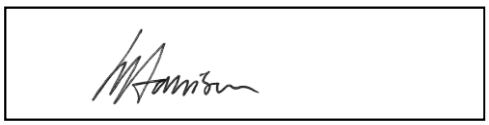
BS EN 14181 Report	
Permit Number:	**RP3133LD**
Operator:	**RWE Generation UK plc.**
Installation:	**Aberthaw Power Station**
Installation Type:	**Coal-Fired Power Station**
Emission Point:	**Unit 7**
Monitoring Dates:	**7th – 9th March 2016**

1709

Contract Reference:	FTBS 29312
Operator:	RWE Generation UK plc.
Address:	Aberthaw Power Plant The Leys Aberthaw, Nr Barry South Glamorgan CF62 4ZW
Client Contact:	Richard Kadim
Monitoring Organisation:	RPS Consultants
Address:	Noble House, Capital Drive, Linford Wood, Milton Keynes. MK14 6QP.
Report Date:	5th October 2016
Report Author:	Carl Redgrove
Report Approved By:	Glyn Harrison
Position:	Operations Manager
MCERTS Qualifications:	Level 2, Technical Endorsements 1, 2, 3 & 4
MCERTS Registration No.:	MM 03 228
Signature:	

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Section 1 – Executive Summary

1B.1 Result Summary – QAL2

EN 14181 Test Type		QAL2				
Stack designation		Unit 7				
Measurand	**Correlation coefficient of parallel data (R^2)**	**Derived Calibration function (y_i)**		**Calibrated Range**	**Extrapolated Calibrated Range**	**Variability Test**
		y_i= a	**+ bx_i**			
Oxides of Nitrogen (GM32)	0.9888	5.064[1]	0.957[1]	0 – 1066 mg/m^3 [2]	0 – 2696 mg/m^3 [3]	Pass
Sulphur Dioxide (GM32 – Low Range)	0.9788	-0.206[1]	1.107[1]	0 – 133 mg/m^3 [2]	0 – 481 mg/m^3 [3]	Pass
Sulphur Dioxide (GM32 – High Range)	0.9836	-0.5092[1]	1.1096[1]	0 – 262 mg/m^3 [2]	0 – 481 mg/m^3 [3]	Pass

Notes

1 – Calibration function derived using Method A.
2 – Calibrated range derived using QAL2 parallel test data extended 10%.
3 – Extrapolated calibrated range derived using reference materials

Note: The calibration functions, once applied, only remain valid as long as the QAL 3 data remains within control limits, and there are no manual adjustments made to the CEMS other than those allowed to bring the settings back within the QAL 3 control limits.

1B.2 Result Summary – AST

EN 14181 Test Type	AST						
Stack designation	Unit 7						
Measurand	**Correlation coefficient of parallel data (R^2)**	**Derived Calibration function (y_i)**		**Established Calibrated Range[4]**	**AST Calibrated Range**	**Extrapolated Calibrated Range**	**Variability Test**	**Test of Calibration Function**
		y_i= a + bx_i						
Nitric Oxide as total NOx (Procal 1)	0.9944	-3.578[1]	1.022[1]	0 – 1634.6 mg/m^3	0 – 1081 mg/m^3 [2]	-	Pass	Pass
Sulphur Dioxide (Procal 1 – Low Range)	0.9529	-6.1[1]	1.082[1]	0 – 749.3 mg/m^3	0 – 267 mg/m^3 [2]	-	Pass	Pass
Sulphur Dioxide (Procal 1 – High Range)	0.9518	7.158[1]	0.952[1]	0 – 2302.4 mg/m^3	0 – 262 mg/m^3 [2]	-	Pass	Pass
Nitric Oxide as total NOx (Procal 2)	0.9600	-1.5[1]	0.979[1]	0 – 1320 mg/m^3	0 – 959 mg/m^3 [2]	-	Pass	Pass
Sulphur Dioxide (Procal 2 – Low Range)	0.1961	-6.072[1]	0.885[1]	0 – 566 mg/m^3	0 – 124 mg/m^3 [2]	-	Pass	Pass
Sulphur Dioxide (Procal 2 – High Range)	0.9596	-5.884[1]	0.757[1]	0 – 599 mg/m^3	0 – 238 mg/m^3 [2]	-	Pass	Pass
Particulate Matter (Erwin SICK)	0.9852	0.6[1]	1.433[1]	0 – 55 mg/m^3	0 – 23.8 mg/m^3 [3]	Not applicable	Pass	Pass

Notes

1 – Calibration function derived using Method A.
2 – Calibrated range derived using AST parallel test data extended 10%.
3 - Calibrated range derived using QAL2 parallel test data extended 100%.
4 – Established calibrated range from QAL 2 - derived using reference materials

Note: The calibration functions, once applied, only remain valid as long as the QAL 3 data remains within control limits, and there are no manual adjustments made to the CEMS other than those allowed to bring the settings back within the QAL 3 control limits.

1C Deviations

SRM deviations	None
Reason for deviation	None
EN 14181 deviations	None
Reason for deviation	N/A
Impact on results	N/A
Further actions required	None

Section 2 - Information about the Regulated Installation

2.1 Regulatory Information

Name of operator	RWE Generation UK plc.
Name of Installation	Aberthaw Power Station
Address of installation	The Leys Aberthaw, Nr Barry South Glamorgan CF62 4ZW
Sector	LCPD
Permit Number	RP3133LD
Date of last QAL 2/AST	March 2015 AST – Procal 1 & 2 & SICK OMD 41, QAL2 - SICK GM32

Regulated Determinands

Determinand	Emission Point	Daily Mean	Calendar Monthly	Uncertainty Requirement
Oxides of Nitrogen	Unit 7	1080 mg/m^3 (NOx as NO_2)	1050 mg/m^3 (NOx as NO_2)	20% at the ELV
Sulphur Dioxide	Unit 7	440 mg/m^3	350 mg/m^3	20% at the ELV
Total Particulate Matter	Unit 7	35 mg/m^3	20 mg/m^3	30% at the ELV

Note: ELVs at reference conditions 273K, 101.3kPa, 6% oxygen, dry gas

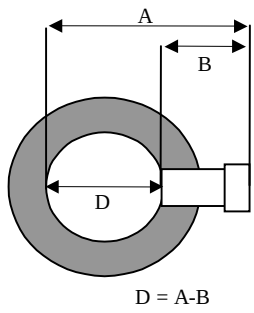
2.2 Operational Information and site monitoring provisions

2.2.1 Process type and emissions variations

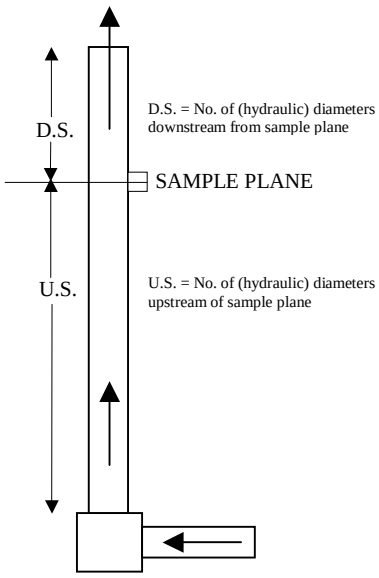
Process Type	Continuous - Coal-Fired Power Station
Process Variations	Once operational at maximum load variation is minimal
Expected emissions variations **1 Oxides of nitrogen** **2 Sulphur Dioxide** **3 Oxygen**	 850 - 1050 mg/m^3 as NO_2 – variable 150 - 300 mg/m^3 – variable 6 – 8 % – constant
Possible low level emissions	Sulphur Dioxide
Provision to deal with low level emissions	Use values from linearity checks to derive calibrated range
Other factors affecting monitoring results	None
Fuel type	Coal
Abatement	Flue Gas Desulphurisation & Combustion control

2.3 Monitoring Provisions at the installation

2.3.1 Stack & sampling ports



SKETCH OF SAMPLING POINT LOCATIONS, STACK GEOMETRY, MONITORING PLATFORM & SURROUNDS



A =~ 6.5m

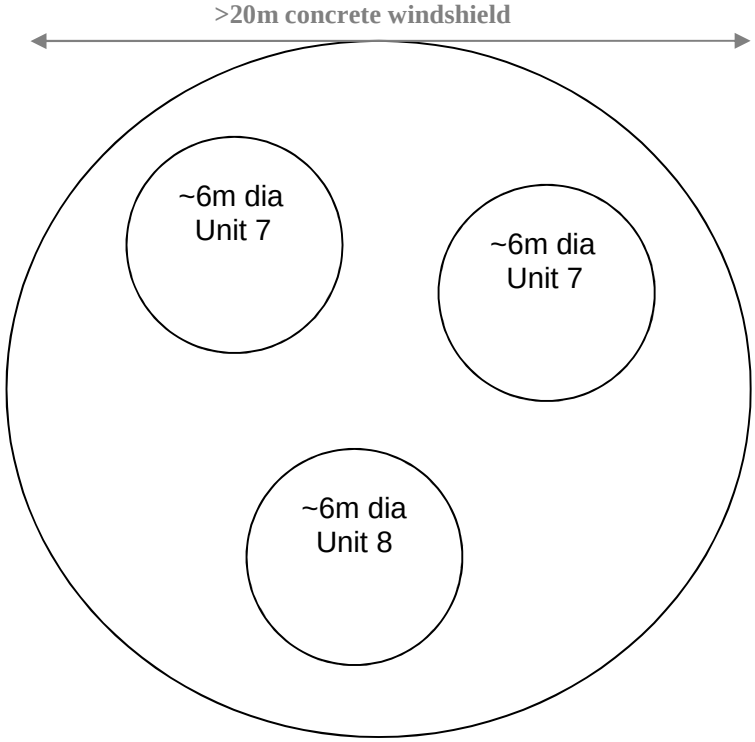
B = ~0.5m

D = ~6.00

D.S. = > 5HD

U.S. = > 5HD

Platform Diagram



Photograph of Stack

Photo of Monitoring Platform

Access was limited to ports due to the stack layout inside the windshield. The port shown is one of four.

2.3.2 Monitoring platform and site provisions

Requirement	Compliant	Notes
• A safe and clean working environment with sufficient space and weather protections.	CEMs cabinet – Monitoring probe -	Both cabinet and probe are located inside the windshield and are thus in a spacious, clean and weatherproof environment.
• Easy and safe access to the CEM.	CEMS cabinet – Monitoring probe -	Stairways to the relevant levels.
• Adequate supplies of reference materials, tools and spare parts.	Yes	
• Facilities to introduce the reference materials for gaseous-monitoring systems, both at the inlet of the sampling line (where present), and at the inlet of the CEM.	N/A	There is no facility to introduce reference materials to the sample line or CEM. The CEMs are cross-duct IR (NO, NO_2, SO_2) and cross-duct forward scatter (particulate).
• Compliance with TGN M1	No	Unable to access sample port B
• Compliance with EN 15259 –		
flow stability criteria (if applicable),	Yes	
Stack gas homogeneity.	Yes	Stack gas homogeneity carried out previously by Atkins.

Temperature and Velocity Profile

Company Name: Aberthaw Power Station
Site Name: Aberthaw
Sampling Point Ref: Unit 7
Project Reference: FTBS 29312

Date: 07/03/16
Run: TPM

Mean Stack Temperature, oC	56.000
Traverse Stack Velocity, m/s	16.524
Stack Gas Volume Flow Rate, m3/s (scms wet)	459.519
Stack Gas Volume Flow Rate, m3/s (scms DRY) O2 Corrected	459.519

Δp Measurement units (Pa or mmH2O)	mmH2O

Pitot Coeficiant	0.827

Barometric	753	mmHg
Static		
Port A	-24	mmH2O
Port B	-24	mmH2O
Mean	-24	mmH2O

Leak Test		
Instrument range	250	mmH2O
Δp for leak test	187.5	mmH2O
Positive leakage rate	0	per 15secs
Negative leakage rate	0	per 15secs
Pass/Fail	Pass	

Stagnation Test		
Static measurement		
Positive side	-24	mmH2O
Negative side	-24	mmH2O
Difference (Pa)	0	
Pass/Fail	Pass	

Stack Dimensions		
Rectangular A		(Width) m
Rectangular B		(Length) m
Circular diam A	6	m
Circular diam B	6	m
Circular Mean	6	m
Area	28.27431	m^2

Traverse Point	Distance	Port A Δ p. mmH2O				Swirl	Temp	Port B Δ p. mmH2O				Swirl	Temp
	m	Reading 1	Reading 2	Reading 3	Average	Degrees	°C	Reading 1	Reading 2	Reading 3	Average	Degrees	°C
1	0.20	22	22	22	22	0	56	22	22	22	22	0	56
2	0.63	21	21	21	21	0	56	23	23	23	23	0	56
3	1.16	23	23	23	23	0	56	24	24	24	24	0	56
4	1.94												
5	4.06												
6	4.84	23	23	23	23	0	56	24	24	24	24	0	56
7	5.37	24	24	24	24	0	56	23	23	23	23	0	56
8	5.80	21	21	21	21	0	56	22	22	22	22	0	56
9													
10													

Gas Data	
Oxygen %	5.28
CO_2 %	13.53
CO %	

Oxygen Correction	
Required Correction Value	
Actual Oxygen Factor	1.00
Enter '0' if correction is not required	

BS EN 13284-1 & M1 Sample Point Requirements	Requirement Met?
Duct gas Flow: angle with regard to duct access <15°?	Y
Duct Gas Flow: No Negative Velocity: Not Permitted	Y
Duct Gas Flow: Ratio of max to min velocity <3:1?	Y
Working Area > $5m^2$?	Y
Handrails with removable chains / self closing gates across the top of the ladder?	Y
Handrails (approx 0,5 and 1,0 m high) and vertical baseboards (approx 0,25m high)?	Y
Scaffold Built to 'Heavy Duty' Scafftag Rating or at least 2.5kN/m2 loading	N/A
Handrails not restricting access to ports?	Y
Room opposite sampling port equal or greater than the length of the sampling probe plus 1 metre?	Y
Sufficient Power (Waterproof 110V BS4343 Standard) close or on the platform?	Y

2.4.1 Continuous Emissions Monitoring Systems at the installation

	Procal 1 & 2	SICK	SICK	ABB
Determinand	**NOx & SO_2 & H_2O**	**NOx & SO_2**	**Particulate**	**Oxygen**
Type	In Situ IR	In-situ Probe – UV-DOAS	Cross Duct Forward Scatter	Zirconia Cell
Make	Procal	SICK Maihak GmbH	Erwin Sick	ABB
Model	Pulsi 200 series	GM32 – In-situ	OMD41	AZ20
MCERTS Certificate	MC990006/13	MC100163/01	MC040042/01	MC110191/01
QAL1 Compliance?	Yes	Yes	Yes	Yes
Certification ranges	NO = 0 – 1000 ppm SO2 low = 0 – 250 ppm SO2 high = 0 – 1000 ppm H_2O = 0 – 30 %	Measuring path length 1.25m: NO 0 to 70 mg/m3 & 0 to 700 mg/m3 SO2 0 to 75mg/m3 & 0 to 1000mg/m3 Measuring path length 1.00m NO 0 to 87.5 mg/m3 & 0 to 875 mg/m3 SO2 0 to 93.8 mg/m3 and 0 to 1250 mg/m3	0 – 0.3 extinction	0 to 25% 0 to 5%
Operational ranges	As Above	SO2 Low: 0 – 250 ppm SO2 High: 0 – 1000ppm NO: 0 – 1000ppm NO2: 0 - 100ppm	0 – 50 mg/m^3	0 to 25%vol
Principle	Dual wavelength infra-red	UV DOAS	Opacity	Zirconia Cell
Raw data units	SO2 & NO = ppm H_2O = %	ppm	Extinction	%
Reference condition of raw data	(SO2 & NO only) wet gas, no oxygen correction	wet gas, no oxygen correction	wet gas, no oxygen, temp or pressure correction	wet gas
Signal output	4-20 mA	4 – 20mA	Fibre optics	4 – 20mA
Provision for logging of 14181 data	Data logged by DCS			
Location of sample	Measurement taken at monitoring platform. SRM sample obtained from monitoring platform.			
Moisture – Measurement or calculated	Measured	Measured	Measured	Measured

Section 3 – Information about the Monitoring campaign

Table 3.1 - Monitoring Organisation Staff Details

Project Manager	Position	MCERTS Level	Technical Endorsements	Expiry Dates	MCERTS Registration Number
Glyn Harrison	Operations Manager (Stack Emissions)	2	1	10/19	MM 03 228
			2	06/17	
			3	12/16	
			4	07/20	

Site Team	Position	MCERTS Level	Technical Endorsements	Expiry Dates	MCERTS Registration Number
Edwin Powell	Consultant	2	1	12/17	MM 05 621
			2	12/17	
			3	12/17	
			4	12/17	
Daniel Lewis	Technician	1	--	-	MM 14 1291

Report Author	Position	MCERTS Level	Technical Endorsements	Expiry Dates	MCERTS Registration Number
Carl Redgrove	Senior Consultant	2	1	10/19	MM 03 173
			2	03/20	
			3	03/21	
			4	06/21	

Report Reviewer	Position	MCERTS Level	Technical Endorsements	Expiry Dates	MCERTS Registration Number
Glyn Harrison	Operations Manager (Stack Emissions)	2	1	10/19	MM 03 228
			2	06/17	
			3	12/16	
			4	07/20	

3.2 - Monitoring Organisation Method Details

Emission Parameter	Standard Method	Monitoring Procedure No.	Monitoring Accreditation Status	Analysis Technique	Expected Uncertainty (%)	Analysis Procedure No.	Analytical Laboratory	Analysis Accreditation Status
Oxides of Nitrogen (as NO_2)	BS EN 14792:2005	RPSCE/1/21f	MCERTS	Chemiluminescence	6	N/A	N/A	N/A
Oxygen	BS EN 14789:2005	RPSCE/1/21g	MCERTS	Zirconia Cell	5	N/A	N/A	N/A
Sulphur Dioxide	TGN M22	RPSCE/1/24	MCERTS	FTIR	10	N/A	N/A	N/A
Total particulate Matter	BS EN 13284:2002	RPSCE/1/7c	MCERTS	Gravimetric	10 - 30	D9	RPS	UKAS

Equipment details

Emission Parameter	Analysis Technique	Analyser	Analyser Certification Status	Certified Ranges	Operational Ranges	Operating Principle
Oxygen	Zirconia Cell	Horiba PG 250 SRM	MCERTs certificate No MC110186/03	0 – 25%	0-25%	Extractive, multicomponent dry gas analyser. Sample extracted through sample probe and 5metre heated sample line (with integral heated filter) – line temperature 180°C. Sample line connected directly to a gas conditioner (peltier cooler) set at 3°C. Cold dry sample then passes to analyser. Sample is drawn through system by integral pump built into analyser.
Oxides of Nitrogen	Chemiluminescence	Horiba PG 250 SRM	MCERTs certificate No MC110186/03	0 – 130 mg/m^3 as NO 0 – 200 mg/m^3 as NO_2	0 – 1000ppm	
Sulphur Dioxide	FTIR	Gasmet DX4000	MCERTs certificate No MC30014/05	0 – 75mg/m^3	0 – 500 ppm	Extractive wet gas analyser. Sample obtained non-isokinetically. Sample extracted through sample probe and filtered before passing through 5metre heated sample line (with integral heated filter) – line temperature 180°C. Sample line connected directly to a heated sample pump which in turn was connected to the FTIR. Hot, wet sample then passes to analyser.
Stack Gas Moisture	FTIR	Gasmet DX4000	MCERTs certificate No MC30014/05	0-40%	0-40%	
Total Particulate Matter	Multipoint isokinetic sampling with in stack filtration	N/A	N/A	0 – 50mg/m^3	-	Extractive manual test. Sample obtained isokinetically through sharp edged nozzle. Sample gas passed through a pre weighed, pre blown filter. Filter holder mounted in-stack.

Section 4A1: Data & calculations – QAL2 – Unit 7, SICK GM32

Section 4A – Data and calculations – QAL2 SICK GM32

4A1.1 Table 4.1.1 – Raw monitoring Data – Oxides of Nitrogen

Test No	Date	Test Start Time	Test End Time	CEMS Raw Value (Wet)	CEMS Oxygen (dry)	CEMS Moisture	SRM Raw Value (dry)	SRM Oxygen (Dry)	SRM Moisture	SRM at CEMs Raw conditions
		hr:min		NO (ppm)	(%)	(%)	NOx (ppm)	(%)	(%)	NOx (ppm)
1	07-Mar-16	9:22	10:22	424.49	5.53	1.87	416.57	6.03	1.81	409.0
2	07-Mar-16	10:23	11:23	444.96	5.34	1.80	440.18	5.89	1.90	431.8
3	07-Mar-16	12:25	13:25	413.32	6.71	1.95	418.07	6.51	1.91	410.1
4	07-Mar-16	13:26	14:26	410.66	6.46	1.89	417.79	6.51	1.86	410.0
5	07-Mar-16	14:27	15:27	393.86	6.14	1.85	397.94	6.18	1.82	390.7
6	07-Mar-16	15:28	16:28	385.10	6.00	1.86	387.23	6.14	1.84	380.1
7	07-Mar-16	16:29	17:29	415.08	6.15	2.08	408.89	6.13	2.07	400.4
8	07-Mar-16	17:30	18:30	459.43	6.22	1.91	452.67	6.16	1.85	444.3
9	07-Mar-16	18:31	19:31	469.08	6.14	1.93	463.46	6.09	1.84	454.9
10	07-Mar-16	19:32	20:32	461.65	5.80	1.91	457.23	5.87	1.86	448.7
11	07-Mar-16	20:33	21:33	464.16	5.73	1.92	456.62	5.89	1.86	448.1
12	07-Mar-16	21:34	22:34	446.96	5.89	1.94	439.27	6.00	1.91	430.9
13	07-Mar-16	22:35	23:35	442.68	5.93	1.97	433.19	6.06	1.90	425.0
14	07-8/03/2016	23:36	0:36	442.85	5.93	1.97	425.86	6.09	1.92	417.7
15	08-Mar-16	0:37	1:37	430.05	6.15	1.99	420.10	6.18	1.94	411.9
16	08-Mar-16	1:38	2:38	444.61	6.43	1.95	431.24	6.41	1.87	423.2
17	08-Mar-16	2:39	3:39	448.12	6.50	1.91	439.23	6.45	1.85	431.1
18	08-Mar-16	3:40	4:40	274.69	7.55	1.73	283.26	7.51	1.73	278.4
19	08-Mar-16	4:41	5:41	330.50	6.92	1.66	322.98	6.93	1.63	317.7
20	08-Mar-16	5:42	6:42	447.20	6.03	1.87	435.47	6.02	1.77	427.8
21	08-Mar-16	6:43	7:43	450.76	6.25	1.91	440.41	6.21	1.83	432.3
22	08-Mar-16	7:44	8:44	466.41	6.36	1.91	453.99	6.27	1.83	445.7
23	08-Mar-16	9:35	10:35	330.92	6.00	1.92	334.75	6.39	1.08	331.1
24	08-Mar-16	10:36	11:36	310.81	6.22	1.70	310.99	6.45	1.79	305.4
25	08-Mar-16	11:37	12:37	293.69	6.25	1.89	293.90	6.42	1.83	288.5
26	08-Mar-16	12:38	13:38	303.93	6.17	1.92	302.53	6.35	1.89	296.8
27	08-Mar-16	13:39	14:39	333.23	6.46	1.88	327.06	6.35	1.90	320.8
28	08-Mar-16	14:40	15:40	346.47	6.44	1.88	342.95	6.68	1.42	338.1
29	08-Mar-16	15:41	16:41	343.88	5.59	1.88	341.08	6.07	1.80	334.9
30	08-Mar-16	16:42	17:42	371.30	5.93	1.88	363.53	6.12	1.81	357.0
31	08-Mar-16	17:43	18:43	370.35	5.72	1.87	362.40	6.04	1.80	355.9
32	08-Mar-16	18:44	19:44	354.21	4.82	1.88	346.94	5.74	1.81	340.6
33	08-Mar-16	19:45	20:45	386.37	5.53	1.90	374.61	6.10	1.80	367.9
34	08-Mar-16	20:46	21:46	392.09	5.44	1.89	379.59	6.04	1.80	372.7
35	08-Mar-16	21:47	22:47	429.37	5.21	1.92	416.98	5.87	1.83	409.4
36	08-Mar-16	22:48	23:48	435.21	5.49	1.94	424.02	5.85	1.87	416.1
37	08-9/03/2016	23:49	0:49	453.76	5.41	1.95	444.32	5.66	1.88	436.0
38	09-Mar-16	0:50	1:50	467.19	5.38	1.97	464.66	5.57	1.90	455.8
39	09-Mar-16	1:51	2:51	460.29	5.51	1.91	457.79	5.64	1.86	449.3
40	09-Mar-16	2:52	3:52	456.71	5.47	1.88	453.86	5.67	1.80	445.7
41	09-Mar-16	3:53	4:53	462.50	5.67	1.85	458.35	5.78	1.76	450.3
42	09-Mar-16	4:54	5:54	459.60	5.74	1.83	457.17	5.87	1.75	449.2
43	09-Mar-16	5:55	6:55	471.96	5.47	1.84	467.60	5.61	1.76	459.4
44	09-Mar-16	6:56	7:56	491.06	5.38	1.83	484.71	5.59	1.76	476.2
45	09-Mar-16	7:57	8:57	486.82	5.69	1.83	484.15	5.72	1.76	475.6

Note:

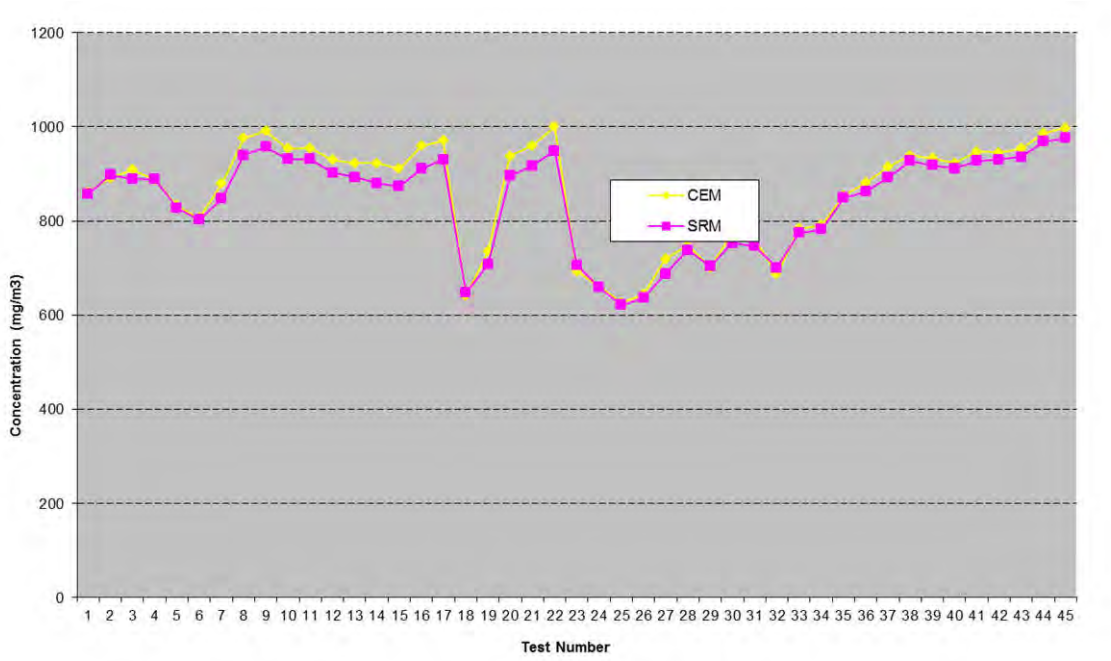
Emission concentrations expresed at reference conditions 273K, 101.3kPa

4A1.2 Table 4.2.1 - Standardised monitoring Data – Oxides of Nitrogen

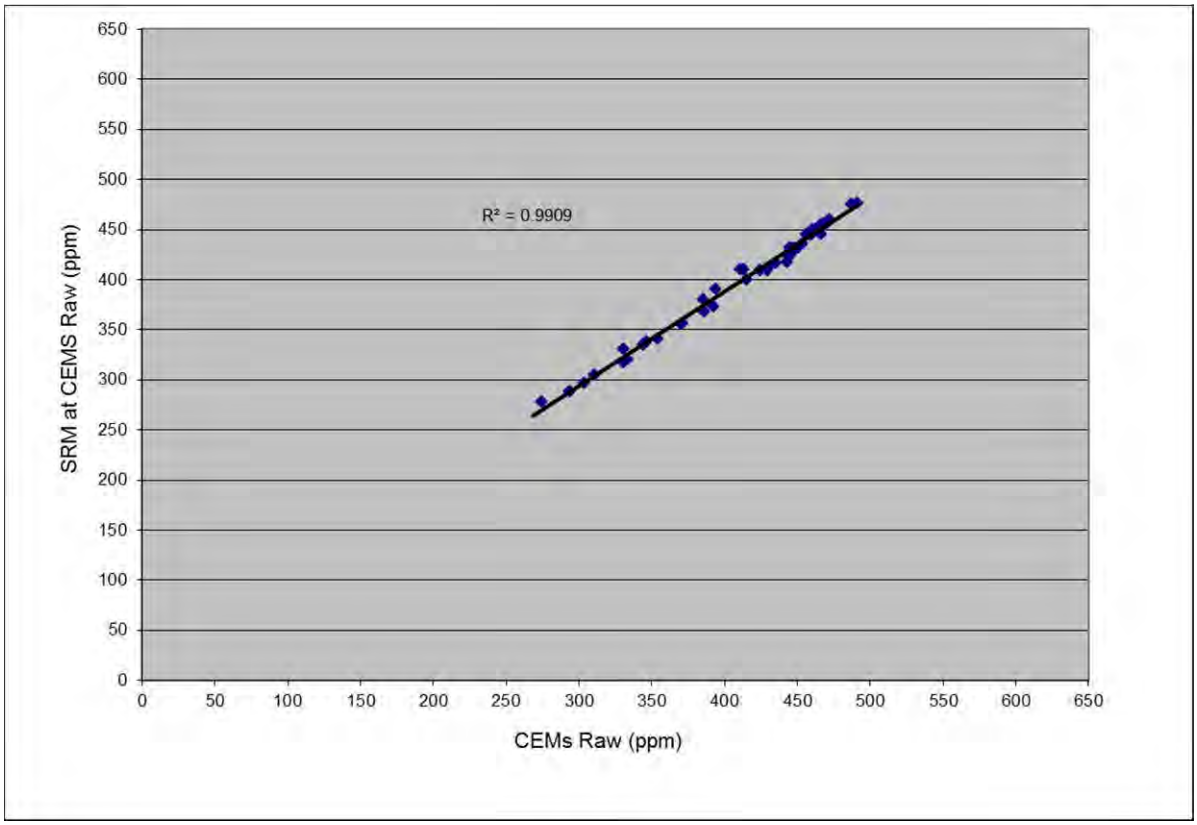
Test No	Date	Test Start Time	Test End Time	CEMS Standardised	SRM Standardised	SRM Uncertainty
		hr:min		(NOx as NO2 mg/m3)	(NOx as NO2 mg/m3)	(mg/m3)
1	07-Mar-16	9:22	10:22	861.0	857.0	28.0
2	07-Mar-16	10:23	11:23	890.8	897.5	29.0
3	07-Mar-16	12:25	13:25	908.9	889.2	29.0
4	07-Mar-16	13:26	14:26	887.1	888.4	29.0
5	07-Mar-16	14:27	15:27	832.0	827.4	27.0
6	07-Mar-16	15:28	16:28	805.9	802.6	26.0
7	07-Mar-16	16:29	17:29	879.2	847.3	28.0
8	07-Mar-16	17:30	18:30	976.1	939.6	31.0
9	07-Mar-16	18:31	19:31	991.3	957.5	31.0
10	07-Mar-16	19:32	20:32	953.9	931.1	30.0
11	07-Mar-16	20:33	21:33	954.4	931.0	30.0
12	07-Mar-16	21:34	22:34	929.4	902.3	30.0
13	07-Mar-16	22:35	23:35	923.0	893.3	29.0
14	07-8/03/2016	23:36	0:36	923.2	880.1	29.0
15	08-Mar-16	0:37	1:37	910.3	873.1	29.0
16	08-Mar-16	1:38	2:38	958.8	910.7	30.0
17	08-Mar-16	2:39	3:39	970.7	930.4	30.0
18	08-Mar-16	3:40	4:40	640.8	647.3	21.0
19	08-Mar-16	4:41	5:41	735.5	707.4	23.0
20	08-Mar-16	5:42	6:42	937.5	895.4	29.0
21	08-Mar-16	6:43	7:43	959.8	917.3	30.0
22	08-Mar-16	7:44	8:44	1000.6	949.3	31.0
23	08-Mar-16	9:35	10:35	693.0	705.9	23.0
24	08-Mar-16	10:36	11:36	659.1	658.6	22.0
25	08-Mar-16	11:37	12:37	625.4	621.1	20.0
26	08-Mar-16	12:38	13:38	643.8	636.1	21.0
27	08-Mar-16	13:39	14:39	719.4	687.6	23.0
28	08-Mar-16	14:40	15:40	747.1	737.7	24.0
29	08-Mar-16	15:41	16:41	700.4	703.6	23.0
30	08-Mar-16	16:42	17:42	773.7	752.8	25.0
31	08-Mar-16	17:43	18:43	760.6	746.4	24.0
32	08-Mar-16	18:44	19:44	687.0	700.3	23.0
33	08-Mar-16	19:45	20:45	783.9	774.3	25.0
34	08-Mar-16	20:46	21:46	790.7	781.8	26.0
35	08-Mar-16	21:47	22:47	853.7	848.8	28.0
36	08-Mar-16	22:48	23:48	881.1	862.1	28.0
37	08-9/03/2016	23:49	0:49	914.0	892.4	29.0
38	09-Mar-16	0:50	1:50	939.5	927.2	30.0
39	09-Mar-16	1:51	2:51	933.1	918.2	30.0
40	09-Mar-16	2:52	3:52	922.9	911.6	30.0
41	09-Mar-16	3:53	4:53	947.0	927.9	30.0
42	09-Mar-16	4:54	5:54	944.9	930.4	30.0
43	09-Mar-16	5:55	6:55	953.6	935.7	31.0
44	09-Mar-16	6:56	7:56	986.0	968.8	32.0
45	09-Mar-16	7:57	8:57	997.6	975.9	32.0

Note:
Emission concentrations expresed at reference conditions 273K, 101.3kPa 6 % Oxygen, dry gas

4A1.3 – Plot 1.1 - Time Series of Standardised CEM versus Standardised SRM data – Oxides of Nitrogen, (Expressed at reference conditions 273K, 101.3kPa, dry gas, 6% oxygen)



4A1.4 – Elimination of Outliers – Oxides of Nitrogen



Guidance on performing tests for outliers in MID 14181 section 6.3, states the following:

'As a general guide, when plotting the raw SRM and raw CEM data, if the R^2 value for the linear regression line is equal or more than 0.9, then it is not ordinarily necessary to perform an outlier test.
Additionally, any data points are not likely to be outliers unless they are more than three standard deviations from the regression line'

As the R^2 value for this determinand was 0.9909, an outlier test has not been undertaken.

4A1.5.1 Determination of Method A or Method B - Oxides of Nitrogen

Test No	Test Start Time	Test End Time	SRM measured value (y)	SRM O2	SRM Standardised
	hr:min		(ppm)	(%)	(mg/m3)
1	9:22	10:22	416.6	6.0	857.0
2	10:23	11:23	440.2	5.9	897.5
3	12:25	13:25	418.1	6.5	889.2
4	13:26	14:26	417.8	6.5	888.4
5	14:27	15:27	397.9	6.2	827.4
6	15:28	16:28	387.2	6.1	802.6
7	16:29	17:29	408.9	6.1	847.3
8	17:30	18:30	452.7	6.2	939.6
9	18:31	19:31	463.5	6.1	957.5
10	19:32	20:32	457.2	5.9	931.1
11	20:33	21:33	456.6	5.9	931.0
12	21:34	22:34	439.3	6.0	902.3
13	22:35	23:35	433.2	6.1	893.3
14	23:36	0:36	425.9	6.1	880.1
15	0:37	1:37	420.1	6.2	873.1
16	1:38	2:38	431.2	6.4	910.7
17	2:39	3:39	439.2	6.5	930.4
18	3:40	4:40	283.3	7.5	647.3
19	4:41	5:41	323.0	6.9	707.4
20	5:42	6:42	435.5	6.0	895.4
21	6:43	7:43	440.4	6.2	917.3
22	7:44	8:44	454.0	6.3	949.3
23	9:35	10:35	334.7	6.4	705.9
24	10:36	11:36	311.0	6.5	658.6
25	11:37	12:37	293.9	6.4	621.1
26	12:38	13:38	302.5	6.3	636.1
27	13:39	14:39	327.1	6.3	687.6
28	14:40	15:40	342.9	6.7	737.7
29	15:41	16:41	341.1	6.1	703.6
30	16:42	17:42	363.5	6.1	752.8
31	17:43	18:43	362.4	6.0	746.4
32	18:44	19:44	346.9	5.7	700.3
33	19:45	20:45	374.6	6.1	774.3
34	20:46	21:46	379.6	6.0	781.8
35	21:47	22:47	417.0	5.9	848.8
36	22:48	23:48	424.0	5.9	862.1
37	23:49	0:49	444.3	5.7	892.4
38	0:50	1:50	464.7	5.6	927.2
39	1:51	2:51	457.8	5.6	918.2
40	2:52	3:52	453.9	5.7	911.6
41	3:53	4:53	458.4	5.8	927.9
42	4:54	5:54	457.2	5.9	930.4
43	5:55	6:55	467.6	5.6	935.7
44	6:56	7:56	484.7	5.6	968.8
45	7:57	8:57	484.2	5.7	975.9
Sum			18335.57		

Emission Limit Value (ELV) =	1080	mg/Nm^3	Y_{max}	975.89
Maximum Permissable uncertainty =	20	%	Y_{min}	621.13
Maximum Permissable uncertainty (at I	216	mg/Nm^3		
15% of the ELV =	162	mg/Nm^3		
Is Ymax - Ymin > MPU at ELV?	Yes		$Y_{max - Ymin}$	354.76
Is Ymin > 15% of ELV?	Yes			

Derivation of Calibration Function	**Method A**

4A1.6.1 Table 4.3.1 - Data used to derive calibration function - Oxides of Nitrogen,

Test No	Test Start Time	Test End Time	SRM measured value (y)	CEMS measured signal (x)	Yi	Xi	Xi * Yi	Xi^2	b
	hr:min		(ppm)	(ppm)	1	2	3	4	
1	Reference		0.0	0.0	-391.36	-403.88	158060.38	163115.84	
2	9:22	10:22	409.0	424.5	17.67	20.61	364.13	424.78	
3	10:23	11:23	431.8	445.0	40.47	41.08	1662.63	1687.62	
4	12:25	13:25	410.1	413.3	18.73	9.44	176.83	89.10	
5	13:26	14:26	410.0	410.7	18.66	6.78	126.51	45.98	
6	14:27	15:27	390.7	393.9	-0.68	-10.02	6.83	100.35	
7	15:28	16:28	380.1	385.1	-11.26	-18.78	211.43	352.50	
8	16:29	17:29	400.4	415.1	9.05	11.20	101.40	125.54	
9	17:30	18:30	444.3	459.4	52.91	55.55	2939.58	3086.29	
10	18:31	19:31	454.9	469.1	63.58	65.21	4145.71	4251.98	
11	19:32	20:32	448.7	461.6	57.39	57.77	3315.26	3337.63	
12	20:33	21:33	448.1	464.2	56.75	60.29	3421.25	3634.75	
13	21:34	22:34	430.9	447.0	39.52	43.08	1702.61	1856.15	
14	22:35	23:35	425.0	442.7	33.60	38.80	1303.65	1505.54	
15	23:36	0:36	417.7	442.8	26.31	38.97	1025.59	1518.96	
16	0:37	1:37	411.9	430.1	20.57	26.18	538.50	685.21	
17	1:38	2:38	423.2	444.6	31.81	40.73	1295.53	1659.01	
18	2:39	3:39	431.1	448.1	39.75	44.24	1758.53	1957.33	
19	3:40	4:40	278.4	274.7	-112.99	-129.19	14597.34	16689.63	
20	4:41	5:41	317.7	330.5	-73.65	-73.38	5404.47	5384.33	
21	5:42	6:42	427.8	447.2	36.41	43.32	1577.40	1876.60	
22	6:43	7:43	432.3	450.8	40.99	46.89	1921.93	2198.37	
23	7:44	8:44	445.7	466.4	54.34	62.53	3398.02	3910.48	
24	9:35	10:35	331.1	330.9	-60.23	-72.96	4393.98	5323.05	
25	10:36	11:36	305.4	310.8	-85.93	-93.07	7997.26	8661.66	
26	11:37	12:37	288.5	293.7	-102.82	-110.18	11329.19	12140.49	
27	12:38	13:38	296.8	303.9	-94.56	-99.95	9451.14	9989.41	
28	13:39	14:39	320.8	333.2	-70.53	-70.65	4982.58	4991.33	
29	14:40	15:40	338.1	346.5	-53.29	-57.41	3059.37	3295.79	
30	15:41	16:41	334.9	343.9	-56.43	-60.00	3385.70	3599.82	
31	16:42	17:42	357.0	371.3	-34.40	-32.57	1120.42	1061.05	
32	17:43	18:43	355.9	370.3	-35.48	-33.53	1189.38	1124.06	
33	18:44	19:44	340.6	354.2	-50.71	-49.67	2518.67	2466.98	
34	19:45	20:45	367.9	386.4	-23.50	-17.50	411.36	306.34	
35	20:46	21:46	372.7	392.1	-18.61	-11.79	219.45	139.02	
36	21:47	22:47	409.4	429.4	18.00	25.49	458.89	649.75	
37	22:48	23:48	416.1	435.2	24.76	31.33	775.62	981.56	
38	23:49	0:49	436.0	453.8	44.61	49.88	2225.31	2488.30	
39	0:50	1:50	455.8	467.2	64.46	63.31	4081.20	4008.67	
40	1:51	2:51	449.3	460.3	57.90	56.41	3266.27	3182.40	
41	2:52	3:52	445.7	456.7	54.33	52.84	2870.69	2791.83	
42	3:53	4:53	450.3	462.5	58.91	58.62	3453.78	3436.79	
43	4:54	5:54	449.2	459.6	57.82	55.73	3221.86	3105.36	
44	5:55	6:55	459.4	472.0	68.04	68.08	4631.99	4635.13	
45	6:56	7:56	476.2	491.1	84.81	87.19	7394.24	7601.56	
46	7:57	8:57	475.6	486.8	84.29	82.94	6990.69	6879.14	
Sum			18002.50	18578.30	0.00	0.00	298484.54	312353.46	0.96

4A1.7.1 Determination of Calibration Function - Oxides of Nitrogen

Method A

If Ymax-Ymin >15% of the ELV, the following formulae are used:

$b=\sum_{i=1}^{N}(xi-x)(y$ where $x=1/N\sum_{i=1}^{N}xi$ $y=1/N\sum_{i=1}^{N}yi$

x= 403.88

y= 391.36

b= 0.956

a=y-bx a = 391.36 - 403.88 * 0.955

a= 5.415

The calibration is function $y_i = a + bxi$ or $yi =$ 5.415 + 0.956 * xi

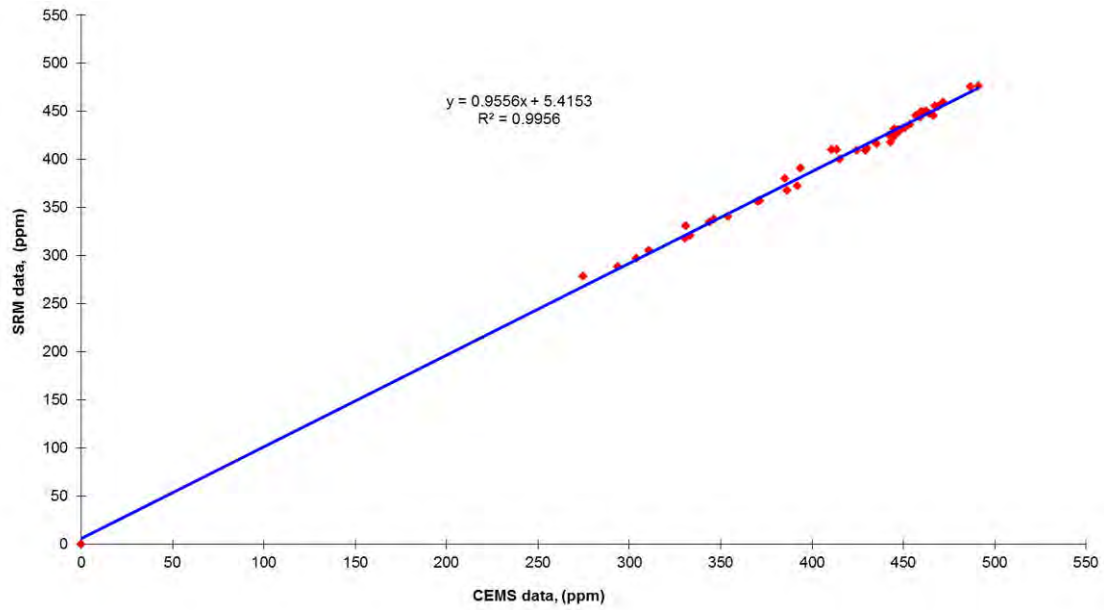
4A1.8.1 Table 4.4.1 - Calculation of calibrated CEMS values - Oxides of Nitrogen

Test No	Test Start Time	Test End Time	CEMS Raw Value (x)	CEMS Calibrated signal	CEMS Dry Oxygen	CEMS Moisture	CEMS Standardised Value (dry)	CEMS Calibrated Standardised Value	SRM Standardised
	hr:min		(ppm)	(ppm)	(%)	(%)	(mg/Nm^3)	(mg/Nm^3)	(mg/Nm3)
1	Reference		0.0	5.4	N/A	N/A	0.0	11.1	0.0
2	09:22	10:22	424.5	411.1	5.5	1.9	861.0	833.7	857.0
3	10:23	11:23	445.0	430.6	5.3	1.8	890.8	862.1	897.5
4	12:25	13:25	413.3	400.4	6.7	1.9	908.9	880.5	889.2
5	13:26	14:26	410.7	397.8	6.5	1.9	887.1	859.4	888.4
6	14:27	15:27	393.9	381.8	6.1	1.9	832.0	806.5	827.4
7	15:28	16:28	385.1	373.4	6.0	1.9	805.9	781.4	802.6
8	16:29	17:29	415.1	402.1	6.1	2.1	879.2	851.6	847.3
9	17:30	18:30	459.4	444.4	6.2	1.9	976.1	944.3	939.6
10	18:31	19:31	469.1	453.7	6.1	1.9	991.3	958.7	957.5
11	19:32	20:32	461.6	446.6	5.8	1.9	953.9	922.7	931.1
12	20:33	21:33	464.2	449.0	5.7	1.9	954.4	923.1	931.0
13	21:34	22:34	447.0	432.5	5.9	1.9	929.4	899.4	902.3
14	22:35	23:35	442.7	428.4	5.9	2.0	923.0	893.3	893.3
15	23:36	00:36	442.8	428.6	5.9	2.0	923.2	893.5	880.1
16	00:37	01:37	430.1	416.4	6.2	2.0	910.3	881.4	873.1
17	01:38	02:38	444.6	430.3	6.4	1.9	958.8	927.9	910.7
18	02:39	03:39	448.1	433.6	6.5	1.9	970.7	939.4	930.4
19	03:40	04:40	274.7	267.9	7.6	1.7	640.8	625.0	647.3
20	04:41	05:41	330.5	321.2	6.9	1.7	735.5	714.9	707.4
21	05:42	06:42	447.2	432.8	6.0	1.9	937.5	907.2	895.4
22	06:43	07:43	450.8	436.2	6.3	1.9	959.8	928.8	917.3
23	07:44	08:44	466.4	451.1	6.4	1.9	1000.6	967.7	949.3
24	09:35	10:35	330.9	321.6	6.0	1.9	693.0	673.5	705.9
25	10:36	11:36	310.8	302.4	6.2	1.7	659.1	641.4	658.6
26	11:37	12:37	293.7	286.1	6.3	1.9	625.4	609.2	621.1
27	12:38	13:38	303.9	295.8	6.2	1.9	643.8	626.6	636.1
28	13:39	14:39	333.2	323.8	6.5	1.9	719.4	699.2	687.6
29	14:40	15:40	346.5	336.5	6.4	1.9	747.1	725.6	737.7
30	15:41	16:41	343.9	334.0	5.6	1.9	700.4	680.3	703.6
31	16:42	17:42	371.3	360.2	5.9	1.9	773.7	750.6	752.8
32	17:43	18:43	370.3	359.3	5.7	1.9	760.6	738.0	746.4
33	18:44	19:44	354.2	343.9	4.8	1.9	687.0	667.0	700.3
34	19:45	20:45	386.4	374.6	5.5	1.9	783.9	760.1	774.3
35	20:46	21:46	392.1	380.1	5.4	1.9	790.7	766.5	781.8
36	21:47	22:47	429.4	415.7	5.2	1.9	853.7	826.5	848.8
37	22:48	23:48	435.2	421.3	5.5	1.9	881.1	852.9	862.1
38	23:49	00:49	453.8	439.0	5.4	2.0	914.0	884.3	892.4
39	00:50	01:50	467.2	451.9	5.4	2.0	939.5	908.7	927.2
40	01:51	02:51	460.3	445.3	5.5	1.9	933.1	902.7	918.2
41	02:52	03:52	456.7	441.9	5.5	1.9	922.9	892.8	911.6
42	03:53	04:53	462.5	447.4	5.7	1.9	947.0	916.1	927.9
43	04:54	05:54	459.6	444.6	5.7	1.8	944.9	914.0	930.4
44	05:55	06:55	472.0	456.4	5.5	1.8	953.6	922.2	935.7
45	06:56	07:56	491.1	474.7	5.4	1.8	986.0	953.1	968.8
46	07:57	08:57	486.8	470.6	5.7	1.8	997.6	964.4	975.9
				Sum			38687.67		

Emission Limit Value (ELV) = 1080 mg/Nm^3

Reference Oxygen 6 %

4A1.9.1 Plot 2.1 CEM versus SRM Parallel Test Data at CEM measurement conditions –NOx ppm, wet gas.



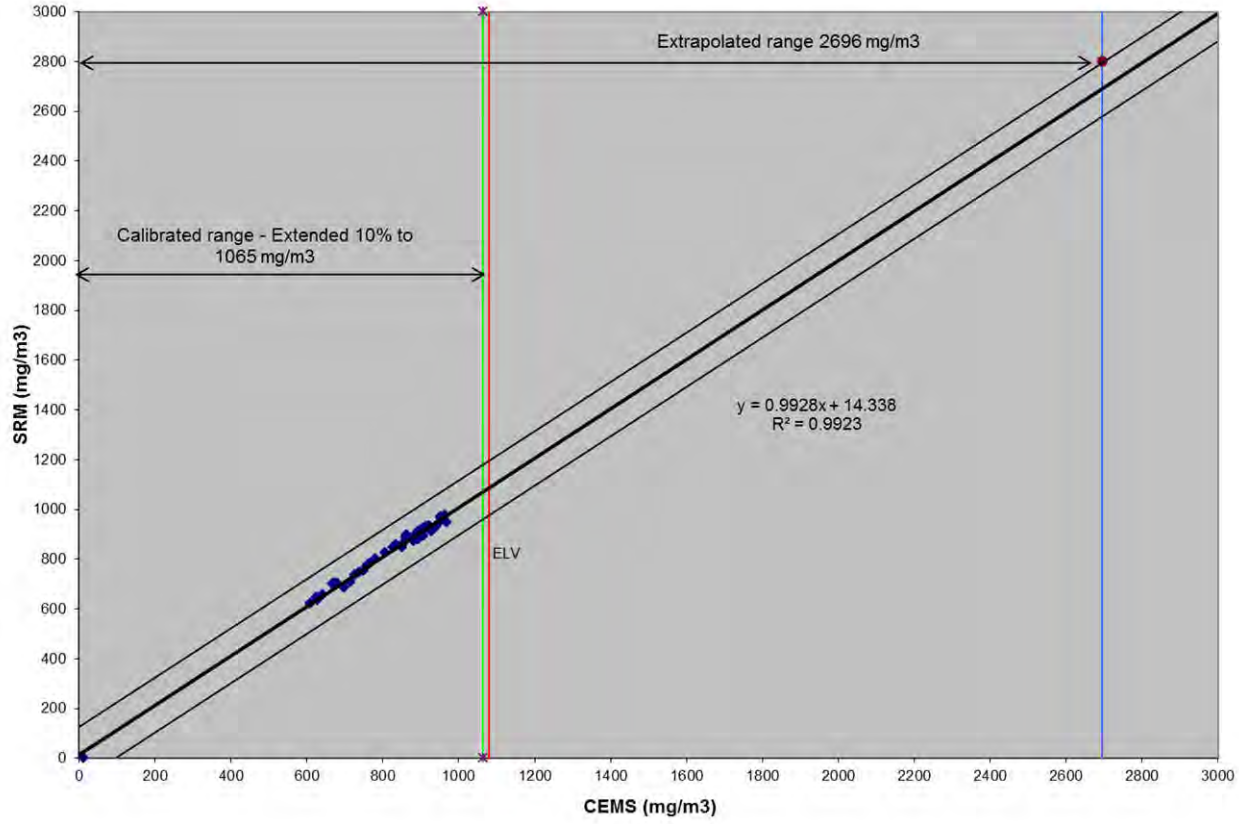
4A1.10.1 Table 4.5.1 – Data used for the Variability Test – Oxides of Nitrogen

Test No	Test Start Time	Test End Time	CEMS Calibrated Standardised value	SRM Standardised value	Difference D1	Difference D1 - D	Squared Difference D1 - D
	hr:min		mg/m3	mg/m3			
2	09:22	10:22	833.7	857.0	23.30	14.36	206.28
3	10:23	11:23	862.1	897.5	35.43	26.50	702.19
4	12:25	13:25	880.5	889.2	8.67	-0.27	0.07
5	13:26	14:26	859.4	888.4	28.98	20.04	401.70
6	14:27	15:27	806.5	827.4	20.91	11.98	143.54
7	15:28	16:28	781.4	802.6	21.16	12.22	149.43
8	16:29	17:29	851.6	847.3	-4.28	-13.21	174.56
9	17:30	18:30	944.3	939.6	-4.67	-13.60	184.94
10	18:31	19:31	958.7	957.5	-1.17	-10.11	102.13
11	19:32	20:32	922.7	931.1	8.37	-0.56	0.31
12	20:33	21:33	923.1	931.0	7.88	-1.05	1.11
13	21:34	22:34	899.4	902.3	2.89	-6.04	36.52
14	22:35	23:35	893.3	893.3	-0.04	-8.97	80.52
15	23:36	00:36	893.5	880.1	-13.36	-22.29	496.84
16	00:37	01:37	881.4	873.1	-8.26	-17.19	295.54
17	01:38	02:38	927.9	910.7	-17.26	-26.20	686.31
18	02:39	03:39	939.4	930.4	-9.01	-17.94	322.01
19	03:40	04:40	625.0	647.3	22.38	13.45	180.86
20	04:41	05:41	714.9	707.4	-7.43	-16.36	267.81
21	05:42	06:42	907.2	895.4	-11.81	-20.75	430.46
22	06:43	07:43	928.8	917.3	-11.42	-20.35	414.09
23	07:44	08:44	967.7	949.3	-18.47	-27.40	750.86
24	09:35	10:35	673.5	705.9	32.41	23.47	551.07
25	10:36	11:36	641.4	658.6	17.23	8.30	68.85
26	11:37	12:37	609.2	621.1	11.95	3.02	9.12
27	12:38	13:38	626.6	636.1	9.47	0.53	0.28
28	13:39	14:39	699.2	687.6	-11.60	-20.53	421.45
29	14:40	15:40	725.6	737.7	12.04	3.11	9.68
30	15:41	16:41	680.3	703.6	23.23	14.30	204.36
31	16:42	17:42	750.6	752.8	2.16	-6.78	45.91
32	17:43	18:43	738.0	746.4	8.46	-0.48	0.23
33	18:44	19:44	667.0	700.3	33.30	24.37	593.69
34	19:45	20:45	760.1	774.3	14.18	5.25	27.57
35	20:46	21:46	766.5	781.8	15.31	6.38	40.71
36	21:47	22:47	826.5	848.8	22.26	13.33	177.56
37	22:48	23:48	852.9	862.1	9.17	0.23	0.05
38	23:49	00:49	884.3	892.4	8.04	-0.89	0.79
39	00:50	01:50	908.7	927.2	18.45	9.52	90.62
40	01:51	02:51	902.7	918.2	15.54	6.60	43.58
41	02:52	03:52	892.8	911.6	18.78	9.85	96.95
42	03:53	04:53	916.1	927.9	11.78	2.84	8.09
43	04:54	05:54	914.0	930.4	16.41	7.47	55.86
44	05:55	06:55	922.2	935.7	13.52	4.59	21.06
45	06:56	07:56	953.1	968.8	15.67	6.73	45.35
46	07:57	08:57	964.4	975.9	11.45	2.52	6.35
45 Tests		Mean			8.93		
Sum							8547.28

4A1.11.1 - Variability Test Calculation – Oxides of Nitrogen

SD=	Root(1-Number).Integral(D1-D)^2	13.94	mg/m3(s,d),6%O2
The uncertainty laid down by the authorities is 20% ELV as a 95% confidence interval. O_0 is therefore calculated as:-			
O_0=	0.2*1080 mg/m3 (s,d,6%O2)/1.96	110.20	mg/m3(s,d),6%O2
For 45 tests, kv =	0.9885		
Therefore variability=	13.94 <= 110.2 * 0.9885		
or	13.94 <=	108.94	
Which is TRUE therefore the CEMS passes the test			

4A1.12.1 Plot 3.1 –Standardised CEM data versus standardised SRM - Oxides of Nitrogen (as NO_2) – Reference conditions 273K, 101.3kPa, dry gas, 6% oxygen



4A1.1.2 Table 4.1.2 – Raw monitoring Data – Sulphur Dioxide, Low Range

Test No	Date	Test Start Time	Test End Time	CEMS Raw Value (wet)	CEMS Oxygen (dry)	CEMS Moisture	SRM Raw value (wet)	SRM Oxygen (dry)	SRM Moisture	SRM at CEMs Raw conditions
		hr:min		(ppm)	(%)	(%)	(ppm)	(%)	(%)	(ppm)
1	07-Mar-16	10:23	11:23	31.06	5.34	1.80	33.65	5.89	1.90	33.7
2	07-Mar-16	12:25	13:25	28.42	6.71	1.95	32.00	6.51	1.91	32.0
3	07-Mar-16	13:26	14:26	29.28	6.46	1.89	32.96	6.51	1.86	33.0
4	07-Mar-16	14:27	15:27	28.16	6.14	1.85	31.16	6.18	1.82	31.2
5	07-Mar-16	15:28	16:28	37.61	6.00	1.86	41.60	6.14	1.84	41.6
6	07-Mar-16	16:29	17:29	66.60	6.15	2.08	81.10	6.13	2.07	81.1
7	07-Mar-16	17:30	18:30	27.09	6.22	1.91	31.29	6.16	1.85	31.3
8	07-Mar-16	18:31	19:31	27.85	6.14	1.93	31.31	6.09	1.84	31.3
9	07-Mar-16	19:32	20:32	27.67	5.80	1.91	30.83	5.87	1.86	30.8
10	07-Mar-16	20:33	21:33	28.44	5.73	1.92	31.00	5.89	1.86	31.0
11	07-Mar-16	21:34	22:34	29.19	5.89	1.94	31.26	6.00	1.91	31.3
12	07-Mar-16	22:35	23:35	27.90	5.93	1.97	30.91	6.06	1.90	30.9
13	07-8/03/2016	23:36	0:36	27.91	5.93	1.97	31.22	6.09	1.92	31.2
14	08-Mar-16	0:37	1:37	28.01	6.15	1.99	31.76	6.18	1.94	31.8
15	08-Mar-16	1:38	2:38	26.88	6.43	1.95	30.57	6.41	1.87	30.6
16	08-Mar-16	2:39	3:39	26.12	6.50	1.91	29.96	6.45	1.85	30.0
17	08-Mar-16	3:40	4:40	21.23	7.55	1.73	24.09	7.51	1.73	24.1
18	08-Mar-16	4:41	5:41	23.85	6.92	1.66	26.46	6.93	1.63	26.5
19	08-Mar-16	5:42	6:42	26.37	6.03	1.87	30.30	6.02	1.77	30.3
20	08-Mar-16	6:43	7:43	26.11	6.25	1.91	30.44	6.21	1.83	30.4
21	08-Mar-16	7:44	8:44	27.91	6.36	1.91	31.17	6.27	1.83	31.2
22	08-Mar-16	9:35	10:35	18.44	6.00	1.92	10.79	6.39	1.08	10.8
23	08-Mar-16	10:36	11:36	11.22	6.22	1.70	12.00	6.45	1.79	12.0
24	08-Mar-16	11:37	12:37	8.43	6.25	1.89	8.96	6.42	1.83	9.0
25	08-Mar-16	12:38	13:38	7.56	6.17	1.92	8.21	6.35	1.89	8.2
26	08-Mar-16	13:39	14:39	6.97	6.46	1.88	8.21	6.35	1.90	8.2
27	08-Mar-16	15:41	16:41	6.82	5.59	1.88	8.25	6.07	1.80	8.2
28	08-Mar-16	16:42	17:42	6.06	5.93	1.88	7.71	6.12	1.81	7.7
29	08-Mar-16	17:43	18:43	6.65	5.72	1.87	7.95	6.04	1.80	7.9
30	08-Mar-16	18:44	19:44	7.46	4.82	1.88	8.67	5.74	1.81	8.7
31	08-Mar-16	19:45	20:45	8.20	5.53	1.90	8.90	6.10	1.80	8.9
32	08-Mar-16	20:46	21:46	11.77	5.44	1.89	13.13	6.04	1.80	13.1
33	08-Mar-16	21:47	22:47	19.82	5.21	1.92	20.32	5.87	1.83	20.3
34	08-Mar-16	22:48	23:48	22.95	5.49	1.94	24.50	5.85	1.87	24.5
35	08-9/03/2016	23:49	0:49	25.01	5.41	1.95	27.47	5.66	1.88	27.5
36	09-Mar-16	0:50	1:50	26.91	5.38	1.97	28.92	5.57	1.90	28.9
37	09-Mar-16	1:51	2:51	27.03	5.51	1.91	28.71	5.64	1.86	28.7
38	09-Mar-16	2:52	3:52	25.94	5.47	1.88	28.58	5.67	1.80	28.6
39	09-Mar-16	3:53	4:53	24.90	5.67	1.85	27.37	5.78	1.76	27.4
40	09-Mar-16	4:54	5:54	25.31	5.74	1.83	26.90	5.87	1.75	26.9
41	09-Mar-16	5:55	6:55	25.73	5.47	1.84	27.60	5.61	1.76	27.6
42	09-Mar-16	6:56	7:56	26.52	5.38	1.83	28.25	5.59	1.76	28.2
43	09-Mar-16	7:57	8:57	26.16	5.69	1.83	28.84	5.72	1.76	28.8

Note:

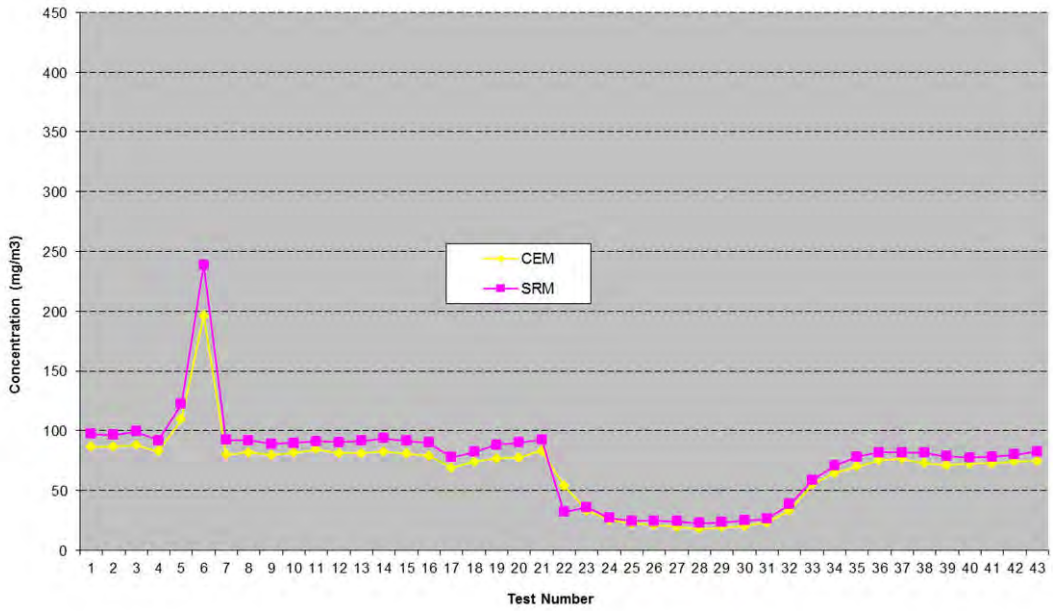
Emission concentrations expresed at reference conditions 273K, 101.3kPa

4A1.2.2 Table 4.2.2 -Standardised monitoring Data – Sulphur Dioxide, Low Range

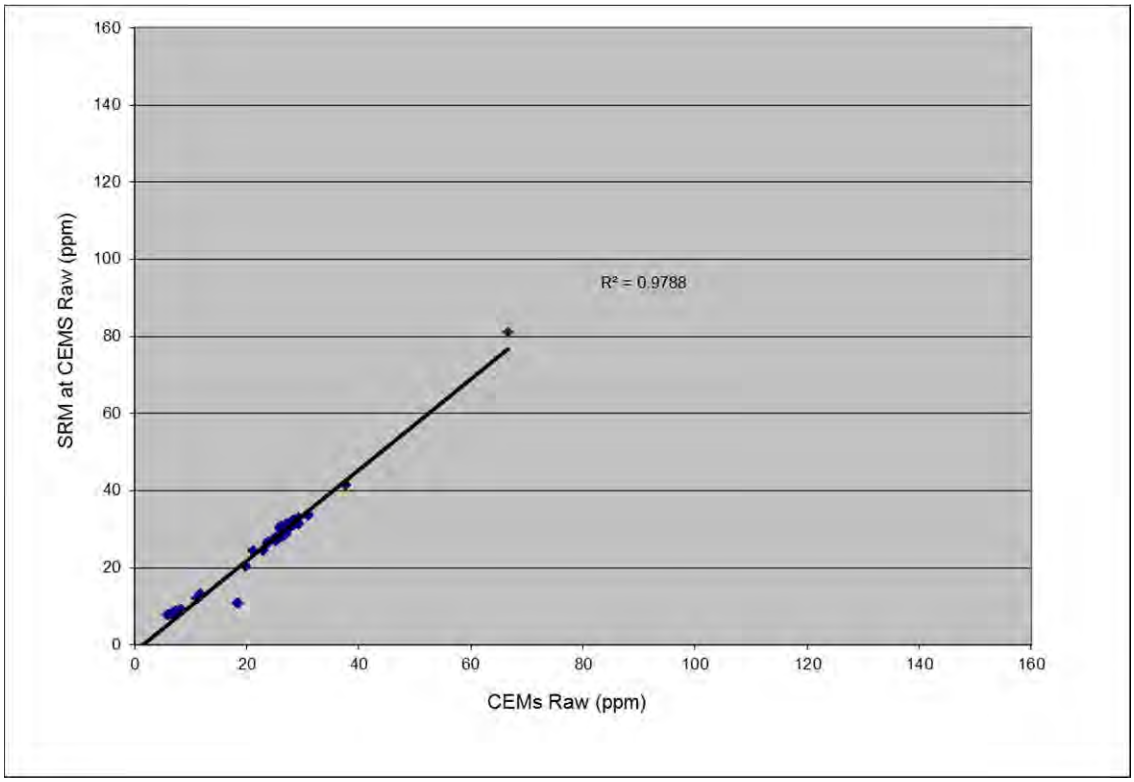
Test No	Date	Test Start Time	Test End Time	CEMS Standardised	SRM Standardised	SRM Uncertainty
		hr:min		(SO2 mg/m3)	(SO2 mg/m3)	(mg/m3)
1	07-Mar-16	10:23	11:23	86.5	97.3	5.0
2	07-Mar-16	12:25	13:25	87.0	96.5	5.0
3	07-Mar-16	13:26	14:26	88.0	99.4	5.1
4	07-Mar-16	14:27	15:27	82.8	91.8	4.8
5	07-Mar-16	15:28	16:28	109.5	122.2	6.3
6	07-Mar-16	16:29	17:29	196.3	238.8	12.4
7	07-Mar-16	17:30	18:30	80.1	92.1	4.8
8	07-Mar-16	18:31	19:31	81.9	91.7	4.8
9	07-Mar-16	19:32	20:32	79.6	89.0	4.6
10	07-Mar-16	20:33	21:33	81.3	89.6	4.7
11	07-Mar-16	21:34	22:34	84.4	91.1	4.7
12	07-Mar-16	22:35	23:35	80.9	90.4	4.7
13	07-8/03/2016	23:36	0:36	80.9	91.5	4.8
14	08-Mar-16	0:37	1:37	82.5	93.6	4.9
15	08-Mar-16	1:38	2:38	80.7	91.5	4.8
16	08-Mar-16	2:39	3:39	78.7	90.0	4.7
17	08-Mar-16	3:40	4:40	68.9	77.9	4.1
18	08-Mar-16	4:41	5:41	73.8	82.0	4.3
19	08-Mar-16	5:42	6:42	76.9	88.2	4.6
20	08-Mar-16	6:43	7:43	77.4	89.8	4.7
21	08-Mar-16	7:44	8:44	83.3	92.4	4.8
22	08-Mar-16	9:35	10:35	53.7	32.0	1.6
23	08-Mar-16	10:36	11:36	33.1	36.0	1.9
24	08-Mar-16	11:37	12:37	25.0	26.8	1.4
25	08-Mar-16	12:38	13:38	22.3	24.5	1.2
26	08-Mar-16	13:39	14:39	20.9	24.5	1.2
27	08-Mar-16	15:41	16:41	19.3	24.1	1.2
28	08-Mar-16	16:42	17:42	17.6	22.6	1.2
29	08-Mar-16	17:43	18:43	19.0	23.2	1.2
30	08-Mar-16	18:44	19:44	20.1	24.8	1.3
31	08-Mar-16	19:45	20:45	23.1	26.1	1.4
32	08-Mar-16	20:46	21:46	33.0	38.3	2.0
33	08-Mar-16	21:47	22:47	54.8	58.6	3.1
34	08-Mar-16	22:48	23:48	64.7	70.6	3.7
35	08-9/03/2016	23:49	0:49	70.1	78.2	4.1
36	09-Mar-16	0:50	1:50	75.3	81.8	4.3
37	09-Mar-16	1:51	2:51	76.2	81.6	4.3
38	09-Mar-16	2:52	3:52	72.9	81.3	4.2
39	09-Mar-16	3:53	4:53	70.9	78.5	4.1
40	09-Mar-16	4:54	5:54	72.4	77.5	4.1
41	09-Mar-16	5:55	6:55	72.3	78.2	4.1
42	09-Mar-16	6:56	7:56	74.1	80.0	4.1
43	09-Mar-16	7:57	8:57	74.6	82.3	4.3

Note:
Emission concentrations expresed at reference conditions 273K, 101.3kPa 6 % Oxygen, dry gas

4A1.3.2 – Plot 1.2 - Time Series of Standardised CEM versus Standardised SRM data – Sulphur Dioxide, Low Range (Expressed at reference conditions 273K, 101.3kPa, dry gas, 6% oxygen)



4A1.4.2 – Elimination of Outliers – Sulphur Dioxide, Low Range.



Guidance on performing tests for outliers in MID 14181 section 6.3, states the following:

'As a general guide, when plotting the raw SRM and raw CEM data, if the R^2 value for the linear regression line is equal or more than 0.9, then it is not ordinarily necessary to perform an outlier test.
Additionally, any data points are not likely to be outliers unless they are more than two standard deviations from the regression line'

As the R^2 value for this determinand was 0.9788, an outlier test has not been undertaken.

Test 6 (highlighted in red above) has been eliminated as inspection of the raw CEMS data indicated that the analyser was operating above its maximum range for part of the test.

4A1.5.2 Determination of Method A or Method B - Sulphur Dioxide, Low Range.

Test No	Test Start Time	Test End Time	SRM measured value (y)	SRM O2	SRM Standardised
	hr:min		(ppm)	(%)	(mg/m3)
1	10:23	11:23	33.7	5.9	97.3
2	12:25	13:25	32.0	6.5	96.5
3	13:26	14:26	33.0	6.5	99.4
4	14:27	15:27	31.2	6.2	91.8
5	15:28	16:28	41.6	6.1	122.2
7	17:30	18:30	31.3	6.2	92.1
8	18:31	19:31	31.3	6.1	91.7
9	19:32	20:32	30.8	5.9	89.0
10	20:33	21:33	31.0	5.9	89.6
11	21:34	22:34	31.3	6.0	91.1
12	22:35	23:35	30.9	6.1	90.4
13	23:36	0:36	31.2	6.1	91.5
14	0:37	1:37	31.8	6.2	93.6
15	1:38	2:38	30.6	6.4	91.5
16	2:39	3:39	30.0	6.5	90.0
17	3:40	4:40	24.1	7.5	77.9
18	4:41	5:41	26.5	6.9	82.0
19	5:42	6:42	30.3	6.0	88.2
20	6:43	7:43	30.4	6.2	89.8
21	7:44	8:44	31.2	6.3	92.4
22	9:35	10:35	10.8	6.4	32.0
23	10:36	11:36	12.0	6.5	36.0
24	11:37	12:37	9.0	6.4	26.8
25	12:38	13:38	8.2	6.3	24.5
26	13:39	14:39	8.2	6.3	24.5
27	15:41	16:41	8.2	6.1	24.1
28	16:42	17:42	7.7	6.1	22.6
29	17:43	18:43	7.9	6.0	23.2
30	18:44	19:44	8.7	5.7	24.8
31	19:45	20:45	8.9	6.1	26.1
32	20:46	21:46	13.1	6.0	38.3
33	21:47	22:47	20.3	5.9	58.6
34	22:48	23:48	24.5	5.9	70.6
35	23:49	0:49	27.5	5.7	78.2
36	0:50	1:50	28.9	5.6	81.8
37	1:51	2:51	28.7	5.6	81.6
38	2:52	3:52	28.6	5.7	81.3
39	3:53	4:53	27.4	5.8	78.5
40	4:54	5:54	26.9	5.9	77.5
41	5:55	6:55	27.6	5.6	78.2
42	6:56	7:56	28.2	5.6	80.0
43	7:57	8:57	28.8	5.7	82.3
Sum			1024.17		

Emission Limit Value (ELV) =	440	mg/Nm^3	Y_{max}	122.21
Maximum Permissable uncertainty =	20	%	Y_{min}	22.62
Maximum Permissable uncertainty (at E	88	mg/Nm^3		
15% of the ELV =	66	mg/Nm^3		
Is Ymax - Ymin > MPU at ELV?	Yes		$Y_{max - Ymin}$	99.59
Is Ymin > 15% of ELV?	No			

Derivation of Calibration Function	**Method A**

4A1.6.2 Table 4.3.2 - Data used to derive calibration function - Sulphur Dioxide, Low Range.

Test No	Test Start Time	Test End Time	SRM measured value (y)	CEMS measured signal (x)	Yi	Xi	Xi * Yi	Xi^2	b
	hr:min		(ppm)	(ppm)	1	2	3	4	
1	Reference	16/02/2016	0.0	0.0	-23.82	-21.70	516.76	470.72	
2	10:23	11:23	33.7	31.1	9.84	9.36	92.09	87.64	
3	12:25	13:25	32.0	28.4	8.18	6.72	55.00	45.20	
4	13:26	14:26	33.0	29.3	9.15	7.59	69.38	57.54	
5	14:27	15:27	31.2	28.2	7.34	6.47	47.44	41.81	
6	15:28	16:28	41.6	37.6	17.78	15.91	282.98	253.27	
8	17:30	18:30	31.3	27.1	7.47	5.40	40.32	29.12	
9	18:31	19:31	31.3	27.9	7.49	6.16	46.12	37.90	
10	19:32	20:32	30.8	27.7	7.01	5.98	41.90	35.74	
11	20:33	21:33	31.0	28.4	7.18	6.74	48.44	45.45	
12	21:34	22:34	31.3	29.2	7.44	7.49	55.74	56.13	
13	22:35	23:35	30.9	27.9	7.09	6.20	43.96	38.46	
14	23:36	0:36	31.2	27.9	7.40	6.21	46.01	38.61	
15	0:37	1:37	31.8	28.0	7.94	6.31	50.11	39.85	
16	1:38	2:38	30.6	26.9	6.75	5.19	35.01	26.91	
17	2:39	3:39	30.0	26.1	6.15	4.42	27.20	19.58	
18	3:40	4:40	24.1	21.2	0.27	-0.46	-0.13	0.21	
19	4:41	5:41	26.5	23.8	2.64	2.15	5.69	4.64	
20	5:42	6:42	30.3	26.4	6.48	4.67	30.27	21.82	
21	6:43	7:43	30.4	26.1	6.62	4.42	29.22	19.50	
22	7:44	8:44	31.2	27.9	7.35	6.21	45.68	38.58	
23	9:35	10:35	10.8	18.4	-13.03	-3.25	42.41	10.59	
24	10:36	11:36	12.0	11.2	-11.82	-10.48	123.89	109.84	
25	11:37	12:37	9.0	8.4	-14.86	-13.26	197.04	175.93	
26	12:38	13:38	8.2	7.6	-15.60	-14.14	220.65	199.93	
27	13:39	14:39	8.2	7.0	-15.61	-14.72	229.74	216.72	
28	15:41	16:41	8.2	6.8	-15.57	-14.87	231.59	221.26	
29	16:42	17:42	7.7	6.1	-16.11	-15.64	251.91	244.56	
30	17:43	18:43	7.9	6.6	-15.87	-15.05	238.76	226.40	
31	18:44	19:44	8.7	7.5	-15.15	-14.23	215.63	202.59	
32	19:45	20:45	8.9	8.2	-14.91	-13.50	201.32	182.20	
33	20:46	21:46	13.1	11.8	-10.68	-9.93	106.09	98.58	
34	21:47	22:47	20.3	19.8	-3.49	-1.88	6.56	3.53	
35	22:48	23:48	24.5	23.0	0.68	1.26	0.86	1.58	
36	23:49	0:49	27.5	25.0	3.65	3.32	12.12	11.01	
37	0:50	1:50	28.9	26.9	5.10	5.21	26.59	27.17	
38	1:51	2:51	28.7	27.0	4.89	5.33	26.11	28.46	
39	2:52	3:52	28.6	25.9	4.76	4.25	20.21	18.02	
40	3:53	4:53	27.4	24.9	3.55	3.20	11.37	10.27	
41	4:54	5:54	26.9	25.3	3.08	3.62	11.16	13.09	
42	5:55	6:55	27.6	25.7	3.79	4.03	15.26	16.25	
43	6:56	7:56	28.2	26.5	4.43	4.82	21.36	23.28	
44	7:57	8:57	28.8	26.2	5.02	4.46	22.39	19.91	
Sum			1024.17	932.93	0.00	0.00	3842.21	3469.85	1.11

4A1.7.2 Determination of Calibration Function - Sulphur Dioxide, Low Range.

Method A

If Ymax-Ymin >15% of the ELV, the following formulae are used:

$b=\sum_{i=1}^{N}(x_i-x)(y$ where $x=1/N\sum_{i=1}^{N}x_i$ $y=1/N\sum_{i=1}^{N}y_i$

$x=$ 21.70

$y=$ 23.82

$b=$ 1.107

$a=y-bx$ $a = 23.82 - 21.7 * 1.107$ $a=$ -0.206

The calibration is function $y_i = a + bx_i$ or $y_i =$ -0.206 + 1.107 * xi

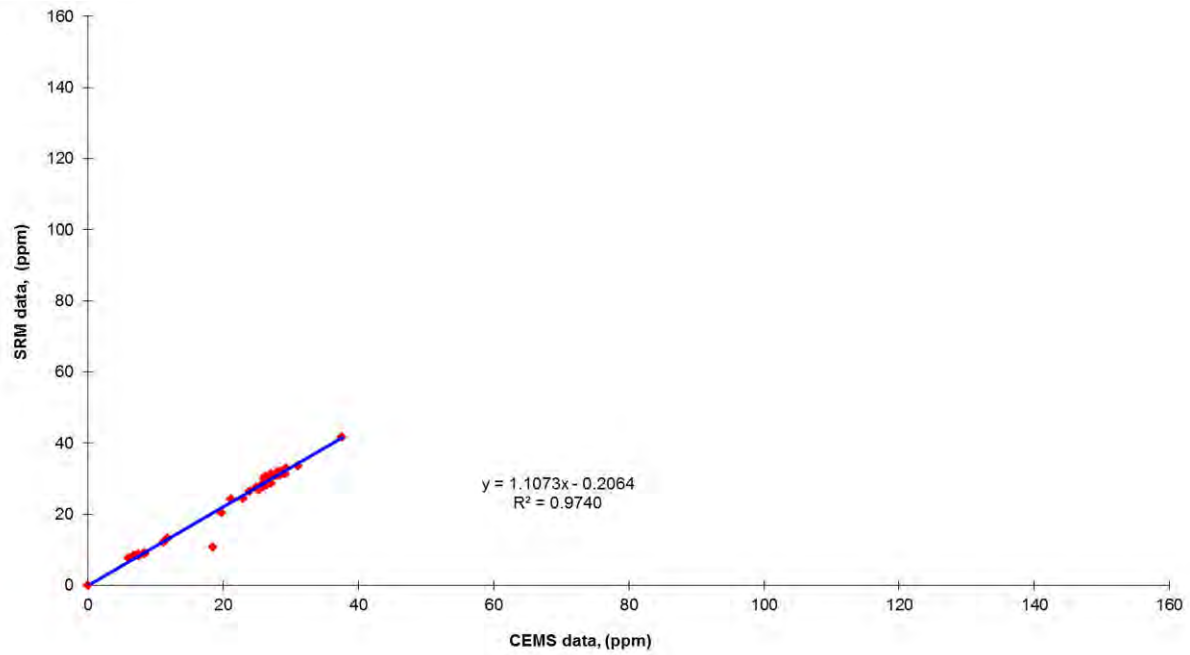
4A1.8.2 Table A.4.4.2 - Calculation of calibrated CEMS values - Sulphur Dioxide, Low Range

Test No	Test Start Time	Test End Time	CEMS Raw Value (x)	CEMS Calibrated signal	CEMS Dry Oxygen	CEMS Moisture	CEMS Standardised Value (dry)	CEMS Calibrated Standardised Value	SRM Standardised
	hr:min		(ppm)	(ppm)	(%)	(%)	(mg/Nm^3)	(mg/Nm^3)	(mg/Nm3)
1	Reference	16/02/2016	0.0	-0.2	N/A	N/A	0.0	-0.6	0.0
2	10:23	11:23	31.1	34.2	5.3	1.8	87.0	95.2	97.3
3	12:25	13:25	28.4	31.3	6.7	1.9	82.8	95.7	96.5
4	13:26	14:26	29.3	32.2	6.5	1.9	109.5	96.8	99.4
5	14:27	15:27	28.2	31.0	6.1	1.9	196.3	91.0	91.8
6	15:28	16:28	37.6	41.4	6.0	1.9	80.1	120.7	122.2
8	17:30	18:30	27.1	29.8	6.2	1.9	79.6	88.1	92.1
9	18:31	19:31	27.9	30.6	6.1	1.9	81.3	90.1	91.7
10	19:32	20:32	27.7	30.4	5.8	1.9	84.4	87.5	89.0
11	20:33	21:33	28.4	31.3	5.7	1.9	80.9	89.5	89.6
12	21:34	22:34	29.2	32.1	5.9	1.9	80.9	92.9	91.1
13	22:35	23:35	27.9	30.7	5.9	2.0	82.5	89.0	90.4
14	23:36	00:36	27.9	30.7	5.9	2.0	80.7	89.0	91.5
15	00:37	01:37	28.0	30.8	6.2	2.0	78.7	90.7	93.6
16	01:38	02:38	26.9	29.6	6.4	1.9	68.9	88.7	91.5
17	02:39	03:39	26.1	28.7	6.5	1.9	73.8	86.6	90.0
18	03:40	04:40	21.2	23.3	7.6	1.7	76.9	75.6	77.9
19	04:41	05:41	23.8	26.2	6.9	1.7	77.4	81.1	82.0
20	05:42	06:42	26.4	29.0	6.0	1.9	83.3	84.6	88.2
21	06:43	07:43	26.1	28.7	6.3	1.9	53.7	85.0	89.8
22	07:44	08:44	27.9	30.7	6.4	1.9	33.1	91.6	92.4
23	09:35	10:35	18.4	20.2	6.0	1.9	25.0	58.9	32.0
24	10:36	11:36	11.2	12.2	6.2	1.7	22.3	36.0	36.0
25	11:37	12:37	8.4	9.1	6.3	1.9	20.9	27.1	26.8
26	12:38	13:38	7.6	8.2	6.2	1.9	19.3	24.0	24.5
27	13:39	14:39	7.0	7.5	6.5	1.9	17.6	22.6	24.5
28	15:41	16:41	6.8	7.3	5.6	1.9	19.0	20.8	24.1
29	16:42	17:42	6.1	6.5	5.9	1.9	20.1	18.8	22.6
30	17:43	18:43	6.6	7.2	5.7	1.9	23.1	20.4	23.2
31	18:44	19:44	7.5	8.1	4.8	1.9	33.0	21.7	24.8
32	19:45	20:45	8.2	8.9	5.5	1.9	54.8	25.0	26.1
33	20:46	21:46	11.8	12.8	5.4	1.9	64.7	36.0	38.3
34	21:47	22:47	19.8	21.7	5.2	1.9	70.1	60.1	58.6
35	22:48	23:48	23.0	25.2	5.5	1.9	75.3	71.0	70.6
36	23:49	00:49	25.0	27.5	5.4	2.0	76.2	77.0	78.2
37	00:50	01:50	26.9	29.6	5.4	2.0	72.9	82.8	81.8
38	01:51	02:51	27.0	29.7	5.5	1.9	70.9	83.8	81.6
39	02:52	03:52	25.9	28.5	5.5	1.9	72.4	80.2	81.3
40	03:53	04:53	24.9	27.4	5.7	1.9	72.3	78.0	78.5
41	04:54	05:54	25.3	27.8	5.7	1.8	74.1	79.6	77.5
42	05:55	06:55	25.7	28.3	5.5	1.8	74.6	79.5	78.2
43	06:56	07:56	26.5	29.2	5.4	1.8	0.0	81.5	80.0
44	07:57	08:57	26.2	28.8	5.7	1.8	0.0	82.0	82.3
				Sum			2650.57		

Emission Limit Value (ELV) = 440 mg/Nm^3

Reference Oxygen 6 %

4A1.9.2 Plot 2.2 CEM versus SRM Parallel Test Data at CEM measurement conditions –Sulphur dioxide, wet gas



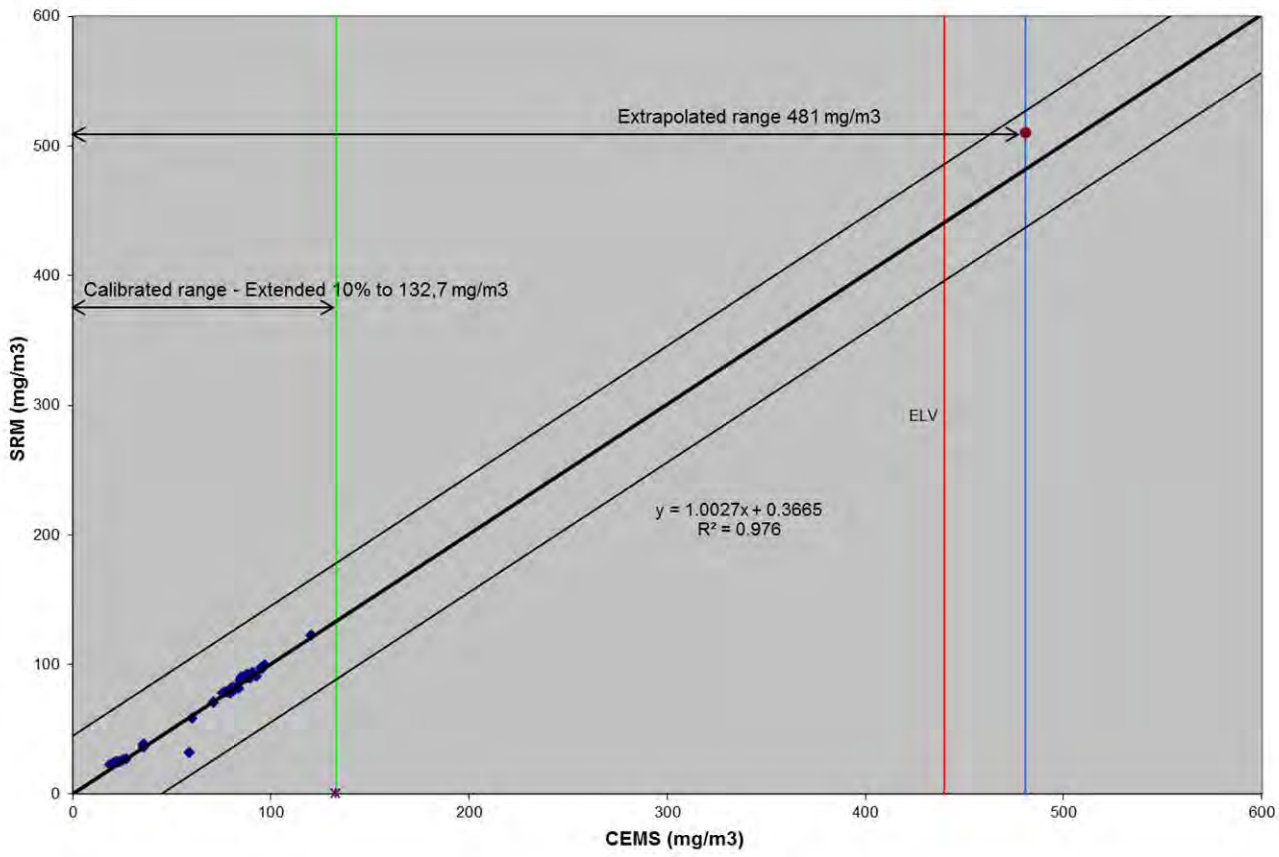
4A1.10.2 Table 4.5.2 – Data used for the Variability Test – Sulphur Dioxide, Low Range.

Test No	Test Start Time	Test End Time	CEMS Calibrated Standardised value	SRM Standardised value	Difference D1	Difference D1 - D	Squared Difference D1 - D
	hr:min		mg/m3	mg/m3			
2	10:23	11:23	95.2	97.3	2.10	1.55	2.39
3	12:25	13:25	95.7	96.5	0.88	0.32	0.10
4	13:26	14:26	96.8	99.4	2.54	1.98	3.94
5	14:27	15:27	91.0	91.8	0.76	0.20	0.04
6	15:28	16:28	120.7	122.2	1.56	1.00	1.00
8	17:30	18:30	88.1	92.1	4.00	3.45	11.87
9	18:31	19:31	90.1	91.7	1.62	1.06	1.12
10	19:32	20:32	87.5	89.0	1.49	0.93	0.87
11	20:33	21:33	89.5	89.6	0.13	-0.43	0.18
12	21:34	22:34	92.9	91.1	-1.84	-2.39	5.72
13	22:35	23:35	89.0	90.4	1.37	0.82	0.67
14	23:36	00:36	89.0	91.5	2.50	1.94	3.78
15	00:37	01:37	90.7	93.6	2.92	2.36	5.58
16	01:38	02:38	88.7	91.5	2.82	2.27	5.14
17	02:39	03:39	86.6	90.0	3.42	2.86	8.19
18	03:40	04:40	75.6	77.9	2.30	1.75	3.05
19	04:41	05:41	81.1	82.0	0.85	0.29	0.08
20	05:42	06:42	84.6	88.2	3.68	3.12	9.75
21	06:43	07:43	85.0	89.8	4.80	4.24	17.98
22	07:44	08:44	91.6	92.4	0.76	0.20	0.04
23	09:35	10:35	58.9	32.0	-26.90	-27.46	753.80
24	10:36	11:36	36.0	36.0	-0.04	-0.60	0.36
25	11:37	12:37	27.1	26.8	-0.21	-0.76	0.59
26	12:38	13:38	24.0	24.5	0.44	-0.12	0.01
27	13:39	14:39	22.6	24.5	1.91	1.35	1.83
28	15:41	16:41	20.8	24.1	3.29	2.73	7.47
29	16:42	17:42	18.8	22.6	3.77	3.22	10.34
30	17:43	18:43	20.4	23.2	2.75	2.19	4.81
31	18:44	19:44	21.7	24.8	3.05	2.50	6.23
32	19:45	20:45	25.0	26.1	1.03	0.48	0.23
33	20:46	21:46	36.0	38.3	2.35	1.79	3.20
34	21:47	22:47	60.1	58.6	-1.50	-2.05	4.22
35	22:48	23:48	71.0	70.6	-0.39	-0.95	0.90
36	23:49	00:49	77.0	78.2	1.18	0.63	0.39
37	00:50	01:50	82.8	81.8	-0.95	-1.51	2.27
38	01:51	02:51	83.8	81.6	-2.20	-2.75	7.57
39	02:52	03:52	80.2	81.3	1.15	0.60	0.35
40	03:53	04:53	78.0	78.5	0.50	-0.06	0.00
41	04:54	05:54	79.6	77.5	-2.05	-2.61	6.79
42	05:55	06:55	79.5	78.2	-1.27	-1.83	3.35
43	06:56	07:56	81.5	80.0	-1.51	-2.07	4.27
44	07:57	08:57	82.0	82.3	0.32	-0.24	0.06
42 Tests		Mean			0.56		
Sum							900.54

4A1.11.2 - Variability Test Calculation – Sulphur Dioxide, Low Range.

SD=	Root(1-Number).Integral(D1-D)^2	4.69	mg/m3(s,d),6%O2
The uncertainty laid down by the authorities is 20% ELV as a 95% confidence interval. O_0 is therefore calculated as:-			
O_0=	0.2*440 mg/m3 (s,d,6%O2)/1.96	44.90	mg/m3(s,d),6%O2
For 42 tests, kv =	0.9885		
Therefore variability=	4.69 <= 44.9 * 0.9885		
or	4.69 <=	44.38	
Which is TRUE therefore the CEMS passes the test			

4A1.12.2 Plot 3.2 –Standardised CEM data versus standardised SRM - Sulphur dioxide, Low Range – Reference conditions 273K, 101.3kPa 6% oxygen, dry gas.



4A1.1.3 Table 4.1.3– Raw monitoring Data – Sulphur Dioxide, High Range

Test No	Date	Test Start Time	Test End Time	CEMS Raw Value (wet)	CEMS Oxygen (dry)	CEMS Moisture	SRM Raw value (wet)	SRM Oxygen (dry)	SRM Moisture	SRM at CEMs Raw conditions
		hr:min		(ppm)	(%)	(%)	(ppm)	(%)	(%)	(ppm)
1	07-Mar-16	10:23	11:23	31.23	5.34	1.80	33.65	5.89	1.90	33.7
2	07-Mar-16	12:25	13:25	28.64	6.71	1.95	32.00	6.51	1.91	32.0
3	07-Mar-16	13:26	14:26	29.49	6.46	1.89	32.96	6.51	1.86	33.0
4	07-Mar-16	14:27	15:27	28.39	6.14	1.85	31.16	6.18	1.82	31.2
5	07-Mar-16	15:28	16:28	38.54	6.00	1.86	41.60	6.14	1.84	41.6
6	07-Mar-16	16:29	17:29	73.24	6.15	2.08	81.10	6.13	2.07	81.1
7	07-Mar-16	17:30	18:30	27.31	6.22	1.91	31.29	6.16	1.85	31.3
8	07-Mar-16	18:31	19:31	28.07	6.14	1.93	31.31	6.09	1.84	31.3
9	07-Mar-16	19:32	20:32	27.91	5.80	1.91	30.83	5.87	1.86	30.8
10	07-Mar-16	20:33	21:33	28.66	5.73	1.92	31.00	5.89	1.86	31.0
11	07-Mar-16	21:34	22:34	29.32	5.89	1.94	31.26	6.00	1.91	31.3
12	07-Mar-16	22:35	23:35	28.14	5.93	1.97	30.91	6.06	1.90	30.9
13	07-8/03/2016	23:36	0:36	28.15	5.93	1.97	31.22	6.09	1.92	31.2
14	08-Mar-16	0:37	1:37	28.19	6.15	1.99	31.76	6.18	1.94	31.8
15	08-Mar-16	1:38	2:38	27.07	6.43	1.95	30.57	6.41	1.87	30.6
16	08-Mar-16	2:39	3:39	26.30	6.50	1.91	29.96	6.45	1.85	30.0
17	08-Mar-16	3:40	4:40	21.39	7.55	1.73	24.09	7.51	1.73	24.1
18	08-Mar-16	4:41	5:41	24.02	6.92	1.66	26.46	6.93	1.63	26.5
19	08-Mar-16	5:42	6:42	26.55	6.03	1.87	30.30	6.02	1.77	30.3
20	08-Mar-16	6:43	7:43	26.33	6.25	1.91	30.44	6.21	1.83	30.4
21	08-Mar-16	7:44	8:44	28.10	6.36	1.91	31.17	6.27	1.83	31.2
22	08-Mar-16	9:35	10:35	18.66	6.00	1.92	10.79	6.39	1.08	10.8
23	08-Mar-16	10:36	11:36	11.46	6.22	1.70	12.00	6.45	1.79	12.0
24	08-Mar-16	11:37	12:37	8.67	6.25	1.89	8.96	6.42	1.83	9.0
25	08-Mar-16	12:38	13:38	7.81	6.17	1.92	8.21	6.35	1.89	8.2
26	08-Mar-16	13:39	14:39	7.24	6.46	1.88	8.21	6.35	1.90	8.2
27	08-Mar-16	15:41	16:41	7.09	5.59	1.88	8.25	6.07	1.80	8.2
28	08-Mar-16	16:42	17:42	6.33	5.93	1.88	7.71	6.12	1.81	7.7
29	08-Mar-16	17:43	18:43	6.93	5.72	1.87	7.95	6.04	1.80	7.9
30	08-Mar-16	18:44	19:44	7.74	4.82	1.88	8.67	5.74	1.81	8.7
31	08-Mar-16	19:45	20:45	8.47	5.53	1.90	8.90	6.10	1.80	8.9
32	08-Mar-16	20:46	21:46	12.05	5.44	1.89	13.13	6.04	1.80	13.1
33	08-Mar-16	21:47	22:47	20.10	5.21	1.92	20.32	5.87	1.83	20.3
34	08-Mar-16	22:48	23:48	23.23	5.49	1.94	24.50	5.85	1.87	24.5
35	08-9/03/2016	23:49	0:49	25.29	5.41	1.95	27.47	5.66	1.88	27.5
36	09-Mar-16	0:50	1:50	27.15	5.38	1.97	28.92	5.57	1.90	28.9
37	09-Mar-16	1:51	2:51	27.23	5.51	1.91	28.71	5.64	1.86	28.7
38	09-Mar-16	2:52	3:52	26.15	5.47	1.88	28.58	5.67	1.80	28.6
39	09-Mar-16	3:53	4:53	25.12	5.67	1.85	27.37	5.78	1.76	27.4
40	09-Mar-16	4:54	5:54	25.53	5.74	1.83	26.90	5.87	1.75	26.9
41	09-Mar-16	5:55	6:55	25.94	5.47	1.84	27.60	5.61	1.76	27.6
42	09-Mar-16	6:56	7:56	26.72	5.38	1.83	28.25	5.59	1.76	28.2
43	09-Mar-16	7:57	8:57	26.37	5.69	1.83	28.84	5.72	1.76	28.8

Note:

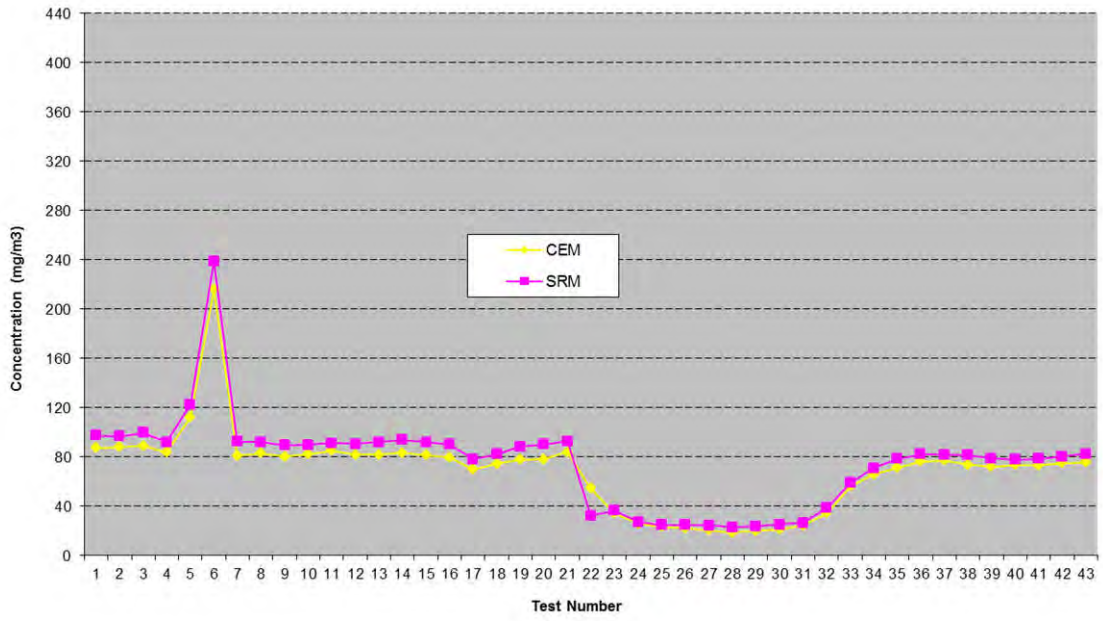
Emission concentrations expresed at reference conditions 273K, 101.3kPa

4A1.2.3 Table 4.2.3 -Standardised monitoring Data – Sulphur Dioxide, High Range

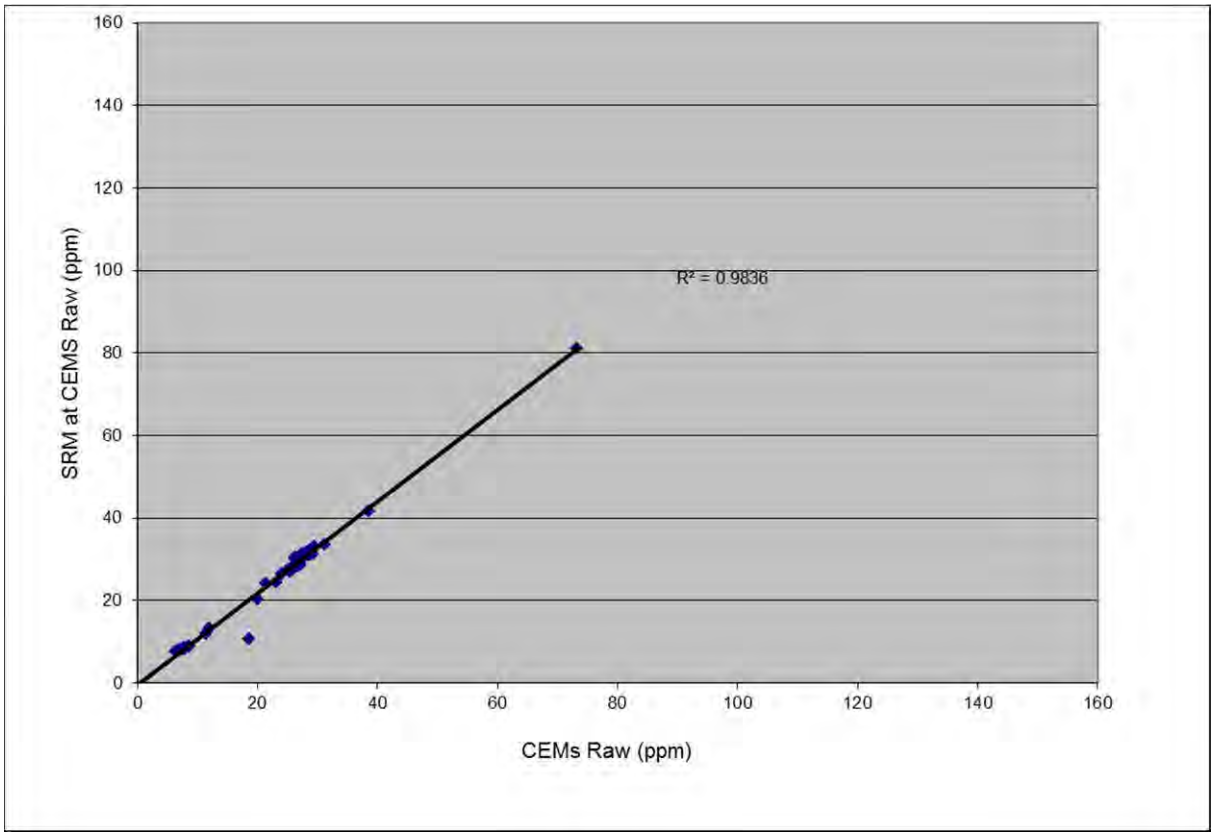
Test No	Date	Test Start Time	Test End Time	CEMS Standardised	SRM Standardised	SRM Uncertainty
		hr:min		(SO2 mg/m3)	(SO2 mg/m3)	(mg/m3)
1	07-Mar-16	10:23	11:23	87.0	97.3	5.0
2	07-Mar-16	12:25	13:25	87.6	96.5	5.0
3	07-Mar-16	13:26	14:26	88.6	99.4	5.1
4	07-Mar-16	14:27	15:27	83.4	91.8	4.8
5	07-Mar-16	15:28	16:28	112.2	122.2	6.3
6	07-Mar-16	16:29	17:29	215.8	238.8	12.4
7	07-Mar-16	17:30	18:30	80.7	92.1	4.8
8	07-Mar-16	18:31	19:31	82.5	91.7	4.8
9	07-Mar-16	19:32	20:32	80.2	89.0	4.6
10	07-Mar-16	20:33	21:33	82.0	89.6	4.7
11	07-Mar-16	21:34	22:34	84.8	91.1	4.7
12	07-Mar-16	22:35	23:35	81.6	90.4	4.7
13	07-8/03/2016	23:36	0:36	81.6	91.5	4.8
14	08-Mar-16	0:37	1:37	83.0	93.6	4.9
15	08-Mar-16	1:38	2:38	81.2	91.5	4.8
16	08-Mar-16	2:39	3:39	79.3	90.0	4.7
17	08-Mar-16	3:40	4:40	69.4	77.9	4.1
18	08-Mar-16	4:41	5:41	74.4	82.0	4.3
19	08-Mar-16	5:42	6:42	77.4	88.2	4.6
20	08-Mar-16	6:43	7:43	78.0	89.8	4.7
21	08-Mar-16	7:44	8:44	83.9	92.4	4.8
22	08-Mar-16	9:35	10:35	54.4	32.0	1.6
23	08-Mar-16	10:36	11:36	33.8	36.0	1.9
24	08-Mar-16	11:37	12:37	25.7	26.8	1.4
25	08-Mar-16	12:38	13:38	23.0	24.5	1.2
26	08-Mar-16	13:39	14:39	21.7	24.5	1.2
27	08-Mar-16	15:41	16:41	20.1	24.1	1.2
28	08-Mar-16	16:42	17:42	18.3	22.6	1.2
29	08-Mar-16	17:43	18:43	19.8	23.2	1.2
30	08-Mar-16	18:44	19:44	20.9	24.8	1.3
31	08-Mar-16	19:45	20:45	23.9	26.1	1.4
32	08-Mar-16	20:46	21:46	33.8	38.3	2.0
33	08-Mar-16	21:47	22:47	55.6	58.6	3.1
34	08-Mar-16	22:48	23:48	65.4	70.6	3.7
35	08-9/03/2016	23:49	0:49	70.9	78.2	4.1
36	09-Mar-16	0:50	1:50	76.0	81.8	4.3
37	09-Mar-16	1:51	2:51	76.8	81.6	4.3
38	09-Mar-16	2:52	3:52	73.5	81.3	4.2
39	09-Mar-16	3:53	4:53	71.6	78.5	4.1
40	09-Mar-16	4:54	5:54	73.0	77.5	4.1
41	09-Mar-16	5:55	6:55	72.9	78.2	4.1
42	09-Mar-16	6:56	7:56	74.6	80.0	4.1
43	09-Mar-16	7:57	8:57	75.2	82.3	4.3

Note:
Emission concentrations expresed at reference conditions 273K, 101.3kPa 6 % Oxygen, dry gas

4A1.3.3 – Plot 1.3 - Time Series of Standardised CEM versus Standardised SRM data – Sulphur Dioxide, High Range (Expressed at reference conditions 273K, 101.3kPa, dry gas, 6% oxygen)



4A1.4.3 – Elimination of Outliers – Sulphur Dioxide, High Range.



Guidance on performing tests for outliers in MID 14181 section 6.3, states the following:

'As a general guide, when plotting the raw SRM and raw CEM data, if the R^2 value for the linear regression line is equal or more than 0.9, then it is not ordinarily necessary to perform an outlier test.
Additionally, any data points are not likely to be outliers unless they are more than two standard deviations from the regression line'

As the R^2 value for this determinand was 0.9836, an outlier test has not been undertaken.

4A1.5.3 Determination of Method A or Method B - Sulphur Dioxide, High Range.

Test No	Test Start Time	Test End Time	SRM measured value (y)	SRM O2	SRM Standardised
	hr:min		(ppm)	(%)	(mg/m3)
1	10:23	11:23	33.7	5.9	97.3
2	12:25	13:25	32.0	6.5	96.5
3	13:26	14:26	33.0	6.5	99.4
4	14:27	15:27	31.2	6.2	91.8
5	15:28	16:28	41.6	6.1	122.2
6	16:29	17:29	81.1	6.1	238.8
7	17:30	18:30	31.3	6.2	92.1
8	18:31	19:31	31.3	6.1	91.7
9	19:32	20:32	30.8	5.9	89.0
10	20:33	21:33	31.0	5.9	89.6
11	21:34	22:34	31.3	6.0	91.1
12	22:35	23:35	30.9	6.1	90.4
13	23:36	0:36	31.2	6.1	91.5
14	0:37	1:37	31.8	6.2	93.6
15	1:38	2:38	30.6	6.4	91.5
16	2:39	3:39	30.0	6.5	90.0
17	3:40	4:40	24.1	7.5	77.9
18	4:41	5:41	26.5	6.9	82.0
19	5:42	6:42	30.3	6.0	88.2
20	6:43	7:43	30.4	6.2	89.8
21	7:44	8:44	31.2	6.3	92.4
22	9:35	10:35	10.8	6.4	32.0
23	10:36	11:36	12.0	6.5	36.0
24	11:37	12:37	9.0	6.4	26.8
25	12:38	13:38	8.2	6.3	24.5
26	13:39	14:39	8.2	6.3	24.5
27	15:41	16:41	8.2	6.1	24.1
28	16:42	17:42	7.7	6.1	22.6
29	17:43	18:43	7.9	6.0	23.2
30	18:44	19:44	8.7	5.7	24.8
31	19:45	20:45	8.9	6.1	26.1
32	20:46	21:46	13.1	6.0	38.3
33	21:47	22:47	20.3	5.9	58.6
34	22:48	23:48	24.5	5.9	70.6
35	23:49	0:49	27.5	5.7	78.2
36	0:50	1:50	28.9	5.6	81.8
37	1:51	2:51	28.7	5.6	81.6
38	2:52	3:52	28.6	5.7	81.3
39	3:53	4:53	27.4	5.8	78.5
40	4:54	5:54	26.9	5.9	77.5
41	5:55	6:55	27.6	5.6	78.2
42	6:56	7:56	28.2	5.6	80.0
43	7:57	8:57	28.8	5.7	82.3
Sum			1105.27		

Emission Limit Value (ELV) =	440	mg/Nm^3	Y_{max}	238.77
Maximum Permissable uncertainty =	20	%	Y_{min}	22.62
Maximum Permissable uncertainty (at	88	mg/Nm^3		
15% of the ELV =	66	mg/Nm^3		
Is Ymax - Ymin > MPU at ELV?	Yes		$Y_{max - Ymin}$	216.15
Is Ymin > 15% of ELV?	No			

Derivation of Calibration Function	**Method A**

4A1.6.3 Table 4.3.3 - Data used to derive calibration function - Sulphur Dioxide, High Range.

Test No	Test Start Time	Test End Time	SRM measured value (y)	CEMS measured signal (x)	Yi	Xi	Xi * Yi	Xi^2	b
	hr:min		(ppm)	(ppm)	1	2	3	4	
1	Reference	16/02/2016	0.0	0.0	-25.12	-23.10	580.21	533.50	
2	10:23	11:23	33.7	31.2	8.53	8.14	69.43	66.18	
3	12:25	13:25	32.0	28.6	6.88	5.55	38.15	30.75	
4	13:26	14:26	33.0	29.5	7.84	6.39	50.13	40.84	
5	14:27	15:27	31.2	28.4	6.04	5.29	31.95	28.01	
6	15:28	16:28	41.6	38.5	16.48	15.44	254.45	238.42	
7	16:29	17:29	81.1	73.2	55.98	50.15	2807.05	2514.53	
8	17:30	18:30	31.3	27.3	6.17	4.22	26.02	17.79	
9	18:31	19:31	31.3	28.1	6.19	4.98	30.80	24.76	
10	19:32	20:32	30.8	27.9	5.71	4.81	27.46	23.16	
11	20:33	21:33	31.0	28.7	5.88	5.56	32.73	30.95	
12	21:34	22:34	31.3	29.3	6.14	6.22	38.17	38.67	
13	22:35	23:35	30.9	28.1	5.79	5.04	29.15	25.38	
14	23:36	0:36	31.2	28.1	6.10	5.05	30.81	25.49	
15	0:37	1:37	31.8	28.2	6.64	5.10	33.82	25.96	
16	1:38	2:38	30.6	27.1	5.45	3.97	21.62	15.74	
17	2:39	3:39	30.0	26.3	4.84	3.20	15.51	10.26	
18	3:40	4:40	24.1	21.4	-1.03	-1.71	1.76	2.91	
19	4:41	5:41	26.5	24.0	1.34	0.92	1.24	0.85	
20	5:42	6:42	30.3	26.5	5.18	3.45	17.85	11.89	
21	6:43	7:43	30.4	26.3	5.32	3.23	17.16	10.42	
22	7:44	8:44	31.2	28.1	6.05	5.00	30.26	24.99	
23	9:35	10:35	10.8	18.7	-14.33	-4.44	63.67	19.73	
24	10:36	11:36	12.0	11.5	-13.12	-11.64	152.73	135.46	
25	11:37	12:37	9.0	8.7	-16.16	-14.43	233.09	208.11	
26	12:38	13:38	8.2	7.8	-16.91	-15.28	258.42	233.63	
27	13:39	14:39	8.2	7.2	-16.91	-15.86	268.20	251.62	
28	15:41	16:41	8.2	7.1	-16.87	-16.01	270.11	256.34	
29	16:42	17:42	7.7	6.3	-17.41	-16.77	292.00	281.27	
30	17:43	18:43	7.9	6.9	-17.17	-16.16	277.53	261.25	
31	18:44	19:44	8.7	7.7	-16.45	-15.36	252.72	235.98	
32	19:45	20:45	8.9	8.5	-16.22	-14.63	237.20	213.94	
33	20:46	21:46	13.1	12.0	-11.99	-11.05	132.43	122.06	
34	21:47	22:47	20.3	20.1	-4.80	-3.00	14.39	9.00	
35	22:48	23:48	24.5	23.2	-0.62	0.14	-0.08	0.02	
36	23:49	0:49	27.5	25.3	2.35	2.19	5.15	4.79	
37	0:50	1:50	28.9	27.1	3.80	4.05	15.39	16.41	
38	1:51	2:51	28.7	27.2	3.59	4.13	14.85	17.10	
39	2:52	3:52	28.6	26.2	3.46	3.05	10.56	9.33	
40	3:53	4:53	27.4	25.1	2.25	2.02	4.54	4.08	
41	4:54	5:54	26.9	25.5	1.78	2.43	4.33	5.91	
42	5:55	6:55	27.6	25.9	2.48	2.84	7.06	8.08	
43	6:56	7:56	28.2	26.7	3.13	3.62	11.31	13.10	
44	7:57	8:57	28.8	26.4	3.72	3.27	12.16	10.71	
Sum			1105.27	1016.29	0.00	0.00	6723.46	6059.35	1.11

4A1.7.3 Determination of Calibration Function - Sulphur Dioxide, High Range.

Method A

If Ymax-Ymin >15% of the ELV, the following formulae are used:

$$b=\sum_{i=1}^{N}(x_i-\bar{x})(y \quad \text{where} \quad \bar{x}=1/N\sum_{i=1}^{N}x_i \quad \bar{y}=1/N\sum_{i=1}^{N}y_i$$

$\bar{x}$ = 23.10

$\bar{y}$ = 25.12

b = 1.110

$a=\bar{y}-b\bar{x}$ a = 25.12 - 23.1 * 1.109 a = -0.509

The calibration is function $y_i = a + bx_i$ or y_i = -0.509 + 1.11 * xi

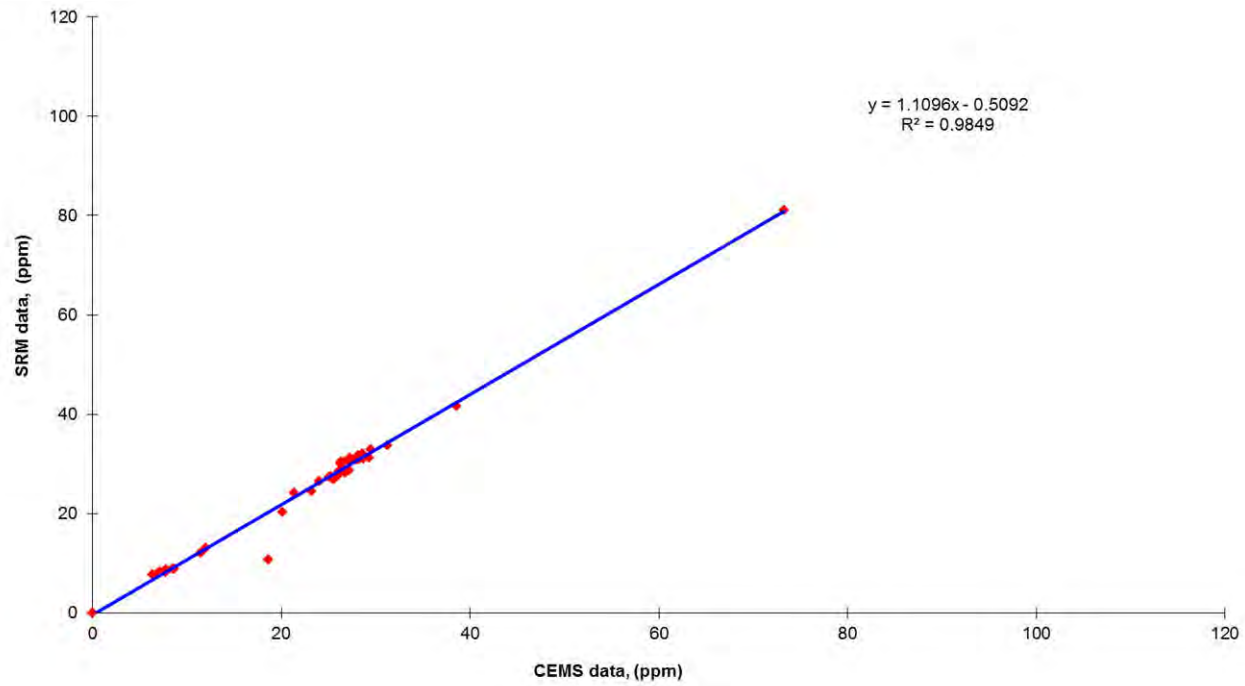
4A1.8.3 Table A.4.4.3 - Calculation of calibrated CEMS values - Sulphur Dioxide, High Range.

Test No	Test Start Time	Test End Time	CEMS Raw Value (x)	CEMS Calibrated signal	CEMS Dry Oxygen	CEMS Moisture	CEMS Standardised Value (dry)	CEMS Calibrated Standardised Value	SRM Standardised
	hr:min		(ppm)	(ppm)	(%)	(%)	(mg/Nm^3)	(mg/Nm^3)	(mg/m3)
1	Reference	16/02/2016	0.0	-0.5	N/A	N/A	0.0	-1.5	0.0
2	10:23	11:23	31.2	34.1	5.3	1.8	87.6	95.1	97.3
3	12:25	13:25	28.6	31.3	6.7	1.9	83.4	95.7	96.5
4	13:26	14:26	29.5	32.2	6.5	1.9	112.2	96.8	99.4
5	14:27	15:27	28.4	31.0	6.1	1.9	215.8	91.1	91.8
6	15:28	16:28	38.5	42.3	6.0	1.9	80.7	123.0	122.2
7	16:29	17:29	73.2	80.8	6.1	2.1	82.5	238.0	238.8
8	17:30	18:30	27.3	29.8	6.2	1.9	80.2	88.1	92.1
9	18:31	19:31	28.1	30.6	6.1	1.9	82.0	90.1	91.7
10	19:32	20:32	27.9	30.5	5.8	1.9	84.8	87.6	89.0
11	20:33	21:33	28.7	31.3	5.7	1.9	81.6	89.5	89.6
12	21:34	22:34	29.3	32.0	5.9	1.9	81.6	92.6	91.1
13	22:35	23:35	28.1	30.7	5.9	2.0	83.0	89.1	90.4
14	23:36	00:36	28.1	30.7	5.9	2.0	81.2	89.1	91.5
15	00:37	01:37	28.2	30.8	6.2	2.0	79.3	90.6	93.6
16	01:38	02:38	27.1	29.5	6.4	1.9	69.4	88.6	91.5
17	02:39	03:39	26.3	28.7	6.5	1.9	74.4	86.4	90.0
18	03:40	04:40	21.4	23.2	7.6	1.7	77.4	75.4	77.9
19	04:41	05:41	24.0	26.1	6.9	1.7	78.0	81.0	82.0
20	05:42	06:42	26.5	28.9	6.0	1.9	83.9	84.4	88.2
21	06:43	07:43	26.3	28.7	6.3	1.9	54.4	85.0	89.8
22	07:44	08:44	28.1	30.7	6.4	1.9	33.8	91.5	92.4
23	09:35	10:35	18.7	20.2	6.0	1.9	25.7	58.8	32.0
24	10:36	11:36	11.5	12.2	6.2	1.7	23.0	36.0	36.0
25	11:37	12:37	8.7	9.1	6.3	1.9	21.7	27.0	26.8
26	12:38	13:38	7.8	8.2	6.2	1.9	20.1	24.0	24.5
27	13:39	14:39	7.2	7.5	6.5	1.9	18.3	22.6	24.5
28	15:41	16:41	7.1	7.4	5.6	1.9	19.8	20.8	24.1
29	16:42	17:42	6.3	6.5	5.9	1.9	20.9	18.9	22.6
30	17:43	18:43	6.9	7.2	5.7	1.9	23.9	20.5	23.2
31	18:44	19:44	7.7	8.1	4.8	1.9	33.8	21.8	24.8
32	19:45	20:45	8.5	8.9	5.5	1.9	55.6	25.1	26.1
33	20:46	21:46	12.0	12.9	5.4	1.9	65.4	36.1	38.3
34	21:47	22:47	20.1	21.8	5.2	1.9	70.9	60.3	58.6
35	22:48	23:48	23.2	25.3	5.5	1.9	76.0	71.2	70.6
36	23:49	00:49	25.3	27.5	5.4	2.0	76.8	77.2	78.2
37	00:50	01:50	27.1	29.6	5.4	2.0	73.5	82.9	81.8
38	01:51	02:51	27.2	29.7	5.5	1.9	71.6	83.8	81.6
39	02:52	03:52	26.2	28.5	5.5	1.9	73.0	80.1	81.3
40	03:53	04:53	25.1	27.4	5.7	1.9	72.9	77.9	78.5
41	04:54	05:54	25.5	27.8	5.7	1.8	74.6	79.6	77.5
42	05:55	06:55	25.9	28.3	5.5	1.8	75.2	79.5	78.2
43	06:56	07:56	26.7	29.1	5.4	1.8	0.0	81.4	80.0
44	07:57	08:57	26.4	28.8	5.7	1.8	0.0	82.0	82.3
				Sum			2780.23		

Emission Limit Value (ELV) = 440 mg/Nm^3

Reference Oxygen 6 %

4A1.9.3 Plot 2.3 CEM versus SRM Parallel Test Data at CEM measurement conditions –Sulphur dioxide, wet gas.



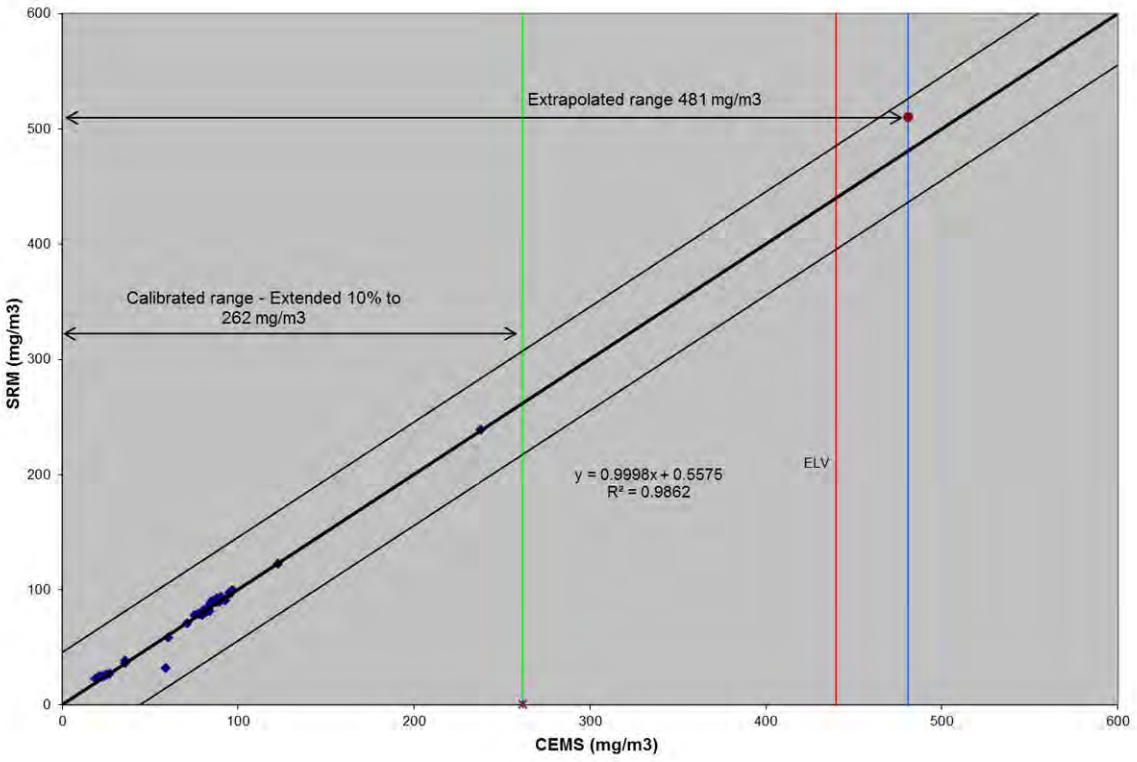
4A1.10.3 Table 4.5.3 – Data used for the Variability Test – Sulphur Dioxide, High Range.

Test No	Test Start Time	Test End Time	CEMS Calibrated Standardised value	SRM Standardised value	Difference D1	Difference D1 - D	Squared Difference D1 - D
	hr:min		mg/m3	mg/m3			
2	10:23	11:23	95.1	97.3	2.21	1.69	2.85
3	12:25	13:25	95.7	96.5	0.85	0.33	0.11
4	13:26	14:26	96.8	99.4	2.56	2.04	4.16
5	14:27	15:27	91.1	91.8	0.72	0.20	0.04
6	15:28	16:28	123.0	122.2	-0.81	-1.33	1.77
7	16:29	17:29	238.0	238.8	0.78	0.26	0.07
8	17:30	18:30	88.1	92.1	3.98	3.46	12.00
9	18:31	19:31	90.1	91.7	1.60	1.08	1.16
10	19:32	20:32	87.6	89.0	1.43	0.91	0.82
11	20:33	21:33	89.5	89.6	0.10	-0.42	0.18
12	21:34	22:34	92.6	91.1	-1.57	-2.08	4.35
13	22:35	23:35	89.1	90.4	1.30	0.78	0.61
14	23:36	00:36	89.1	91.5	2.43	1.91	3.66
15	00:37	01:37	90.6	93.6	3.02	2.50	6.25
16	01:38	02:38	88.6	91.5	2.94	2.42	5.87
17	02:39	03:39	86.4	90.0	3.55	3.03	9.19
18	03:40	04:40	75.4	77.9	2.56	2.04	4.18
19	04:41	05:41	81.0	82.0	1.02	0.50	0.25
20	05:42	06:42	84.4	88.2	3.81	3.29	10.83
21	06:43	07:43	85.0	89.8	4.81	4.29	18.43
22	07:44	08:44	91.5	92.4	0.84	0.32	0.10
23	09:35	10:35	58.8	32.0	-26.83	-27.35	748.04
24	10:36	11:36	36.0	36.0	-0.02	-0.54	0.29
25	11:37	12:37	27.0	26.8	-0.16	-0.68	0.46
26	12:38	13:38	24.0	24.5	0.44	-0.08	0.01
27	13:39	14:39	22.6	24.5	1.90	1.38	1.91
28	15:41	16:41	20.8	24.1	3.27	2.75	7.55
29	16:42	17:42	18.9	22.6	3.74	3.23	10.40
30	17:43	18:43	20.5	23.2	2.67	2.15	4.61
31	18:44	19:44	21.8	24.8	3.00	2.49	6.18
32	19:45	20:45	25.1	26.1	0.98	0.46	0.21
33	20:46	21:46	36.1	38.3	2.24	1.72	2.96
34	21:47	22:47	60.3	58.6	-1.65	-2.17	4.69
35	22:48	23:48	71.2	70.6	-0.56	-1.08	1.17
36	23:49	00:49	77.2	78.2	1.02	0.51	0.26
37	00:50	01:50	82.9	81.8	-1.02	-1.54	2.37
38	01:51	02:51	83.8	81.6	-2.15	-2.67	7.11
39	02:52	03:52	80.1	81.3	1.18	0.66	0.44
40	03:53	04:53	77.9	78.5	0.51	-0.01	0.00
41	04:54	05:54	79.6	77.5	-2.03	-2.55	6.52
42	05:55	06:55	79.5	78.2	-1.25	-1.77	3.14
43	06:56	07:56	81.4	80.0	-1.44	-1.96	3.84
44	07:57	08:57	82.0	82.3	0.34	-0.18	0.03
43 Tests		Mean			0.52		
Sum							899.08

4A1.11.3 - Variability Test Calculation – Sulphur Dioxide, High Range.

SD=	Root(1-Number).Integral(D1-D)^2		4.63	mg/m3(s,d),6%O2
The uncertainty laid down by the authorities is 20% ELV as a 95% confidence interval. O_0 is therefore calculated as:-				
O_0=	0.2*440 mg/m3 (s,d,6%O2)/1.96		44.90	mg/m3(s,d),6%O2
For 43 tests, kv =	0.9885			
Therefore variability=		4.63 <= 44.9 * 0.9885		
	or 4.63	<=	44.38	
Which is TRUE therefore the CEMS passes the test				

4A1.12.3 Plot 3.3 –Standardised CEM data versus standardised SRM - Sulphur dioxide, High Range – Reference conditions 273K, 101.3kPa., 6% oxygen, dry gas.



Section 4B1: Data & Calculations – AST – Unit 7, Procal 1

Section 4B1 – Data and calculations – AST Procal 1

4B1 4.1.1 Table 4.1.1 – Raw monitoring Data – Oxides of Nitrogen

Test No	Date	Test Start Time	Test End Time	CEMS Raw Value (wet)	CEMS Oxygen (dry)	CEMS Moisture	SRM Raw value (dry)	SRM Oxygen (dry)	SRM Moisture	SRM at CEMs Raw conditions
		hr:min		NO (ppm)	(%)	(%)	NOx(ppm)	(%)	(%)	NOx(ppm)
1	07-Mar-16	12:25	13:25	408.96	6.71	1.95	418.07	6.51	1.91	410.09
2	07-Mar-16	13:26	14:26	403.89	6.46	1.89	417.79	6.51	1.86	410.02
3	07-Mar-16	14:27	15:27	389.48	6.14	1.85	397.94	6.18	1.82	390.68
4	07-Mar-16	15:28	16:28	379.02	6.00	1.86	387.23	6.14	1.84	380.10
5	07-Mar-16	16:29	17:29	398.06	6.15	2.08	408.89	6.13	2.07	400.41
6	07-Mar-16	17:30	18:30	446.40	6.22	1.91	452.67	6.16	1.85	444.27
7	07-Mar-16	18:31	19:31	458.58	6.14	1.93	463.46	6.09	1.84	454.94
8	07-Mar-16	19:32	20:32	450.57	5.80	1.91	457.23	5.87	1.86	448.74
9	07-Mar-16	20:33	21:33	450.00	5.73	1.92	456.62	5.89	1.86	448.11
10	07-Mar-16	21:34	22:34	434.40	5.89	1.94	439.27	6.00	1.91	430.88
11	07-Mar-16	22:35	23:35	425.07	5.93	1.97	433.19	6.06	1.90	424.96

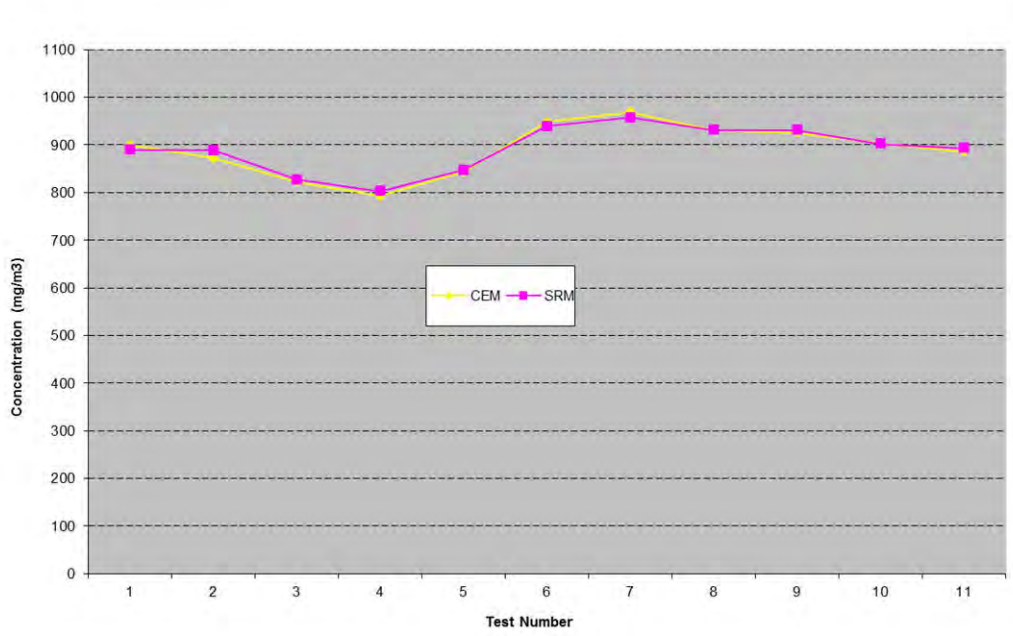
Note:
Emission concentrations expresed at reference conditions 273K, 101.3kPa

4B1 4.2.1 Table 4.2.1 – Standardised monitoring Data – Oxides of Nitrogen

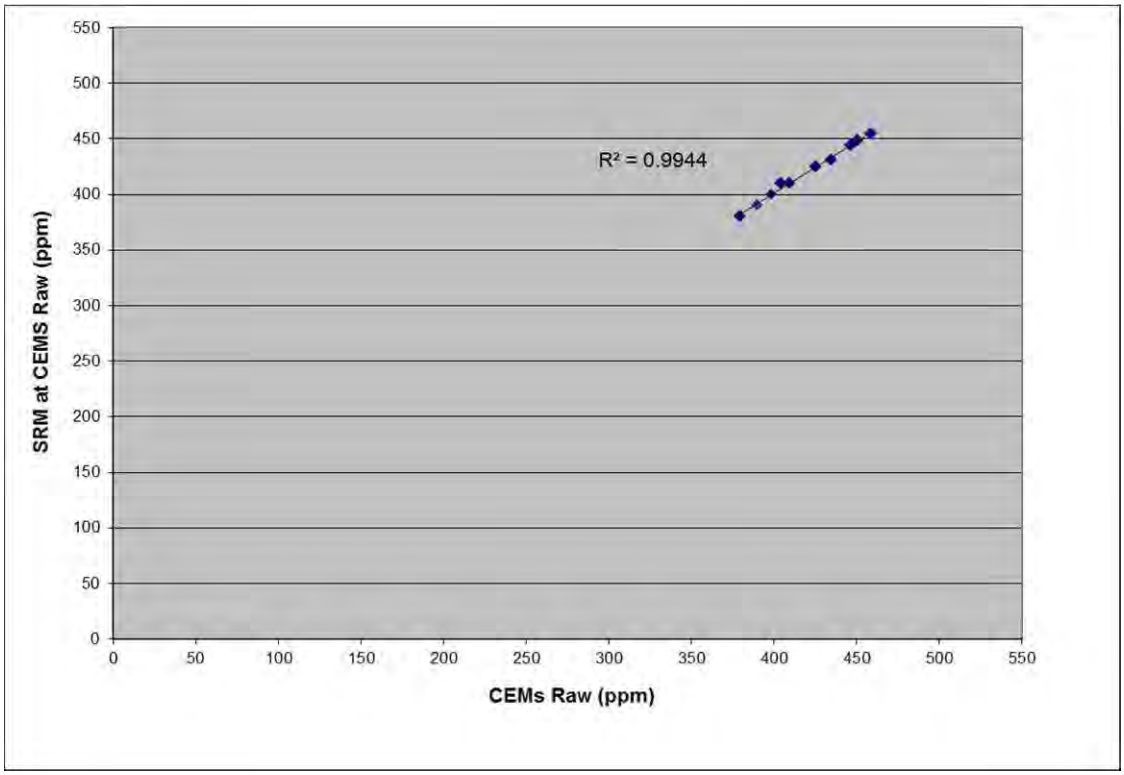
Test No	Date	Test Start Time	Test End Time	CEMS Standardised	SRM Standardised	SRM Uncertainty
		hr:min		NOx as NO2(mg/m3)	NOx as NO2(mg/m3)	(mg/m3)
1	07-Mar-16	12:25	13:25	899.4	889.2	29.0
2	07-Mar-16	13:26	14:26	872.5	888.4	29.0
3	07-Mar-16	14:27	15:27	822.7	827.4	27.0
4	07-Mar-16	15:28	16:28	793.1	802.6	26.0
5	07-Mar-16	16:29	17:29	843.1	847.3	28.0
6	07-Mar-16	17:30	18:30	948.4	939.6	31.0
7	07-Mar-16	18:31	19:31	969.1	957.5	31.0
8	07-Mar-16	19:32	20:32	931.0	931.1	30.0
9	07-Mar-16	20:33	21:33	925.2	931.0	30.0
10	07-Mar-16	21:34	22:34	903.3	902.3	30.0
11	07-Mar-16	22:35	23:35	886.3	893.3	29.0

Note:
Emission concentrations expresed at reference conditions 273K, 101.3kPa 6 % Oxygen, dry gas

4B1 4.3.1 Plot 1.1 –Time Series of Standardised CEM versus Standardised SRM data – Oxides of Nitrogen. Reference conditions: 273K, 101.3kPa, dry gas, 6% oxygen.



4B1 4.4.1 –Elimination of Outliers – Oxides of Nitrogen.



Guidance on performing tests for outliers in MID 14181 section 6.3, states the following:

'As a general guide, when plotting the raw SRM and raw CEM data, if the R^2 value for the linear regression line is equal or more than 0.9, then it is not ordinarily necessary to perform an outlier test.
Additionally, any data points are not likely to be outliers unless they are more than two standard deviations from the regression line'

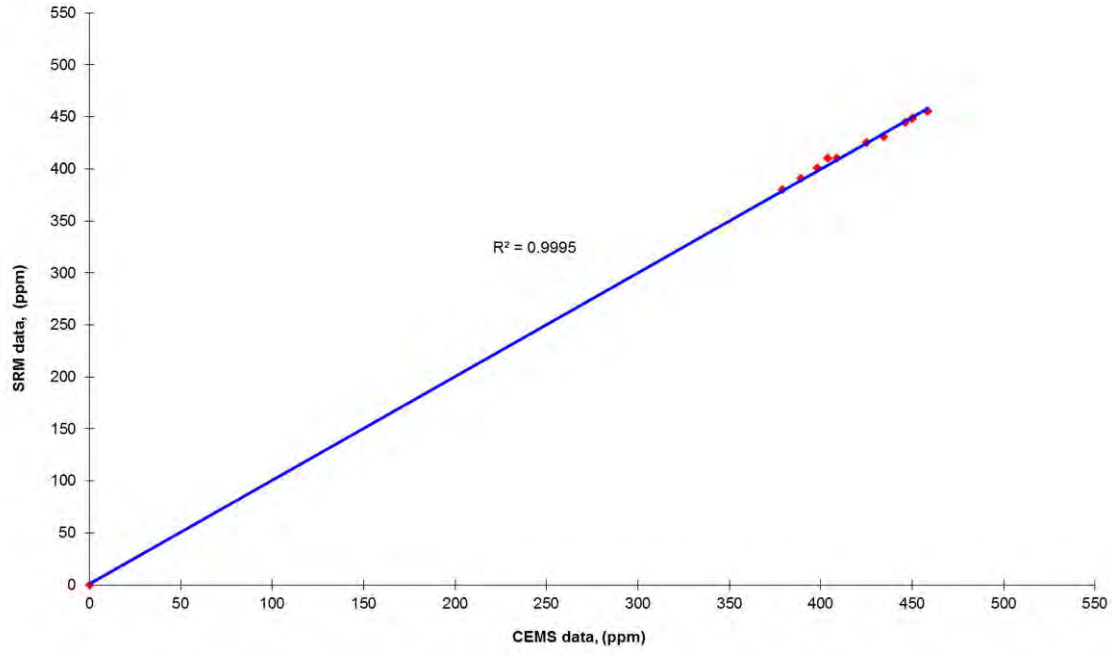
As the R^2 value for this determinand was 0.9944, an outlier test has not been undertaken.

4B1 4.5.1 Table 4.3.1 - Data used to Calculate Calibrated Values – Oxides of Nitrogen

Test No	Date	Test Start Time	Test End Time	CEMS Raw Value (x)	CEMS Calibrated signal	CEMS dry Oxygen	CEMS Moisture	CEMS Standardised Value (dry)	CEMS Calibrated Standardised Value	SRM Standardised
		hr:min		NO (ppm)	NO (ppm)	%	%	(mg/Nm^3)	(mg/Nm^3)	(mg/m3)
1	24-Feb-16	Reference		0.5	-3.1	N/A	N/A	1.0	-6.3	0.0
2	07-Mar-16	12:25	13:25	409.0	414.4	6.71	1.95	899.4	911.3	889.2
3	07-Mar-16	13:26	14:26	403.9	409.2	6.46	1.89	872.5	883.9	888.4
4	07-Mar-16	14:27	15:27	389.5	394.5	6.14	1.85	822.7	833.3	827.4
5	07-Mar-16	15:28	16:28	379.0	383.8	6.00	1.86	793.1	803.1	802.6
6	07-Mar-16	16:29	17:29	398.1	403.2	6.15	2.08	843.1	854.1	847.3
7	07-Mar-16	17:30	18:30	446.4	452.6	6.22	1.91	948.4	961.7	939.6
8	07-Mar-16	18:31	19:31	458.6	465.1	6.14	1.93	969.1	982.8	957.5
9	07-Mar-16	19:32	20:32	450.6	456.9	5.80	1.91	931.0	944.1	931.1
10	07-Mar-16	20:33	21:33	450.0	456.3	5.73	1.92	925.2	938.2	931.0
11	07-Mar-16	21:34	22:34	434.4	440.4	5.89	1.94	903.3	915.7	902.3
12	07-Mar-16	22:35	23:35	425.1	430.8	5.93	1.97	886.3	898.3	893.3
					Sum			9795.13		

Emission Limit Value (ELV) =	1080	mg/Nm^3
	Reference Oxygen	6 %
Established Calibration Function y_i=	-3.578 + 1.022xi	

Plot of CEM versus SRM Parallel Test Data at CEM measurement conditions – wet gas



4B1 4.6.1 Table 4.4.1 – Data used for the Variability Test – Oxides of Nitrogen

Test No	Date	Test Start Time	Test End Time	CEMS Calibrated Standardised value	SRM Standardised value	Difference D1	Difference D1 - D	Squared Difference D1 - D
		hr:min		mg/m3	mg/m3			
2	07-Mar-16	12:25	13:25	911.3	889.2	-22.12	-11.49	131.97
3	07-Mar-16	13:26	14:26	883.9	888.4	4.43	15.06	226.84
4	07-Mar-16	14:27	15:27	833.3	827.4	-5.88	4.75	22.57
5	07-Mar-16	15:28	16:28	803.1	802.6	-0.52	10.11	102.18
6	07-Mar-16	16:29	17:29	854.1	847.3	-6.76	3.88	15.02
7	07-Mar-16	17:30	18:30	961.7	939.6	-22.07	-11.44	130.87
8	07-Mar-16	18:31	19:31	982.8	957.5	-25.30	-14.67	215.29
9	07-Mar-16	19:32	20:32	944.1	931.1	-13.00	-2.37	5.60
10	07-Mar-16	20:33	21:33	938.2	931.0	-7.24	3.39	11.49
11	07-Mar-16	21:34	22:34	915.7	902.3	-13.42	-2.79	7.79
12	07-Mar-16	22:35	23:35	898.3	893.3	-5.06	5.57	31.06
Mean						-10.63		
Sum								900.67

4B1 4.7.1 - Variability Test and Test of Calibration Function Calculations – Oxides of Nitrogen

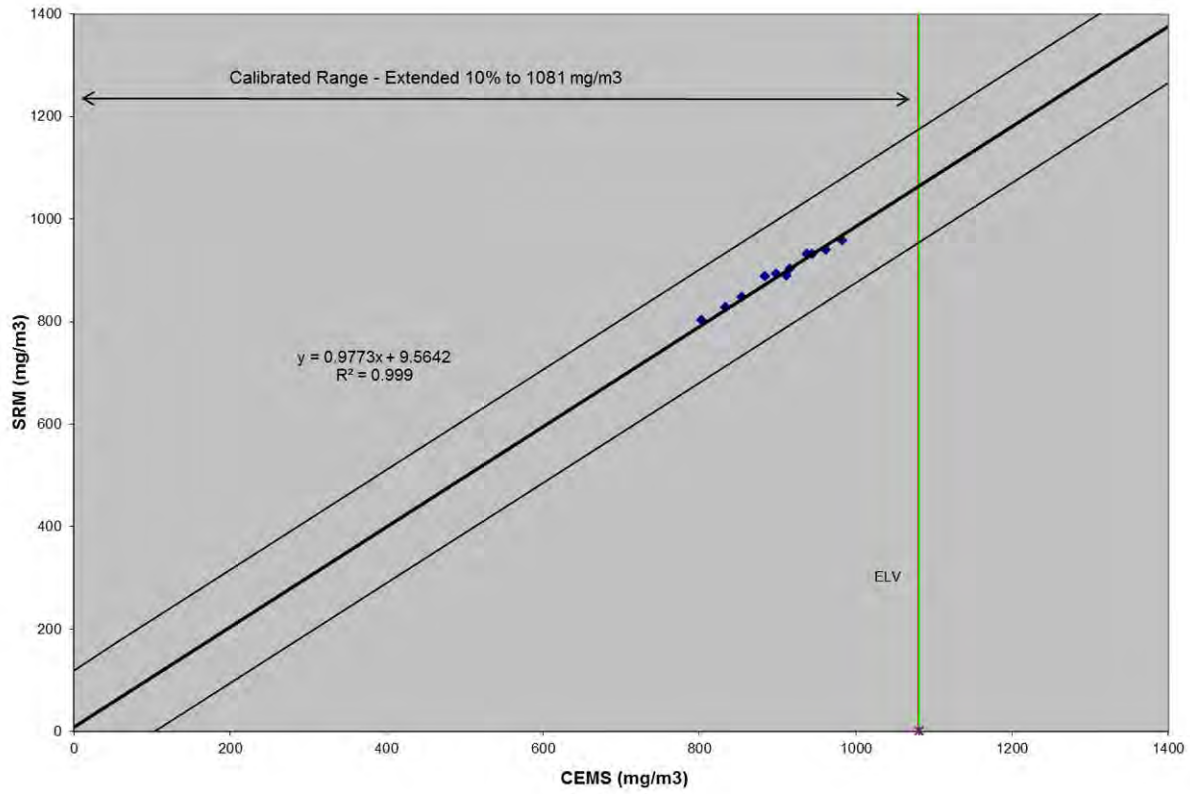
Variability Test

SD=	Root(1-Number).Integral(D1-D)^2	9.49	mg/m3(s,d),6%O2
The uncertainty laid down by the authorities is 20% ELV as a 95% confidence interval. O_0 is therefore calculated as:-			
O_0=	0.2*1080 mg/m3 (s,d,6%O2)/1.96	110.20	mg/m3(s,d),6%O2
For 11 tests, kv =	0.9665		
Therefore variability=	9.49 <= 110.2 * 0.9665*1.5		
or	9.49 <= 159.77		
Which is TRUE therefore the CEMS passes the test			

Test of Calibration Function

The calibration of the AMS is accepted if:	D1<= $t_{0.95}(N\text{-}1)$*(s,d/root N)+O_0		
	D1=	10.63	
For 11 tests, t0.95(N-1) =	1.812		
Therefore test of calibration =	10.63 <=1.812*(9.49/root 12)+110.2		
or	10.63 <=	115.17	
Which is TRUE therefore the calibration function is VALID			

4B1 4.8.1 Plot 2.1 –Standardised CEM data versus standardised SRM - Oxides of Nitrogen (as NO_2) – Reference conditions 273K, 101.3kPa, dry gas, 6% oxygen.



4B1 4.1.2 Table 4.1.2 – Raw monitoring Data – Sulphur Dioxide Low Range

Test No	Date	Test Start Time	Test End Time	CEMS Raw Value (wet)	CEMS Oxygen (dry)	CEMS Moisture	SRM Raw value (wet)	SRM Oxygen (dry)	SRM Moisture	SRM at CEMs Raw conditions
		hr:min		(ppm)	(%)	(%)	(ppm)	(%)	(%)	(ppm)
1	07-Mar-16	12:25	13:25	28.99	6.71	1.95	32.00	6.51	1.91	32.00
2	07-Mar-16	13:26	14:26	27.52	6.46	1.89	32.96	6.51	1.86	32.96
3	07-Mar-16	14:27	15:27	24.59	6.14	1.85	31.16	6.18	1.82	31.16
4	07-Mar-16	15:28	16:28	25.66	6.00	1.86	41.60	6.14	1.84	41.60
5	07-Mar-16	16:29	17:29	81.89	6.15	2.08	81.10	6.13	2.07	81.10
6	07-Mar-16	17:30	18:30	26.24	6.22	1.91	31.29	6.16	1.85	31.29
7	07-Mar-16	18:31	19:31	26.80	6.14	1.93	31.31	6.09	1.84	31.31
8	07-Mar-16	19:32	20:32	24.23	5.80	1.91	30.83	5.87	1.86	30.83
9	07-Mar-16	20:33	21:33	24.28	5.73	1.92	31.00	5.89	1.86	31.00
10	07-Mar-16	21:34	22:34	24.71	5.89	1.94	31.26	6.00	1.91	31.26
11	07-Mar-16	22:35	23:35	25.34	5.93	1.97	30.91	6.06	1.90	30.91

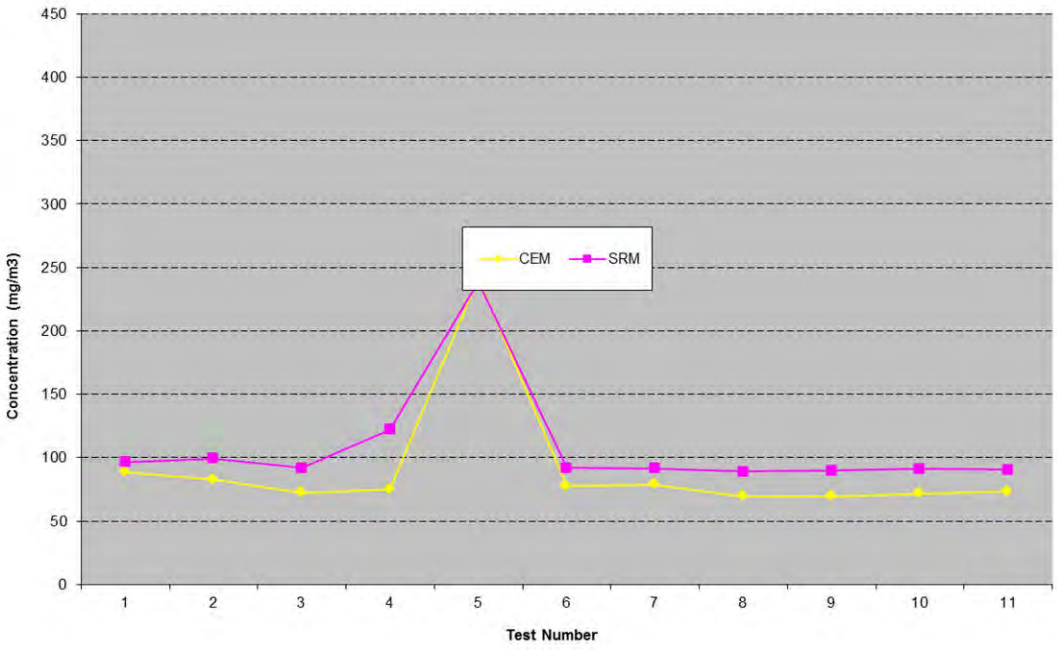
Note:
Emission concentrations expresed at reference conditions 273K, 101.3kPa

B1 4.2.2 Table 4.2.2 – Standardised monitoring Data – Sulphur Dioxide - Low Range

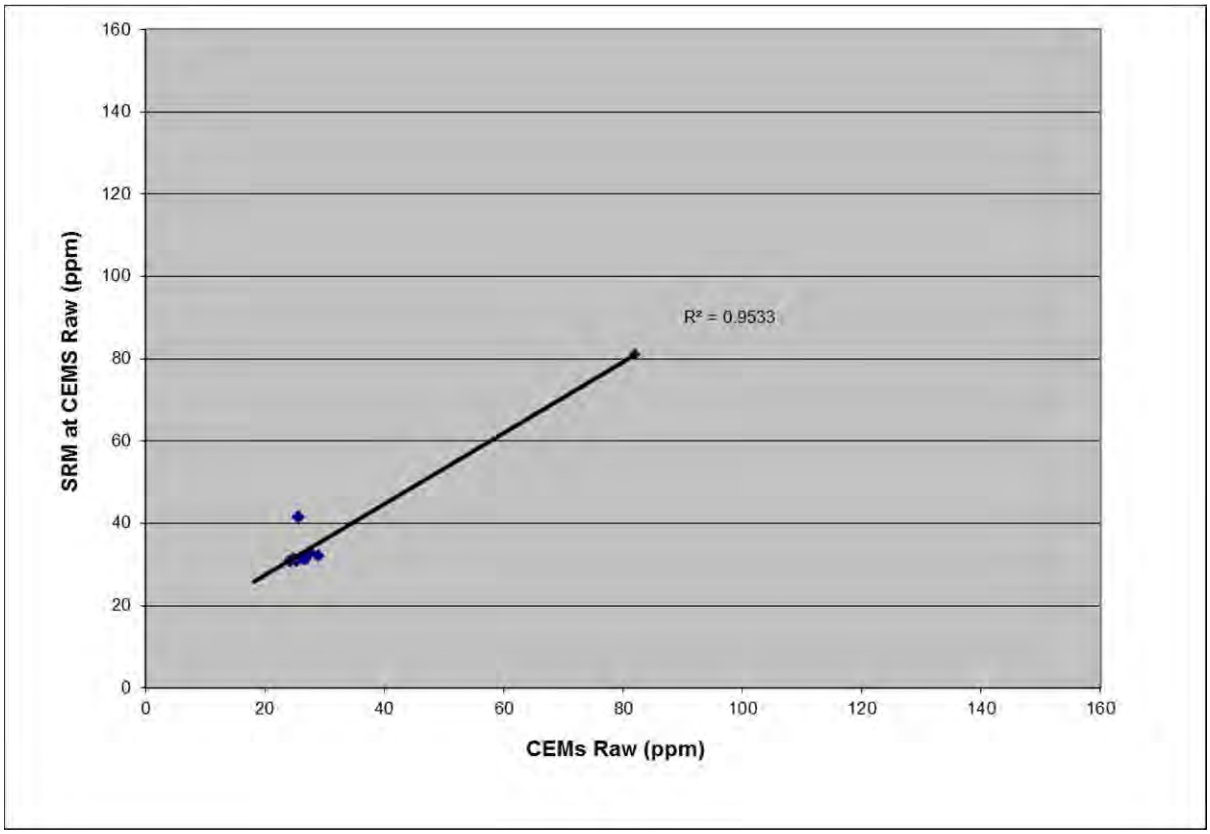
Test No	Date	Test Start Time	Test End Time	CEMS Standardised	SRM Standardised	SRM Uncertainty
		hr:min		(mg/m3)	(mg/m3)	(mg/m3)
1	07-Mar-16	12:25	13:25	88.7	96.5	5.0
2	07-Mar-16	13:26	14:26	82.7	99.4	5.1
3	07-Mar-16	14:27	15:27	72.3	91.8	4.8
4	07-Mar-16	15:28	16:28	74.7	122.2	6.3
5	07-Mar-16	16:29	17:29	241.3	238.8	12.4
6	07-Mar-16	17:30	18:30	77.6	92.1	4.8
7	07-Mar-16	18:31	19:31	78.8	91.7	4.8
8	07-Mar-16	19:32	20:32	69.6	89.0	4.6
9	07-Mar-16	20:33	21:33	69.5	89.6	4.7
10	07-Mar-16	21:34	22:34	71.5	91.1	4.7
11	07-Mar-16	22:35	23:35	73.5	90.4	4.7

Note:
Emission concentrations expresed at reference conditions 273K, 101.3kPa 6 % Oxygen, dry gas

4B1 4.3.2 Plot 1.2 –Time Series of Standardised CEM versus Standardised SRM data – Sulphur Dioxide - Low Range. Reference conditions: 273K, 101.3kPa, dry gas, 6% oxygen.



4B1 4.4.2 – Elimination of Outliers – Sulphur Dioxide - Low Range.



Guidance on performing tests for outliers in MID 14181 section 6.3, states the following:

'As a general guide, when plotting the raw SRM and raw CEM data, if the R^2 value for the linear regression line is equal or more than 0.9, then it is not ordinarily necessary to perform an outlier test.
Additionally, any data points are not likely to be outliers unless they are more than two standard deviations from the regression line'
As the R^2 value for this determinand was 0.9533, an outlier test has not been undertaken

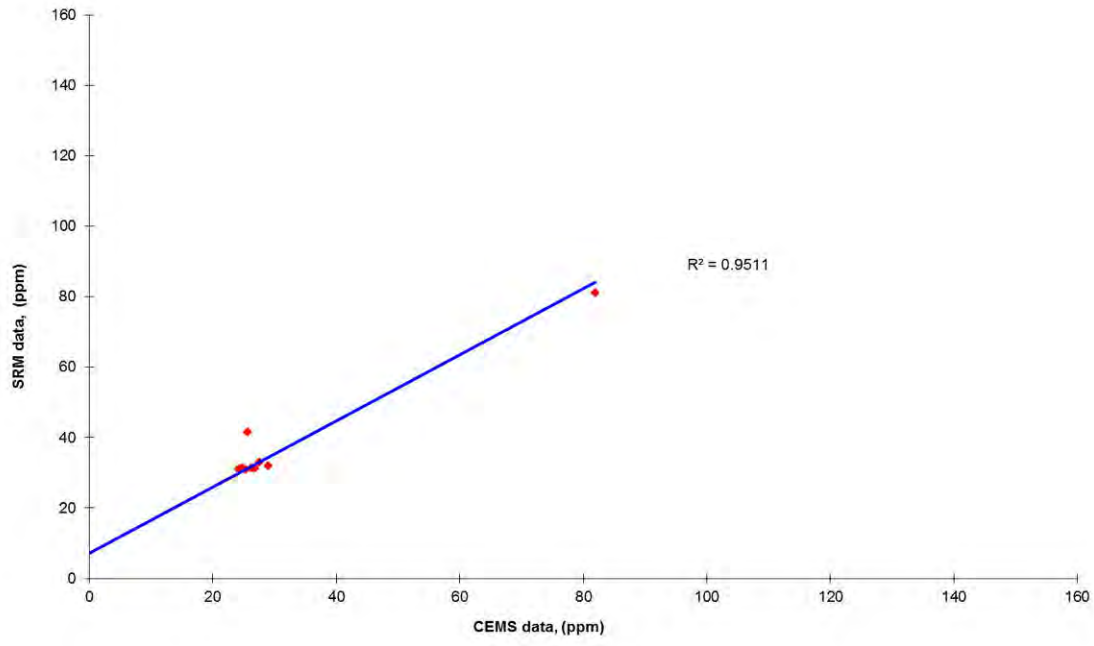
4B1 4.5.2 Table 4.3.2 - Data used to Calculate Calibrated Values – Sulphur Dioxide - Low Range.

Test No	Date	Test Start Time	Test End Time	CEMS Raw Value (x)	CEMS Calibrated signal	CEMS dry Oxygen	CEMS Moisture	CEMS Standardised Value (dry)	CEMS Calibrated Standardised Value	SRM Standardised
		hr:min		(ppm)	(ppm)	%	%	(mg/Nm^3)	(mg/Nm^3)	(mg/m3)
1	24-Feb-16	Reference		-0.5	-6.6	N/A	N/A	-0.5	-19.0	0.0
2	07-Mar-16	12:25	13:25	29.0	25.3	6.71	1.95	88.7	77.3	96.5
3	07-Mar-16	13:26	14:26	27.5	23.7	6.46	1.89	82.7	71.2	99.4
4	07-Mar-16	14:27	15:27	24.6	20.5	6.14	1.85	72.3	60.3	91.8
5	07-Mar-16	15:28	16:28	25.7	21.7	6.00	1.86	74.7	63.1	122.2
6	07-Mar-16	16:29	17:29	81.9	82.5	6.15	2.08	241.3	243.2	238.8
7	07-Mar-16	17:30	18:30	26.2	22.3	6.22	1.91	77.6	65.9	92.1
8	07-Mar-16	18:31	19:31	26.8	22.9	6.14	1.93	78.8	67.3	91.7
9	07-Mar-16	19:32	20:32	24.2	20.1	5.80	1.91	69.6	57.8	89.0
10	07-Mar-16	20:33	21:33	24.3	20.2	5.73	1.92	69.5	57.7	89.6
11	07-Mar-16	21:34	22:34	24.7	20.6	5.89	1.94	71.5	59.7	91.1
12	07-Mar-16	22:35	23:35	25.3	21.3	5.93	1.97	73.5	61.8	90.4
Sum								999.67		

Emission Limit Value (ELV) =	440	mg/Nm^3

	Reference Oxygen	6	%
Established Calibration Function y_i=	-6.1 + 1.082xi		

Plot of CEM versus SRM Data at CEM measurement conditions– Sulphur Dioxide - Low Range. wet gas



4B1 4.6.2 Table 4.4.2 – Data used for the Variability Test – Sulphur Dioxide - Low Range

Test No	Date	Test Start Time	Test End Time	CEMS Calibrated Standardised value	SRM Standardised value	Difference D1	Difference D1 - D	Squared Difference D1 - D
		hr:min		mg/m3	mg/m3			
2	07-Mar-16	12:25	13:25	77.3	96.5	19.24	-8.70	75.63
3	07-Mar-16	13:26	14:26	71.2	99.4	28.20	0.26	0.07
4	07-Mar-16	14:27	15:27	60.3	91.8	31.54	3.61	13.02
5	07-Mar-16	15:28	16:28	63.1	122.2	59.14	31.21	973.84
6	07-Mar-16	16:29	17:29	243.2	238.8	-4.38	-32.31	1043.90
7	07-Mar-16	17:30	18:30	65.9	92.1	26.17	-1.76	3.10
8	07-Mar-16	18:31	19:31	67.3	91.7	24.37	-3.57	12.73
9	07-Mar-16	19:32	20:32	57.8	89.0	31.17	3.23	10.45
10	07-Mar-16	20:33	21:33	57.7	89.6	31.90	3.97	15.77
11	07-Mar-16	21:34	22:34	59.7	91.1	31.36	3.43	11.77
12	07-Mar-16	22:35	23:35	61.8	90.4	28.56	0.62	0.39
Mean						27.93		
Sum								2160.67

4B1 4.7.2 - Variability Test and Test of Calibration Function Calculations – Sulphur Dioxide - Low Range.

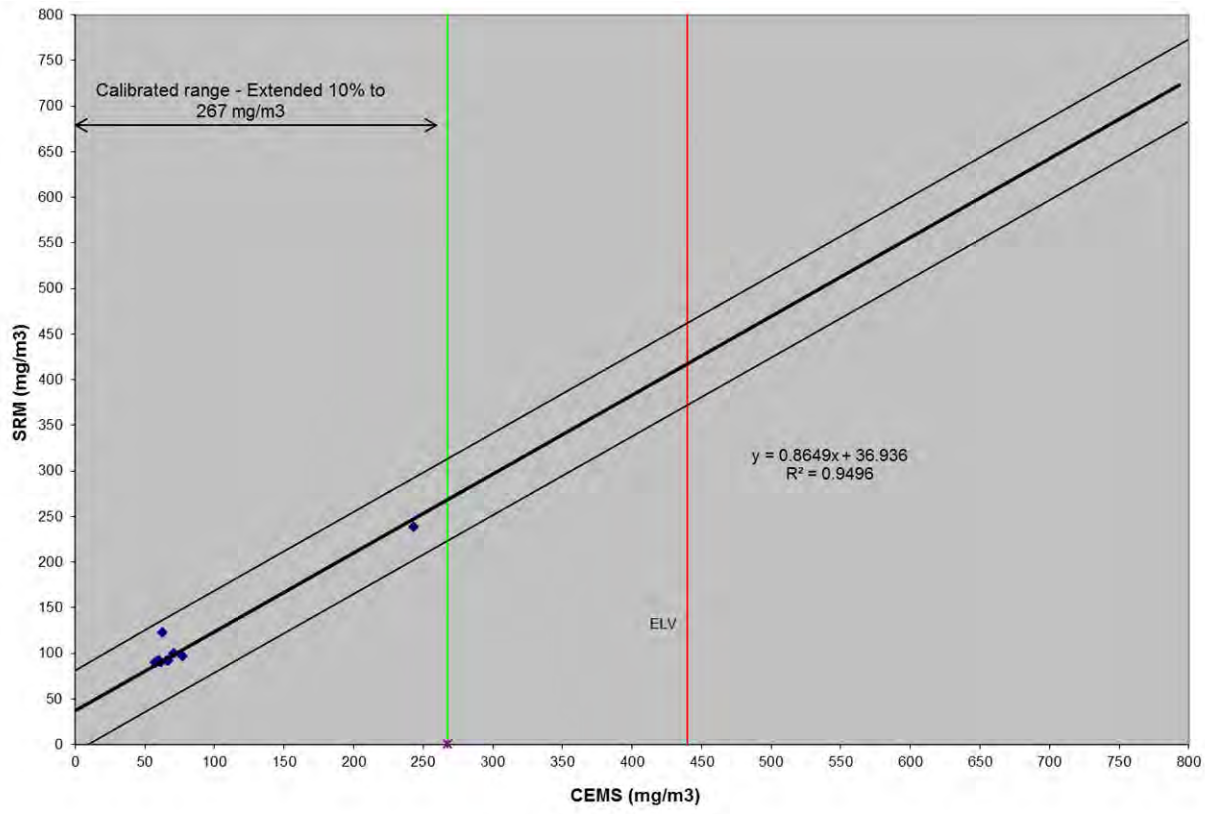
Variability Test

SD=	Root(1-Number).Integral(D1-D)^2	14.70	mg/m3(s,d),6%O2
The uncertainty laid down by the authorities is 20% ELV as a 95% confidence interval. O_0 is therefore calculated as:-			
O_0=	0.2*440 mg/m3 (s,d,6%O2)/1.96	44.90	mg/m3(s,d),6%O2
For 11 tests, kv =	0.9665		
Therefore variability=	14.7 <= 44.9 * 0.9665*1.5		
or	14.70 <= 65.09		
Which is TRUE therefore the CEMS passes the test			

Test of Calibration Function

The calibration of the AMS is accepted if:	D1<= $t_{0.95}(N\text{-}1)$*(s,d/root N)+O_0	
	D1=	27.93
For 11 tests, t0.95(N-1) =	1.812	
Therefore test of calibration =	27.93 <=1.812*(14.7/root 12)+44.9	
or	27.93 <=	52.59
Which is TRUE therefore the calibration function is VALID		

4B1 4.8.2 Plot 2.2 – Standardised CEM data versus standardised SRM - Sulphur Dioxide - Low Range – Reference conditions 273K, 101.3kPa, dry gas, 6% oxygen.



4B1 4.1.3 Table 4.1.3 – Raw monitoring Data – Sulphur Dioxide High Range

Test No	Date	Test Start Time	Test End Time	CEMS Raw Value (wet)	CEMS Oxygen (dry)	CEMS Moisture	SRM Raw value (wet)	SRM Oxygen (dry)	SRM Moisture	SRM at CEMs Raw conditions
		hr:min		(ppm)	(%)	(%)	(ppm)	(%)	(%)	(ppm)
1	07-Mar-16	12:25	13:25	27.72	6.71	1.95	32.00	6.51	1.91	32.00
2	07-Mar-16	13:26	14:26	26.34	6.46	1.89	32.96	6.51	1.86	32.96
3	07-Mar-16	14:27	15:27	23.53	6.14	1.85	31.16	6.18	1.82	31.16
4	07-Mar-16	15:28	16:28	24.45	6.00	1.86	41.60	6.14	1.84	41.60
5	07-Mar-16	16:29	17:29	77.22	6.15	2.08	81.10	6.13	2.07	81.10
6	07-Mar-16	17:30	18:30	25.11	6.22	1.91	31.29	6.16	1.85	31.29
7	07-Mar-16	18:31	19:31	25.64	6.14	1.93	31.31	6.09	1.84	31.31
8	07-Mar-16	19:32	20:32	23.20	5.80	1.91	30.83	5.87	1.86	30.83
9	07-Mar-16	20:33	21:33	23.25	5.73	1.92	31.00	5.89	1.86	31.00
10	07-Mar-16	21:34	22:34	23.66	5.89	1.94	31.26	6.00	1.91	31.26
11	07-Mar-16	22:35	23:35	24.24	5.93	1.97	30.91	6.06	1.90	30.91

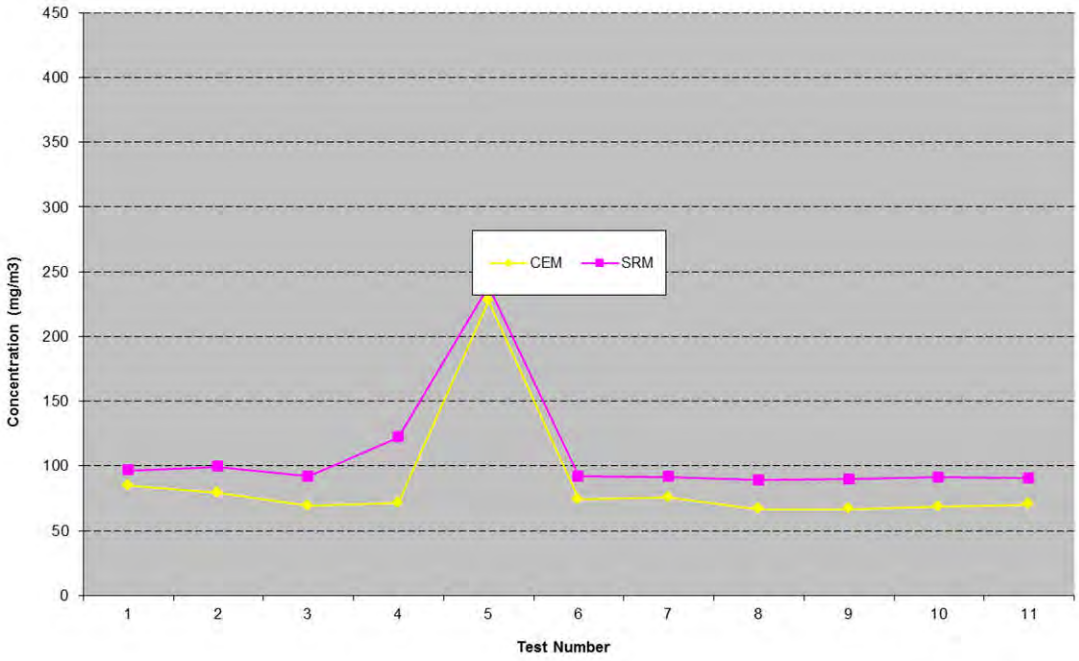
Note:
Emission concentrations expresed at reference conditions 273K, 101.3kPa

4B1 4.2.3 Table 4.2.3 – Standardised monitoring Data – Sulphur Dioxide - High Range

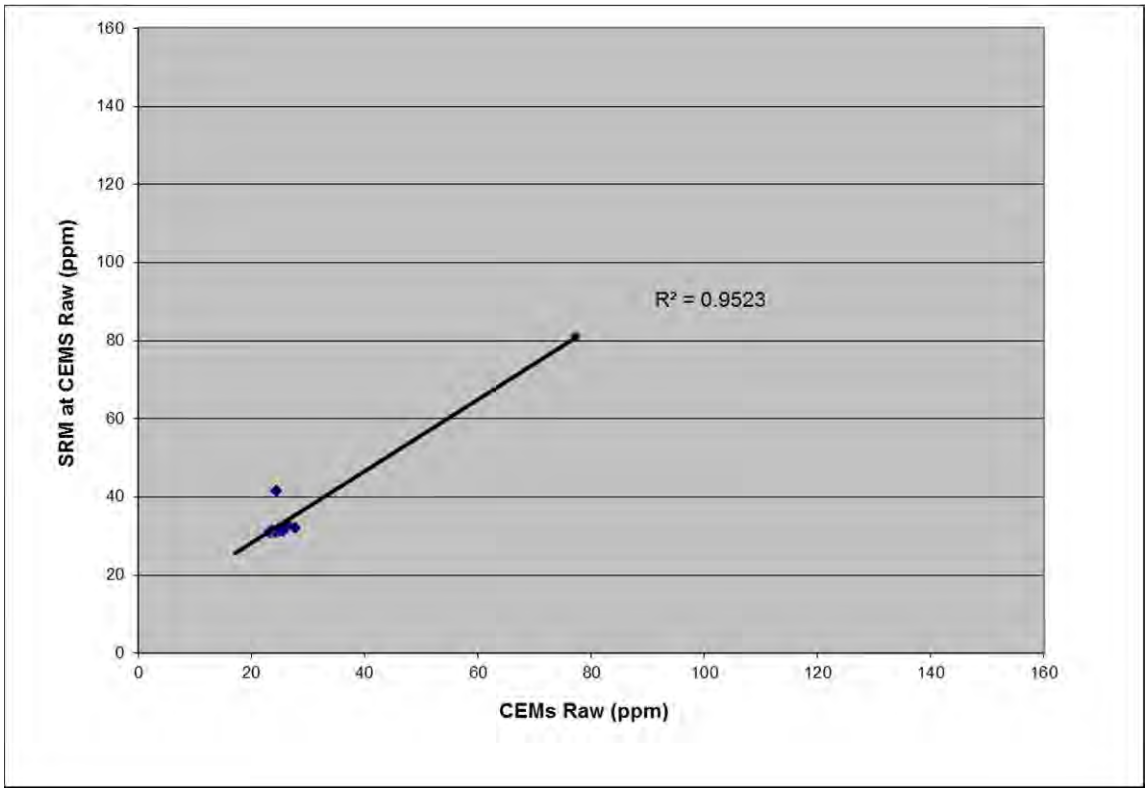
Test No	Date	Test Start Time	Test End Time	CEMS Standardised	SRM Standardised	SRM Uncertainty
		hr:min		(mg/m3)	(mg/m3)	(mg/m3)
1	07-Mar-16	12:25	13:25	84.8	96.5	5.0
2	07-Mar-16	13:26	14:26	79.2	99.4	5.1
3	07-Mar-16	14:27	15:27	69.2	91.8	4.8
4	07-Mar-16	15:28	16:28	71.2	122.2	6.3
5	07-Mar-16	16:29	17:29	227.6	238.8	12.4
6	07-Mar-16	17:30	18:30	74.2	92.1	4.8
7	07-Mar-16	18:31	19:31	75.4	91.7	4.8
8	07-Mar-16	19:32	20:32	66.7	89.0	4.6
9	07-Mar-16	20:33	21:33	66.5	89.6	4.7
10	07-Mar-16	21:34	22:34	68.4	91.1	4.7
11	07-Mar-16	22:35	23:35	70.3	90.4	4.7

Note:
Emission concentrations expresed at reference conditions 273K, 101.3kPa 6 % Oxygen, dry gas

4B1 4.3.3 Plot 1.3 –Time Series of Standardised CEM versus Standardised SRM data – Sulphur Dioxide - High Range. Reference conditions: 273K, 101.3kPa, dry gas, 6% oxygen.



4B1 4.4.3 – Elimination of Outliers – Sulphur Dioxide - High Range.



Guidance on performing tests for outliers in MID 14181 section 6.3, states the following:

'As a general guide, when plotting the raw SRM and raw CEM data, if the R^2 value for the linear regression line is equal or more than 0.9, then it is not ordinarily necessary to perform an outlier test.
Additionally, any data points are not likely to be outliers unless they are more than two standard deviations from the regression line'

As the R^2 value for this determinand was 0.9523, an outlier test has not been undertaken

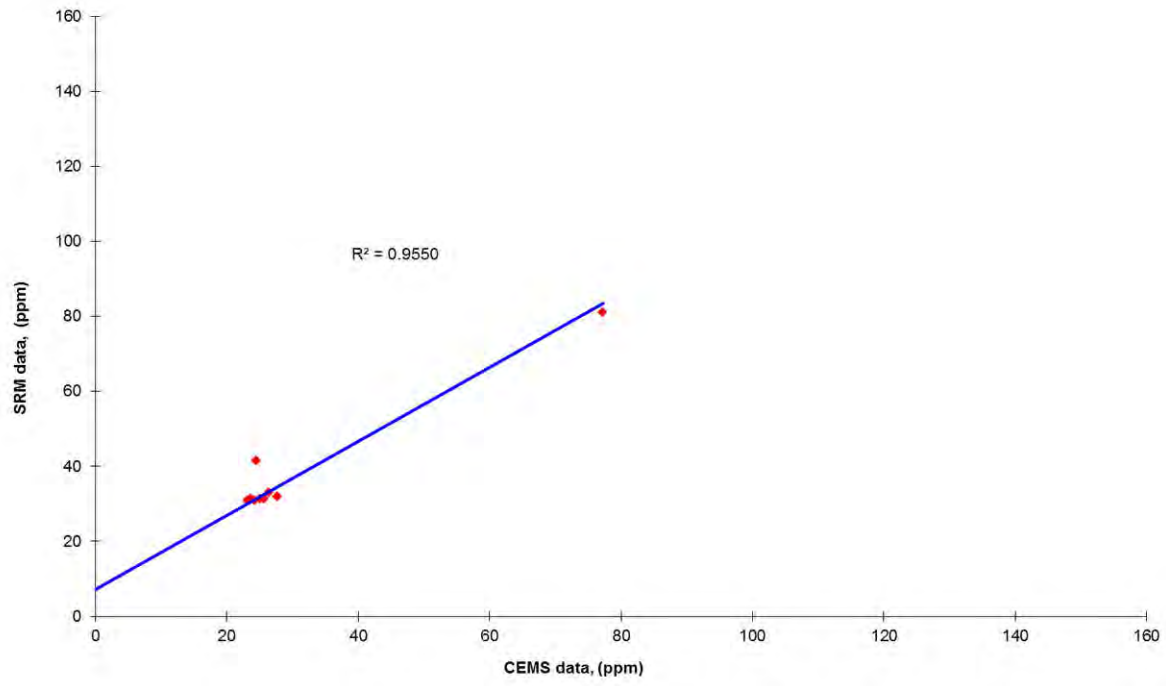
4B1 4.5.3 Table 4.3.3 - Data used to Calculate Calibrated Values – Sulphur Dioxide - High Range.

Test No	Date	Test Start Time	Test End Time	CEMS Raw Value (x)	CEMS Calibrated signal	CEMS dry Oxygen	CEMS Moisture	CEMS Standardised Value (dry)	CEMS Calibrated Standardised Value	SRM Standardised
		hr:min		(ppm)	(ppm)	%	%	(mg/Nm^3)	(mg/Nm^3)	(mg/m3)
1	24-Feb-16	Reference		-0.5	6.7	N/A	N/A	-0.5	19.1	1.0
2	07-Mar-16	12:25	13:25	27.7	33.5	6.71	1.95	84.8	102.6	96.5
3	07-Mar-16	13:26	14:26	26.3	32.2	6.46	1.89	79.2	96.9	99.4
4	07-Mar-16	14:27	15:27	23.5	29.6	6.14	1.85	69.2	86.9	91.8
5	07-Mar-16	15:28	16:28	24.4	30.4	6.00	1.86	71.2	88.6	122.2
6	07-Mar-16	16:29	17:29	77.2	80.7	6.15	2.08	227.6	237.7	238.8
7	07-Mar-16	17:30	18:30	25.1	31.1	6.22	1.91	74.2	91.8	92.1
8	07-Mar-16	18:31	19:31	25.6	31.6	6.14	1.93	75.4	92.8	91.7
9	07-Mar-16	19:32	20:32	23.2	29.2	5.80	1.91	66.7	84.1	89.0
10	07-Mar-16	20:33	21:33	23.2	29.3	5.73	1.92	66.5	83.8	89.6
11	07-Mar-16	21:34	22:34	23.7	29.7	5.89	1.94	68.4	85.9	91.1
12	07-Mar-16	22:35	23:35	24.2	30.2	5.93	1.97	70.3	87.7	90.4
					Sum			952.91		

Emission Limit Value (ELV) =	440	mg/Nm^3

	Reference Oxygen	6	%
Established Calibration Function y_i=	7.158 + 0.952xi		

Plot of CEM versus SRM Data at CEM measurement conditions– Sulphur Dioxide - High Range. wet gas



4B1 4.6.3 Table 4.4.3 – Data used for the Variability Test – Sulphur Dioxide - High Range.

Test No	Date	Test Start Time	Test End Time	CEMS Calibrated Standardised value	SRM Standardised value	Difference D1	Difference D1 - D	Squared Difference D1 - D
		hr:min		mg/m3	mg/m3			
2	07-Mar-16	12:25	13:25	102.6	96.5	-6.11	-10.99	120.87
3	07-Mar-16	13:26	14:26	96.9	99.4	2.49	-2.39	5.71
4	07-Mar-16	14:27	15:27	86.9	91.8	4.93	0.05	0.00
5	07-Mar-16	15:28	16:28	88.6	122.2	33.61	28.72	824.94
6	07-Mar-16	16:29	17:29	237.7	238.8	1.05	-3.84	14.71
7	07-Mar-16	17:30	18:30	91.8	92.1	0.25	-4.64	21.50
8	07-Mar-16	18:31	19:31	92.8	91.7	-1.12	-6.01	36.12
9	07-Mar-16	19:32	20:32	84.1	89.0	4.92	0.04	0.00
10	07-Mar-16	20:33	21:33	83.8	89.6	5.83	0.95	0.90
11	07-Mar-16	21:34	22:34	85.9	91.1	5.21	0.33	0.11
12	07-Mar-16	22:35	23:35	87.7	90.4	2.67	-2.21	4.89
Mean						4.89		
Sum								1029.76

4B1 4.7.3 - Variability Test and Test of Calibration Function Calculations – Sulphur Dioxide - High Range.

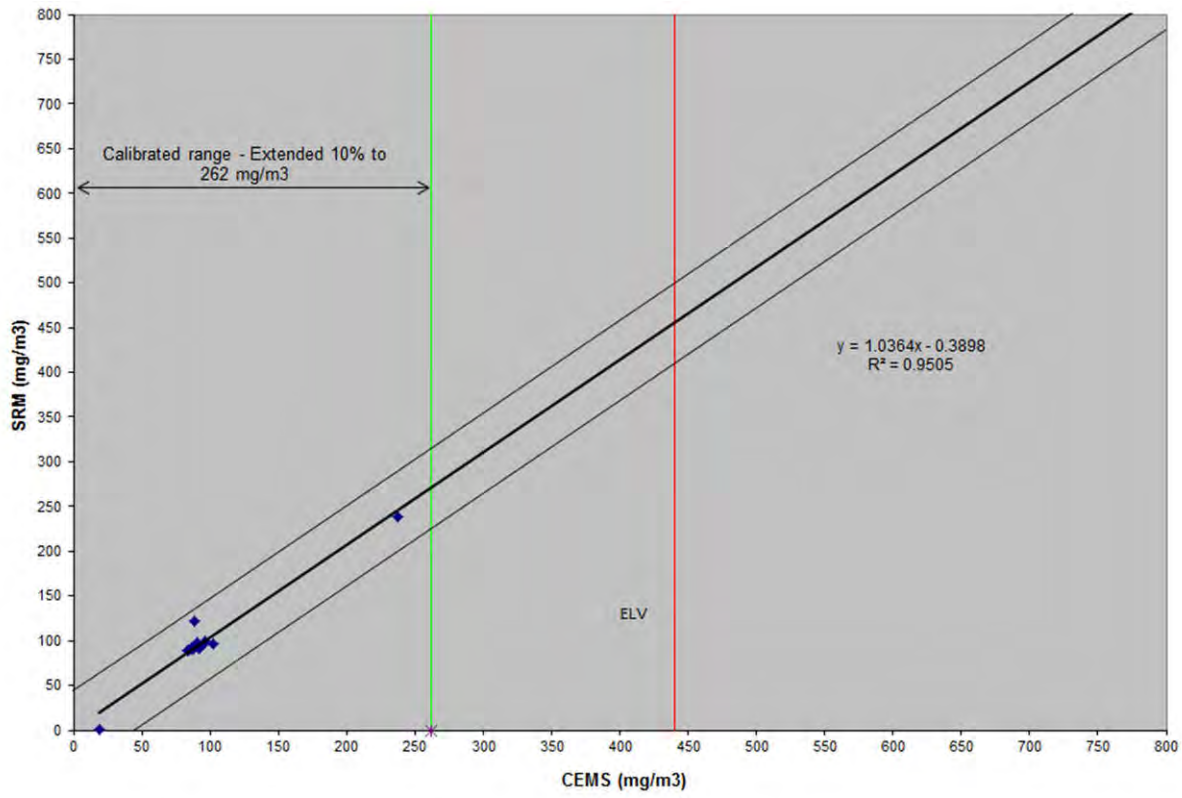
Variability Test

SD=	Root(1-Number).Integral(D1-D)^2	10.15	mg/m3(s,d),6%O2
The uncertainty laid down by the authorities is 20% ELV as a 95% confidence interval. O_0 is therefore calculated as:-			
O_0=	0.2*440 mg/m3 (s,d,6%O2)/1.96	44.90	mg/m3(s,d),6%O2
For 11 tests, kv =	0.9665		
Therefore variability=	10.15 <= 44.9 * 0.9665*1.5		
or	10.15 <=	65.09	
Which is TRUE therefore the CEMS passes the test			

Test of Calibration Function

The calibration of the AMS is accepted if:	D1<= $t_{0.95}(N-1)$*(s,d/root N)+O_0		
	D1=	4.89	
For 11 tests, t0.95(N-1) =	1.812		
Therefore test of calibration =	4.89 <=1.812*(10.15/root 12)+44.9		
or	4.89 <=	50.21	
Which is TRUE therefore the calibration function is VALID			

4B1 4.8.3 Plot 2.3 – Standardised CEM data versus standardised SRM - Sulphur Dioxide - High Range – Reference conditions 273K, 101.3kPa, dry gas, 6% oxygen.



Section 4B2: Data & calculations – AST – Unit 7, Procal 2

Section 4B2 – Data and calculations – AST Procal 2

4B2 4.1.1 Table 4.1.1 – Raw monitoring Data – Oxides of Nitrogen

Test No	Date	Test Start Time	Test End Time	CEMS Raw Value (wet)	CEMS Oxygen (dry)	CEMS Moisture	SRM Raw value (dry)	SRM Oxygen (dry)	SRM Moisture	SRM at CEMs Raw conditions
		hr:min		NO (ppm)	(%)	(%)	NOx(ppm)	(%)	(%)	NOx(ppm)
1	07-Mar-16	10:23	11:23	418.85	5.34	1.61	440.18	5.89	1.90	431.83
2	07-Mar-16	11:24	12:24	409.06	6.13	1.65	448.66	6.19	1.92	440.06
3	07-Mar-16	14:27	15:27	362.05	6.14	1.66	397.94	6.18	1.82	390.68
4	07-Mar-16	15:28	16:28	356.69	6.00	1.76	387.23	6.14	1.84	380.10
5	07-Mar-16	16:29	17:29	374.81	6.15	1.79	408.89	6.13	2.07	400.41
6	07-Mar-16	17:30	18:30	414.01	6.22	1.74	452.67	6.16	1.85	444.27
7	07-Mar-16	18:31	19:31	423.85	6.14	1.72	463.46	6.09	1.84	454.94
8	07-Mar-16	19:32	20:32	422.04	5.80	1.70	457.23	5.87	1.86	448.74
9	07-Mar-16	20:33	21:33	424.07	5.73	1.68	456.62	5.89	1.86	448.11
10	07-Mar-16	21:34	22:34	405.53	5.89	1.67	439.27	6.00	1.91	430.88
11	07-Mar-16	22:35	23:35	399.84	5.93	1.67	433.19	6.06	1.90	424.96

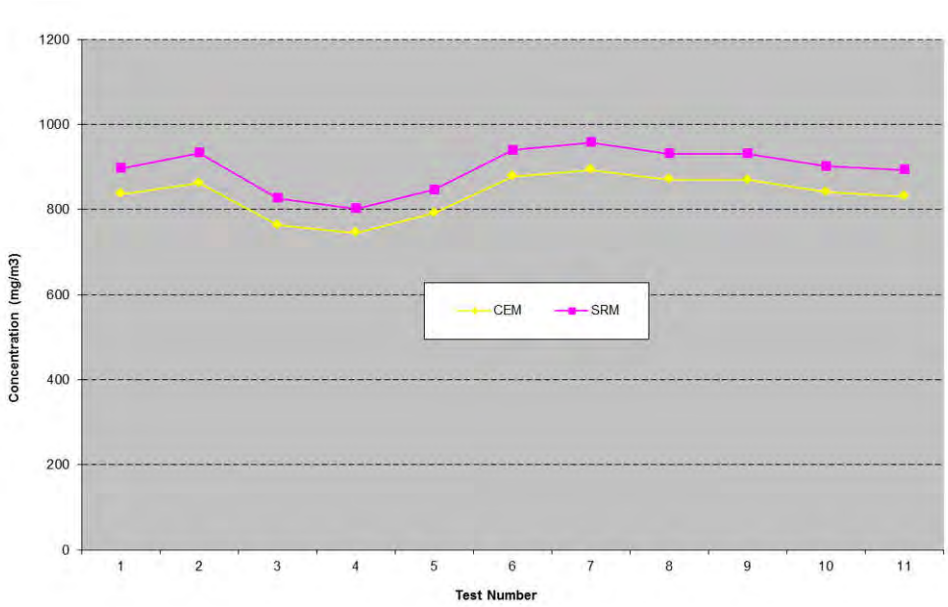
Note:
Emission concentrations expresed at reference conditions 273K, 101.3kPa

4B2 4.2.1 Table 4.2.1 – Standardised monitoring Data – Oxides of Nitrogen

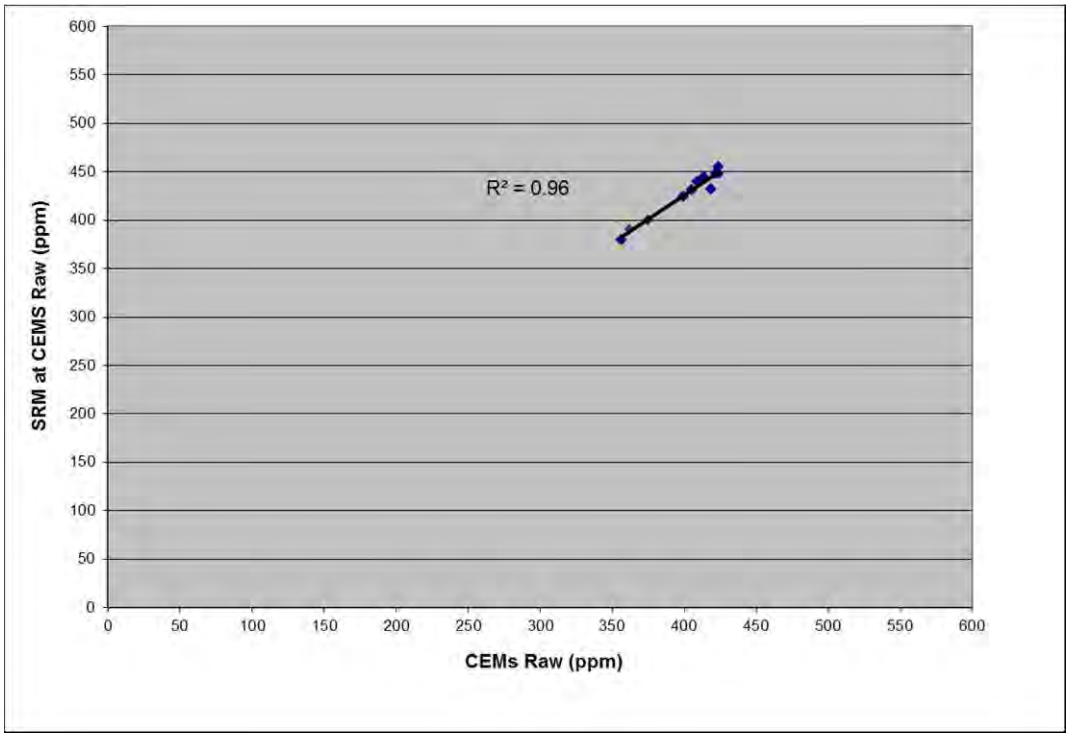
Test No	Date	Test Start Time	Test End Time	CEMS Standardised	SRM Standardised	SRM Uncertainty
		hr:min		NOx as NO2(mg/m3)	NOx as NO2(mg/m3)	(mg/m3)
1	07-Mar-16	10:23	11:23	836.9	897.5	30.4
2	07-Mar-16	11:24	12:24	861.8	933.2	29.4
3	07-Mar-16	14:27	15:27	763.3	827.4	27.0
4	07-Mar-16	15:28	16:28	745.6	802.6	28.0
5	07-Mar-16	16:29	17:29	791.6	847.3	29.0
6	07-Mar-16	17:30	18:30	878.1	939.6	30.0
7	07-Mar-16	18:31	19:31	893.8	957.5	31.0
8	07-Mar-16	19:32	20:32	870.2	931.1	32.0
9	07-Mar-16	20:33	21:33	869.8	931.0	33.0
10	07-Mar-16	21:34	22:34	840.9	902.3	34.0
11	07-Mar-16	22:35	23:35	831.2	893.3	35.0

Note:
Emission concentrations expresed at reference conditions 273K, 101.3kPa 6 % Oxygen, dry gas

4B2 4.3.1 Plot 1.1 – Time Series of Standardised CEM versus Standardised SRM data – Oxides of Nitrogen. Reference conditions: 273K, 101.3kPa, dry gas, 6% oxygen.



4B2 4.4.1 –Elimination of Outliers – Oxides of Nitrogen.



Guidance on performing tests for outliers in MID 14181 section 6.3, states the following:

'As a general guide, when plotting the raw SRM and raw CEM data, if the R^2 value for the linear regression line is equal or more than 0.9, then it is not ordinarily necessary to perform an outlier test.
Additionally, any data points are not likely to be outliers unless they are more than two standard deviations from the regression line'

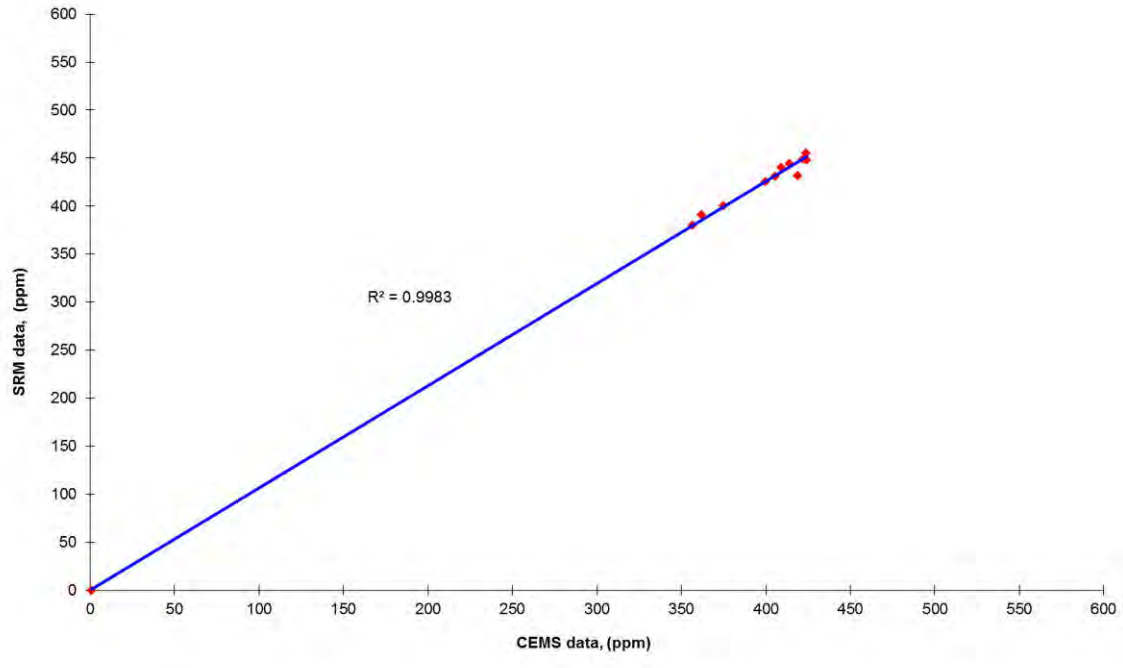
As the R^2 value for this determinand was 0.96, an outlier test has not been undertaken.

4B2 4.5.1 Table 4.3.1 - Data used to Calculate Calibrated Values – Oxides of Nitrogen

Test No	Date	Test Start Time	Test End Time	CEMS Raw Value (x)	CEMS Calibrated signal	CEMS dry Oxygen	CEMS Moisture	CEMS Standardised Value (dry)	CEMS Calibrated Standardised Value	SRM Standardised
		hr:min		NO (ppm)	NO (ppm)	%	%	(mg/Nm^3)	(mg/Nm^3)	(mg/m3)
1	24-Feb-16	Reference		0.8	-0.7	N/A	N/A	1.7	-1.4	0.0
2	07-Mar-16	10:23	11:23	418.9	408.6	5.34	1.61	836.9	816.3	897.5
3	07-Mar-16	11:24	12:24	409.1	399.0	6.13	1.65	861.8	840.6	933.2
4	07-Mar-16	14:27	15:27	362.0	352.9	6.14	1.66	763.3	744.1	827.4
5	07-Mar-16	15:28	16:28	356.7	347.7	6.00	1.76	745.6	726.8	802.6
6	07-Mar-16	16:29	17:29	374.8	365.4	6.15	1.79	791.6	771.8	847.3
7	07-Mar-16	17:30	18:30	414.0	403.8	6.22	1.74	878.1	856.5	939.6
8	07-Mar-16	18:31	19:31	423.9	413.5	6.14	1.72	893.8	871.9	957.5
9	07-Mar-16	19:32	20:32	422.0	411.7	5.80	1.70	870.2	848.8	931.1
10	07-Mar-16	20:33	21:33	424.1	413.7	5.73	1.68	869.8	848.4	931.0
11	07-Mar-16	21:34	22:34	405.5	395.5	5.89	1.67	840.9	820.2	902.3
12	07-Mar-16	22:35	23:35	399.8	389.9	5.93	1.67	831.2	810.6	893.3
				Sum				9184.91		

Emission Limit Value (ELV) =	1080	mg/Nm^3
	Reference Oxygen	6 %
Established Calibration Function y_i=	-1.5 + 0.979xi	

Plot of CEM versus SRM Parallel Test Data at CEM measurement conditions – wet gas



4B2 4.6.1 Table 4.4.1 – Data used for the Variability Test – Oxides of Nitrogen

Test No	Date	Test Start Time	Test End Time	CEMS Calibrated Standardised value	SRM Standardised value	Difference D1	Difference D1 - D	Squared Difference D1 - D
		hr:min		mg/m3	mg/m3			
2	07-Mar-16	10:23	11:23	816.3	897.5	81.19	-1.25	1.57
3	07-Mar-16	11:24	12:24	840.6	933.2	92.69	10.25	105.02
4	07-Mar-16	14:27	15:27	744.1	827.4	83.28	0.84	0.70
5	07-Mar-16	15:28	16:28	726.8	802.6	75.76	-6.68	44.66
6	07-Mar-16	16:29	17:29	771.8	847.3	75.52	-6.92	47.91
7	07-Mar-16	17:30	18:30	856.5	939.6	83.09	0.64	0.41
8	07-Mar-16	18:31	19:31	871.9	957.5	85.65	3.21	10.31
9	07-Mar-16	19:32	20:32	848.8	931.1	82.30	-0.14	0.02
10	07-Mar-16	20:33	21:33	848.4	931.0	82.55	0.11	0.01
11	07-Mar-16	21:34	22:34	820.2	902.3	82.14	-0.30	0.09
12	07-Mar-16	22:35	23:35	810.6	893.3	82.69	0.25	0.06
Mean						82.44		
Sum								210.78

4B2 4.7.1 - Variability Test and Test of Calibration Function Calculations – Oxides of Nitrogen

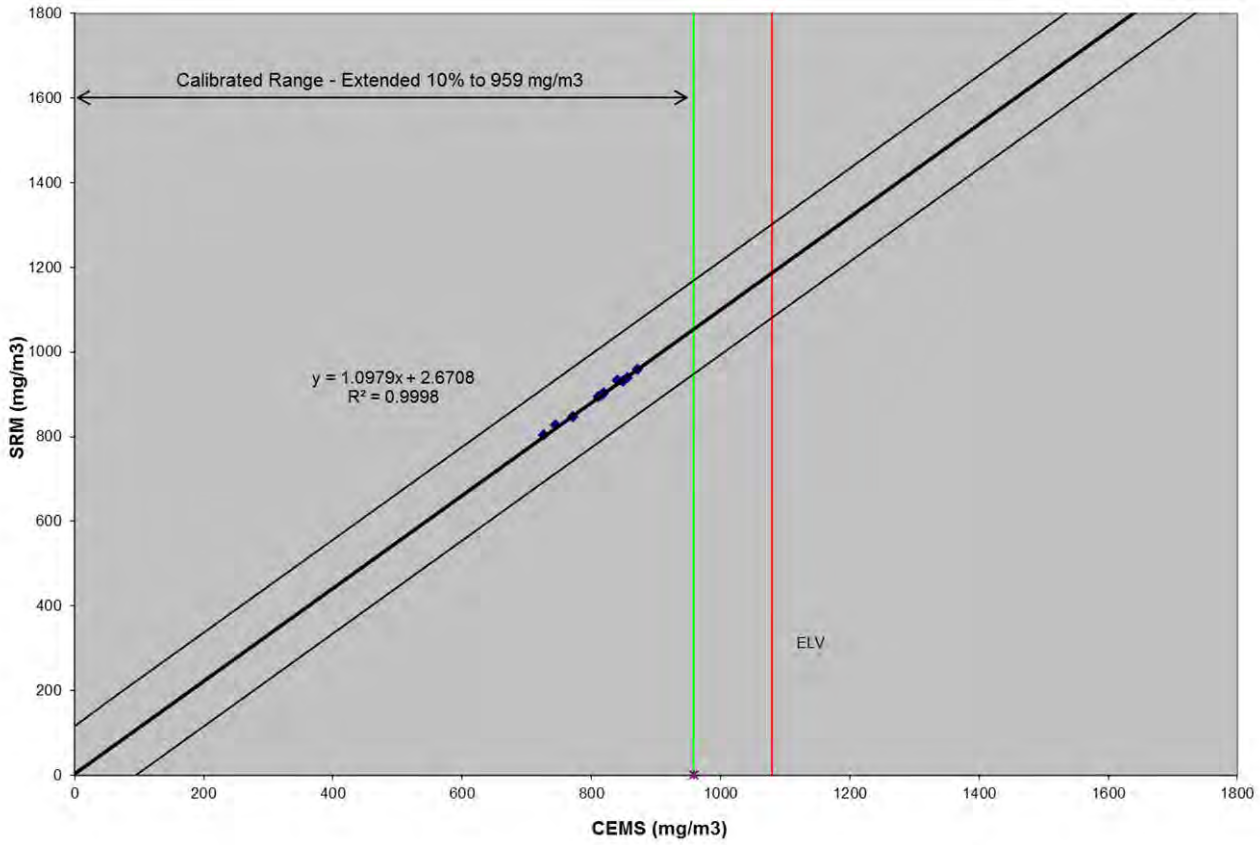
Variability Test

SD=	Root(1-Number).Integral(D1-D)^2	4.59	mg/m3(s,d),6%O2
The uncertainty laid down by the authorities is 20% ELV as a 95% confidence interval. O_0 is therefore calculated as:-			
O_0=	0.2*1080 mg/m3 (s,d,6%O2)/1.96	110.20	mg/m3(s,d),6%O2
For 11 tests, kv =	0.9665		
Therefore variability=	4.59 <= 110.2 * 0.9665*1.5		
or	4.59 <=	159.77	
Which is TRUE therefore the CEMS passes the test			

Test of Calibration Function

The calibration of the AMS is accepted if:	D1<= $t_{0.95}$ (N-1)*(s,d/root N)+O_0		
	D1=	82.44	
For 11 tests, t0.95(N-1) =	1.812		
Therefore test of calibration =	82.44 <=1.812*(4.59/root 12)+110.2		
or	82.44 <=	112.61	
Which is TRUE therefore the calibration function is VALID			

4B2 4.8.1 Plot 2.1 –Standardised CEM data versus standardised SRM - Oxides of Nitrogen (as NO_2) – Reference conditions 273K, 101.3kPa, dry gas, 6% oxygen.



4B2 4.1.2 Table 4.1.2 – Raw monitoring Data – Sulphur Dioxide Low Range

Test No	Date	Test Start Time	Test End Time	CEMS Raw Value (wet)	CEMS Oxygen (dry)	CEMS Moisture	SRM Raw value (wet)	SRM Oxygen (dry)	SRM Moisture	SRM at CEMs Raw conditions
		hr:min		(ppm)	(%)	(%)	(ppm)	(%)	(%)	(ppm)
1	07-Mar-16	10:23	11:23	52.84	5.34	1.61	33.65	5.89	1.90	33.65
2	07-Mar-16	11:24	12:24	48.35	6.13	1.65	32.82	6.19	1.92	32.82
3	07-Mar-16	14:27	15:27	44.28	6.14	1.66	31.16	6.18	1.82	31.16
4	07-Mar-16	15:28	16:28	47.80	6.00	1.76	41.60	6.14	1.84	41.60
5	07-Mar-16	17:30	18:30	43.85	6.22	1.74	31.29	6.16	1.85	31.29
6	07-Mar-16	18:31	19:31	43.93	6.14	1.72	31.31	6.09	1.84	31.31
7	07-Mar-16	19:32	20:32	44.48	5.80	1.70	30.83	5.87	1.86	30.83
8	07-Mar-16	20:33	21:33	46.30	5.73	1.68	31.00	5.89	1.86	31.00
9	07-Mar-16	21:34	22:34	45.34	5.89	1.67	31.26	6.00	1.91	31.26
10	07-Mar-16	22:35	23:35	44.84	5.93	1.67	30.91	6.06	1.90	30.91

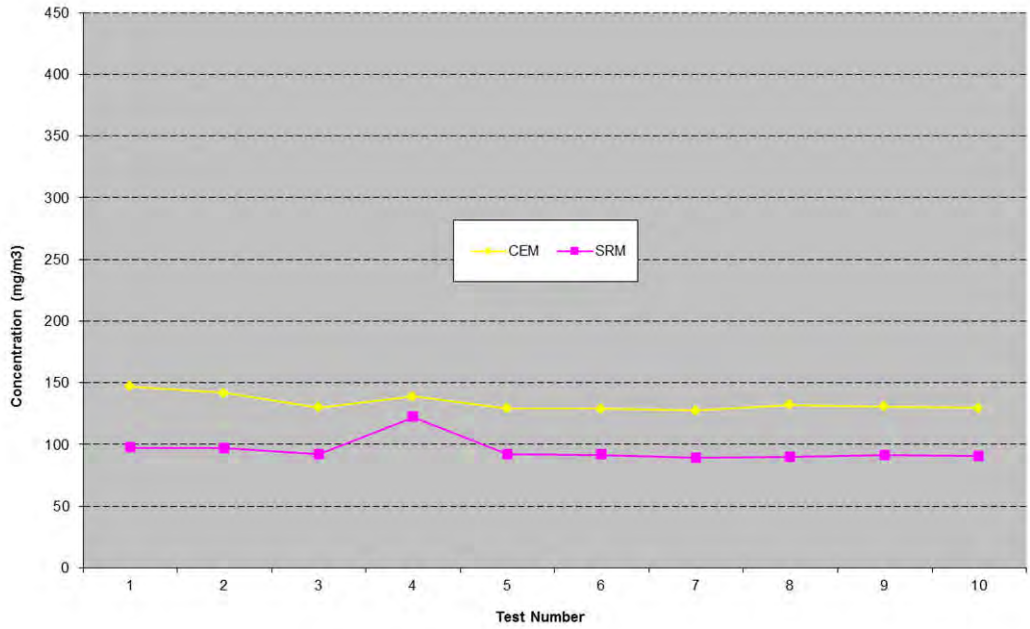
Note:
Emission concentrations expresed at reference conditions 273K, 101.3kPa

4B2 4.2.2 Table 4.2.2 – Standardised monitoring Data – Sulphur Dioxide - Low Range

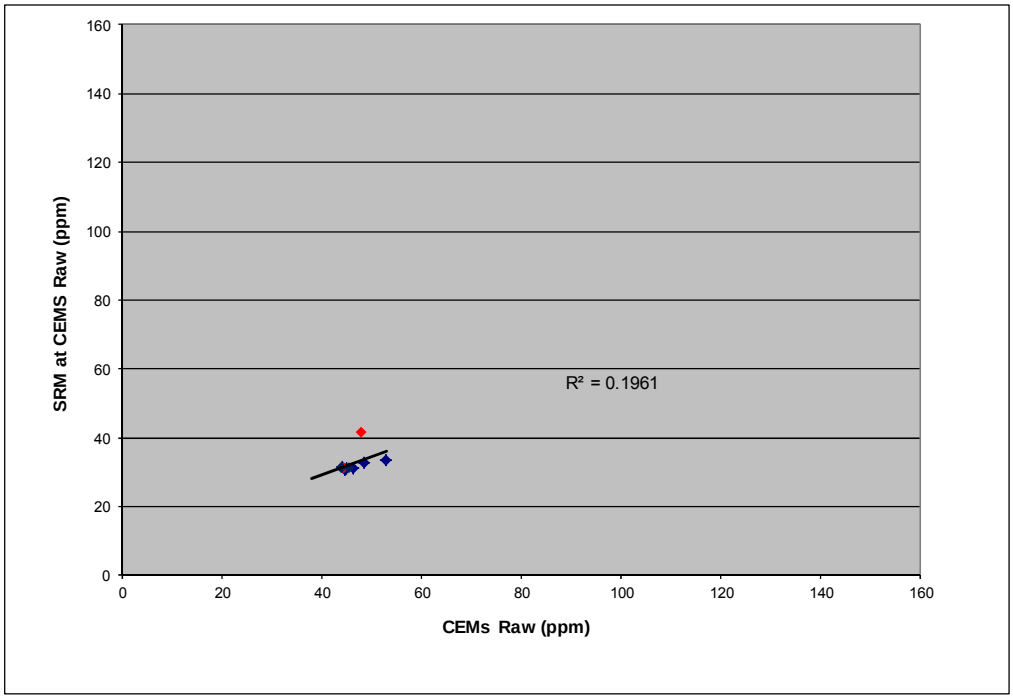
Test No	Date	Test Start Time	Test End Time	CEMS Standardised	SRM Standardised	SRM Uncertainty
		hr:min		(mg/m3)	(mg/m3)	(mg/m3)
1	07-Mar-16	10:23	11:23	146.9	97.3	5.0
2	07-Mar-16	11:24	12:24	141.7	96.8	5.0
3	07-Mar-16	14:27	15:27	129.9	91.8	4.8
4	07-Mar-16	15:28	16:28	139.0	122.2	6.3
5	07-Mar-16	17:30	18:30	129.4	92.1	4.8
6	07-Mar-16	18:31	19:31	128.9	91.7	4.8
7	07-Mar-16	19:32	20:32	127.6	89.0	4.6
8	07-Mar-16	20:33	21:33	132.1	89.6	4.7
9	07-Mar-16	21:34	22:34	130.8	91.1	4.7
10	07-Mar-16	22:35	23:35	129.7	90.4	4.7

Note:
Emission concentrations expresed at reference conditions 273K, 101.3kPa 6 % Oxygen, dry gas

4B2 4.3.2 Plot 1.2 –Time Series of Standardised CEM versus Standardised SRM data – Sulphur Dioxide - Low Range. Reference conditions: 273K, 101.3kPa, dry gas, 6% oxygen.



4B2 4.4.2 – Elimination of Outliers – Sulphur Dioxide - Low Range.



Test No	Test Start Time	Test End Time	CEMS Raw Value	SRM Value at CEMS Raw conditions	Difference Di	Difference Di - $\bar{D}i$	Is Result an Outlier - Di-$\bar{D}i$> 2SD
	hr:min		(ppm)	(ppm)			
1	10:23	11:23	52.8	33.7	-19.19	-5.57	No
2	11:24	12:24	48.4	32.8	-15.53	-1.92	No
3	14:27	15:27	44.3	31.2	-13.13	0.49	No
4	15:28	16:28	47.8	41.6	-6.20	7.42	Yes
5	17:30	18:30	43.9	31.3	-12.56	1.06	No
6	18:31	19:31	43.9	31.3	-12.62	1.00	No
7	19:32	20:32	44.5	30.8	-13.65	-0.03	No
8	20:33	21:33	46.3	31.0	-15.30	-1.68	No
9	21:34	22:34	45.3	31.3	-14.09	-0.47	No
10	22:35	23:35	44.8	30.9	-13.94	-0.32	No
				Average $\bar{D}i$	-13.62		
			Standard Deviation		3.25		
			Standard Deviation x2		6.51		

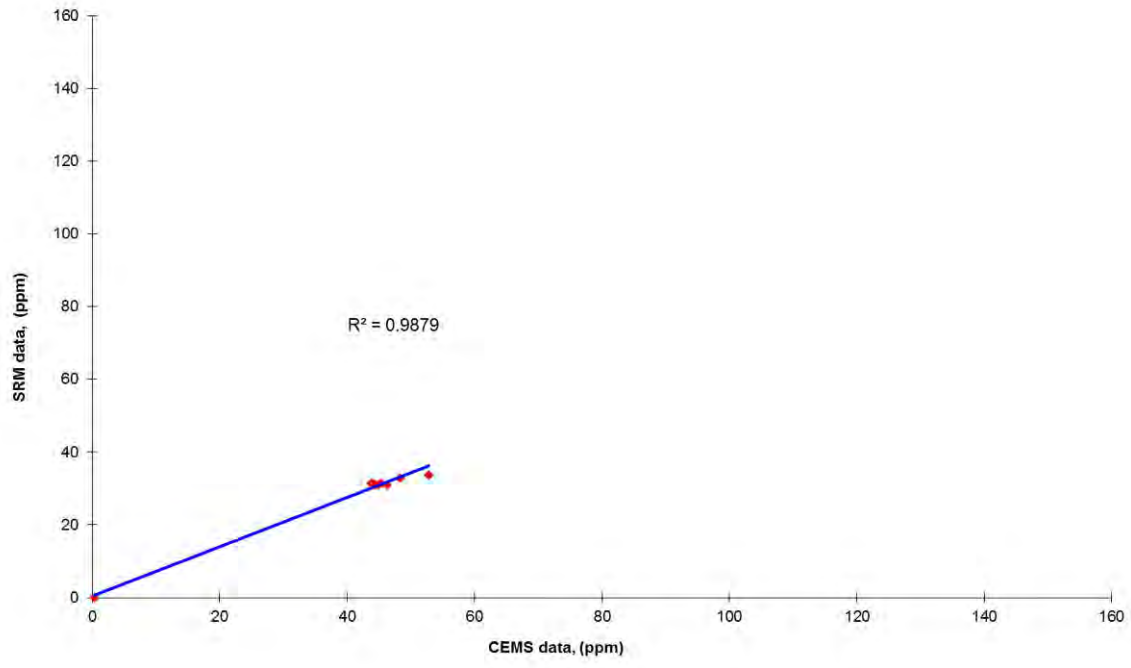
4B2 4.5.2 Table 4.3.2 - Data used to Calculate Calibrated Values – Sulphur Dioxide - Low Range.

Test No	Date	Test Start Time	Test End Time	CEMS Raw Value (x)	CEMS Calibrated signal	CEMS dry Oxygen	CEMS Moisture	CEMS Standardised Value (dry)	CEMS Calibrated Standardised Value	SRM Standardised
		hr:min		(ppm)	(ppm)	%	%	(mg/Nm^3)	(mg/Nm^3)	(mg/m3)
1	24-Feb-16	Reference		0.3	-5.8	N/A	N/A	0.3	-16.5	0.0
2	07-Mar-16	10:23	11:23	52.8	40.7	5.34	1.61	146.9	113.1	97.3
3	07-Mar-16	11:24	12:24	48.4	36.7	6.13	1.65	141.7	107.6	96.8
4	07-Mar-16	14:27	15:27	44.3	33.1	6.14	1.66	129.9	97.1	91.8
6	07-Mar-16	17:30	18:30	43.9	32.7	6.22	1.74	129.4	96.6	92.1
7	07-Mar-16	18:31	19:31	43.9	32.8	6.14	1.72	128.9	96.2	91.7
8	07-Mar-16	19:32	20:32	44.5	33.3	5.80	1.70	127.6	95.5	89.0
9	07-Mar-16	20:33	21:33	46.3	34.9	5.73	1.68	132.1	99.6	89.6
10	07-Mar-16	21:34	22:34	45.3	34.1	5.89	1.67	130.8	98.3	91.1
11	07-Mar-16	22:35	23:35	44.8	33.6	5.93	1.67	129.7	97.2	90.4
					Sum			1197.36		

Emission Limit Value (ELV) =	440	mg/Nm^3

	Reference Oxygen	6	%
Established Calibration Function y_i=	-6.072 + 0.885xi		

Plot of CEM versus SRM Data at CEM measurement conditions– Sulphur Dioxide - Low Range. wet gas



4B2 4.6.2 Table 4.4.2 – Data used for the Variability Test – Sulphur Dioxide - Low Range

Test No	Date	Test Start Time	Test End Time	CEMS Calibrated Standardised value	SRM Standardised value	Difference D1	Difference D1 - D	Squared Difference D1 - D
		hr:min		mg/m3	mg/m3			
2	07-Mar-16	10:23	11:23	113.1	97.3	-15.81	-7.85	61.70
3	07-Mar-16	11:24	12:24	107.6	96.8	-10.80	-2.85	8.13
4	07-Mar-16	14:27	15:27	97.1	91.8	-5.34	2.61	6.82
6	07-Mar-16	17:30	18:30	96.6	92.1	-4.54	3.41	11.64
7	07-Mar-16	18:31	19:31	96.2	91.7	-4.56	3.39	11.51
8	07-Mar-16	19:32	20:32	95.5	89.0	-6.51	1.44	2.08
9	07-Mar-16	20:33	21:33	99.6	89.6	-9.98	-2.03	4.12
10	07-Mar-16	21:34	22:34	98.3	91.1	-7.19	0.76	0.58
11	07-Mar-16	22:35	23:35	97.2	90.4	-6.83	1.12	1.25
Mean						-7.95		
Sum								107.83

4B2 4.7.2 - Variability Test and Test of Calibration Function Calculations – Sulphur Dioxide - Low Range.

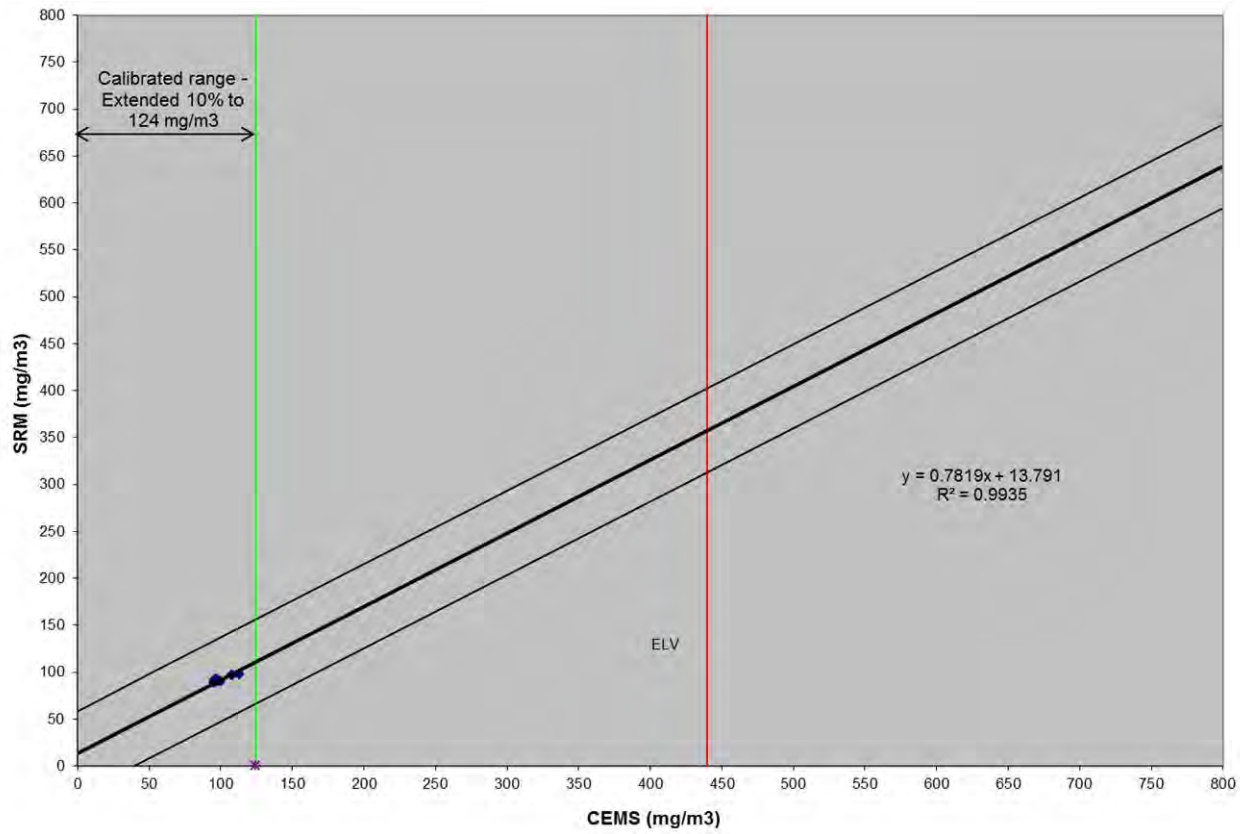
Variability Test

SD=	Root(1-Number).Integral(D1-D)^2	3.67	mg/m3(s,d),6%O2
The uncertainty laid down by the authorities is 20% ELV as a 95% confidence interval. O_0 is therefore calculated as:-			
O_0=	0.2*440 mg/m3 (s,d,6%O2)/1.96	44.90	mg/m3(s,d),6%O2
For 9 tests, kv =	0.9581		
Therefore variability=	3.67 <= 44.9 * 0.9581*1.5		
or	3.67 <=	64.53	
Which is TRUE therefore the CEMS passes the test			

Test of Calibration Function

The calibration of the AMS is accepted if:	D1<= $t_{0.95}(N-1)$*(s,d/root N)+O_0		
	D1=	7.95	
For 9 tests, t0.95(N-1) =	1.86		
Therefore test of calibration =	7.95 <=1.86*(3.67/root 10)+44.9		
or	7.95 <=	47.06	
Which is TRUE therefore the calibration function is VALID			

4B2 4.8.2 Plot 2.2 – Standardised CEM data versus standardised SRM - Sulphur Dioxide - Low Range – Reference conditions 273K, 101.3kPa, dry gas, 6% oxygen.



4B2 4.1.3 Table 4.1.3 – Raw monitoring Data – Sulphur Dioxide High Range

Test No	Date	Test Start Time	Test End Time	CEMS Raw Value (wet)	CEMS Oxygen (dry)	CEMS Moisture	SRM Raw value (wet)	SRM Oxygen (dry)	SRM Moisture	SRM at CEMs Raw conditions
		hr:min		(ppm)	(%)	(%)	(ppm)	(%)	(%)	(ppm)
1	07-Mar-16	10:23	11:23	56.09	5.34	1.61	33.65	5.89	1.90	33.65
2	07-Mar-16	11:24	12:24	51.50	6.13	1.65	32.82	6.19	1.92	32.82
3	07-Mar-16	14:27	15:27	47.19	6.14	1.66	31.16	6.18	1.82	31.16
4	07-Mar-16	15:28	16:28	50.77	6.00	1.76	41.60	6.14	1.84	41.60
5	07-Mar-16	16:29	17:29	105.08	6.15	1.79	81.10	6.13	2.07	81.10
6	07-Mar-16	17:30	18:30	46.71	6.22	1.74	31.29	6.16	1.85	31.29
7	07-Mar-16	18:31	19:31	46.84	6.14	1.72	31.31	6.09	1.84	31.31
8	07-Mar-16	19:32	20:32	47.44	5.80	1.70	30.83	5.87	1.86	30.83
9	07-Mar-16	20:33	21:33	49.30	5.73	1.68	31.00	5.89	1.86	31.00
10	07-Mar-16	21:34	22:34	48.34	5.89	1.67	31.26	6.00	1.91	31.26
11	07-Mar-16	22:35	23:35	47.86	5.93	1.67	30.91	6.06	1.90	30.91

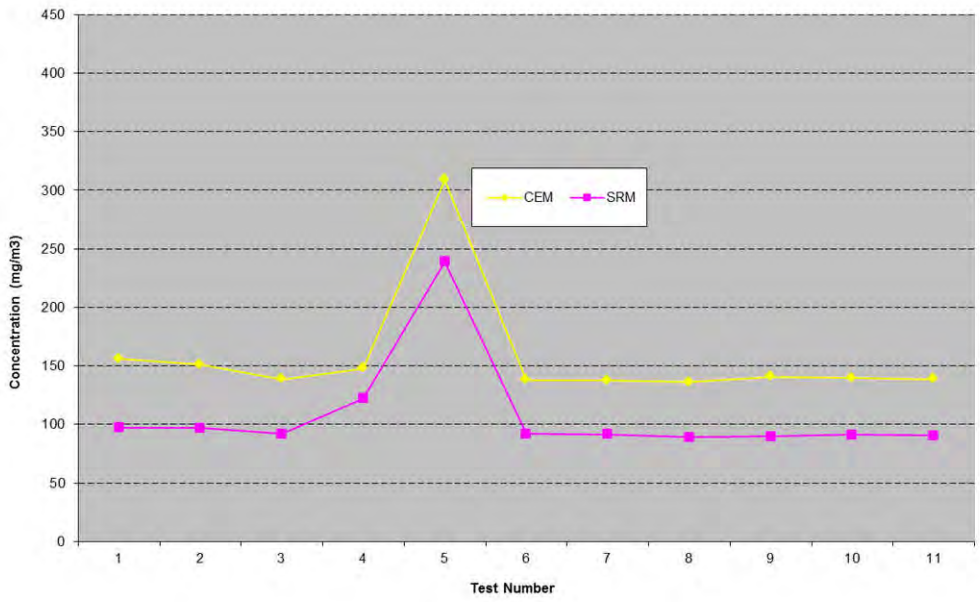
Note:
Emission concentrations expresed at reference conditions 273K, 101.3kPa

4B2 4.2.3 Table 4.2.3 – Standardised monitoring Data – Sulphur Dioxide - High Range

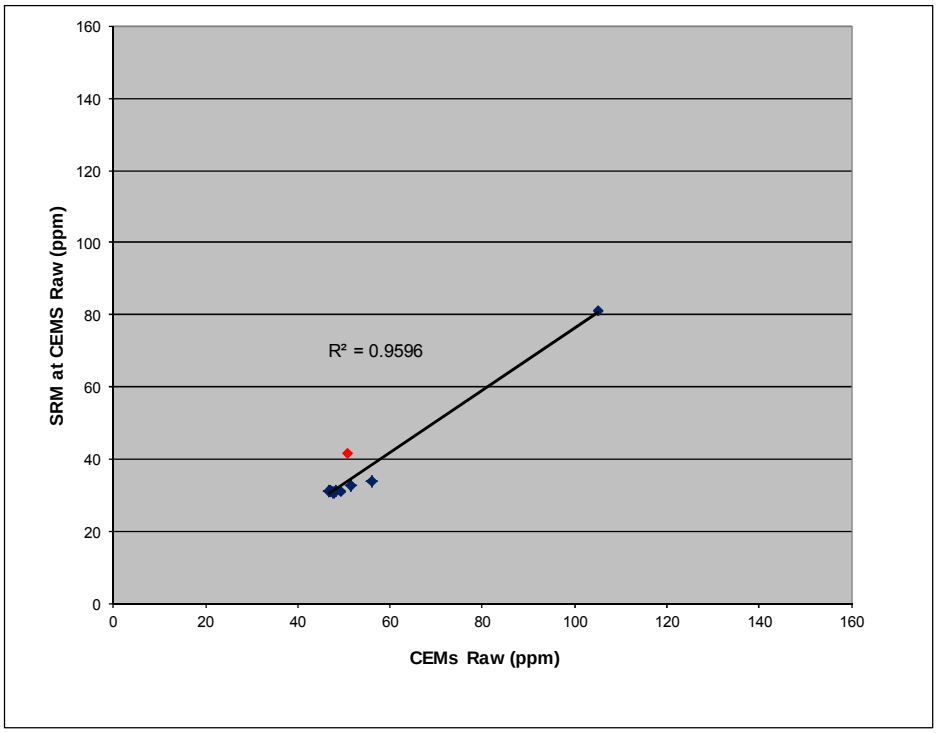
Test No	Date	Test Start Time	Test End Time	CEMS Standardised	SRM Standardised	SRM Uncertainty
		hr:min		(mg/m3)	(mg/m3)	(mg/m3)
1	07-Mar-16	10:23	11:23	155.9	97.3	5.0
2	07-Mar-16	11:24	12:24	151.0	96.8	5.0
3	07-Mar-16	14:27	15:27	138.4	91.8	4.8
4	07-Mar-16	15:28	16:28	147.7	122.2	6.3
5	07-Mar-16	16:29	17:29	308.8	238.8	12.4
6	07-Mar-16	17:30	18:30	137.8	92.1	4.8
7	07-Mar-16	18:31	19:31	137.4	91.7	4.8
8	07-Mar-16	19:32	20:32	136.1	89.0	4.6
9	07-Mar-16	20:33	21:33	140.7	89.6	4.7
10	07-Mar-16	21:34	22:34	139.5	91.1	4.7
11	07-Mar-16	22:35	23:35	138.4	90.4	4.7

Note:
Emission concentrations expresed at reference conditions 273K, 101.3kPa 6 % Oxygen, dry gas

4B2 4.3.3 Plot 1.3 –Time Series of Standardised CEM versus Standardised SRM data – Sulphur Dioxide - High Range. Reference conditions: 273K, 101.3kPa, dry gas, 6% oxygen.



4B2 4.4.3 – Elimination of Outliers – Sulphur Dioxide - High Range.



Test No	Test Start Time	Test End Time	CEMS Raw Value	SRM Value at CEMS Raw conditions	Difference Di	Difference Di - $\bar{D}i$	Is Result an Outlier - Di-$\bar{D}i$> 2SD
	hr:min		(ppm)	(ppm)			
1	10:23	11:23	56.1	33.7	-22.43	-5.14	No
2	11:24	12:24	51.5	32.8	-18.68	-1.39	No
3	14:27	15:27	47.2	31.2	-16.03	1.26	No
4	15:28	16:28	50.8	41.6	-9.17	8.12	Yes
5	16:29	17:29	105.1	81.1	-23.98	-6.69	No
6	17:30	18:30	46.7	31.3	-15.42	1.87	No
7	18:31	19:31	46.8	31.3	-15.53	1.76	No
8	19:32	20:32	47.4	30.8	-16.62	0.68	No
9	20:33	21:33	49.3	31.0	-18.30	-1.01	No
10	21:34	22:34	48.3	31.3	-17.08	0.21	No
11	22:35	23:35	47.9	30.9	-16.95	0.34	No
				Average $\bar{D}i$	-17.29		
			Standard Deviation		3.86		
			Standard Deviation x2		7.71		

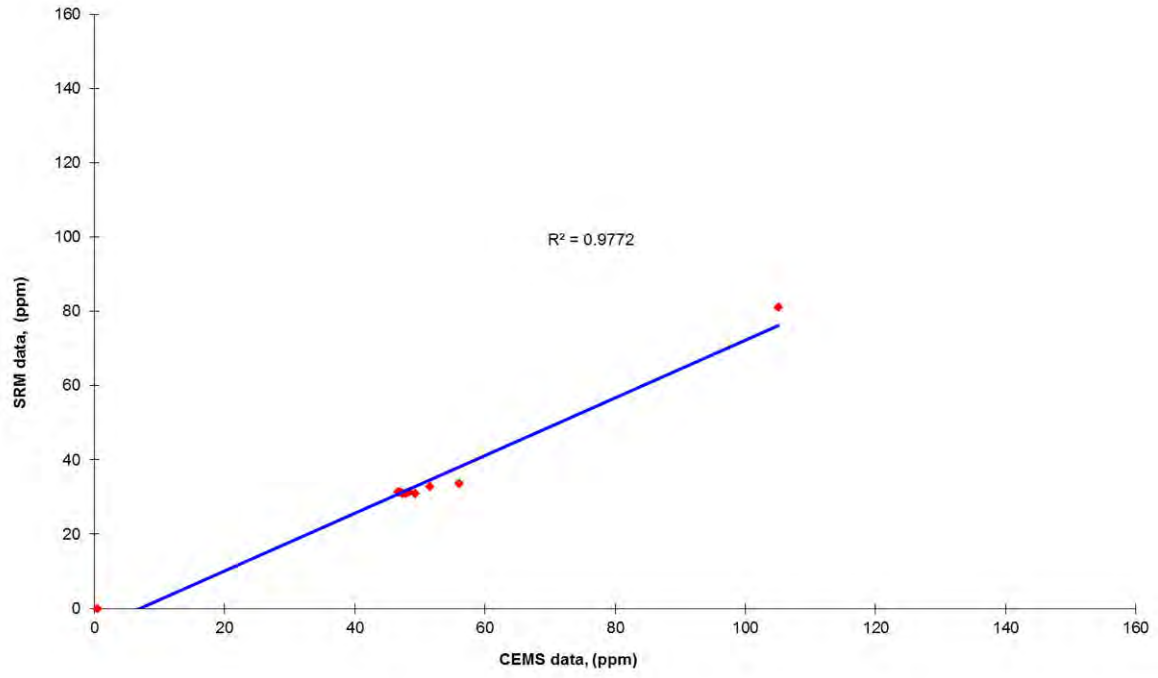
4B2 4.5.3 Table 4.3.3 - Data used to Calculate Calibrated Values – Sulphur Dioxide - High Range.

Test No	Date	Test Start Time	Test End Time	CEMS Raw Value (x)	CEMS Calibrated signal	CEMS dry Oxygen	CEMS Moisture	CEMS Standardised Value (dry)	CEMS Calibrated Standardised Value	SRM Standardised
		hr:min		(ppm)	(ppm)	%	%	(mg/Nm^3)	(mg/Nm^3)	(mg/m3)
1	24-Feb-16	Reference		0.5	-5.5	N/A	N/A	0.5	-15.7	0.0
2	07-Mar-16	10:23	11:23	56.1	36.6	5.34	1.61	155.9	101.7	97.3
3	07-Mar-16	11:24	12:24	51.5	33.1	6.13	1.65	151.0	97.0	96.8
4	07-Mar-16	14:27	15:27	47.2	29.8	6.14	1.66	138.4	87.5	91.8
6	07-Mar-16	16:29	17:29	105.1	73.7	6.15	1.79	308.8	216.4	238.8
7	07-Mar-16	17:30	18:30	46.7	29.5	6.22	1.74	137.8	87.0	92.1
8	07-Mar-16	18:31	19:31	46.8	29.6	6.14	1.72	137.4	86.8	91.7
9	07-Mar-16	19:32	20:32	47.4	30.0	5.80	1.70	136.1	86.1	89.0
10	07-Mar-16	20:33	21:33	49.3	31.4	5.73	1.68	140.7	89.7	89.6
11	07-Mar-16	21:34	22:34	48.3	30.7	5.89	1.67	139.5	88.6	91.1
12	07-Mar-16	22:35	23:35	47.9	30.3	5.93	1.67	138.4	87.8	90.4
Sum								1584.49		

Emission Limit Value (ELV) =	440	mg/Nm^3

	Reference Oxygen	6	%
Established Calibration Function y_i=	-5.884 + 0.757xi		

Plot of CEM versus SRM Data at CEM measurement conditions– Sulphur Dioxide - High Range. wet gas



4B2 4.6.3 Table 4.4.3 – Data used for the Variability Test – Sulphur Dioxide - High Range.

Test No	Date	Test Start Time	Test End Time	CEMS Calibrated Standardised value	SRM Standardised value	Difference D1	Difference D1 - D	Squared Difference D1 - D
		hr:min		mg/m3	mg/m3			
2	07-Mar-16	10:23	11:23	101.7	97.3	-4.35	-8.34	69.64
3	07-Mar-16	11:24	12:24	97.0	96.8	-0.20	-4.19	17.56
4	07-Mar-16	14:27	15:27	87.5	91.8	4.28	0.29	0.08
6	07-Mar-16	16:29	17:29	216.4	238.8	22.33	18.34	336.28
7	07-Mar-16	17:30	18:30	87.0	92.1	5.08	1.09	1.19
8	07-Mar-16	18:31	19:31	86.8	91.7	4.92	0.93	0.86
9	07-Mar-16	19:32	20:32	86.1	89.0	2.85	-1.14	1.31
10	07-Mar-16	20:33	21:33	89.7	89.6	-0.09	-4.08	16.67
11	07-Mar-16	21:34	22:34	88.6	91.1	2.47	-1.52	2.30
12	07-Mar-16	22:35	23:35	87.8	90.4	2.62	-1.37	1.87
Mean						3.99		
Sum								447.76

4B2 4.7.3 - Variability Test and Test of Calibration Function Calculations – Sulphur Dioxide - High Range.

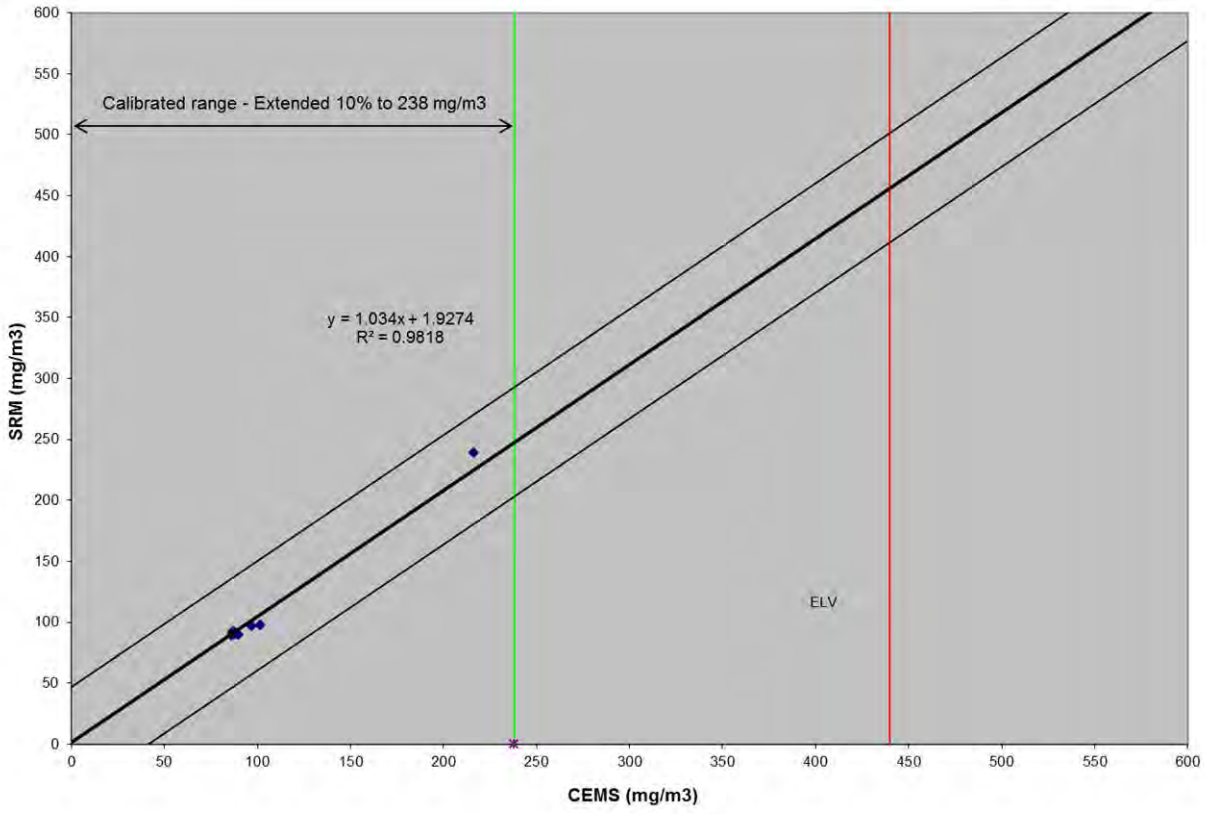
Variability Test

SD=	Root(1-Number).Integral(D1-D)^2	7.05	mg/m3(s,d),6%O2
The uncertainty laid down by the authorities is 20% ELV as a 95% confidence interval. O_0 is therefore calculated as:-			
O_0=	0.2*440 mg/m3 (s,d,6%O2)/1.96	44.90	mg/m3(s,d),6%O2
For 10 tests, kv =	0.9629		
Therefore variability=	7.05 <= 44.9 * 0.9629*1.5		
or	7.05 <=	64.85	
Which is TRUE therefore the CEMS passes the test			

Test of Calibration Function

The calibration of the AMS is accepted if:	D1<= $t_{0.95}(N\text{-}1)$*(s,d/root N)+O_0		
	D1=	3.99	
For 10 tests, t0.95(N-1) =	1.833		
Therefore test of calibration =	3.99 <=1.833*(7.05/root 11)+44.9		
or	3.99 <=	48.80	
Which is TRUE therefore the calibration function is VALID			

4B2 4.8.3 Plot 2.3 – Standardised CEM data versus standardised SRM - Sulphur Dioxide - High Range – Reference conditions 273K, 101.3kPa, dry gas, 6% oxygen.



Section 4B3: Data & Calculations – AST – Unit 7, SICK OMD 41

4B3 4.1 Table 4.1 – Raw monitoring Data – Total Particulate Matter

Test No	Date	Test Start Time	Test End Time	CEMS Raw Value (Extinction)	CEMS Oxygen (Wet)	CEMS Moisture (Wet)	CEM Stack Temp	CEM Stack Press	SRM Raw value (dry)	SRM Moisture (Wet FT)	SRM Oxygen (Dry)	SRM Stack Temp	SRM Stack Press	SRM at CEMs Raw conditions
		hr:min		%	(%)	(%)	C	kpa	(mg/m3)	(%)	(%)	C	kpa	(mg/m3)
1	07-Mar-16	9:25	10:25	6.6	5.4	1.87	55.2	100.9	8.6	1.9	6.0	51.4	100.2	7.0
2	07-Mar-16	10:53	11:53	5.9	5.6	1.69	55.0	100.9	7.4	1.9	6.0	52.0	100.2	6.0
3	07-Mar-16	12:00	13:00	4.3	6.6	1.98	50.3	100.0	3.3	1.9	6.5	52.0	100.2	2.6
4	08-Mar-16	10:38	11:38	4.0	6.1	1.70	54.8	101.1	2.5	1.8	6.5	53.0	100.2	2.0
5	08-Mar-16	11:46	12:46	4.4	6.1	1.88	54.9	101.1	3.3	1.8	6.4	52.8	100.2	2.7
6	08-Mar-16	12:54	13:54	4.0	6.1	1.92	55.2	100.9	3.1	1.9	6.4	52.0	100.2	2.6
7	08-Mar-16	14:01	15:01	4.4	6.3	1.89	54.9	100.9	3.3	1.9	6.5	52.9	100.2	2.6

Note:

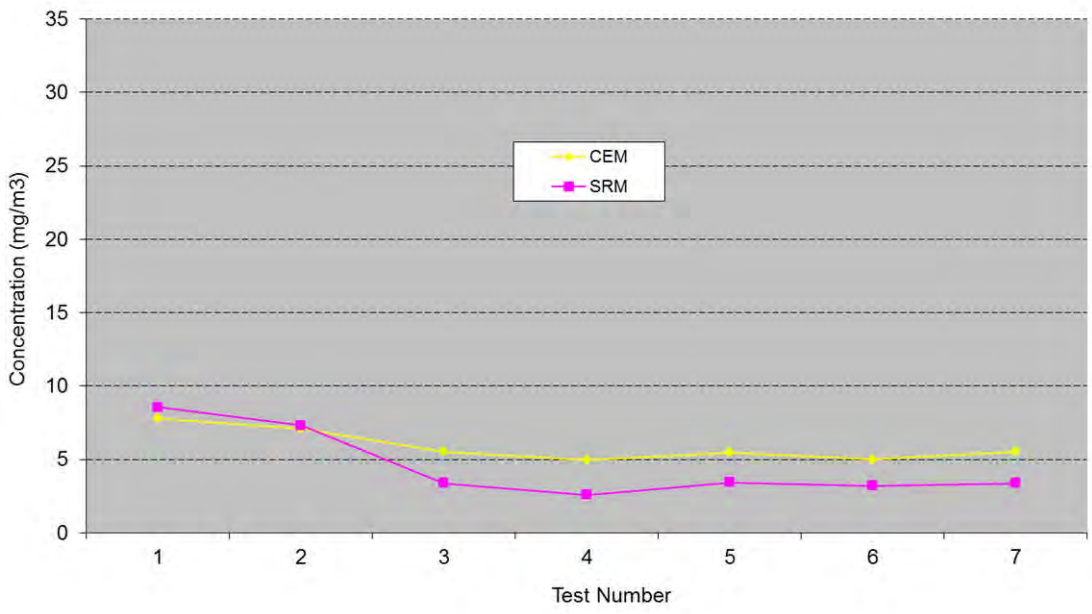
Emission concentrations expresed at reference conditions 273K, 101.3kPa

4B3 4.2 Table 4.2 – Standardised monitoring Data – Total Particulate Matter

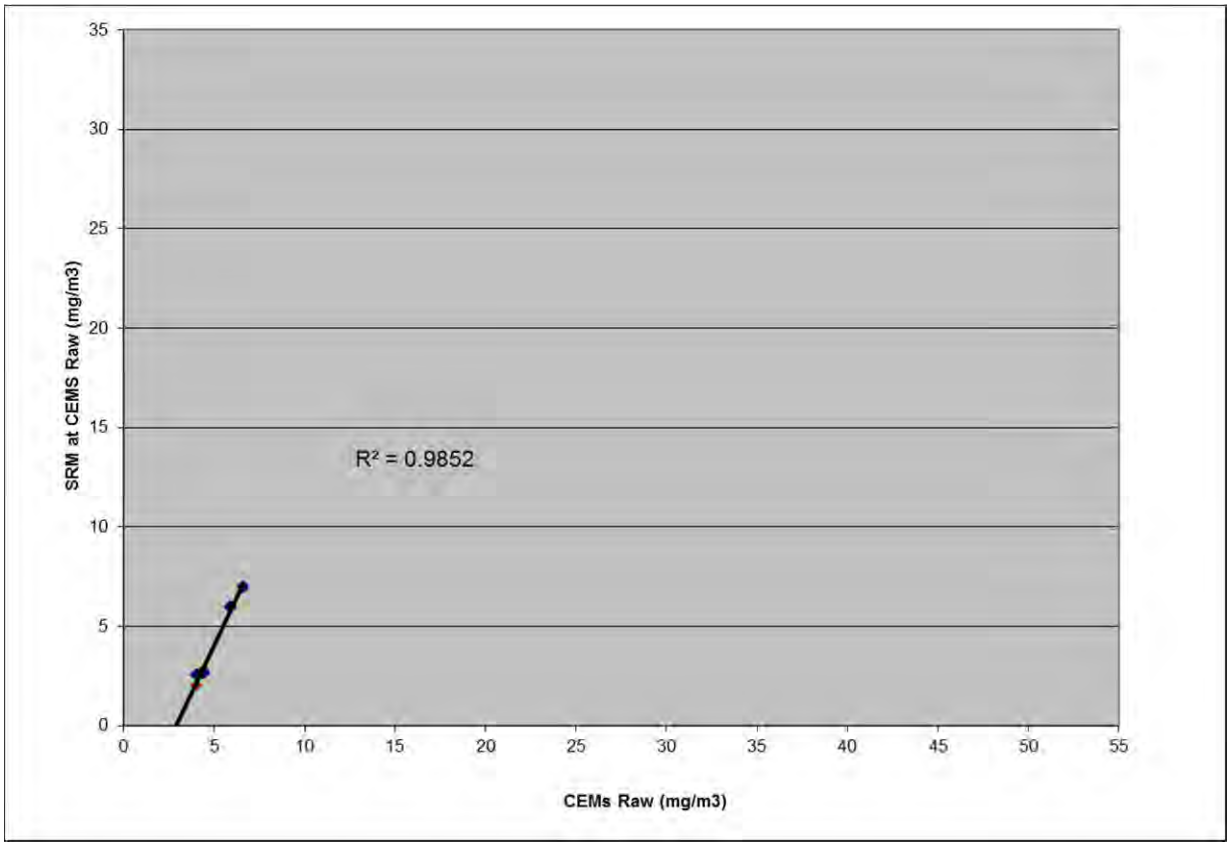
Test No	Date	Test Start Time	Test End Time	CEMS Standardised Value	SRM Standardised Value	SRM Uncertainty
		hr:min		(mg/m3)	mg/m3)	(mg/m3)
1	07-Mar-16	9:25	10:25	7.8	8.6	0.33
2	07-Mar-16	10:53	11:53	7.1	7.3	0.30
3	07-Mar-16	12:00	13:00	5.5	3.4	0.21
4	08-Mar-16	10:38	11:38	5.0	2.6	0.18
5	08-Mar-16	11:46	12:46	5.5	3.4	0.22
6	08-Mar-16	12:54	13:54	5.0	3.2	0.20
7	08-Mar-16	14:01	15:01	5.5	3.4	0.21

Note:
Emission concentrations expresed at reference conditions 273K, 101.3kPa 6 % Oxygen, dry gas

4B3 4.3 Plot 1.1 –Time Series of Standardised CEM versus Standardised SRM data – Total Particulate Matter. Reference conditions: 273K, 101.3kPa, dry gas, 6% oxygen.



4B3 4.4 – Elimination of Outliers – Total Particulate Matter.



Guidance on performing tests for outliers in MID 14181 section 6.3, states the following:

'As a general guide, when plotting the raw SRM and raw CEM data, if the R^2 value for the linear regression line is equal or more than 0.9, then it is not ordinarily necessary to perform an outlier test.
Additionally, any data points are not likely to be outliers unless they are more than three standard deviations from the regression line'

As the R^2 value for this determinand was 0.9852, an outlier test has not been undertaken

4B3 4.5 Table 4.3 - Data used to Calculate Calibrated Values – Total Particulate Matter.

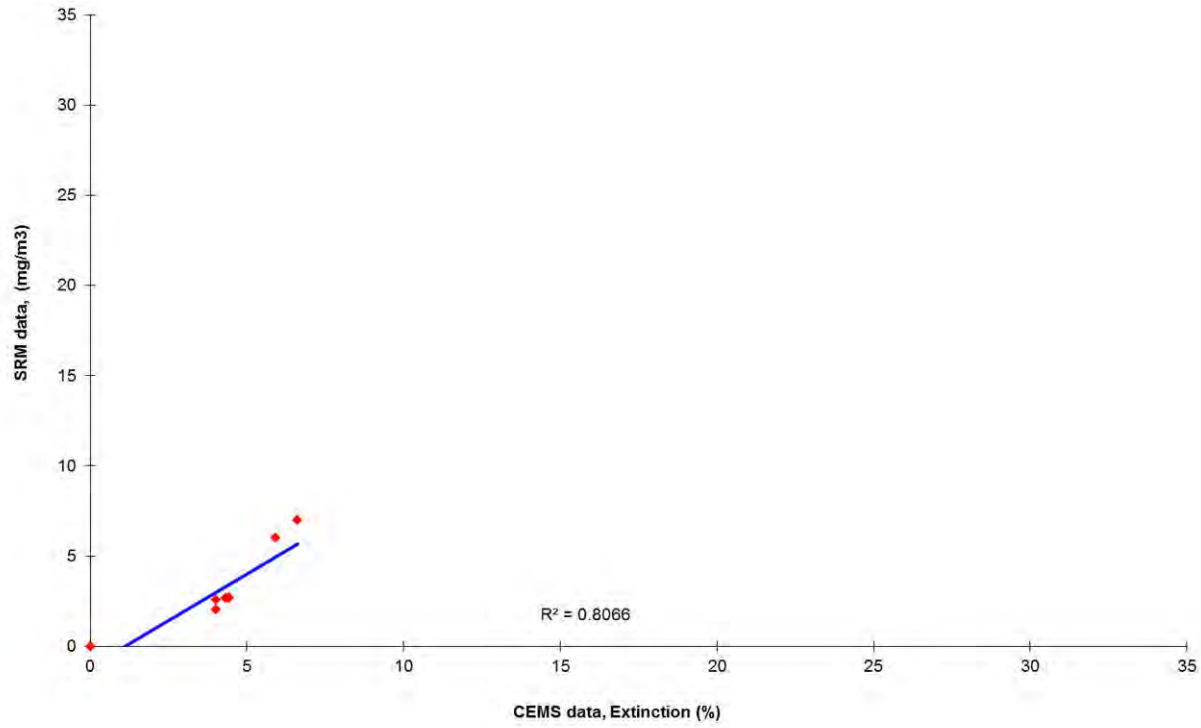
Test No	Date	Test Start Time	Test End Time	CEMS Raw Value (Extinction)	CEMS Calibrated signal	CEMS Moisture	CEMS Temp	CEMS Pressure	CEMS Dry Oxygen	CEMS Standardised Value (dry)	CEMS Calibrated Standardised Value	SRM Standardised
		hr:min		%	(mg/m3)	(%)	(^{o}C)	(kPa)	(%)	(mg/Nm^{3})	(mg/Nm^{3})	(mg/m3)
1	17-Feb-16	Reference		0.0	0.6	N/A	N/A	N/A	0.0	0.0	0.4	0.0
2	07-Mar-16	09:25	10:25	6.6	10.1	1.9	55.2	100.9	5.4	7.8	11.9	8.6
3	07-Mar-16	10:53	11:53	5.9	9.1	1.7	55.0	100.9	5.6	7.1	10.9	7.3
4	07-Mar-16	12:00	13:00	4.3	6.8	2.0	50.3	100.0	6.6	5.5	8.7	3.4
5	08-Mar-16	10:38	11:38	4.0	6.3	1.7	54.8	101.1	6.1	5.0	7.8	2.6
6	08-Mar-16	11:46	12:46	4.4	6.9	1.9	54.9	101.1	6.1	5.5	8.6	3.4
7	08-Mar-16	12:54	13:54	4.0	6.4	1.9	55.2	100.9	6.1	5.0	7.9	3.2
8	08-Mar-16	14:01	15:01	4.4	6.9	1.9	54.9	100.9	6.3	5.0	8.7	3.2
					Sum					**40.81**		

Emission Limit Value (ELV) =	**35**	mg/Nm^{3}

Reference Oxygen **6 %**

Established Calibration Function y_i=	0.6 + 1.433xi

Plot of CEM versus SRM Data at CEM measurement conditions– Total Particulate Matter, at stack temperature, pressure and moisture conditions.



4B3 4.6 Table 4.4 – Data used for the Variability Test – Total Particulate Matter.

Test No	Test Start Time	Test End Time	CEMS Calibrated Standardised value	SRM Standardised value	Difference D1	Difference D1 - D	Squared Difference D1 - D
	hr:min		mg/m3	mg/m3			
1	Reference		0.4	0.0	-0.43	3.72	13.81
2	09:25	10:25	11.9	8.6	-3.32	0.82	0.67
3	10:53	11:53	10.9	7.3	-3.54	0.61	0.37
4	12:00	13:00	8.7	3.4	-5.30	-1.16	1.35
5	10:38	11:38	7.8	2.6	-5.25	-1.10	1.22
6	11:46	12:46	8.6	3.4	-5.14	-1.00	0.99
7	12:54	13:54	7.9	3.2	-4.69	-0.55	0.30
8	14:01	15:01	8.7	3.2	-5.48	-1.33	1.78
8 Tests		Mean			-4.14		
Sum							20.49

4B3 4.7 - Variability Test and Test of Calibration Function Calculations – Total Particulate Matter.

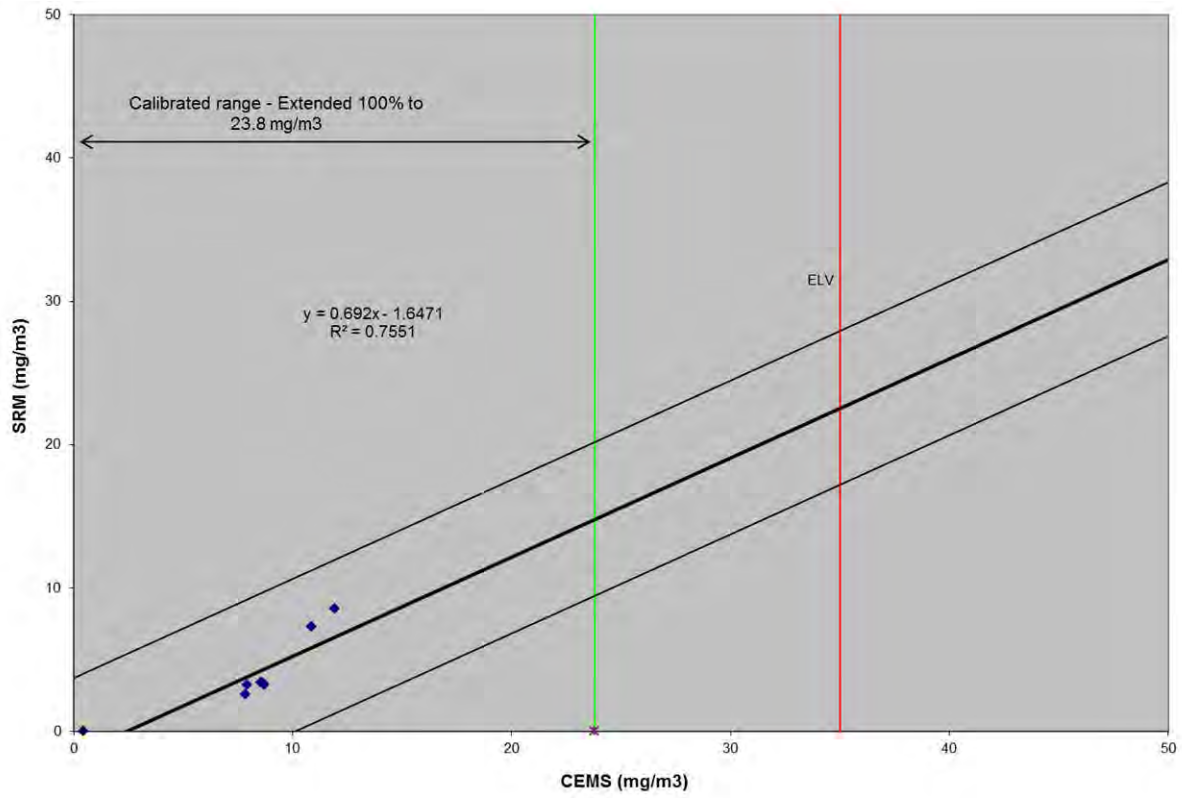
Variability Test

SD=	Root(1-Number).Integral(D1-D)^2		1.71	mg/m3(s,d),6%O_2
The uncertainty laid down by the authorities is 30% ELV as a 95% confidence interval. O_0 is therefore calculated as:-				
O_0=	0.3*35 mg/m3 (s,d,6%O2)/1.96		5.36	mg/m3(s,d),6%O_2
For 8 tests, k_v =	0.9521			
Therefore variability=		1.71 <= 5.36 * 0.9521 * 1.5		
	or	1.71 <=	7.65	
Which is TRUE therefore the CEMS passes the test				

Test of Calibration Function

The calibration of the AMS is accepted if:			D1<= $t_{0.95}$(*N*-1)*(s,d/root *N*)+O_0	
		D1=	4.14	
For 8 tests, t0.95(N-1) =	1.895			
Therefore test of calibration =		4.14 <=1.895*(1.71/root 8)+5.36		
	or	4.14 <=	6.50	
Which is TRUE therefore the calibration function is VALID				

4B3 4.8 Plot 2 – Standardised CEM data versus standardised SRM - Total Particulate Matter – Reference conditions 273K, 101.3kPa, dry gas, 6% oxygen.



Section 5 – Results of Functional tests

Table 5.1 - Audit of functional tests

Operator	RWE Generation UK plc.	
Site	Aberthaw Power Plant	
Stack	Unit 7	
Process Sector	LCPD	
Analyser A - Make Model **MCERTs Certificate Number**	Procal 1 - Pulsi 2000, In Situ IR MC990006/07	
Analyser B - Make Model **MCERTs Certificate Number**	Procal 2 - Pulsi 2000, In Situ IR MC990006/07	
Analyser C - Make Model **MCERTs Certificate Number**	Erwin SICK OMD41, Cross Duct Forward Scatter MC040042/01	
Analyser D - Make Model **MCERTs Certificate Number**	SICK Maihak GmbH GM32 – In-situ MC100163/01	
Parameters Tested	**Daily ELV**	**Certified range**
NO & NO_2	1080 mg/m^3 (NO_x as NO_2)	PROCAL: NO = 0 – 1000 ppm GM 32: Measuring path length 1.25m: NO 0 to 70 mg/m3 & 0 to 700 mg/m3 GM 32: Measuring path length 1.00m NO 0 to 87.5 mg/m3 & 0 to 875 mg/m3
Total Particulate Matter	35 mg/m^3	Erwin SICK: TPM = 0 – 200 mg/m3
SO_2	440 mg/m^3	PROCAL = SO2 low = 0 – 250 ppm SO2 high = 0 – 1000 ppm GM 32: Measuring path length 1.25m: SO2 0 to 75mg/m3 & 0 to 1000mg/m3 GM 32: Measuring path length 1.00m SO2 0 to 93.8 mg/m3 and 0 to 1250 mg/m3

Analysers A & B	
Organisation carrying out tests -	Parker/Procal
Status of organisation – CEMS manufacturer/operator/service contractor	CEMS OEM
Test engineer	M Findley
Date of tests	16th – 24h February 2016
Analyser C & D	
Organisation carrying out tests -	SICK
Status of organisation – CEMS manufacturer/operator/service contractor	CEMS OEM
Test engineer	P. Burgess & Rhodri Jones
Date of tests	16th to 25th February 2016

Functional Test compliance with EN 14181

Requirement	Compliance Y/N	Notes
1 – Alignment and cleanliness All checks specified in MID 14181 carried out ? – Sampling System A visual inspection of the sampling system shall be performed, noting the condition of the following components, when fitted: - sampling probe; - gas conditioning systems; - pumps; - all connections; - sample lines; - power lines; - filters. The sampling system shall be in good condition and free of any visible faults, which may decrease the quality of the testing.	Yes Yes	**Procal** – Yes **SICK (OMD)** – Yes – Optics cleaned **SICK (GM32)** – Yes
2 - Leak Test Leak testing shall be performed according to the AMS manuals. The test shall cover the entire sampling system.	N/A	**Procal** – N/A although differential pressure noted as OK **SICK (OMD & GM32)** – N/A
Results of leak check compliant with requirements of relevant standards	N/A	
3 - Zero and Span Check Analyser Reference zero and span materials shall be used to verify the corresponding readings of the AMS.	Yes	**Procal** – Yes **SICK (OMD 41)** – Yes – although based on the use of filters **SICK (GM32)** – Yes, although based on the use of filters
Results compliant with requirements of relevant standards Parameter:		
NO SO_2 TPM	Yes (Procal) Yes (Procal) Yes	**SICK (GM32)** – Span value of filters not stated, though analyser response recorded **SICK (OMD41)** - Span values recorded as mA signals

Requirement	Compliance Y/N	Notes
4 - Zero and Span Check Full System Reference zero and span materials shall be used to verify the corresponding readings of the AMS.	N/A	Procal, & SICK GM 32 analysers are in situ type and therefore there is as such, no 'full system'.
5 – NOx converter efficiency check	N/A	
6 - Linearity The linearity of the analysers shall be checked using five different reference materials, including zero concentration.	Yes – Procal, SICK OMD 41 No – SICK GM32	**Procal** – Yes **SICK (OMD)** – Yes – although based on the use of filters
The reference material with zero concentration, as well as the reference materials with four different concentrations, shall have a verifiable quantity and quality.	Yes	**Procal** – Yes **SICK** – Yes – although based on the use of filters **SICK (GM32)** - N/A
The reference material concentrations shall be selected such that the measured values are approximately 20%, 40%, 60% and 80% of two times the emission limit.	See note	**Procal** – Yes **SICK** – Used 8 points using filters **SICK (GM32)** - N/A
The dry test reference material shall be applied to the inlet of the AMS. Reference materials can be introduced directly into the analyser as long as the integrity of the sample system has been proved	N/A	N/A

Requirement	Compliance Y/N	Notes
6 – Linearity (continued) After each change in concentration, the first instrument readings shall be taken after a time period equal to at least three times the response time of the AMS. At each reference material concentration, at least three readings shall be made. The time period between the start of each of the three readings shall be separated by at least four times the response time. A risk based approach may be adopted in order to reduce the time for the linearity tests	No N/A	**Procal** – No times stated in report **SICK (OMD & GM32)** – No times stated in report
Linearity Test Pass Parameter		**Procal** – Yes **SICK (OMD)** – Yes
NO, SO_2 & TPM	Yes	
6 – Interferences (only required in the event of a failure of the QAL 2/AST)	N/A	
7 – Zero and Span Drift (Audit)	Yes	
8- Response time The response of the AMS shall be checked. This can be performed, if appropriate, by feeding the reference material at the end of the sampling probe. The response time shall not exceed the measured value as identified during QAL 1.	See Note	**Procal** – Yes **SICK (OMD 41)** – Yes **SICK (GM 32)** – No

Requirement	Compliance Y/N	Notes
9a – Service Report - **PROCAL**		
• Document reference	Yes	
• Instrument manufacturer	Yes	Procal
• Instrument Type	Yes	In-situ
• Instrument model	Yes	PULSI 200
• Instrument Serial No's	Yes	
• Operating principal	Yes	
• Operating range	Yes	
• Certification details	Yes	
• Compliance with MCERTS	Yes	
• Location	Yes	
• Date and time of work	Yes	Date only
• Equipment used - Type serial no's etc	Yes	Gas divider and regulator nos
• Gases used – certificate numbers, expiry dates, type	No	Copy of gas certificates offered to customer
• NOx converter efficiency check	N/A	
• Calibration and linearity data	Yes	
• Logged data for period of calibration/linearity	No	
• Name & signature of test engineer	Yes	

Requirement	Compliance Y/N	Notes
9b – Service Report – **SICK OMD**		
• Document reference	Yes	
• Instrument manufacturer	Yes	
• Instrument Type	Yes	
• Instrument model	Yes	
• Instrument Serial No's	Yes	
• Operating principal	Yes	
• Operating range	Yes	
• Certification details	Yes	
• Compliance with MCERTS	Yes	
• Location	Yes	
• Date and time of work	Yes	Date Only
• Equipment used - Type serial no's etc	Yes	On Linearity Sheet
• Gases used – certificate numbers, expiry dates, type	N/A	Linearity carried out using filters. Filter numbers stated (F1 to F8)
• NOx converter efficiency check	N/A	
• Calibration and linearity data	Yes	
• Logged data for period of calibration/linearity	Yes	Data supplied separately by client
• Name & signature of test engineer	Yes	

Requirement	Compliance Y/N	Notes
9c – Service Report – **SICK GM32**		
• Document reference	Yes	
• Instrument manufacturer	Yes	
• Instrument Type	Yes	
• Instrument model	Yes	
• Instrument Serial No's	Yes	
• Operating principal	Yes	
• Operating range	Yes	
• Certification details	Yes	
• Compliance with MCERTS	Yes	
• Location	Yes	
• Date and time of work	Yes	
• Equipment used - Type serial no's etc	No	
• Gases used – certificate numbers, expiry dates, type	Yes	
• NOx converter efficiency check	N/A	
• Calibration and linearity data	Yes	
• Logged data for period of calibration/linearity	Yes	Analyser readout checked against DCS values
• Name & signature of test engineer	Yes	

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GM32 – Probe

BS EN 14181 – Functional Test & Maintenance Report

Customer	RWE NPower
Site	Aberthaw
Contact	Dan Peters
Service Ref No.	SVON
Survey Dates	16-2-16
Device Type	GM32 Probe version
Serial Number	1406 8012
Device Location	Unit 7
MCERTS Cert No	MC100163/01
Certification Details	See Certificate
Measurement Principle	UV Spectroscopy
SICK Engineer	P. Burgess
Signature	P. Burgess

Actual installation data			Remarks
Location	Outside ☐	Under cover ☐	Inside ☐
Ambient temperature	8 °C		
Gas temperature	63 °C		
Length of the probe / Flange – Flange (CD)	1500 mm		
Active measurement distance	500 mm		
Zero path	500 mm		

Plant operating status:	ON LINE

Measurement values before check					
	Unit	Range	Reading	Zero point	Span point
SO_2	PPM	1200	18	0	858.9
NO	PPM	1000	536	0	715.7
NO_2	PPM	100	3.8	-0.1	71.6
SO2 L	PPM	250	17.8	0	178.9
Temp.	DEGREES C		57	- X -	- X -
Press.	MBAR		1031	- X -	- X -

Lamp data				
Max. lamp intensity	14800	Exposure:	500	ms
		Lamp pulse:	127	mA

1. Alignment & Cleanliness		
1.1 Visual Inspection of the analyser	☒	OK
1.2 Internal check of the analyser	☒	OK
1.3 Cleanliness of optical components	☒	OK
1.4 Flushing of air supply	☒	OK
1.5 Obstructions in the optical path	☒	NONE
1.6 Check optical alignment of the Analyser	☒	OK

2.	**Sampling System**		
2.1	System in good condition and free from faults	☒	YES
2.2	Visual Inspection of sampling probe	☒	OK
2.3	Check of the Gas Conditioning System	☒	NA
2.4	Check of the sample pump	☒	NA
2.5	Check of all hoses, gas lines and connections	☒	ALL OK
2.6	Check of power supplies	☒	OK
2.7	Check of all filters	☒	CUSTOMERS OWN SCHEDULE
2.8	Check of heated lines are operating correctly	☒	NA
2.9	Efficiency of NOx converter > 95% (if applicable)	☒	NA
2.10	Has the response time been checked by applying gas to probe	☒	NA

3.	**Serviceability**		
3.1	Safe & Clean working environment for servicing	☒	GOOD
3.2	Adequate supply of reference gases	☒	YES
3.3	Adequate supply of spare parts	☒	YES
3.4	Ability to apply gas at probe	☒	NO
3.5	Output signals checked	☒	YES

4.	**Zero Span & Leak Checks**		
4.1	Leak check of whole system carried out	☒	NA
4.2	Have span checks been carried out at suitable levels	☒	70% RANGE
4.3	Have zero checks been carried out at suitable levels	☒	YES @ ZERO

5.	**Linearity**		
5.1	Checks at 0, 20%, 40%, 60% & 80% of 2 X Daily ELV's	☒	REF TO LIN REPORT
5.2	Different concentrations applied in a random sequence	☒	AS ABOVE
5.3	Has the response time for each component been recorded (T90)	☒	AS ABOVE
5.4	Have the first readings been taken at 3 x T90	☒	AS ABOVE
5.5	Have three readings been taken at least 4 x T90 apart	☒	AS ABOVE
5.6	Are the gases used traceable to ISO 17025 standards	☒	AS ABOVE

6. Visual inspection	
6.1 Check measured values are plausible in control room	☐ YES
6.2 Check if control cycle is (zero/span) valid	☐ YES
6.3 Check if messages are active	☐ NONE
Failure:	
Maintenance Req:	
Uncertain:	
6.4 Check for mechanical damages	☐ NONE
6.5 Check attachments and connections	☐ ALL OK

7. Purge air unit (only GMP and Cross-Duct)	
7.3 Check the hoses and clamps for hose	☐ OK
7.4 Exchange purge air filter (order no 5306091)	☐ CUSTOMERS OWN SCHEDULE
7.5 Clean pre-filter housing	☐ OK
7.6 Check noise of blower	☐ QUIET
7.7 Check function of purge air heating and setting (option)	☐ 70 DEGREES
7.8 Check function of differential pressure monitor (option)	☐ OK

8. Probe (GMP or GPP)	
8.3 Clean probe	☐ OK
8.4 Check Probe for corrosion	☐ NONE
8.5 Check probe for damage and functionality	☐ ALL OK

9. Connection unit	
9.3 Clean housing	☐ OK
9.4 Check power supply	☐ OK
26V±0,3V: 25.7 115V±1V: 114.4	
9.5 Check analogue input / output (option)	☐
9.6 Check digital input / output (option)	☐
9.7 Check parameterization of the I/O-Module	☐

10. Sender / receiver unit (reflector)			
10.3	Check drying agent cartridges, exchange if req.	☐	NOT REQD
10.4	Clean all optical surfaces of the and the reflector	☐	OK
10.5	Check stepper motor for proper function	☐	OK
10.6	Check fans	☐	GOOD
10.7	Check spectrometer signals	☐	ALL OK
10.8	Check lamp	☐	CHANGED
10.9	Check emission free zero point	☐	OK
10.10	Check the alignment adjust	☐	DONE
10.11	Check signal strength	☐	DONE
A: 255	B: 288		OK
C: 269	D: 300		OK
10.12	Check mirror steps	☐	DONE
Dx: -0.25	Dy: -0.05		OK
10.13	Check parameterization	☐	OK

11. Final check			
11.3	Check function of complete measurement system	☐	OK
11.4	Check the availability of the system	☐	NA
11.5	Save device data external	☐	DONE
11.6	Complete service report	☐	DONE

12. Additional comments	
Quality of maintenance work by plant personnel: OK	
Cleanliness of measuring station and devices: OK	
Maintenance work done (in addition to Annex 1): LAMP CHANGED	
Problems found, solution applied: NONE	
Recommendation for repair, changes NONE	
Availability of the unit:	NA
Proposal how to reach higher availability and better emission data quality:	NO
Training provided to plant personnel, proposal for settlement:NO	
Training requirements detected: NONE	

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13. Measurement values after check					
	Unit	Range	Reading	Zero point	Span point
SO_2	PPM	1200	25	0.0	843.3
NO	PPM	1000	495	0.0	702.8
NO_2	PPM	100	6.0	0.0	70.3
SO2 LOW	PPM	250	24.7	0.0	175.7
Temp.	DEGREES C		56	- X -	- X -
Press.	MBAR		1027	- X -	- X -

Remarks
Lamp changed.
Approved by customer Name: Position:

GM32 Probe Version – Functional Test & Maintenance Report 6 / 6

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SICK

Maintenance Report OMD41 Stack UNIT 7

☒ Maintenance ☐ Repair

Customer:	RWE Aberthaw	Customer no:	SVON 018532
Country:	UK	Location:	Aberthaw PS
Receiver:	1012184	Serial no.:	98078000
Reflector:	1012385	Serial no.:	98078000
Eval.Unit:	n/a	Serial no.:	n/a

Plant operating status:	Off Line Stack UNIT 7

	done	Remarks:
Check weekly/monthly/ quarterly log files: Log files ok?	☐	Not available
Training recommended:	☐	Not required

Dust reading before check

Opacity or Extinction		NA Removed by RWE Staff.
Dust in Ex	Ex	
Contamination	mA	
Dust reading, measured values	mA	
Control cycle, Zero point values	mA	
Control cycle, Span value	mA	

1. Visual Inspection

1.1	Check if measured values are plausible in the control room	☒	OK
1.2	Check if control cycle is (zero/span) valid (control room or recorder or evaluation unit)	☒	O.K.
1.3	Check if there is any error message	☒	None
1.4	Check for mechanical or electrical connection damage	☒	OK
1.5	Check mechanical mounting	☒	O.K.

2. Purge Air Unit

2.1	Check the hoses and ring nozzles	☒	NA RWE STAFF
2.2	Clean the pre-filter	☐	
2.3	Replace the filter insert, part no. 5306091 for OMD41 SN > 97xxxxxx, or part no.6700149 for OMD41 SN <96xxxxxx	☐	
2.4	Check function of filter monitor purge switch.	☐	

3. Fail Safe Shutter (FSS Optional)

3.1	☐ Check function of fail-safe shutter	☐	NA

4. Optical unit

4.1	Clean housing	☒	O.K.
4.2	Check and, if necessary readjust optical axis	☒	O.K.
4.3	Clean optical boundary surfaces for sender/receiver and reflector, 2 x part no. 4003353	☒	O.K.

4.4	Check and replace desiccant cartridge, part no. 2008475	☒	Not required Still blue.
4.5.	Check the transmitter diode	☒	O.K.
4.6	Check the stepper motor	☒	O.K.
4.7	Check zero point, re-calibrate at smoke-free measurement point if it deviates	☒	O.K.
4.8	Check function of control cycle	☒	O.K.
4.9	Linearity check	☒	Not required this visit.

Linearity Measurement	Set value	Actual Value		Deviation in %		< 2% OK?
Zero	0.0 mA	0.0	mA	0.00	0.0%	OK
Span 1 (aprox. 30%)	14.10 mA	14.10	mA	0.00	0%	OK
Span 2 (aprox. 70%)	16.80 mA	16.80	mA	0.00	0%	OK
Span 3 (100%)	20.00 mA	20.00	mA	0.03	0.0%	OK

5. Connection unit

	Check the analogue and digital input and output signals	☐	n/a

6. Final check

6.1	Check function of complete measurement system	☒	OK
6.2	Check the availability of the system	☒	Not available
6.3	Write device data into the report file	☒	OK
6.4	Complete Service Report and Measurement Log-file	☒	OK

7. Report in writing to the plant manager as follows:

Quality of maintenance work by plant personnel: OK
Cleanliness of measuring station and devices: OK
Maintenance work done(in addition to Annex 1): None
Problems found, solution applied: None
Recommendation for repair, changes: None
Availability of the unit: Off line
Proposal how to reach higher availability and better emission data quality: None
Training provided to plant personnel, proposal for settlement: None
Training requirements detected: None
Others:

Dust reading after check

	Opacity or Extinction	EX	0.091
	Dust in mg / m³	mg/m³	0.0
	Contamination	mA	0.0
	Dust reading, measured values	mA	0.0
	Control cycle, Zero point values	mA	0.00
	Control cycle, Span value	mA	16.00

Remarks :

Date : 17-2-16	Name Plant person: Dan Peters Technician: Paul Burgess

SICK

OMD41- Particulate Linearity Report

Customer	ABERTHAW
Site	ABERTHAW
Permit Ref	
Contact	DAN PETERS
Service Ref No.	18532
Survey Date	18/02/2016
Device Type	OMD41
Serial Number	98078000
MCERTS Cert No	MC 040042/01
Certification Details	See Certificate
Measurement Principle	OPACITY
Gas Box Serial Number	91148002
SICK Engineer	P BURGESS
Signature	P BURGESS

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Particulate Linearity

Customer	ABERTHAW
Plant	ABERTHAW
Site Contact	DAN PETERS
Product	OMD41
MCERTS Certificate Number	MC 040042/01
Location	WORKSHOP

Site Permit Ref	0
SVON No	18532
Order Number	
QAL2/AST/Routine	QAL2
Date	23/05/2014
Engineer	P BURGESS

Filter Set S/N	91148002
Calibration Date	15/10/2015
Results Visible on DCS?	Not possible in Linearity mode
Corrections Applied?	NA

Response time (T_{90}) seconds	2
Permit Daily ELV for Dust mg.m^{-3}	200
Plant ELV x 2, mg.m^{-3} (c_v)	400
Analyser Range mg.m^{-3}	500

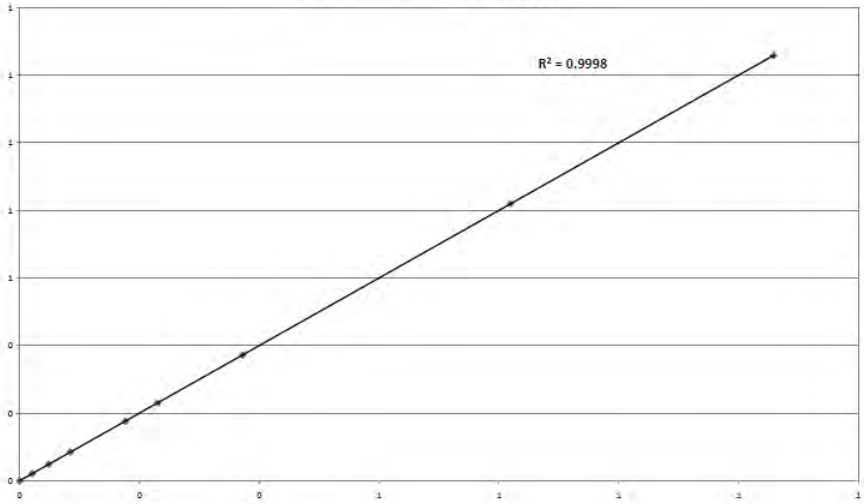
Component 1	Particulate
Set pt time (4xT_{90}) sec	8
Log time (3xT_{90}) sec	6

Linearity Results						
Expected Extinction	Reading 1	Reading 2	Reading 3	Average Reading	DCS	DCS Time
0.0213	0.0215	0.0216	0.0218	**0.0216**	NA	NA
0.0486	0.0490	0.0490	0.0490	**0.0490**	NA	NA
0.0848	0.0849	0.0850	0.0850	**0.0850**	NA	NA
0.1767	0.1764	0.1763	0.1762	**0.1763**	NA	NA
0.2301	0.2310	0.2311	0.2311	**0.2311**	NA	NA
0.3728	0.3722	0.3722	0.3723	**0.3722**	NA	NA
0.8191	0.8198	0.8198	0.8199	**0.8198**	NA	NA
1.2589	1.2580	1.2580	1.2581	**1.2580**	NA	NA

Zero Results				
ZERO	Expected Transmission	Analyser Reading mg.m^{-3}	DCS mg.m^{-3}	DCS Time
Zero Reading 1	0.00	0.00	NA	NA
Zero Reading 2	0.00	0.00	NA	NA
Zero Reading 3	0.00	0.00	NA	NA
Zero Reading 4	0.00	0.00	NA	NA
Zero Reading 5	0.00	0.00	NA	NA
Zero Reading 6	0.00	0.00	NA	NA
AVERAGE		**0.00**		

Actual Extinction	Average CEM Reading (Ex)	$d_{c/ref}$	$d_{c/ref}$ <5% (EN 14181)
0.0000	0.0000	-0.01%	PASS
0.0213	0.0216	0.00%	PASS
0.0486	0.0490	0.01%	PASS
0.0848	0.0850	-0.01%	PASS
0.1767	0.1763	0.00%	PASS
0.2301	0.2311	0.00%	PASS
0.3728	0.3722	0.01%	PASS
0.8191	0.8198	-0.01%	PASS
1.2589	1.2580	0.00%	PASS

Actual Extinction v CEM Reading (Ex)



Engineer	P BURGESS
Signature	
Comments	Analyser exhibiting a linear response

Version 2016 - Uncontrolled when printed

Filter Extinction i %	Reference value x_i %	CEM value y_i mg.m^{-3}	Difference X_i-X_z	Product $Y_i(X_i$-$X_z)$	Squared difference $(X_i$-$X_z)^2$
0%	0.00	0.00	-0.30	0.00	0.09
0%	0.00	0.00	-0.30	0.00	0.09
0%	0.00	0.00	-0.30	0.00	0.09
0.0213	0.02	0.02	-0.28	-0.01	0.08
0.0213	0.02	0.02	-0.28	-0.01	0.08
0.0213	0.02	0.02	-0.28	-0.01	0.08
0.0486	0.05	0.05	-0.25	-0.01	0.06
0.0486	0.05	0.05	-0.25	-0.01	0.06
0.0486	0.05	0.05	-0.25	-0.01	0.06
0.0848	0.18	0.18	-0.12	-0.02	0.02
0.0848	0.18	0.18	-0.12	-0.02	0.02
0.0848	0.18	0.18	-0.12	-0.02	0.02
0.1767	0.08	0.08	-0.22	-0.02	0.05
0.1767	0.08	0.09	-0.22	-0.02	0.05
0.1767	0.08	0.09	-0.22	-0.02	0.05
0.2301	0.23	0.23	-0.07	-0.02	0.01
0.2301	0.23	0.23	-0.07	-0.02	0.01
0.2301	0.23	0.23	-0.07	-0.02	0.01
0.3728	0.37	0.37	0.07	0.03	0.01
0.3728	0.37	0.37	0.07	0.03	0.01
0.3728	0.37	0.37	0.07	0.03	0.01
0.8191	0.82	0.82	0.52	0.42	0.27
0.8191	0.82	0.82	0.52	0.42	0.27
0.8191	0.82	0.82	0.52	0.42	0.27
1.2589	1.26	1.26	0.96	1.20	0.92
1.2589	1.26	1.26	0.96	1.20	0.92
1.2589	1.26	1.26	0.96	1.20	0.92
0%	0.00	0.00	-0.30	0.00	0.09
0%	0.00	0.00	-0.30	0.00	0.09
0%	0.00	0.00	-0.30	0.00	0.09
Average	0.30	0.30			
Sum	9.04	9.04	0.00	4.74	4.74

a =	0.30
B =	1.00
A =	0.00

Residuals				
Averages	c %	Average Y_c	d_c	$d_{c,rel}$
0	0.00	0.00	0.00	-0.01%
0.0213	0.02	0.02	0.00	0.00%
0.0486	0.05	0.05	0.00	0.01%
0.0848	0.18	0.18	0.00	-0.01%
0.1767	0.08	0.08	0.00	0.00%
0.2301	**0.23**	**0.23**	0.00	0.02%

Parker

PROCAL

CALIBRATION CERTIFICATE

Site	Aberthaw
Date	16/02/2016
Instrument	Unit 7 Primary
Instrument Ref	8800623 8500442M
Engineer	Michael Findley

Results:

Component	Units	Range FSD	Gas conc	Cert ref	Results		% error FSD
					pre cal	post cal	
H2O	%	10	n/a				
CO2	mAU	400	n/a				
CO	PPM	500	321	103588	338	338	3.4
NO	PPM	1000	634		659	659	2.5
SO2-H	PPM	1000	663	184198	719	719	5.6
SO2-L	PPM	250	204.9	9414329003	195	195	-4.0

Cross sensitivity tests:

Test/	Response			% Error FSD		
	CO	NO	SO2-H	CO	NO	SO2-H
CO2 15%	0	4	-2	0.0	0.4	-0.2
H2O 3%	3	-15	-3	0.6	-1.5	-0.3
CO2 15% + H2O 3%	4	-8	-5	0.8	-0.8	-0.5

Test/	Response			% Error FSD		
	SO2-L			SO2-L		
CO2 15%	-2			-0.8		
H2O 3%	-3			-1.2		
CO2 15% + H2O 3%	-5			-2.0		

Signature:

M.Findley
Procal Customer Support Engineer

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7-7853-02 cal cert site visit general use Change note: 7007110 Date: 17/03/09

Parker

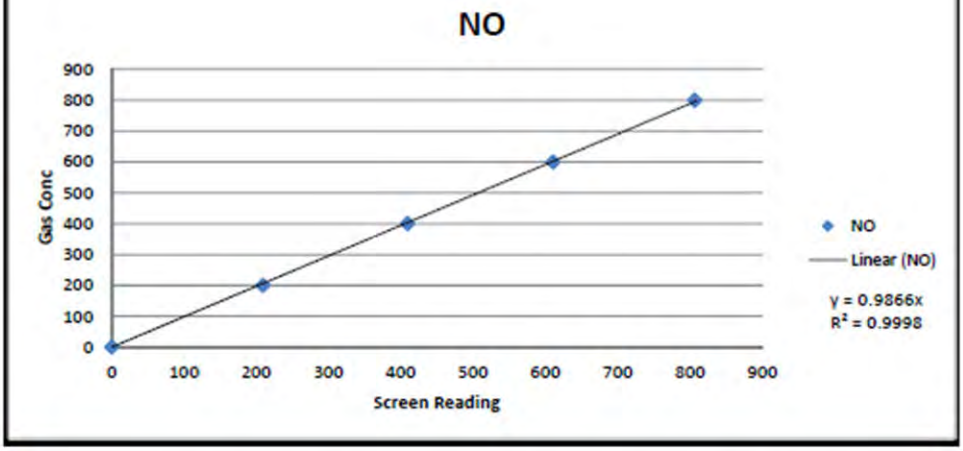
PROCAL

LINEARISATION RESULTS

Site	Aberthaw
Date	24/02/2016
Instrument	Unit 7 Primary
Instrument Ref	8800623 8500442M
Engineer	Michael Findley

The above analyser has undergone a linearisation check and calibration, if required, in accordance with the company's quality system. The following results were obtained.

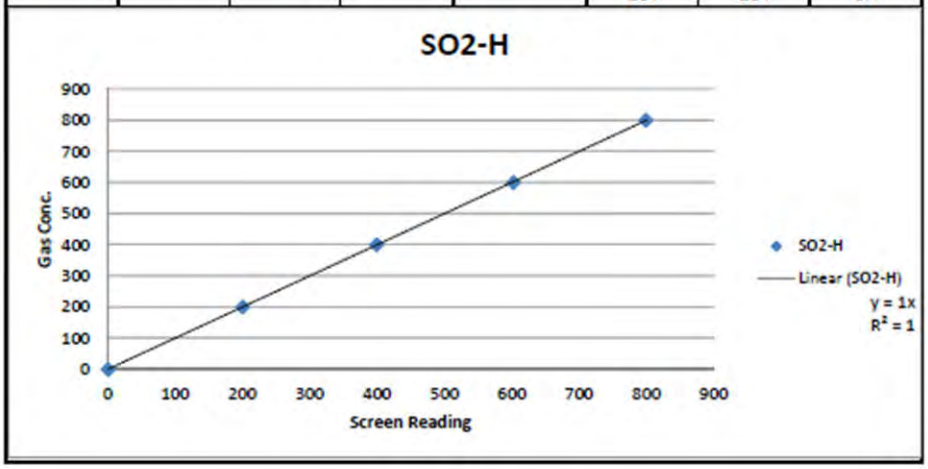
Component	Units	Range FSD	Gas conc	Cert ref	Results		% error FSD
					pre cal	post cal	
NO	PPM	1000	800	40005501914	806	806	0.6
					803	803	0.3
					808	808	0.8
NO	PPM	1000	600	40006064936	610	610	1.0
					613	613	1.3
					616	616	1.6
NO	PPM	1000	400	40006064936	409	409	0.9
					411	411	1.1
					411	411	1.1
NO	PPM	1000	200	40006064936	209	209	0.9
					211	211	1.1
					211	211	1.1



Kittiwake Procal Ltd, 5 Maxwell Road, Woodston, Peterborough, PE2 7HU, UK
Tel: +44 (0) 17336 232495 Email: procalsales@parker.com Website: www.procal.com

7-7862-04 Linearisation Certificate Change note: 7009251 Date: 30/07/12

Component	Units	Range FSD	Gas conc	Cert ref	Results		% error FSD
					pre cal	post cal	
SO2-H	PPM	1000	800	40006094212	799	799	-0.1
					801	801	0.1
					800	800	0.0
SO2-H	PPM	1000	600	40006094212	602	602	0.2
					600	600	0.0
					601	601	0.1
SO2-H	PPM	1000	400	40006094212	399	399	-0.1
					399	399	-0.1
					400	400	0.0
SO2-H	PPM	1000	200	40006094212	200	200	0.0
					200	200	0.0
					201	201	0.1



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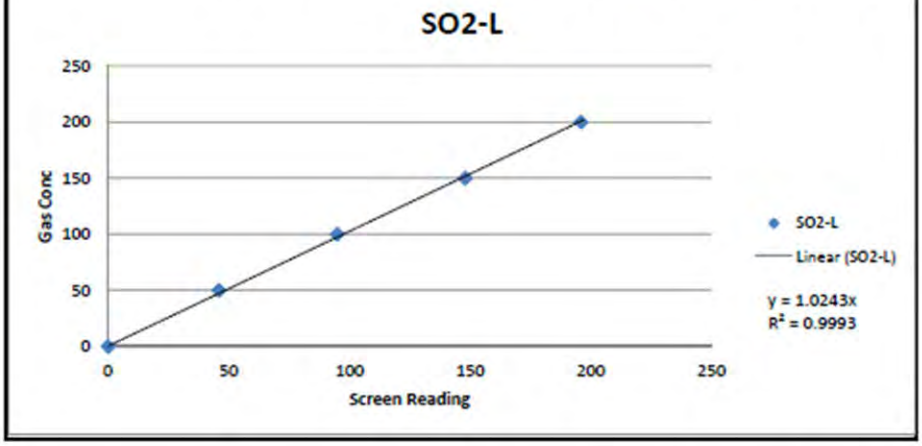
E-mail: asampson@procal.com Website: www.procal.com

7-7862-04 Linearisation Certificate Change note: 7009251 Date: 30/07/12

Component	Units	Range FSD	Gas conc	Cert ref	Results		% error
					pre cal	post cal	FSD
SO2-L	PPM	250	200	40005732643	196	196	-1.6
					196	196	-1.6
					197	197	-1.2
SO2-L	PPM	250	150	40005732643	148	148	-0.8
					149	149	-0.4
					150	150	0.0
SO2-L	PPM	250	100	40005732643	95	95	-2.0
					95	95	-2.0
					95	95	-2.0
SO2-L	PPM	250	50	40005732643	46	46	-1.6
					45	45	-2.0
					45	45	-2.0



Zero	H2O	CO2	CO	NO	SO2-H	SO2-L
#1	0	2	0	1	2	2
#2	0.1	3	3	6	3	3
#3	0.1	2	1	5	0	0
#4	0	-1	-1	-2	1	1
#5	0	0	-2	-6	1	1
#6	0	0	2	-1	-1	-1

Signature:

M.Findley
Procal Customer Support Engineer

Kittiwake Procal Ltd, 5 Maxwell Road, Woodston, Peterborough, PE2 7HU, UK TEL:+44(0)1733 23495 FAX:+44(0)1733 235255
E-mail: asampson@procal.com Website: www.procal.com

7-7862-04 Linearisation Certificate Change note: 7009251 Date: 30/07/12

Functionality Test Results

DECLARATION OF CONFORMITY

We,

Kittiwake Procal Ltd
5 Maxwell Road
Woodston
Peterborough
Cambridgeshire
PE2 7HU
United Kingdom

Tel: (+44) (0) 1733 232495
Fax: (+44) (0) 1733 235255
e-mail: post@procal.com
Web site: www.procal.com

declare that the product: Type PULSI 200 Analyser *installed at*

Customer	**Aberthaw Power Station**
Control Unit Serial Number	**8800623**
P200 Serial Number	**8500442M**
Site Identification	**Unit 7 Primary**

to which this declaration relates is in conformance with the MCERTs Performance Standard for Continuous Emission Monitoring Systems: Version 2. Revision 1 (April 2003).

MCERTS Product Conformance Certificates:

Licence	Certificate Number	Variation	Dated
ACU	SIRA MC 990006/	8	02/10/09
ACWn	SIRA MC 050060/	6	02/10/09

MCERTs Certification Body:

Sira Certification Service	
12 Acorn Industrial Park	Tel: (+44) (0) 1322 520500
Crayford Road	
Crayford	Fax: (+44) (0) 1322 520501
Dartford	
Kent	
DA1 4AL	e-mail: info@siraenvironmental.com
United Kingdom	Web site: www.siracertification.com

Quality System:

ISO 9001:2008	Certificate Nr: 062043	Dated: 11/06/09

Technical Standards Used:

EN 15267-2	Dated:	2009
EN 15267-3	Dated:	2007

All tests carried out to Kittiwake Procal's working procedures and those within Annex A of EN14181, Version 2.3 June 2010, relating to functionality testing by CEMs' manufacturers.

Signed:..... *Date:...16/02/2016.....*

1.0 Alignment and Cleanliness.

1.1 Internal Check of Analyser

Analyser under test	Status	Notes
Optical path clear	Yes	
Optics clean	Yes	Optical components replaced
Internal wiring ok	Yes	
Air supply on	Yes	
Purge flow >300 ltrs/hr	Yes	
Pressure differential <80mBar	Yes	49mbar

2.0 Zero and Span Checks.

2.1 Zero Check

Component:	H2O	CO2	CO	NO	SO2-H	SO2-L	Ta	Ts	Ps
Units:	%	mAU	ppm	ppm	ppm	ppm			
Process conc	1.9	142	349	573	38	29	24.7	130	1000
Zero conc	0	0	0	4	3	3	24.7	127	1049
% error	<2	<2	<2	<2	<2	<2			
Pass/Fail	Pass	Pass	Pass	Pass	Pass	Pass			
T90 recovery									

2.2 Span Check

Component:	H2O	CO2	CO	NO	SO2-H	SO2-L	Ta	Ts	Ps
Units:	%	mAU	ppm	ppm	ppm	ppm			
Full range	10	-	500	1000	1000	250			
Zero Conc	0	1	1	2	3	3	24.7	127	1050
Test Gas Conc			321	634	663	204.9	24.8	131	1058
Cert number			103588		184198	941432 9003			
Response Conc			338	659	719	195			
% Error			>2	>2	>2	>2			
Pass/Fail			Fail	Fail	Fail	Fail			
T90 time				80	100	80			

2.3 Filter Level Checks

All on zero air	F6	F2	F7	F5G	F3	F1G	F4	F8	
Factory	1890	3979	4090	2306	3471	2218	539	3481	
Last visit	1667	3407	3765	2151	3203	2124	565	3204	
This visit	1543	3058	3379	1923	2817	1876	484	2911	

2.4 Interference Checks

Component:	H2O	CO2	CO	NO	SO2-H	SO2-L
Units:	%	mAU	ppm	ppm	ppm	ppm
ZERO	0	-1	1	1	-3	-2
CO2 15%	-0.1	146	0	4	-2	-2
H2O 3%	2.6	-4	3	-15	-3	-3
H2O 3% & CO2 15%	2.8	141	4	-8	-5	-5

3.0 Data Acquisition.

Displayed \ Component							
Zero	Analyser						
	DCS						
	4-20mA						
Span	Analyser						
	DCS						
	4-20mA						

4.0 Linear coefficient record.

Coefficient \ Component		H2O	CO2	CO	NO	SO2-H	SO2-L
	Linear	2.160E-2	1	8.152E0	1.379E1	5.105E0	4.423E0
Last test	Squared	4.210E-5	0	1.202E-1	4.429E-02	-5.319E-4	1.431E-3
	Cubed						
	Linear	2.160E-2	1	8.152E0	1.342E1	4.609E0	4.804E+0
This test	Squared	4.210E-5	0	1.202E-1	4.310E-2	-4.802E-4	1.555E-3
	Cubed						

5.0 Test Information

5.1 Procal Engineer: Michael Findley

5.2 Test House:

5.3 Test House Engineer:

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Appendix 1. Pro-forma for assessing and reporting the results of the functional tests

Requirement		Notes
1. Alignment and Cleanliness		
A visual inspection, with reference to the CEMs manuals, shall be carried out on the following when applicable:		
• Internal check of the CEM	√	All functions ok
• Cleanliness of the optical components	√	Optical components replaced
• Flushing air supply	√	Ok
• Obstructions in the optical path	√	None
• After re-assembly at the measurement location at least the following shall be checked	√	No re-alignment required
• Alignment of the measuring system	√	No alignment required
• Contamination control (internal check of optical surfaces)	√	Filter levels ok after replacement of optics
2. Sampling Systems		
A visual inspection of the sampling system shall be performed, noting the condition of the following components, when fitted:		
• Sampling probe	n/a	
• Gas conditioning systems	n/a	
• Pumps	n/a	
• All connections	√	Ok
• Sample lines	n/a	
• Power supplies	√	Ok
• Filters	√	Ok
• NOx converters - if the sampling system contains a NOx converter, then the test laboratory shall record when the last efficiency-test was performed, and the result of this test.	n/a	
• The sampling system shall be in good condition and free of any visible faults, which may decrease the quality of data	√	Ok
3. Leak testing		
• Leak testing shall be performed according to the CEMs manuals. The tests shall cover the entire sampling system.	n/a	
4. Zero and Span check		
• Reference zero and span materials shall be used to verify the corresponding readings of the CEM.	√	Ok
• In case of non-extractive CEM, zero and span checks shall be performed using a reference-path free of flue gas before and after readjustment and after re-assembly of the CEM at the measurement location.	√	Ok
5. Linearity		
• During the calibration/linearity tests the applied concentrations should be logged onto the DCS to prove the complete system i.e. concentration applied to the instrument is represented by the instrument output and identical to the value logged on the DCS.	√	Data collected on ACU MK3 customer DCS during testing

Requirement		Notes
DCS logged values should be included in the instrument service report.	√	Data collected on ACU MK3 & customer DCS during testing
• The linearity of the CEM's response shall be checked using five different reference materials, including a zero concentration.	√	See linearity Cert
• The reference material with zero concentration, as well as the reference materials with four different concentrations, shall have a verifiable quantity and quality.	√	See gas certs
• In case of gaseous reference materials, these four reference materials can be obtained from different gas cylinders or can be prepared by means of a calibrated dilution system from one single gas concentration.	√	Gas points derived from blending full gas range using a Procal P9000, a water generator/gas blender
• The reference material concentrations shall be selected such that the measured values are at approximately 20 %, 40 %, 60 % and 80 % of the range of two times the emission limit. It is necessary to know the values of the ratios of their concentrations precisely enough so that an incorrect failure of the linearity test does not occur. The dry test reference material shall be applied to the inlet of the CEM.	√	See linearity cert
The individual CEMs are tested using the following concentrations applied in a randomised sequence:		
• Reference material with zero concentration;	√	See linearity cert
Reference material concentration approximately 20 % of 2 times the emission limit;	√	See linearity cert
• Reference material concentration approximately 40 % of 2 times the emission limit;	√	See linearity cert
• Reference material concentration approximately 60 % of 2 times the emission limit;	√	See linearity cert
• Reference material concentration approximately 80 % of 2 times the emission limit;	√	See linearity cert
• Reference material with zero concentration;	√	See linearity cert
After each change in concentration, the first instrument reading shall ordinarily be taken after a time period equal to at least three times the response time of the CEM. At each reference material concentration, at least three readings shall be made, six readings shall be taken at zero. The time period between the start of each of the three readings shall be separated by at least four times the response time. The test-laboratory may apply a risk-based approach to linearity testing in order to reduce the time for the tests. For example, the readings may be taken after less than 3x the response time; however, if the CEM fails the linearity test, then the test laboratory shall repeat the linearity test and wait at least 3x the response time as stated above. Alternatively, the number of repetitions of the test may be reduced if the CEM passes the required performance criteria by a factor of at least 2 (i.e. half the allowable residual). Increasing the waiting time to 5x the response time, for example, may be a means of meeting this requirement. Where no other method is possible, the linearity can also be performed with the aid of reference materials such as grating filters or gas filters.		

Requirement		Notes
The linearity shall be calculated and tested using the procedure as given in EN 14181 annex B. If the CEM does not pass this test; then the problem shall be identified and rectified.		
6. Interferences		
• A test shall be undertaken if the process gases to be monitored contain components that are known interferences, as identified during QAL1 and there is a failure of the QAL2 or AST which could be due to interferents.	√	Interference checks made with Water vapour, CO2 and each gas species
7. Zero and Span drift (Audit)		
• The test laboratory shall assess whether the operator has a QAL3 procedure in place, and whether the operator has applied this procedure. The evidence would comprise (i) a documented procedure, (ii) zero and span data, (iii) control charts.	√	Customer has procedure in place and has documented evidence
Response Time		
• The response time of the CEM shall be checked. This can be performed, if appropriate, by feeding of the reference material at the end of the sampling probe. The response time shall not exceed the performance requirement applied during the QAL1 tests.	√	Response time recorded on test sheet and this test sheet
9. Service Report		
As a minimum requirement the service report should include the following:		
• Document reference for work instruction for the type of work being undertaken	√	Procal Method Statement
• Instrument manufacturer	√	Procal
• Instrument type	√	Pulsi 2000
• Instrument model	√	P2000
• Instrument Serial No	√	8500442M
• Operating principle	√	GFCIR & NIR
• Operating range	√	Recorded on this report
• Certification details	√	Mcerted
• Compliance with MCERTS (including certificate no.)	√	SIRA MC 990006/08
• Location	√	Unit 7 Primary
• Date and time work was undertaken	√	16/02/2016
• Equipment used - type, serial no's, calibration dates	√	Procal Water Generator/Gas divider Pcal #6
• Gases used - certificate numbers, expiry dates, binary / mix	√	Copy of Gas Certs at customer request can be emailed
• NOx converter efficiency test, if applicable	n/a	
• Calibration and linearity data as required by EN14181	√	See Linearity & (Calcert Data)
• Logged data for period of calibration and linearity. Note there may be gaps in the data, in such cases, the test laboratory shall state why there are gaps in the data	√	See Linearity & (Calcert Data)

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CALIBRATION CERTIFICATE

Site	Aberthaw
Date	16/02/2016
Instrument	Unit 7 Back Up
Instrument Ref	8800624 8500705M
Engineer	Michael Findley

Results:

Component	Units	Range FSD	Gas conc	Cert ref	Results pre cal	Results post cal	% error FSD
H2O	%	10	n/a				
CO2	mAU	400	n/a				
CO	PPM	500	321	103588	337	337	3.2
NO	PPM	1000	634		662	662	2.8
SO2-H	PPM	1000	663	184198	667	667	0.4
SO2-L	PPM	250	204.9	9414329003	192	192	-5.2

Cross sensitivity tests:

Test/	Response CO	Response NO	Response SO2-H	% Error FSD CO	% Error FSD NO	% Error FSD SO2-H
CO2 15%	2	-6	-5	0.4	-0.6	-0.5
H2O 3%	-4	-6	3	-0.8	-0.6	0.3
CO2 15% + H2O 3%	0	-9	9	0.0	-0.9	0.9

Test/	Response SO2-L			% Error FSD SO2-L		
CO2 15%	-5			-2.0		
H2O 3%	0			0.0		
CO2 15% + H2O 3%	4			1.6		

Signature:

M.Findley
Procal Customer Support Engineer

Parker Procal, 5 Maxwell Road, Woodston, Peterborough, PE2 7HU, UK
Tel: +44 (0) 17336 232495 Email: procalsales@parker.com Website: www.procal.com

7-7853-02 cal cert site visit general use Change note: 7007110 Date: 17/03/09

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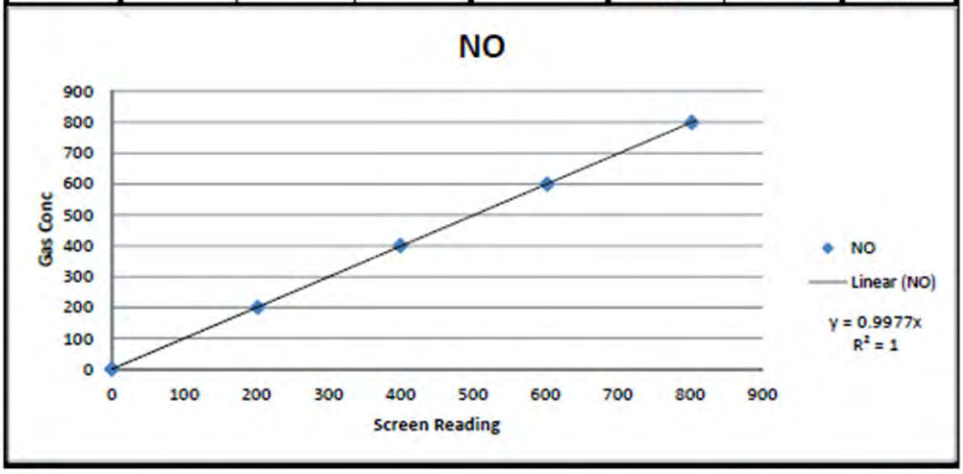
LINEARISATION RESULTS

Site	Aberthaw
Date	24/02/2016
Instrument	Unit 7 Back Up
Instrument Ref	8800624 8500705
Engineer	Michael Findley

The above analyser has undergone a linearisation check and calibration, if required, in accordance with the company's quality system. The following results were obtained.

Component	Units	Range FSD	Gas conc	Cert ref	Results pre cal	Results post cal	% error FSD
NO	PPM	1000	800	40005501914	802	802	0.2
					807	807	0.7
					807	807	0.7
NO	PPM	1000	600	40006065018	602	602	0.2
					605	605	0.5
					601	601	0.1
NO	PPM	1000	400	40006065018	399	399	-0.1
					403	403	0.3
					402	402	0.2
NO	PPM	1000	200	40006065018	202	202	0.2
					203	203	0.3
					200	200	0.0



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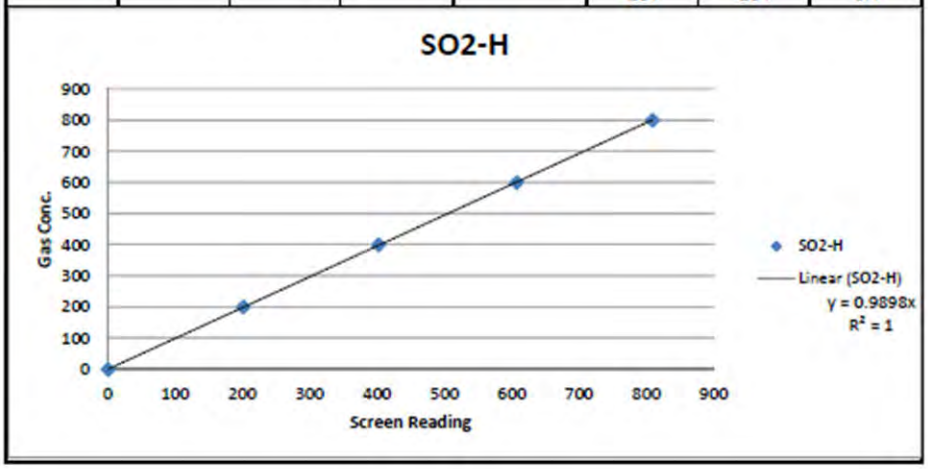
Tel: +44 (0) 17336 232495 Email: procalsales@parker.com Website: www.procal.com

7-7862-04 Linearisation Certificate Change note: 7009251 Date: 30/07/12

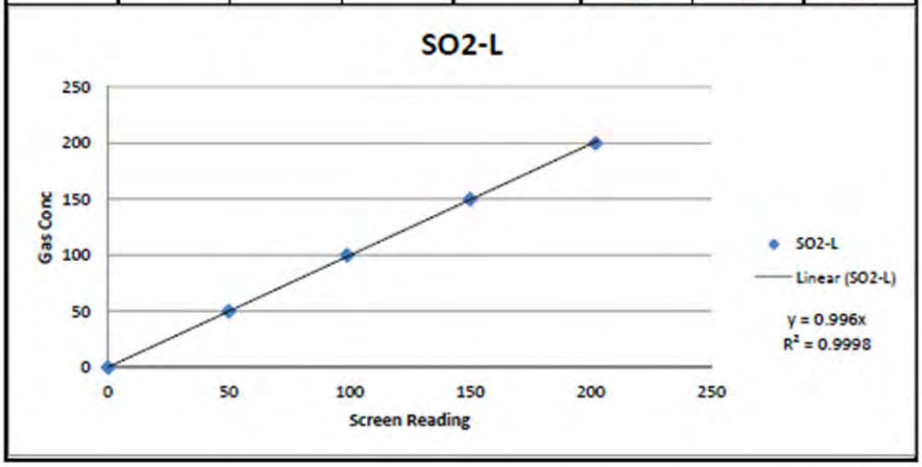
Component	Units	Range FSD	Gas conc	Cert ref	Results		% error FSD
					pre cal	post cal	
SO2-H	PPM	1000	800	40006081302	809	809	0.9
					808	808	0.8
					809	809	0.9
SO2-H	PPM	1000	600	40006081302	607	607	0.7
					610	610	1.0
					609	609	0.9
SO2-H	PPM	1000	400	40006081302	402	402	0.2
					400	400	0.0
					405	405	0.5
SO2-H	PPM	1000	200	40006081302	201	201	0.1
					200	200	0.0
					201	201	0.1



Kittiwake Procal Ltd, 5 Maxwell Road, Woodston, Peterborough, PE2 7HU, UK TEL:+44(0)1733 23495 FAX:+44(0)1733 235255
E-mail: asampson@procal.com Website: www.procal.com

7-7862-04 Linearisation Certificate Change note: 7009251 Date: 30/07/12

Component	Units	Range FSD	Gas conc	Cert ref	Results		% error
					pre cal	post cal	FSD
SO2-L	PPM	250	200	40005732643	202	202	0.8
					201	201	0.4
					203	203	1.2
SO2-L	PPM	250	150	40005732643	150	150	0.0
					151	151	0.4
					150	150	0.0
SO2-L	PPM	250	100	40005732643	99	99	-0.4
					101	101	0.4
					100	100	0.0
SO2-L	PPM	250	50	40005732643	50	50	0.0
					48	48	-0.8
					49	49	-0.4



Zero	H2O	CO2	CO	NO	SO2-H	SO2-L
#1	0.1	3	0	`3	2	1
#2	0	2	-2	2	-1	-1
#3	0	2	-1	1	0	0
#4	-0.1	-6	-2	-5	-2	-1
#5	0	0	1	1	2	1
#6	0.1	6	1	3	2	2

Signature:

M.Findley
Procal Customer Support Engineer

Kittiwake Procal Ltd, 5 Maxwell Road, Woodston, Peterborough, PE2 7HU, UK TEL:+44(0)1733 23495 FAX:+44(0)1733 235255
E-mail: asampson@procal.com Website: www.procal.com

7-7862-04 Linearisation Certificate Change note: 7009251 Date: 30/07/12

Functionality Test Results

DECLARATION OF CONFORMITY

We,

Kittiwake Procal Ltd
5 Maxwell Road
Woodston
Peterborough
Cambridgeshire
PE2 7HU
United Kingdom

Tel: (+44) (0) 1733 232495
Fax: (+44) (0) 1733 235255
e-mail: post@procal.com
Web site: www.procal.com

declare that the product: Type PULSI 200 Analyser *installed at*

Customer	Aberthaw
Control Unit Serial Number	8800624
P200 Serial Number	8500705
Site Identification	Stack 7 Back Up

to which this declaration relates is in conformance with the MCERTs Performance Standard for Continuous Emission Monitoring Systems: Version 2. Revision 1 (April 2003).

MCERTS Product Conformance Certificates:

Licence	Certificate Number	Variation	Dated
ACU	SIRA MC 990006/	8	02/10/09
ACWn	SIRA MC 050060/	6	02/10/09

MCERTs Certification Body:

Sira Certification Service	
12 Acorn Industrial Park	Tel: (+44) (0) 1322 520500
Crayford Road	
Crayford	Fax: (+44) (0) 1322 520501
Dartford	
Kent	
DA1 4AL	e-mail: info@siraenvironmental.com
United Kingdom	Web site: www.siracertification.com

Quality System:

ISO 9001:2008	Certificate Nr: 062043	Dated: 11/06/09

EN 15267-2	Dated:	2009
EN 15267-3	Dated:	2007

Technical Standards Used:

All tests carried out to Kittiwake Procal's working procedures and those within Annex A of EN14181, Version 2.3 June 2010, relating to functionality testing by CEMs' manufacturers.

Signed:..... ..... *Date:...19/02/2016.....*

1.0 Alignment and Cleanliness.

1.1 Internal Check of Analyser

Analyser under test	Status	Notes
Optical path clear	Yes	OK
Optics clean	Yes	OK
Internal wiring ok	Yes	
Air supply on	Yes	
Purge flow >300 ltrs/hr	Yes	
Pressure differential <80mBar	Yes	16 mbar

2.0 Zero and Span Checks.

2.1 Zero Check

Component: Units:	H2O %	CO2 mAU	CO ppm	NO ppm	SO2-H ppm	SO2-L ppm	Ta	Ts	Ps
Process conc	1.5	193	176	466	41	35	21.7	130.8	1024.8
Zero conc	-0.1	-5	5	-7	1	1	21.7	130	1041
% error	<2	<2	<2	<2	<2	<2			
Pass/Fail	Pass	Pass	Pass	Pass	Pass	Pass			
T90 recovery									

2.2 Span Check

Component: Units:	H2O %	CO2 mAU	CO ppm	NO ppm	SO2-H ppm	SO2-L ppm	Ta	Ts	Ps
Full range	10	-	500	1000	1000	250			
Zero Conc	0	0	-2	-1	-3	-3	22.3	128.1	1022.9
Test Gas Conc			321	634	663	205			
Cert number			103588		184198	329003			
Response Conc			337	662			22.4	130.3	1025.6
Response Conc					667		22.4	130.6	1025.8
Response Conc						192	19.5	129.9	1019.6
% Error			>2	>2	<2	>2			
Pass/Fail			Fail	Fail	Pass	Fail			
T90 time				60	90				

2.3 Filter Level Checks

All on zero air	F2	F4	F6	F1G	F7	F5G	F8	F3	
Factory	2093	3650	3904	2426	3776	2399	463	2281	
Last visit	1976	3416	3725	2406	3761	2663	494	2375	
This visit	1728	3043	3271	2118	3264	2337	414	1977	

2.4 Interference Checks

Component: Units:	H2O %	CO2 mAU	CO ppm	NO ppm	SO2-H ppm	SO2-L ppm
ZERO	0	-2	-1	0	-1	-1
CO2 15%	-0.1	216	2	-6	-5	-5
H2O 3%	2.2	-4	-4	-6	3	0
H2O + CO2	2.7	217	0	-9	9	4

3.0 Data Acquisition.

Displayed \ Component							
Zero	Analyser						
	DCS						
	4-20mA						
Span	Analyser						
	DCS						
	4-20mA						

4.0 Linear coefficient record.

Coefficient \ Component		H2O	CO2	CO	NO	SO2-H	SO2-L
Last test	Linear	1.650e-2	1.000e+0	7.400e+0	1.200e+1	6.373e+0	5.810e+0
	Squared	4.400e-5	0.000e+0	1.120e-1	4.150e-2	-1.570e-3	5.790e-3
	Cubed						
This test	Linear	1.650e-2	1.000e+0	7.400e+0	1.200e+1	6.373e+0	5.810e+0
	Squared	4.400e-5	0.000e+0	1.120e-1	4.150e-2	-1.570e-3	5.790e-3
	Cubed						

5.0 Test Information

5.1 Procal Engineer: Mohsen Hariri

5.2 Test House:

5.3 Test House Engineer:

Appendix 1. Pro-forma for assessing and reporting the results of the functional tests

Requirement		Notes
1. Alignment and Cleanliness		
A visual inspection, with reference to the CEMs manuals, shall be carried out on the following when applicable:		
• Internal check of the CEM	√	All functions ok
• Cleanliness of the optical components	√	
• Flushing air supply	√	Ok
• Obstructions in the optical path	√	None
• After re-assembly at the measurement location at least the following shall be checked	√	No re-assembly required
• Alignment of the measuring system	√	No alignment required
• Contamination control (internal check of optical surfaces)	√	Filter levels ok
2. Sampling Systems		
A visual inspection of the sampling system shall be performed, noting the condition of the following components, when fitted:		
• Sampling probe	n/a	
• Gas conditioning systems	n/a	
• Pumps	n/a	
• All connections	√	Ok
• Sample lines	n/a	
• Power supplies	√	Ok
• Filters	√	Ok
• NOx converters - if the sampling system contains a NOx converter, then the test laboratory shall record when the last efficiency-test was performed, and the result of this test.	n/a	
• The sampling system shall be in good condition and free of any visible faults, which may decrease the quality of data	√	Ok
3. Leak testing		
• Leak testing shall be performed according to the CEMs manuals. The tests shall cover the entire sampling system.	n/a	
4. Zero and Span check		
• Reference zero and span materials shall be used to verify the corresponding readings of the CEM.	√	Ok
• In case of non-extractive CEM, zero and span checks shall be performed using a reference-path free of flue gas before and after readjustment and after re-assembly of the CEM at the measurement location.	√	Ok
5. Linearity		
• During the calibration/linearity tests the applied concentrations should be logged onto the DCS to prove the complete system i.e. concentration applied to the instrument is represented by the instrument output and identical to the value logged on the DCS.	√	Data collected on ACU MK4 & customer DCS during testing

Requirement		Notes
DCS logged values should be included in the instrument service report.	√	Data collected on ACU MK4 & customer DCS during testing
• The linearity of the CEM's response shall be checked using five different reference materials, including a zero concentration.	√	See linearity Cert
• The reference material with zero concentration, as well as the reference materials with four different concentrations, shall have a verifiable quantity and quality.	√	See gas certs
• In case of gaseous reference materials, these four reference materials can be obtained from different gas cylinders or can be prepared by means of a calibrated dilution system from one single gas concentration.	√	Gas points derived from blending full gas range using a Procal P9000, a water generator/gas blender
• The reference material concentrations shall be selected such that the measured values are at approximately 20 %, 40 %, 60 % and 80 % of the range of two times the emission limit. It is necessary to know the values of the ratios of their concentrations precisely enough so that an incorrect failure of the linearity test does not occur. The dry test reference material shall be applied to the inlet of the CEM.	√	See linearity cert
The individual CEMs are tested using the following concentrations applied in a randomised sequence:		
• Reference material with zero concentration;	√	See linearity cert
Reference material concentration approximately 20 % of 2 times the emission limit;	√	See linearity cert
• Reference material concentration approximately 40 % of 2 times the emission limit;	√	See linearity cert
• Reference material concentration approximately 60 % of 2 times the emission limit;	√	See linearity cert
• Reference material concentration approximately 80 % of 2 times the emission limit;	√	See linearity cert
• Reference material with zero concentration;	√	See linearity cert
After each change in concentration, the first instrument reading shall ordinarily be taken after a time period equal to at least three times the response time of the CEM. At each reference material concentration, at least three readings shall be made, six readings shall be taken at zero. The time period between the start of each of the three readings shall be separated by at least four times the response time. The test-laboratory may apply a risk-based approach to linearity testing in order to reduce the time for the tests. For example, the readings may be taken after less than 3x the response time; however, if the CEM fails the linearity test, then the test laboratory shall repeat the linearity test and wait at least 3x the response time as stated above. Alternatively, the number of repetitions of the test may be reduced if the CEM passes the required performance criteria by a factor of at least 2 (i.e. half the allowable residual). Increasing the waiting time to 5x the response time, for example, may be a means of meeting this requirement. Where no other method is possible, the linearity can also be performed with the aid of reference materials such as grating filters or gas filters.		

Requirement		Notes
The linearity shall be calculated and tested using the procedure as given in EN 14181 annex B. If the CEM does not pass this test; then the problem shall be identified and rectified.		
6. Interferences		
• A test shall be undertaken if the process gases to be monitored contain components that are known interferences, as identified during QAL1 and there is a failure of the QAL2 or AST which could be due to interferents.	√	Interference checks made with Water vapour, CO2 and each gas species
7. Zero and Span drift (Audit)		
• The test laboratory shall assess whether the operator has a QAL3 procedure in place, and whether the operator has applied this procedure. The evidence would comprise (i) a documented procedure, (ii) zero and span data, (iii) control charts.	√	Customer has procedure in place and has documented evidence
. Response Time		
• The response time of the CEM shall be checked. This can be performed, if appropriate, by feeding of the reference material at the end of the sampling probe. The response time shall not exceed the performance requirement applied during the QAL1 tests.	√	Response time recorded on test sheet and this test sheet
9. Service Report		
As a minimum requirement the service report should include the following:		
• Document reference for work instruction for the type of work being undertaken	√	Procal Method Statement
• Instrument manufacturer	√	Procal
• Instrument type	√	Pulsi 2000
• Instrument model	√	P2000
• Instrument Serial No	√	8500705
• Operating principle	√	GFCIR & NIR
• Operating range	√	Recorded on this report
• Certification details	√	Mcerted
• Compliance with MCERTS (including certificate no.)	√	SIRA MC 990006/08
• Location	√	Stack 7 Back Up
• Date and time work was undertaken	√	16/02/2016
• Equipment used - type, serial no's, calibration dates	√	Procal Water Generator/Gas divider Pcal #1
• Gases used - certificate numbers, expiry dates, binary / mix	√	Copy of Gas certs emailed to customer
• NOx converter efficiency test, if applicable	n/a	
• Calibration and linearity data as required by EN14181	√	See Linearity & (Calcert Data)
• **Logged** data for period of calibration and linearity. Note there may be gaps in the data, in such cases, the test laboratory shall state why there are gaps in the data	√	See Linearity & (Calcert Data)

SICK

Unit 7 - GM32 Linearity Report

Customer	RWE Npower
Site	Aberthaw Power Station
Permit Ref	A1234
Contact	Dan Peters
Service Ref No.	SVON018532
Survey Date	25.02.2016
Device Type	GM32
Device Location	Unit 7
Serial Number	1406 8012
MCERTS Cert No	MC100163/01
Certification Details	See Certificate
Measurement Principle	U.V DOAS
Gas Box Serial Number	0816 8035
SICK Engineer	Rhodri Jones
Signature	

Sick (UK) Ltd
Waldkirch House
39 Hedley Road
St.Albans
Hertfordshire
AL1 5BN

Tel: 0044 (0) 1727 831121
Fax:0044 (0) 1727 855332
E-Mail: info@sick.co.uk

GM32 SO_2 Linearity

Customer	RWE Npower
Site	Aberthaw Power Station
Product	GM32
Analyser Serial Number	1406 8012
MCERTS Certificate Number	MC100163/01
Location	Unit 7
Active Path Length (mm)	500

Site Permit Ref	A1234
SVON No	SVON018532
Order Number	AXC1235784133
QAL2/AST/Routine	AST
Date	16.02.2015
Engineer	Rhodri Jones

Gas Box Serial Number	0816 8035
Calibration Date	01.01.2016
Calibration Gas Cylinder Ref:	VC3713C
Test Gas Conc. (ppm)	3572
Test Gas Conc. ($mg.m^{-3}$)	10180
Gas Expiry Date	19.01.2018
Tolerance	2%

Response Time (T_{90}) Seconds	40
Permit Daily ELV for SO_2 ($mg.m^{-3}$)	440
Permit Daily ELV x 2 ($mg.m^{-3}$) (c_{ELV})	880
Analyser Range	1200
Ambient Pressure (hPa)	1005
Results Visible on DCS?	Yes, when not in maintenance mode
Corrections Applied?	None - As measured (ppm)

Component 1	SO_2
Set Pt Time ($4xT_{90}$) sec	160
Log Time ($3xT_{90}$) sec	120
Gasbox Temperature (°C)	80
Reference Temperature (K)	273
ppm to $mg.m^{-3}$ for SO_2	2.85

Linearity Results

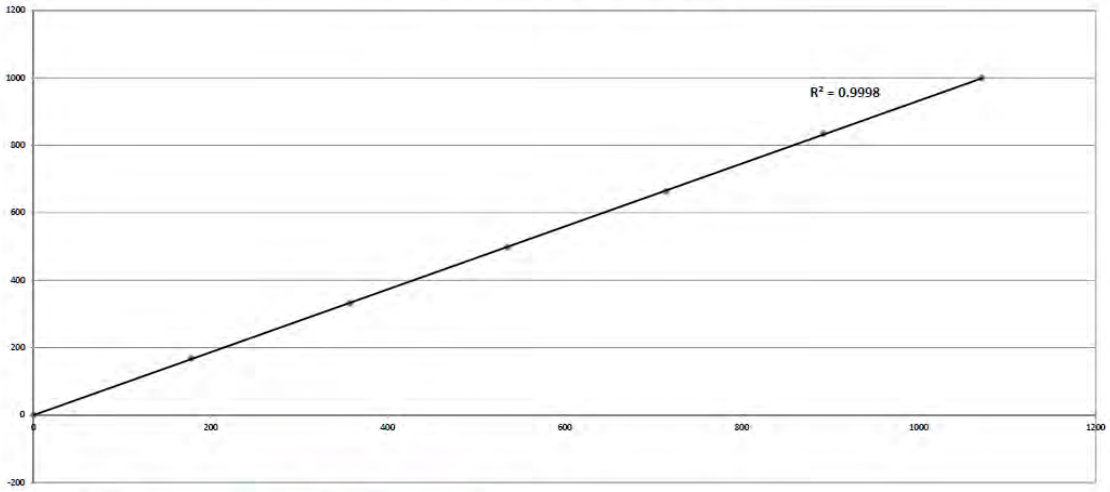
% 2 x ELV	Test Cell Length (mm)	Expected (ppm)	Reading 1 (ppm)	Reading 2 (ppm)	Reading 3 (ppm)	Average Reading	DCS	Time
232%	100	714.40	662.00	661.00	666.00	663.00	663.0	11:47-11:52
174%	75	535.80	500.00	497.00	495.00	497.33	497.0	11:54-11:58
290%	125	893.00	834.00	832.00	839.00	835.00	835.0	12:00-12:04
58%	25	178.60	169.00	168.00	168.00	168.33	168.0	12:12-12:16
116%	50	357.20	334.00	330.00	329.00	331.00	331.0	12:06-12:10
348%	150	1071.60	998.00	1003.00	999.00	1000.00	1000.0	11:40-11:45

Zero Results

ZERO	Analyser Reading (ppm)	DCS (ppm)	Time
Zero Reading 1	0.00	0.00	11:30
Zero Reading 2	0.00	0.00	11:33
Zero Reading 3	0.00	0.00	11:36
Zero Reading 4	0.00	0.00	12:18
Zero Reading 5	0.00	0.00	12:20
Zero Reading 6	0.00	0.00	12:22
AVERAGE	0.00		

Test Cell Length (mm)	Actual Value (ppm)	% Range	% 2 x ELV	Average CEM Reading (ppm)	$d_{c,rel}$	$dc_{,rel}$ <5% (EN 14181)
NA	0.00	0.0%	0%	0.00	0.05%	PASS
25mm	178.60	14.9%	58%	168.33	0.25%	PASS
50mm	357.20	29.8%	116%	331.00	-0.20%	PASS
75mm	535.80	44.7%	174%	497.33	-0.22%	PASS
100mm	714.40	59.5%	232%	663.00	-0.33%	PASS
125mm	893.00	74.4%	290%	835.00	0.29%	PASS
150mm	1071.60	89.3%	348%	1000.00	0.11%	PASS

Applied Concentration (ppm) v CEM Reading (ppm)



Engineer	Rhodri Jones
Signature	
Comments	Analyser exhibiting a linear response

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Sick (UK) Ltd
Waldkirch House
39 Hedley Road
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Hertfordshire
AL1 5BN

Tel: 0044 (0) 1727 831121
Fax:0044 (0) 1727 855332
E-Mail: info@sick.co.uk

GM32 NO Linearity

Customer	RWE Npower
Site	Aberthaw Power Station
Product	GM32
Analyser Serial Number	1406 8012
MCERTS Certificate Number	MC100163/01
Location	Unit 7
Active Path Length (mm)	500

Site Permit Ref	A1234
SVON No	SVON018532
Order Number	AXC123784133
QAL2/AST/Routine	AST
Date	25.02.2016
Engineer	Rhodri Jones

Gas Box Serial Number	0816 8035
Calibration Date	01.01.2016
Calibration Gas Cylinder Ref:	VCSMG3285
Test Gas Conc. (ppm)	6817
Test Gas Conc. (mg.m^{-3})	9135
Gas Expiry Date	30.01.2018
Tolerance	2%

Response Time (T_{90}) Seconds	30
Permit Daily ELV for NO (mg.m^{-3})	1210
Permit Daily ELV x 2 (mg.m^{-3}) (σ_L)	2420
Analyser Range	1000
Ambient Pressure (hPa)	1005
Results Visible on DCS?	Yes, when not in maintenance mode
Corrections Applied?	None - As measured (ppm)

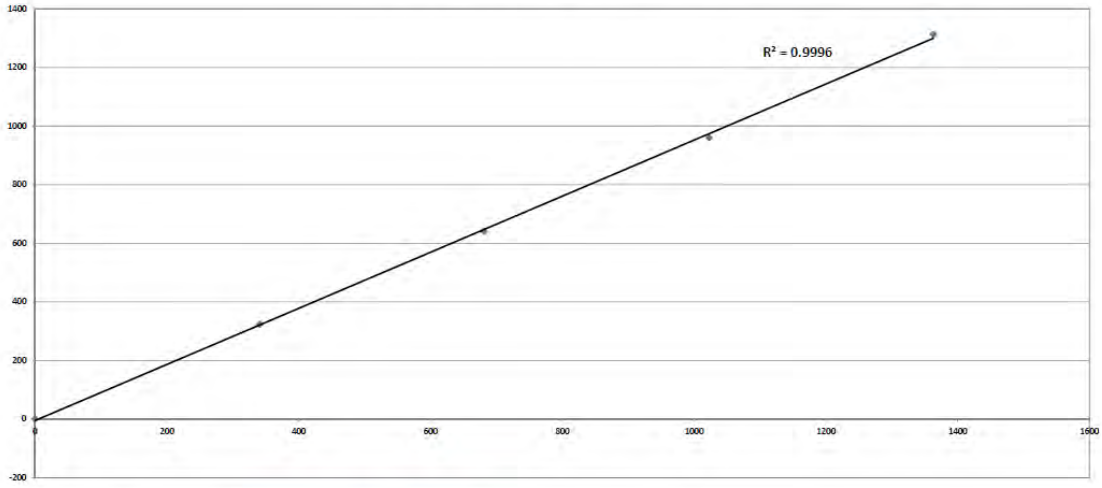
Component 1	NO
Set Pt Time (4xT_{90}) sec	120
Log Time (3xT_{90}) sec	90
Gasbox Temperature (°C)	80
Reference Temperature (K)	273
ppm to mg.m^{-3} for NO	1.34

Linearity Results								
% 2 x ELV	Test Cell Length (mm)	Expected (ppm)	Reading 1 (ppm)	Reading 2 (ppm)	Reading 3 (ppm)	Average Reading	DCS	DCS Time
75%	100	1363.40	1308.00	1313.00	1317.00	1312.67	1313.0	12:26 - 12:30
57%	75	1022.55	956.00	963.00	962.00	960.33	960.0	12:38-12:42
19%	25	340.85	324.00	323.00	323.00	323.33	323.0	12:32-12:36
38%	50	681.70	642.00	641.00	640.00	641.00	641.0	12:45-12:49

Zero Results			
ZERO	Analyser Reading (ppm)	DCS (ppm)	Time
Zero Reading 1	0.00	0.00	12:18
Zero Reading 2	0.00	0.00	12:20
Zero Reading 3	0.00	0.00	12:22
Zero Reading 4	0.00	0.00	12:51
Zero Reading 5	0.00	0.00	12:53
Zero Reading 6	0.00	0.00	12:55
AVERAGE	0.00		

Test Cell Length (mm)	Actual Value (ppm)	% Range	% 2 x ELV	Average CEM Reading (ppm)	$d_{c,rel}$	$dc_{,rel}$ <5% (EN 14181)
NA	0.00	0.0%	0%	0.00	0.13%	PASS
25mm	340.85	34.1%	14%	323.33	0.04%	PASS
50mm	681.70	68.2%	28%	641.00	-0.29%	PASS
75mm	1022.55	102.3%	42%	960.33	-0.55%	PASS
100mm	1363.40	136.3%	56%	1312.67	0.55%	PASS

Applied Concentration (ppm) v CEM Reading (ppm)



Engineer	Rhodri Jones
Signature	
Comments	Analyser exhibiting a linear response

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GM32 NO_2 Linearity

Customer	RWE Npower
Site	Aberthaw Power Station
Product	GM32
Analyser Serial Number	1406 8012
MCERTS Certificate Number	MC100163/01
Location	Unit 7
Active Path Length (mm)	500

Site Permit Ref	A1234
SVON No	SVON018532
Order Number	AXC1235784133
QAL2/AST/Routine	AST
Date	25.02.2016
Engineer	Rhodri Jones

Gas Box Serial Number	0816 8035
Calibration Date	01.01.2016
Calibration Gas Cylinder Ref:	VCD116712
Test Gas Conc. (ppm)	986
Test Gas Conc. ($mg.m^{-3}$)	2021
Gas Expiry Date	30.01.2018
Tolerance	2%

Response Time (T_{90}) Seconds	50
Permit Daily ELV for NO_2 ($mg.m^{-3}$)	121.0
Permit Daily ELV x 2 ($mg.m^{-3}$) (c_{ref})	242
Analyser Range	100
Ambient Pressure (hPa)	1005
Results Visible on DCS?	Yes, when not in maintenance mode
Corrections Applied?	None - As measured (ppm)

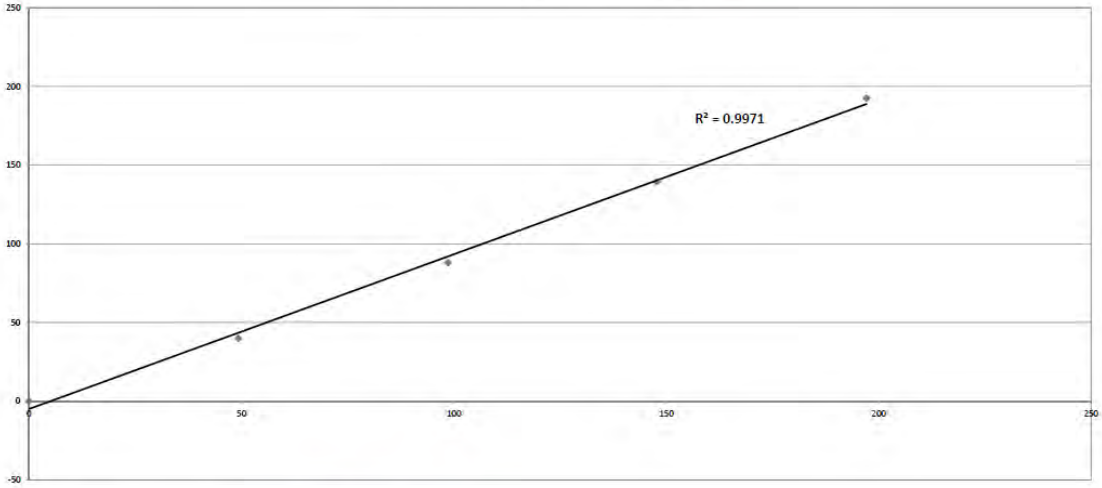
Component 1	NO_2
Set Pt Time ($4xT_{90}$) sec	200
Log Time ($3xT_{90}$) sec	150
Gasbox Temperature (°C)	80
Reference Temperature (K)	273
ppm to $mg.m^{-3}$ for NO_2	2.05

Linearity Results								
% 2 x ELV	Test Cell Length (mm)	Expected (ppm)	Reading 1 (ppm)	Reading 2 (ppm)	Reading 3 (ppm)	Average Reading	DCS	Time
167%	100	197.20	192.50	191.70	193.50	192.57	193.0	12:58-13:02
125%	75	147.90	139.10	139.50	139.50	139.37	139.0	13:16-13:20
42%	25	49.30	42.40	38.10	39.00	39.83	40.0	13:10-13:14
84%	50	98.60	87.50	86.90	89.90	88.10	88.0	13:04-13:08

Zero Results			
ZERO	Analyser Reading (ppm)	DCS (ppm)	Time
Zero Reading 1	-0.10	0.00	12:51
Zero Reading 2	-0.20	0.00	12:53
Zero Reading 3	-0.20	0.00	12:55
Zero Reading 4	0.60	0.00	13:22
Zero Reading 5	-0.10	0.00	13:24
Zero Reading 6	-0.20	0.00	13:26
AVERAGE	-0.03		

Test Cell Length (mm)	Actual Value (ppm)	% Range	% 2 x ELV	Average CEM Reading (ppm)	$d_{c,rel}$	$dc_{,rel}$ <5% (EN 14181)
NA	0.00	0.0%	0%	-0.03	1.28%	PASS
25mm	49.30	49.3%	20%	39.83	-2.02%	PASS
50mm	98.60	98.6%	41%	88.10	-1.85%	PASS
75mm	147.90	147.9%	61%	139.37	-0.44%	PASS
100mm	197.20	197.2%	81%	192.57	1.77%	PASS

Applied Concentration (ppm) v CEM Reading (ppm)



Engineer	Rhodri Jones
Signature	
Comments	

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CERTIFICATE OF CALIBRATION

Unit No	**U 7**
Application	**Stack Flue Gas Oxygen Analyser**
Probe Serial No	**3K220000139813**
WOC No	**3-16-513044-00**

TESTED AGAINST		
Calibration Meter	**Type**	**Beamex**
	Serial No	**25514526**
	Calibration Date	**05-02-16**
2 % Oxygen	**Certified Input Valve**	**1.98 %**
	Cylinder No	**S1358263**
	Expiry Date	**04/10/2017**
	Theoretical Output	**7.168mA**
8 % Oxygen	**Certified Input Valve**	**8.04 %**
	Cylinder No	**S1144548**
	Expiry Date	**19/06/2019**
	Theoretical Output	**16.864mA**

Results

		Local Display	**Current**	**Procal ACU Display**
1.98 % Oxygen (7.168 mA)	**Before**	**1.97%**	**7.133mA**	**2%**
	After			
8.04 % Oxygen (16.864 mA)	**Before**	**7.94%**	**16.7mA**	**8%**
	After			

Signed – Ian Jauncey

Date – 16/02 /16

RWE Npower
C & I Department
Aberthaw Power Station
West Aberthaw
The Leys
Barry
CF62 4ZW

Table 5.2 - Functional Tests carried out by RPS

Requirement	Compliance	Notes
10 Documentation of Records The following documentation shall be controlled, readily accessible and up to date: - a plan of the CEMS; - all manuals (maintenance, users, etc.);	Yes Yes	A plan of the AMS resides in the Electrical Control & Instrumentation section offices and at the analyser. .
- log books to document possible malfunctions and action taken; - service reports;	Yes Yes	All service reports are filed.
- QAL 3 documentation including actions taken as a result of out of control situations	Yes	There is a well established QAL3 system in place and analyser drift is routinely monitored using shewart charts. Evidence was provided to RPS.
Management system procedures for maintenance, calibration and training;	Yes	The Performance dept manage and review maintenance and calibration and training carried out by the EC&I team.
Training records/certificates	Yes	Evidence was provided to RPS

Requirement	Compliance	Notes
Maintenance schedules.	Yes	Maintenance scheduled by Performance.
Auditing Plans & Records – Evidence that the operator includes procedures for the management of the CEMS within the auditing cycle of the management system.	Yes	Carried out using dedicated Technical Team from Swindon Head Office. An auditor witnessed the parallel tests, which suggest a good level of organisation.

APPENDIX 1: SRM Calibration Data

Table A1.1– SRM On-Site Calibrations

Sample Date	Equipment Name	Equipment ID Number	Span Gas Type	ID Number	Span Gas Concentration	Pre-Sampling Result*		Post-Sampling Result*	
						Zero	Span	Zero	Span
7th March	Horiba PG 250	01508	NO (17025)	83649	911 ppm	0 ppm	910 ppm	2 ppm	907 ppm
			O_2 (V.U.)	216463	14.63 %	0.08 %	14.51 %	0.11 %	14.62 %
	Gasmet DX4000	1610	SO_2 (17025)	187970	178 ppm	-0.59 ppm	175.3 ppm	-0.14 ppm	178.7 ppm
8th March	Horiba PG 250	01508	NO (17025)	83649	911 ppm	7 ppm	905 ppm	9 ppm	897 ppm
			O_2 (V.U.)	216463	14.63 %	0.02 %	14.60 %	0.04 %	14.47 %
	Gasmet DX4000	1610	SO_2 (17025)	187970	178 ppm	-0.14 ppm	178.7 ppm	-0.38 ppm	175.2 ppm
9th March	Horiba PG 250	01508	NO (17025)	83649	911 ppm	9 ppm	897 ppm	9 ppm	899 ppm
			O_2 (V.U.)	216463	14.63 %	0.04 %	14.47 %	0.01 %	14.42 %
	Gasmet DX4000	1610	SO_2 (17025)	187970	178 ppm	-0.38 ppm	175.2 ppm	-0.13 ppm	175.6 ppm

Notes

- **- Calibration values are those for the entire sample system.*
- *- Zero gas 99.999% N_2*

APPENDIX 2 – Accreditation Schedule

Schedule of Accreditation

issued by

United Kingdom Accreditation Service

21 - 47 High Street, Feltham, Middlesex, TW13 4UN, UK

1709

Accredited to ISO/IEC 17025:2005

The Environmental Consultancy Ltd
trading as RPS Consultants

Issue No: 064 **Issue date:** 17 December 2015

14 Cornhill **London** **EC3V 3ND**	**Contact: Mr S Hurst** **Tel: +44 (0) 20 7280 3200** **Fax: +44 (0) 20 7283 9248** **E-Mail: hursts@rpsgroup.com** **Website: www.rpsgroup.com**

Testing performed by the Organisation at the locations specified below

Locations covered by the organisation and their relevant activities

Laboratory locations:

Location details		Activity	Location code
Address Tern Place Denmore Road Bridge of Don Aberdeen AB23 8JX	**Local contact** Mr I Edmans Tel: +44 (0)845 60 123 88 Fax: +44 (0)1224 706 998 Email: rpsasb@rpsgroup.com	Health and Hygiene	B
Address 14 Cornhill London EC3V 3ND	**Local contact** Mr D Blyton Tel: +44 (0)20 7280 3200 Fax: +44 (0) 20 7283 9248 Email: rpslo@rpsgroup.com	Health and Hygiene Support Functions: Quality Management, including contract review, document control, auditing and quality control	D
Address Noble House Capital Drive Linford Wood Milton Keynes MK14 6QP	**Local contact** Mr B Durden Tel: +44 (0)1235 437 100 Fax: +44 (0)1908 669899 Email: rpsmk@rpsgroup.com	Health and Hygiene	E
Address Suite 4C Rhodes Business Park Silburn Way Middleton Manchester M24 4NE	**Local contact** Mr B Durden Tel: +44 (0) 161 6549069 Fax: +44 (0)161 6436495 Email: rpswn@rpsgroup.com	Health and Hygiene	F

Assessment Manager: L03 Page 1 of 10

1709 Accredited to ISO/IEC 17025:2005	**Schedule of Accreditation** issued by **United Kingdom Accreditation Service** 21 - 47 High Street, Feltham, Middlesex, TW13 4UN, UK **The Environmental Consultancy Ltd** **trading as RPS Consultants** **Issue No:** 064 **Issue date:** 17 December 2015
Testing performed by the Organisation at the locations specified	

Site activities performed away from the locations listed above:

Location details	Activity	Location code
Premises including domestic, commercial and industrial	Health and Hygiene Environmental Sampling and Testing	Aberdeen - I London - K Milton Keynes - L Middleton - M
Customers sites requiring Stack Emissions Testing	Stack emissions Testing	Milton Keynes - L
Mobile Laboratories	Health and Hygiene	London - J

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Accredited to
ISO/IEC 17025:2005

Schedule of Accreditation
issued by
United Kingdom Accreditation Service
21 - 47 High Street, Feltham, Middlesex, TW13 4UN, UK

The Environmental Consultancy Ltd
trading as RPS Consultants

Issue No: 064 **Issue date:** 17 December 2015

Testing performed by the Organisation at the locations specified

DETAIL OF ACCREDITATION

Materials/Products tested	Type of test/Properties measured/Range of measurement	Standard specifications/ Equipment/Techniques used	Location Code
	Health and Hygiene	Health and Safety Executive Asbestos: The analysts' guide for sampling, analysis and clearance procedures (HSG 248)	
ASBESTOS FIBRES IN AIR	Sampling of air for fibre counting	HSG 248:February 2005 (Documented In-House Procedure)	I, K, L, M
	Fibre counting	HSG 248:February 2005 (Documented In-House Procedure)	B, E, F, I, J, K, L, M
	4 Stage Clearance Process	HSG 248:February 2005 (Documented In-House Procedure)	I, K,L, M
ASBESTOS IN BULK MATERIALS including materials and products suspected of containing asbestos	Sampling of bulk materials for asbestos identification	HSG 248:February 2005 (Documented In-House Procedure)	I, K, L, M
	Identification of: Amosite Chrysotile Crocidolite Fibrous Actinolite Fibrous Anthophyllite Fibrous Tremolite	HSG 248:February 2005 (Documented In-House Procedure using stereo-microscopy, polarised light microscopy and dispersion staining)	B, F

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Materials/Products tested	Type of test/Properties measured/Range of measurement	Standard specifications/ Equipment/Techniques used	Location Code
Testing of Stack Emissions to Atmosphere	Sampling with subsequent analysis by an ISO/IEC 17025 accredited laboratory	National, International and other recognised standards using documented in-house work instructions to meet the requirements of DD CEN/TS 15675:2007/ BS EN 15259:2007	
	Gaseous Organic Compounds - sorbent tube method	USEPA Method 18 (RPSCE/1/19a)	L
	Total Particulate Matter (20 to 1000 mg/m^3)	BS ISO 9096:2003 (RPSCE/1/7/d)	L
Testing of Stack Emissions to Atmosphere	Sampling and On-Line Analysis		
	Pressure, Temperature and Velocity	BS EN 13284-1:2002 BS ISO 9096:2003 (RPSCE/1/2)	L
Testing of Stack Emissions to Atmosphere	Sampling with subsequent analysis by an ISO/IEC 17025 accredited laboratory	National, European, International and Environment Agency specified standards including MIDs and documented in-house work instructions to meet the requirements of the Environment Agency (MCERTS) Performance Standard and DD CEN/TS 15675:2007/ BS EN 15259:2007	
	Total Particulate Matter	BS EN 13284-1:2002 (RPSCE/1/7c)	L
	Hydrogen Chloride	BS EN 1911:2010 (RPSCE/1/8b)	L
	Halides and Halogens: Hydrogen Bromide Chlorine Bromine	US EPA Method 26 and 26A (RPSCE/1/8a)	L

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Materials/Products tested	Type of test/Properties measured/Range of measurement	Standard specifications/ Equipment/Techniques used	Location Code
Testing of Stack Emissions to Atmosphere (cont'd)	Sampling with subsequent analysis by an ISO/IEC 17025 accredited laboratory (cont'd)	National, European, International and Environment Agency specified standards including MIDs and documented in-house work instructions to meet the requirements of the Environment Agency (MCERTS) Performance Standard and DD CEN/TS 15675:2007/ BS EN 15259:2007	
	Sulphur dioxide	BS EN 14791:2005 (RPSCE/1/23)	L
	Hydrogen Fluoride	BS ISO 15713:2006 (RPSCE/1/8c)	L
	Mercury	BS EN 13211:2002 (RPSCE/1/9b)	L
	Metals	BS EN 14385:2004 (RPSCE/1/9c)	L
	Dioxins and furans	BS EN 1948-1:2006 (RPSCE/1/10b)	L
	Dioxin-like Polychlorinated Biphenyls (PCBs)	BS EN 1948-4:2010 (RPSCE/1/10b)	L
	Polycyclic Aromatic hydrocarbons (PAH's)	BS ISO 11338-1:2003 (RPSCE/1/10c)	L
	Formaldehyde	US EPA Method 316 (RPSCE/1/22)	L
	Formaldehyde – sorbent tube method	PD CEN/TS 13649:2014 RPSCE/1/19b Rev D	L

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Materials/Products tested	Type of test/Properties measured/Range of measurement	Standard specifications/ Equipment/Techniques used	Location Code
Testing of Stack Emissions to Atmosphere (cont'd)	Sampling with subsequent analysis by an ISO/IEC 17025 accredited laboratory (cont'd)	National, European, International and Environment Agency specified standards including MIDs and documented in-house work instructions to meet the requirements of the Environment Agency (MCERTS) Performance Standard and DD CEN/TS 15675:2007/ BS EN 15259:2007	
	Speciated VOCs (carbon and other suitable tubes) (Dry stacks only): Aliphatic VOCs Aromatic VOCs Aliphatic amines Aromatic amines Cresols Phenols Acetic acid	PD CEN/TS 13649:2014 (RPSCE/1/19b)	L
	Amines (Total aromatic and aliphatic)	PD CEN/TS 13649:2014, NIOSH method 2010 + 2002 (RPSCE/1/19c)	L
	Isocyanates	USEPA Method 207-1 (documented in-house method RPSCE/1/18C)	L
	Isocyanates	USEPA CTM 036 (documented in-house method RPSCE/1/18D Rev A)	L
	Hydrogen cyanide	US EPA OTM 29 (RPSCE/1/16a)	L
	Hydrogen sulphide	US EPA Method 11 (RPSCE/1/17)	L
	Ammonia	BS EN 14791:2005 (RPSCE/1/14b)	L

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Materials/Products tested	Type of test/Properties measured/Range of measurement	Standard specifications/ Equipment/Techniques used	Location Code
Testing of Stack Emissions to Atmosphere (cont'd)	Sampling with subsequent analysis by an ISO/IEC 17025 accredited laboratory (cont'd)	National, European, International and Environment Agency specified standards including MIDs and documented in-house work instructions to meet the requirements of the Environment Agency (MCERTS) Performance Standard and DD CEN/TS 15675:2007/ BS EN 15259:2007	
	$PM_{10}/PM_{2.5}$ at low concentrations (0-40 mg/m^3)	BS EN ISO 23210 (RPSCE/1/26 Rev A)	L
	Chrome VI	USEPA Method 0061 (RPSCE/1/9d Rev A)	L
Testing of Stack Emissions to Atmosphere	Sampling and On-Site Analysis	National, European, International and Environment Agency specified standards including MIDs and Documented In-House work instructions to meet the requirements of the Environment Agency (MCERTS) Performance Standard and DD CEN/TS 15675:2007/ BS EN 15259:2007	
	Water Vapour	BS EN 14790:2005 (RPSCE/1/12b)	L

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Materials/Products tested	Type of test/Properties measured/Range of measurement	Standard specifications/ Equipment/Techniques used	Location Code
Testing of Stack Emissions to Atmosphere (cont'd)	Sampling and On-Line Analysis	National, European, International and Environment Agency specified standards including MIDs and Documented In-House work instructions to meet the requirements of the Environment Agency (MCERTS) Performance Standard and DD CEN/TS 15675:2007/ BS EN 15259:2007	
	Pressure, Temperature and Velocity (Point Velocity Method)	BS EN 16911-1:2013 (RPSCE 1/2 – Differential Pressure Device (Pitot Tube) Method	L
	Water Vapour*	EA TGN M22 (RPSCE/1/24 - Validated FTIR analyser)	L
	Carbon Monoxide*	BS EN 15058:2006 (RPSCE/1/21h - NDIR analyser) EA TGN M22 (RPSCE/1/24 - Validated FTIR analyser)	L
	Carbon Dioxide*	ISO 12039:2001 (RPSCE/1/21e - NDIR analyser) EA TGN M22 (RPSCE/1/24 - FTIR analyser)	L
	Nitrogen Monoxide (NO)*	BS EN 14792:2005 (RPSCE/1/21f - Chemiluminescence analyser) EA TGN M22 (RPSCE/1/24 - Validated FTIR analyser)	L
	Nitrogen Dioxide (NO_2)*	EA TGN M22 (RPSCE/1/24 - Validated FTIR analyser)	L

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Materials/Products tested	Type of test/Properties measured/Range of measurement	Standard specifications/ Equipment/Techniques used	Location Code
Testing of Stack Emissions to Atmosphere (cont'd)	Sampling and On-Line Analysis (cont'd)	National, European, International and Environment Agency specified standards including MIDs and Documented In-House work instructions to meet the requirements of the Environment Agency (MCERTS) Performance Standard and DD CEN/TS 15675:2007/ BS EN 15259:2007	
	Oxides of Nitrogen (NOx)*	BS EN 14792:2005 (RPSCE/1/21f - Chemiluminescence analyser) EA TGN M22 (RPSCE/1/24 - Validated FTIR analyser)	L
	Nitrous Oxide (N_2O)*	EA TGN M22 (RPSCE/1/24 Rev B - Validated FTIR analyser)	L
	Sulphur dioxide*	EA TGN M22 (RPSCE/1/24 - FTIR analyser)	L
	Oxygen*	BS EN 14789:2005 (RPSCE/1/21g - validated Zirconium cell analyser)	L
	Total Gaseous Organic Carbon* (TOC/VOC) (0 to 1000 mg/m³)	BS EN 12619:2013 (RPSCE/1/4b - FID analyser)	L

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Stack Emissions - Continuous Emissions Monitoring Systems (CEMS)	QAL 2 and the Annual Surveillance Test (AST) for CEMS	Documented in house procedure RPSCE/1/25 to meet the requirements of BS EN 14181:2014, Environment Agency MID 14181 (TGN M20 Annex A) and other requirements of the Environment Agency (MCERTS) Performance Standard and DD CEN/TS 15675:2007/ BS EN 15259:2007	L
END			

* - The scale range of the analyser used for this test must be that detailed on its current MCERTS certificate or a range validated by the organisation to meet MCERTS requirements.

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