unit Temperature	Units	Run 1
Average Temperature	°C	2.4
Allowable Temperature	< °C	4.0
Temperature Acceptable	-	Yes

	Zero Drift	Units	Run 1
CAL 1	Zero at Analyser (Pre)	ppm	0.00
	Zero at Analyser (Post)	ppm	1.90
	Zero Drift	ppm	1.90
	Zero Drift	%	0.78
	Drift Correction Applied	2-5%	No
	Allowable Zero Drift	± %	5.00
	Zero Drift Acceptable	-	Yes

	Span Drift	Units	Run 1
CAL 1	Span at Analyser (Pre)	ppm	243.60
	Span at Analyser (Post)	ppm	240.70
	Span Drift	ppm	-2.90
	Zero Adj. Span Drift	%	1.97
	Drift Correction Applied	2-5%	No
	Allowable Span Drift	± %	5.00
	Span Drift Acceptable	-	Yes

Test Conditions	Units	Run 1
Run Ambient Temperature Range	°C	14 / 10

Method Deviations

Nature of Deviation (x = deviation applies to the associated run)	Run Number 1	
There are no deviations associated with the sampling employed.	x	

OXIDES OF NITROGEN (as NO_2): MEASUREMENT UNCERTAINTY CALCULATIONS

Performance characteristics	RUN 1		Units
Limit value	500.0		mg/m³ (REF)
Allowable MU	10.0		%
Measured concentration	191.79		mg/m³ (STP, dry)
Ratio NO / NO_2	5		%
Range Used	500.0		ppm
Range Used [A]	1026.1		mg/m³
Cal gas conc.	243.6		ppm
Conversion	2.05		ppm to mg/m³
MCERTS Range [B]	205.0		mg/m³
Lower of [A] or [B]	205.0		mg/m³
Cal gas conc.	500.0		mg/m³

Performance characteristics	RUN 1		Units
Response time	31		seconds
Number of readings in measurement	60		-
Repeatability at zero	0.00		% full scale
Repeatability at span level	0.10		% full scale
Deviation from linearity	0.54		% of value
Zero drift	0.78		% full scale
Span drift	-1.97		% full scale
Volume or pressure flow dependence	0.10		% of full scale
Atmospheric pressure dependence	0.10		% of value/kPa
Ambient temperature dependence	0.04		% full scale/10K
Combined interference	0.63		% range
Dependence on voltage	-0.23		% full scale/10V
Converter efficiency	95.5		%
Losses in the line (leak)	0.25		% of value
Uncertainty of calibration gas blending	1.40		% of value
Uncertainty of calibration gas	2.00		% of value

Performance characteristic	RUN 1		Units
Standard deviation of repeatability at zero	use rep at span		mg/m³
Standard deviation of repeatability at span level	0.01		mg/m³
Lack of fit	0.64		mg/m³
Drift	0.07		mg/m³
Volume or pressure flow dependence	0.00		mg/m³
Atmospheric pressure dependence	0.06		mg/m³
Ambient temperature dependence	0.01		mg/m³
Combined interference (from MCERTS Certificate)	0.75		mg/m³
Dependence on voltage	-0.03		mg/m³
Converter efficiency	0.25		mg/m³
Losses in the line (leak)	0.27		mg/m³
Uncertainty of calibration gas blending	1.55		mg/m³
Uncertainty of calibration gas	2.21		mg/m³

			RUN 1		Units
Measurement uncertainty		**Result**	191.79		mg/m³
Combined uncertainty			2.90		mg/m³
Expanded uncertainty	k =	1.96	5.69		mg/m³
Uncertainty corrected to std conds. (O_2)			7.15		mg/m³ (REF)

	RUN 1		Units
Expanded uncertainty (no O_2) - at 95% Confidence	2.97		% of Value
Expanded uncertainty (no O_2) - at 95% Confidence	1.14		% at ELV
Overall Allowable uncertainty (no O_2) - at 95% Confidence	10.0		% at ELV
Result of Compliance with Uncertainty Requirement	**N/A**		-

	RUN 1		Units
Expanded uncertainty (with O_2) - at 95% Confidence	5.22		% of Value
Expanded uncertainty (with O_2) - at 95% Confidence	4.53		% at ELV
Overall Allowable uncertainty (with O_2) - at 95% Confidence	10.9		% at ELV
Result of Compliance with Uncertainty Requirement	**COMPLIANT**		-

Requirement for SRM is that Uncertainty should be <10% of the value at the ELV, on a dry gas basis, or if O_2 correction is applied less than 10% + the uncertainty associated with the O_2 correction (using sqrt of sum squares to add uncertainty components).

CARBON MONOXIDE: RESULTS SUMMARY

Asgard Renewables Ltd, Cardigan
A1 Engine 1 500kWe

Sample Runs

Parameter	Units	Run 1	Mean
Concentration	mg/m³	561	561
Uncertainty	±mg/m³	30.7	30.7

General Sampling Information

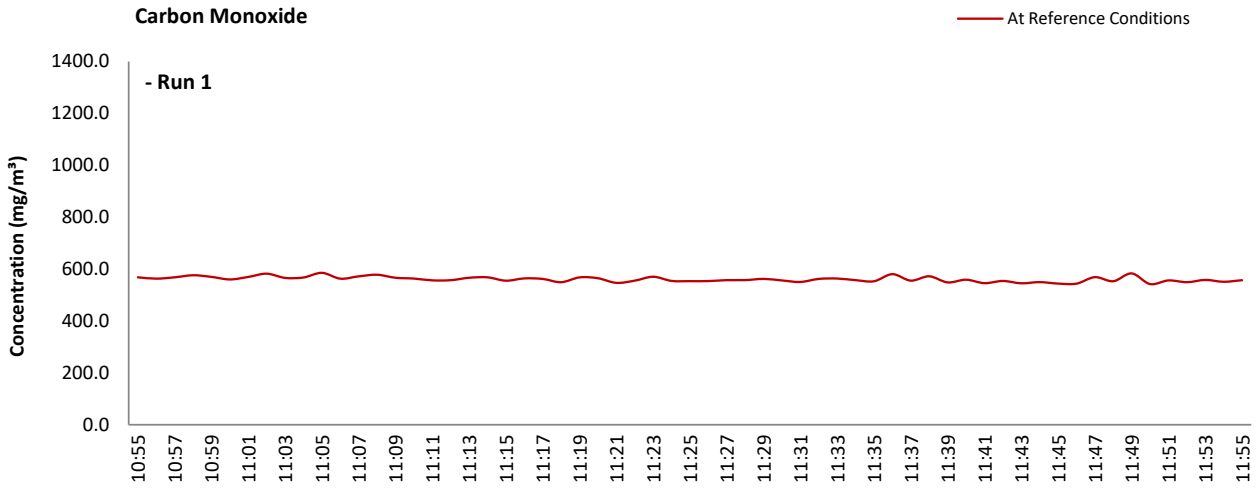
Parameter	Value	
Standard	EN 15058	
Technical Procedure	MD 039	
Probe Material	Stainless Steel	
Filtration Type / Size	0.1µm Glass Fibre	
Heated Head Filter Used	Yes	
Heated Line Temperature	180°C	
Span Gas Type	Carbon Monoxide	
Span Gas Reference Number	12.0593	
Span Gas Expiry Date	28/02/2026	
Span Gas Start Pressure (bar)	180	
Gas Cylinder Concentration (ppm)	4139.2	NOTE: Dilution performed to achieve correct span value
Span Gas Uncertainty (%)	2	
Zero Gas Type	Nitrogen (5 Grade)	
Number of Sampling Lines Used	1 / 1	FORMAT: Number Used / Number Required
Number of Sampling Points Used	1 / 1	FORMAT: Number Used / Number Required
Sample Point I.D.'s	A1	

Reference Conditions

Reference Conditions are: 273K, 101.3kPa, dry gas, 5% oxygen.

CARBON MONOXIDE: DATA TREND

Graphical Trend of Data



CARBON MONOXIDE: SAMPLING DETAILS & QUALITY ASSURANCE

Sampling Details

Parameter	Units	Run 1
Sampling Times	-	10:55 - 11:55
Sampling Dates	-	19/03/2025
Instrument Range	ppm	1000
Span Gas Value	ppm	1120.7

Quality Assurance

Conditioning Unit Temperature	Units	Run 1
Average Temperature	°C	2.4
Allowable Temperature	< °C	4.0
Temperature Acceptable	-	Yes

	Zero Drift	Units	Run 1
CAL 1	Zero at Analyser (Pre)	ppm	0.00
	Zero at Analyser (Post)	ppm	1.00
	Zero Drift	ppm	1.00
	Zero Drift	%	0.09
	Drift Correction Applied	2-5%	No
	Allowable Zero Drift	± %	5.00
	Zero Drift Acceptable	-	Yes

	Span Drift	Units	Run 1
CAL 1	Span at Analyser (Pre)	ppm	1120.00
	Span at Analyser (Post)	ppm	1099.00
	Span Drift	ppm	-21.00
	Zero Adj. Span Drift	%	1.96
	Drift Correction Applied	2-5%	No
	Allowable Span Drift	± %	5.00
	Span Drift Acceptable	-	Yes

Test Conditions	Units	Run 1
Run Ambient Temperature Range	°C	14 / 10

Method Deviations

Nature of Deviation (x = deviation applies to the associated run)	Run Number 1
There are no deviations associated with the sampling employed.	x

CARBON MONOXIDE: MEASUREMENT UNCERTAINTY CALCULATIONS

Performance characteristics	RUN 1		Units
Limit value	1400.0		mg/m³ (REF)
Allowable MU	6.0		%
Measured concentration	446.10		mg/m³ (STP, dry)
Range Used	1000.0		ppm
Range Used [A]	1249.2		mg/m³
Cal gas conc.	1120.7		ppm
Conversion	1.25		ppm to mg/m³
MCERTS Range [B]	75.0		mg/m³
Lower of [A] or [B]	75.0		mg/m³
Cal gas conc.	1400.0		mg/m³

Performance characteristics	RUN 1		Units
Response time	28		seconds
Number of readings in measurement	60		-
Repeatability at zero	0.10		% full scale
Repeatability at span level	0.20		% full scale
Deviation from linearity	0.69		% of value
Zero drift	0.09		% full scale
Span drift	-1.96		% full scale
Volume or pressure flow dependence	0.10		% of full scale
Atmospheric pressure dependence	0.22		% of value/kPa
Ambient temperature dependence	-0.20		% full scale/10K
Combined interference	-0.48		% range
Dependence on voltage	-0.35		% full scale/10V
Losses in the line (leak)	0.45		% of value
Uncertainty of calibration gas blending	1.40		% of value
Uncertainty of calibration gas	2.00		% of value

Performance characteristic	RUN 1		Units
Standard deviation of repeatability at zero	use rep at span		mg/m³
Standard deviation of repeatability at span level	0.03		mg/m³
Lack of fit	0.30		mg/m³
Drift	-4.33		mg/m³
Volume or pressure flow dependence	0.00		mg/m³
Atmospheric pressure dependence	0.05		mg/m³
Ambient temperature dependence	-0.03		mg/m³
Combined interference (from MCERTS Certificate)	-0.21		mg/m³
Dependence on voltage	-0.04		mg/m³
Losses in the line (leak)	1.15		mg/m³
Uncertainty of calibration gas blending	3.61		mg/m³
Uncertainty of calibration gas	5.15		mg/m³

			RUN 1		Units
Measurement uncertainty		**Result**	446.10		mg/m³
Combined uncertainty			7.73		mg/m³
Expanded uncertainty	k =	1.96	15.15		mg/m³
Uncertainty corrected to std conds. (O_2)			19.05		mg/m³ (REF)

	RUN 1		Units
Expanded uncertainty (no O_2) - at 95% Confidence	3.40		% of Value
Expanded uncertainty (no O_2) - at 95% Confidence	1.08		% at ELV
Overall Allowable uncertainty (no O_2) - at 95% Confidence	6.0		% at ELV
Result of Compliance with Uncertainty Requirement	**N/A**		-

	RUN 1		Units
Expanded uncertainty (with O_2) - at 95% Confidence	5.48		% of Value
Expanded uncertainty (with O_2) - at 95% Confidence	4.51		% at ELV
Overall Allowable uncertainty (with O_2) - at 95% Confidence	7.4		% at ELV
Result of Compliance with Uncertainty Requirement	**COMPLIANT**		-

Requirement for SRM is that Uncertainty should be <6% of the value at the ELV, on a dry gas basis, or if O_2 correction is applied less than 6% + the uncertainty associated with the O_2 correction (using sqrt of sum squares to add uncertainty components).

OXYGEN: RESULTS SUMMARY

Asgard Renewables Ltd, Cardigan
A1 Engine 1 500kWe

Sample Runs

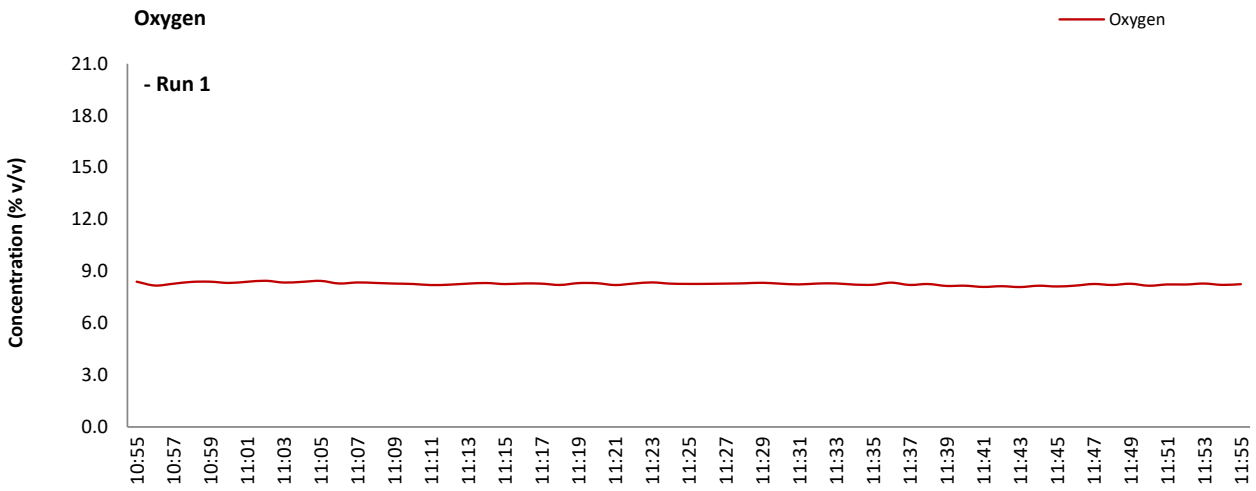
Parameter	Units	Run 1		Mean
Concentration	% v/v	8.3		8.3
Uncertainty	±% v/v	0.36		0.36

General Sampling Information

Parameter	Value	
Standard	EN 14789	
Technical Procedure	MD 039	
Probe Material	Stainless Steel	
Filtration Type / Size	0.1µm Glass Fibre	
Heated Head Filter Used	Yes	
Heated Line Temperature	180°C	
Span Gas Type	Synthetic Air (5 Grade)	
Span Gas Reference Number	11.06	
Span Gas Expiry Date	01/03/2028	
Span Gas Start Pressure (bar)	100	
Gas Cylinder Concentration (% v/v)	21.13	NOTE: Dilution performed to achieve correct span value
Span Gas Uncertainty (%)	2	
Zero Gas Type	Nitrogen (5 Grade)	
Number of Sampling Lines Used	1 / 1	FORMAT: Number Used / Number Required
Number of Sampling Points Used	1 / 1	FORMAT: Number Used / Number Required
Sample Point I.D.'s	A1	

OXYGEN: DATA TREND

Graphical Trend of Data



OXYGEN: SAMPLING DETAILS & QUALITY ASSURANCE

Sampling Details

Parameter	Units	Run 1
Sampling Times	-	10:55 - 11:55
Sampling Dates	-	19/03/2025
Instrument Range	% v/v	25.0
Span Gas Value	% v/v	8.0

Quality Assurance

Conditioning Unit Temperature	Units	Run 1
Average Temperature	°C	2.4
Allowable Temperature	< °C	4.0
Temperature Acceptable	-	Yes

	Zero Drift	Units	Run 1
CAL 1	Zero at Analyser (Pre)	% v/v	0.00
	Zero at Analyser (Post)	% v/v	-0.10
	Zero Drift	% v/v	-0.10
	Zero Drift	%	1.23
	Drift Correction Applied	2-5%	No
	Allowable Zero Drift	± %	5.00
	Zero Drift Acceptable	-	Yes

	Span Drift	Units	Run 1
CAL 1	Span at Analyser (Pre)	% v/v	8.12
	Span at Analyser (Post)	% v/v	8.20
	Span Drift	% v/v	0.08
	Zero Adj. Span Drift	%	2.25
	Drift Correction Applied	2-5%	Yes
	Allowable Span Drift	± %	5.00
	Span Drift Acceptable	-	Yes

Test Conditions	Units	Run 1
Run Ambient Temperature Range	°C	14 / 10

Method Deviations

Nature of Deviation (x = deviation applies to the associated run)	Run Number 1
There are no deviations associated with the sampling employed.	x

OXYGEN: MEASUREMENT UNCERTAINTY CALCULATIONS

Performance characteristics	RUN 1		Units
Limit value	N/A		%vol
Allowable MU	6.0		%
Measured concentration	8.27		%vol
Range Used	25.0		%vol
Cal gas conc.	21.1		%vol

Performance characteristics	RUN 1		Units
Response time	41		seconds
Number of readings in measurement	60		-
Repeatability at zero	0.02		% full scale
Repeatability at span level	0.02		% full scale
Deviation from linearity	0.08		% of value
Zero drift	-1.23		% full scale
Span drift	0.00		% full scale
Volume or pressure flow dependence	0.10		% of full scale
Atmospheric pressure dependence	0.19		% of value/kPa
Ambient temperature dependence	-0.21		% full scale/10K
Combined interference	0.00		% range
Dependence on voltage	0.02		% full scale/10V
Losses in the line (leak)	0.00		% of value
Uncertainty of calibration gas	2.00		% of value

Performance characteristic	RUN 1		Units
Standard deviation of repeatability at zero	use rep at span		%vol
Standard deviation of repeatability at span level	0.00		%vol
Lack of fit	0.01		%vol
Drift	-0.15		%vol
Volume or pressure flow dependence	0.00		%vol
Atmospheric pressure dependence	0.01		%vol
Ambient temperature dependence	-0.03		%vol
Combined interference (from MCERTS Certificate)	0.00		%vol
Dependence on voltage	0.00		%vol
Losses in the line (leak)	0.00		%vol
Uncertainty of calibration gas	0.10		%vol

			RUN 1		Units
Measurement uncertainty		**Result**	8.27		%vol
Combined uncertainty			0.18		%vol
Expanded uncertainty	k =	1.96	0.36		%vol

	RUN 1		Units
Expanded uncertainty (no O_2) - at 95% Confidence	4.30		% of Value
Result of Compliance with Uncertainty Requirement	**COMPLIANT**		-

Requirement for SRM is that Uncertainty should be 0.3% vol absolute or 6% relative whichever is the lower, on a dry gas basis. Source, EN 14789.

VERSION HISTORY

Version Number	Record of changes made within this version of the document
V1	The original document issued to the client