Particulate Emission Monitor Correlation

Camden Power Station
Stack No. 3
2011
RSL152

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REPORT No.: RSL152
CAMDEN POWER STATION STACK NO. 3 PARTICULATE EMISSION MONITOR CORRELATION SEPTEMBER 2011.

Herewith the finalised report for the particulate emission monitor correlation conducted on Stack No. 3 at Camden Power Station during September 2011.

We thank you for the opportunity to be of service. We trust that your requirements were interpreted correctly. Should you however have any queries, please contact us, we will gladly assist.

Stacklabs

PH Pretorius

REPORT TITLE	:	CAMDEN POWER STATION STACK NO. 3 PARTICULATE EMISSION MONITOR CORRELATION SEPTEMBER 2011
REPORT No.	:	2011/10/30 RSL152
CUSTOMER	:	ESKOM CAMDEN POWER STATION
PURCHASE ORDER No.	:	4501131767
DATE	:	30th of September 2011

SUBMITTED BY	:	PH Pretorius Stacklabs

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REPORT SUMMARY

In order to comply with the ESKOM Standard for Emission Monitoring and Reporting, an ESKOM thermal power plant is obligated to conduct full particulate emission monitor correlations on each particulate emission monitor related to its operation. To this end, Stacklabs, an environmental services company, was contracted by Camden Power Station to complete the full particulate emission monitor correlations on the three stacks at Camden Power Station. The full particulate emission monitor correlation for Stack No. 3 was conducted during September of 2011 and the results thereof have been presented in this report. The results have been summarised as follows:

Stack No. 3
Particulate Emissions monitor correlation
Output No. 1
mg/Nm^3 Dry @ 6% O^2 = 4.4127 * mA ï 16.9507 @ 0 to 0 to 120 SL
Correlation coefficient of 0.98
Output No. 2
mg/Nm^3 Dry @ 6% O^2 = 16.1654 * mA ï 64.0293 @ 0 to 0 to 450 SL
Correlation coefficient of 0.98

The air flow to gas flow correlation for Stack No. 3 is described by the following formulae:
Total Gas Flow Nm_3/s Dry @ 6% O_2 = 1.1373 * Total Air Flow (kg/s) ï 7.2616
With a correlation coefficient of 0.99

It is recommended the particulate emission monitor correlation as presented in Figure No. 1 of this report is used to determine the particulate emissions emitted from Stack No. 3 at Camden Power Station.

It is further recommended that a correlations spot check is conducted on the stacks during the third quarter of 2012.

1. INTRODUCTION

In order to meet requirements of the South African Air Quality Act No. 39 of 2004 as well as the ESKOM Standard for Emission Monitoring and Reporting GST 36-742, an ESKOM thermal power plant is obligated to continuously monitor all particulate emissions released into the atmosphere during production. In addition, both the Air Quality Act and the Eskom GTS 36-742 standards dictate specific requirements relating to the selected methods and equipment that may be utilised during the continuous emission monitoring. Included are requirements for equipment compliance with EN 15267-3 (QAL1) and correlation procedures incorporating ISO 9096, ISO 10155 and the VDI 2066 part 4.

In response to these requirements, ESKOMÕs Camden Power Station, situated near Ermelo in Mpumalanga, contracted Stacklabs, an environmental services company, to conduct two site specific emission monitor correlations in compliance with the ISO 9096, ISO 12141, ISO 10155 and the VDI 2066 part 4.

All the required site measurements for the correlation on Stack No. 3Õs monitor were carried out from the 14th to the 18th September 2011and the relevant results and correlation graphs are presented in this report.

The relationships between a particulate emission monitorÕs output signals and the actual particulate emissions depend on several factors such as particulate size, shape and colour. These factors vary from plant to plant and with operating loads. Specific relationship must therefore be determined for each individual monitor over a range of operating conditions. In addition, correlations of total air flows to total gas flows are also required for the purpose of determining the total particulate emission flow rates. From these correlations, the total gas volumes exhausted into the atmosphere are determined. The product of the gas volume and the particulate dust concentration is the total particulate mass emitted from each stack (plant) per second.

2. METHOD AND PROCEDURES

The particulate emission measurements were carried out employing procedures and equipment that comply with the requirements of ISO 9096 1992 (Reference 1) and the VDI 2066 Part 4 (Reference 2).

The Correlation procedures complied with the requirements of the Eskom standard GST 36-742, Standard for Emission Monitoring and Reporting (Reference 3) from which the following extracts have been taken:

- The actual sampling time is as close as practically possible to 1 hour per test.
- The percentage isokineticity shall be between 95% and 105% for any test to be declared successful.
- The tests will be conducted at what are considered ñormal operating conditionsòas would normally be encountered during day to day operation.
- The resulting correlation coefficient (R) should be greater than 94% for electrostatic precipitators and 90% for fabric filters for the correlation to be considered successful. If the correlation coefficient (R) is less than 94% and 90% respectively, the correlation is invalid and will have to be repeated.

Eskom personnel were responsible for the setting of the ESPs prior to the test period. Stacklabs were contracted to provide the service of monitor correlation through isokinetic dust sampling only.

The broad outlines of filter weighing, pre-test preparations, sampling system integrity checks and sampling procedures are discussed in **Appendix A**.

3. RESULTS

A total of 14 successful isokinetic measurements were conducted on Stack No. 3 between the 14th and 18th of September 2011. Of the 14 measurements, 12 were conducted with quartz filters and 2 with a borosilicate filter. The test co-ordinates included in the final correlations are as follows:

Monitor reading [mA] Output No. 1 [0 to 120 SL]	Monitor reading [%CH] Output No. 2 [0 to 450 SL]	Measured Emission [mg/Nm^3 Dry @ 6% O_2]
9.0	5.3	27.5
8.8	5.3	23.7
9.6	5.5	26.2
9.6	5.5	25.1
9.4	5.5	23.7
9.3	5.5	25.7
9.2	5.4	26.5
10.2	5.7	26.2
10.4	5.7	27.7
10.3	5.7	29.6
9.9	5.6	23.8
10.6	5.8	26.7
10.6	5.8	75.7*
9.2	5.5	68.1*

*Borosilicate filter results

The particulate emission monitor correlation that was conducted with quartz filters is described by the following formulae:

Stack No. 3
Particulate Emissions monitor correlation
Output No. 1
mg/Nm^3 Dry @ 6% O^2 = 4.4127 * mA ï 16.9507 @ 0 to 0 to 120 SL
Correlation coefficient of 0.98
Output No. 2
mg/Nm^3 Dry @ 6% O^2 = 16.1654 * mA ï 64.0293 @ 0 to 0 to 450 SL
Correlation coefficient of 0.98

The air flow to gas flow correlation for Stack No. 3 is described by the following formulae:
Total Gas Flow Nm_3/s Dry @ 6% O_2 = 1.1373 * Total Air Flow (kg/s) ï 7.2616
With a correlation coefficient of 0.99

The detailed results of the correlation measurements for Stack No. 3 have been presented in the following Tables and Figures:

Tables 1 to 3: Correlation Test Results
Table 8 to 10: Boiler Data

Figures 1 & 2: North Stack Particulate Emission Monitor Correlation Graphs
Figure 5: North Stack Total Air Flow to Gas Flow Correlation Graph

The following abbreviations were used in the text, tables and figures:

PJFF	Pulse Jet Fabric Filter
MCR	Maximum Continuous Rating
°C	Degrees Celsius
% v/v	Percentage on a Volume-by-Volume basis
Am^3	**Actual** Cubic Metres
Nm^3	**Normal** Cubic Metres
Sm^3	**Standard** Cubic Meters
g/s	Grams per second
mg/s	Milligrams per second
Fo	Fields out

- **'Actual'** refers to the measured temperature and pressure conditions of the gases in the duct
- **'Normal'** refers to the actual conditions being normalised to 0 °C and 101,325 kPa.
- **'Standard'** refers to the actual conditions being converted to 0 °C and 101,325 kPa (This is the preferred description used by Eskom).

4 DISCUSSION

The particulate emission monitor correlations of Stack No. 3's monitors at Camden Power Station were completed during September of 2011. The correlation included 12 measurements which were completed with quartz filters. These measurements produced average particulate emission concentrations that ranged from 23.7 to 29.6 mg/Nm^3 Dry @ 6% O_2 and average gas flow rates which ranged from 369.6 to 508.13 Nm^3/s Dry @ 6% O_2. The monitor readings from Output No. 1 ranged from 8.8 to 10.6 mA with an average value of 9.7 mA. The correlation for Output No. 1 is presented in Figure No. 1 with the selected range of 0 to 120 Scattered Light value which produced the required output range of approximately 33 %. The second monitor output was selected to a range of 0 to 450 Scattered Light value and a correlation based on this outputs values is presented in Figure No. 2.

In addition to the quartz filter correlations, correlations were derived from measurements which were conducted with a borosilicate filter (Figure No. 3 & 4). These correlations are not to be implemented and have been provided for information only. The result of these correlations produced concentrations of approximately 46 mg/Nm^3 Dry @ 6% O_2 greater than the equivalent result from the quartz filter correlations.

The two quartz filter correlations as presented in Figures No. 1 & 2 of this report are representative of the conditions on Stack No. 3 during the correlation periods. The two correlations meet the requirements of the ESKOM standard and must be implemented, if utilised, without modification. The correlations will remain valid as long as the conditions on the plant remain within the parameters that were encountered during the September correlation period.

The Total Air Flow to Gas Flow correlation for this stack is presented in Figure No. 5 and provides the Gas Flow in Nm^3/s Dry corrected for 6% oxygen and may be used with the particulate emission monitor correlations to calculate the total emission flow rate.

5. RECOMMENDATION

It is recommended that:

5.1 The particulate emission monitor correlations as presented in this report (Figures No. 1 & 2) are used to determine the particulate emissions emitted from Stack No. 3 at Camden Power Station.

5.2 Correlation spot checks are conducted on this stack monitor during the third quarter of 2012.

6. ACKNOWLEDGEMENTS

The author expresses sincere appreciation for the co-operation of Eskom's personnel during the test period.

7. REFERENCES

7.1. ISO 9096 Stationary source emission ï Determination of concentration and mass flow rate of particulate material in gas-carrying ducts ï Manual gravimetric method

7.2. German VDI 2066 part 4, 1989, Determination of dust load by continuous measurement of optical transmission.

7.3. ESKOM Standard for Emission Monitoring and Reporting GTS 36-742 1086.

Table No. 1
Stack No. 3 Particulate Emission Monitor Correlation
Test Results Tests No. 1 to 4 (Quartz)

Station		Camden	Camden	Camden	Camden
Unit No.		5 & 6	5 & 6	5 & 6	5 & 6
Location		Stack No. 3	Stack No. 3	Stack No. 3	Stack No. 3
Test No.		1	2	3	4
Date	yyyy/mm/dd	2011/09/14	2011/09/14	2011/09/15	2011/09/15
Start Time	00H00	11H40	13H33	09H00	10H35
End Time	00H00	12H52	14H45	10H11	11H45
Boiler Load	MW	n/a	n/a	348	344
Gas Temperature	°C	125	123	116	117
Barometric pressure	kPa (g)	83.7	83.7	83.7	83.7
Duct pressure	Pa	-102.7	-102.2	-86.0	-52.5
Duct pressure	kPa (abs)	83.6	83.6	83.6	83.6
Moisture	%v/v	7.0	4.2	7.2	4.8
Oxygen	%	7.7	7.7	7.6	7.4
Nozzle diameter	mm	10.0	10.0	10.0	10.0
Sample Time	min	60	60	60	60
Average Face velocity 30x100	m/s	0.093	0.101	0.098	0.099
Average Face velocity 53x135	m/s	0.037	0.040	0.039	0.039
Total Dust Mass	g	0.03264	0.03125	0.03363	0.03373
Velocity	m/s	8.6	9.6	9.2	9.4
Gas Volume Flow	Am^3/s	837.8	938.0	900.2	913.9
Gas Volume Flow	Nm^3/s	473.7	534.1	520.8	527.6
Gas Volume Flow Dry	Nm^3/s	440.8	511.8	483.0	502.3
Gas Volume Flow Dry @ 6% O_2	Nm^3/s	392.3	452.5	432.8	456.1
Gas Volume Sampled	Am^3 (wet)	2.5347	2.7342	2.6725	2.6945
Gas Volume Sampled	Nm^3 (wet)	1.4332	1.5568	1.5462	1.5555
Gas Volume Sampled	Am^3 (dry)	2.3585	2.6205	2.4788	2.5651
Gas Volume Sampled	Nm^3 (dry)	1.3336	1.4921	1.4341	1.4808
Dust Concentration Corrected for 6% O_2	mg/Am^3 (wet)	14.5	12.9	14.0	13.8
Dust Concentration Corrected for 6% O_2	mg/Nm^3 (wet)	25.6	22.7	24.3	23.9
Dust Concentration Corrected for 6% O_2	mg/Am^3 (dry)	15.6	13.5	15.1	14.5
Dust Concentration Corrected for 6% O_2	mg/Nm^3 (dry)	27.5	23.7	26.2	25.1
Dust Concentration	mg/Am^3 (wet)	12.9	11.4	12.6	12.5
Dust Concentration	mg/Nm^3 (wet)	22.8	20.1	21.8	21.7
Dust Concentration	mg/Am^3 (dry)	13.8	11.9	13.6	13.2
Dust Concentration	mg/Nm^3 (dry)	24.5	20.9	23.5	22.8
Outlet Dust Flowrate	g/s	10.8	10.7	11.3	11.4
Stack Diameter	m	11.1	11.1	11.1	11.1
Duct Area	m^2	97.47	97.47	97.47	97.47
Monitor Signal Output No. 1 Average	mA	9.0	8.8	9.6	9.6
Monitor Signal Output No. 2 Average	mA	5.3	5.3	5.5	5.5
Isokineticity	%	104.3	100.5	102.3	101.6

Note: Dust Concentration [mg/Nm^3] is the measured dust concentration Normalised to gas conditions at 0°C and 101,325 kPa.

Table No. 2
Stack No. 3 Particulate Emission Monitor Correlation
Test Results Tests No. 5, 7, 8 & 9 (Quartz)

Station		Camden	Camden	Camden	Camden
Unit No.		5 & 6	5 & 6	5 & 6	5 & 6
Location		Stack No. 3	Stack No. 3	Stack No. 3	Stack No. 3
Test No.		5	7	8	9
Date	yyyy/mm/dd	2011/09/15	2011/09/16	2011/09/16	2011/09/17
Start Time	00H00	12H05	11H32	13H14	09H10
End Time	00H00	13H21	12H55	14H27	10H58
Boiler Load	MW	338	371	370	302
Gas Temperature	°C	119	118	118	116
Barometric pressure	kPa (g)	83.7	83.7	83.7	83.7
Duct pressure	Pa	-53.8	-124.0	-128.5	-106.2
Duct pressure	kPa (abs)	83.6	83.6	83.6	83.6
Moisture	%v/v	4.0	3.8	4.1	8.0
Oxygen	%	7.3	7.0	7.0	7.5
Nozzle diameter	mm	10.0	12.0	12.0	7.0
Sample Time	min	60	60	60	90
Average Face velocity 30x100	m/s	0.100	0.151	0.151	0.046
Average Face velocity 53x135	m/s	0.039	0.060	0.059	0.018
Total Dust Mass	g	0.03238	0.05443	0.05597	0.02369
Velocity	m/s	9.4	10.0	10.1	9.1
Gas Volume Flow	Am^3/s	917.3	970.4	988.2	885.9
Gas Volume Flow	Nm^3/s	527.7	558.6	568.6	513.5
Gas Volume Flow Dry	Nm^3/s	506.5	537.4	545.2	472.6
Gas Volume Flow Dry @ 6% O_2	Nm^3/s	463.0	500.9	508.1	426.3
Gas Volume Sampled	Am^3 (wet)	2.7055	4.1019	4.1007	1.8801
Gas Volume Sampled	Nm^3 (wet)	1.5563	2.3612	2.3595	1.0898
Gas Volume Sampled	Am^3 (dry)	2.5972	3.9462	3.9319	1.7302
Gas Volume Sampled	Nm^3 (dry)	1.4940	2.2716	2.2624	1.0030
Dust Concentration Corrected for 6% O_2	mg/Am^3 (wet)	13.1	14.2	14.6	14.0
Dust Concentration Corrected for 6% O_2	mg/Nm^3 (wet)	22.8	24.7	25.5	24.1
Dust Concentration Corrected for 6% O_2	mg/Am^3 (dry)	13.6	14.8	15.3	15.2
Dust Concentration Corrected for 6% O_2	mg/Nm^3 (dry)	23.7	25.7	26.5	26.2
Dust Concentration	mg/Am^3 (wet)	12.0	13.3	13.6	12.6
Dust Concentration	mg/Nm^3 (wet)	20.8	23.1	23.7	21.7
Dust Concentration	mg/Am^3 (dry)	12.5	13.8	14.2	13.7
Dust Concentration	mg/Nm^3 (dry)	21.7	24.0	24.7	23.6
Outlet Dust Flowrate	g/s	11.0	12.9	13.5	11.2
Stack Diameter	m	11.1	11.1	11.1	11.1
Duct Area	m^2	97.47	97.47	97.47	97.47
Monitor Signal Output No. 1 Average	mA	9.4	9.3	9.2	10.2
Monitor Signal Output No. 2 Average	mA	5.5	5.5	5.4	5.7
Isokineticity	%	101.7	101.2	99.3	99.5

Note: Dust Concentration [mg/Nm^3] is the measured dust concentration Normalised to gas conditions at 0°C and 101,325 kPa.

Table No. 3
Stack No. 3 Particulate Emission Monitor Correlation
Test Results Tests No. 10 to 13 (Quartz)

Station		Camden	Camden	Camden	Camden
Unit No.		5 & 6	5 & 6	5 & 6	5 & 6
Location		Stack No. 3	Stack No. 3	Stack No. 3	Stack No. 3
Test No.		10	11	12	13
Date	yyyy/mm/dd	2011/09/17	2011/09/17	2011/09/18	2011/09/18
Start Time	00H00	11H18	12H54	09H30	11H31
End Time	00H00	12H30	14H10	10H43	12H40
Boiler Load	MW	303	305	227	230
Gas Temperature	°C	115	116	117	107
Barometric pressure	kPa (g)	83.7	83.7	83.7	83.7
Duct pressure	Pa	-112.0	-113.3	-74.5	-71.0
Duct pressure	kPa (abs)	83.6	83.6	83.6	83.6
Moisture	%v/v	4.7	5.4	5.0	4.3
Oxygen	%	7.3	7.6	7.6	7.7
Nozzle diameter	mm	9.0	9.0	9.0	9.0
Sample Time	min	60	60	60	60
Average Face velocity 30x100	m/s	0.084	0.070	0.068	0.063
Average Face velocity 53x135	m/s	0.033	0.028	0.027	0.025
Total Dust Mass	g	0.03189	0.02772	0.02156	0.02317
Velocity	m/s	9.8	8.8	8.1	7.5
Gas Volume Flow	Am^3/s	951.9	855.3	785.3	731.8
Gas Volume Flow	Nm^3/s	552.9	495.5	454.0	433.9
Gas Volume Flow Dry	Nm^3/s	526.8	468.8	431.2	415.3
Gas Volume Flow Dry @ 6% O_2	Nm^3/s	481.5	420.0	386.4	369.6
Gas Volume Sampled	Am^3 (wet)	2.2737	1.9099	1.8407	1.7212
Gas Volume Sampled	Nm^3 (wet)	1.3206	1.1065	1.0642	1.0205
Gas Volume Sampled	Am^3 (dry)	2.1665	1.8067	1.7480	1.6477
Gas Volume Sampled	Nm^3 (dry)	1.2584	1.0467	1.0107	0.9769
Dust Concentration Corrected for 6% O_2	mg/Am^3 (wet)	15.3	16.2	13.1	15.1
Dust Concentration Corrected for 6% O_2	mg/Nm^3 (wet)	26.4	28.0	22.6	25.5
Dust Concentration Corrected for 6% O_2	mg/Am^3 (dry)	16.1	17.1	13.8	15.8
Dust Concentration Corrected for 6% O_2	mg/Nm^3 (dry)	27.7	29.6	23.8	26.7
Dust Concentration	mg/Am^3 (wet)	14.0	14.5	11.7	13.5
Dust Concentration	mg/Nm^3 (wet)	24.1	25.0	20.3	22.7
Dust Concentration	mg/Am^3 (dry)	14.7	15.3	12.3	14.1
Dust Concentration	mg/Nm^3 (dry)	25.3	26.5	21.3	23.7
Outlet Dust Flowrate	g/s	13.4	12.4	9.2	9.9
Stack Diameter	m	11.1	11.1	11.1	11.1
Duct Area	m^2	97.47	97.47	97.47	97.47
Monitor Signal Output No. 1 Average	mA	10.4	10.3	9.9	10.6
Monitor Signal Output No. 2 Average	mA	5.7	5.7	5.6	5.8
Isokineticity	%	101.6	95.0	99.8	100.1

Note: Dust Concentration [mg/Nm^3] is the measured dust concentration Normalised to gas conditions at 0°C and 101,325 kPa.

Table No. 4
Stack No. 3 Particulate Emission Monitor Correlation
Test Results Tests No. 14 & 6 Borosilicate Test

Station		Camden	Camden
Unit No.		5 & 6	5 & 6
Location		Stack No. 3	Stack No. 3
Test No.		14	6
Date	yyyy/mm/dd	2011/09/18	2011/09/16
Start Time	00H00	13H00	09H53
End Time	00H00	14H06	11H10
Boiler Load	MW	230	363
Gas Temperature	°C	107	117
Barometric pressure	kPa (g)	83.7	83.7
Duct pressure	Pa	-71.0	-112.5
Duct pressure	kPa (abs)	83.6	83.6
Moisture	%v/v	4.8	4.4
Oxygen	%	7.7	7.6
Nozzle diameter	mm	12.0	12.0
Sample Time	min	60	60
Average Face velocity 30x100	m/s	0.121	0.143
Average Face velocity 53x135	m/s	0.047	0.056
Total Dust Mass	g	0.12361	0.13127
Velocity	m/s	7.7	9.7
Gas Volume Flow	Am^3/s	748.3	940.8
Gas Volume Flow	Nm^3/s	443.4	543.6
Gas Volume Flow Dry	Nm^3/s	422.1	519.6
Gas Volume Flow Dry @ 6% O_2	Nm^3/s	373.1	465.5
Gas Volume Sampled	Am^3 (wet)	3.2735	3.8933
Gas Volume Sampled	Nm^3 (wet)	1.9398	2.2497
Gas Volume Sampled	Am^3 (dry)	3.1159	3.7209
Gas Volume Sampled	Nm^3 (dry)	1.8464	2.1501
Dust Concentration Corrected for 6% O_2	mg/Am^3 (wet)	42.7	37.6
Dust Concentration Corrected for 6% O_2	mg/Nm^3 (wet)	72.1	65.1
Dust Concentration Corrected for 6% O_2	mg/Am^3 (dry)	44.9	39.4
Dust Concentration Corrected for 6% O_2	mg/Nm^3 (dry)	75.7	68.1
Dust Concentration	mg/Am^3 (wet)	37.8	33.7
Dust Concentration	mg/Nm^3 (wet)	63.7	58.3
Dust Concentration	mg/Am^3 (dry)	39.7	35.3
Dust Concentration	mg/Nm^3 (dry)	66.9	61.1
Outlet Dust Flowrate	g/s	28.3	31.7
Stack Diameter	m	11.1	11.1
Duct Area	m^2	97.47	97.47
Monitor Signal Output No. 1 Average	mA	10.6	9.2
Monitor Signal Output No. 2 Average	mA	5.8	5.5
Isokineticity	%	104.7	99.1

Note: Dust Concentration [mg/Nm^3] is the measured dust concentration Normalised to gas conditions at 0°C and 101,325 kPa.

Table No.5
Unit No. 5
Boiler Data Tests No. 1 to 14

		5 0MKA10 CE901T XQ01	5 0HHY00 DU010 XQ04	5 0HLA00 CF901 XQ01
		GENERATOR MW	TOTAL COAL FLOW	TOTAL AIR FLOW
	Test No.	MW	kg/s	kg/s
Test 1	1	No Data	No Data	No Data
Test 2	2	No Data	No Data	No Data
Test 3	3	177.83	26.76	222.17
Test 4	4	173.96	25.95	222.32
Test 5	5	167.82	24.83	218.33
Test 6	6	184.07	24.57	222.87
Test 7	7	191.34	25.53	233.00
Test 8	8	190.33	25.51	230.44
Test 9	9	157.20	21.07	213.40
Test 10	10	157.86	21.35	214.04
Test 11	11	159.91	21.61	214.43
Test 12	12	116.83	16.67	162.71
Test 13	13	118.99	16.97	163.69
Test 14	14	118.37	16.76	163.84

		5 0HNA10 CT903 XQ01	5 0HNA20 CT903 XQ01	5 0HNA10 CQ901 XQ01
		FFP INLET T AVE LH	FFP INLET T AVE RH	LH AVG O2
	Test No.			%
Test 1	1	No Data	No Data	No Data
Test 2	2	No Data	No Data	No Data
Test 3	3	159.87	155.51	3.13
Test 4	4	158.26	154.49	3.11
Test 5	5	160.18	155.37	3.16
Test 6	6	153.84	153.63	3.12
Test 7	7	156.80	156.95	3.00
Test 8	8	153.92	153.99	3.02
Test 9	9	153.58	152.89	5.56
Test 10	10	154.60	153.63	5.33
Test 11	11	156.42	155.35	5.11
Test 12	12	142.01	137.72	4.41
Test 13	13	142.16	136.23	4.36
Test 14	14	142.94	137.94	4.38

		5 0HNA20 CQ901 XQ01	5 0HLB10 CE201 XQ01	5 0HLB20 CE201 XQ01
		RH AVG O2	LH FD FAN MTR AMPS	RH FD FAN MTR AMPS
	Test No.	%	A	A
Test 1	1	No Data	No Data	No Data
Test 2	2	No Data	No Data	No Data
Test 3	3	4.53	168.79	167.78
Test 4	4	4.58	164.00	162.56
Test 5	5	4.98	160.07	159.64
Test 6	6	4.08	160.91	160.39
Test 7	7	3.82	171.58	170.31
Test 8	8	3.82	169.14	167.69
Test 9	9	3.28	153.21	152.70
Test 10	10	3.27	152.32	153.22
Test 11	11	3.26	153.22	154.24
Test 12	12	7.41	127.05	124.05
Test 13	13	7.15	128.12	126.06
Test 14	14	7.21	128.07	126.14

Table No.6
Unit No. 6
Boiler Data Tests No. 1 to 14

		6 0MKA10 CE901T XQ01	6 0HHY00 DU010 XQ04	6 0HLA00 CF901 XQ01
		GENERATOR MW	TOTAL COAL FLOW	TOTAL AIR FLOW
	Test No.	MW	kg/s	kg/s
Test 1	1	190.08	27.20	210.04
Test 2	2	189.82	27.40	208.76
Test 3	3	170.01	25.11	186.02
Test 4	4	170.08	25.05	185.71
Test 5	5	170.00	24.98	185.39
Test 6	6	179.39	27.44	199.68
Test 7	7	179.58	27.43	199.78
Test 8	8	179.92	27.43	199.62
Test 9	9	144.94	21.52	165.75
Test 10	10	144.64	21.80	166.67
Test 11	11	145.13	21.91	167.18
Test 12	12	110.55	16.62	136.20
Test 13	13	111.08	17.06	138.83
Test 14	14	111.30	16.90	137.63

		6 0HNA10 CT903 XQ01	6 0HNA20 CT903 XQ01	6 0HNA10 CQ901 XQ01
		FFP INLET T AVE LH	FFP INLET T AVE RH	LH AVG O2
	Test No.			%
Test 1	1	150.56	149.62	3.40
Test 2	2	152.31	152.08	3.41
Test 3	3	140.91	145.70	4.30
Test 4	4	144.80	149.26	4.47
Test 5	5	145.09	149.78	4.42
Test 6	6	146.96	149.31	4.40
Test 7	7	148.31	150.75	4.37
Test 8	8	150.06	152.28	4.43
Test 9	9	139.10	143.44	4.43
Test 10	10	140.12	145.05	4.53
Test 11	11	140.91	144.85	4.49
Test 12	12	132.52	139.11	5.96
Test 13	13	127.92	137.45	5.98
Test 14	14	129.06	138.73	6.08

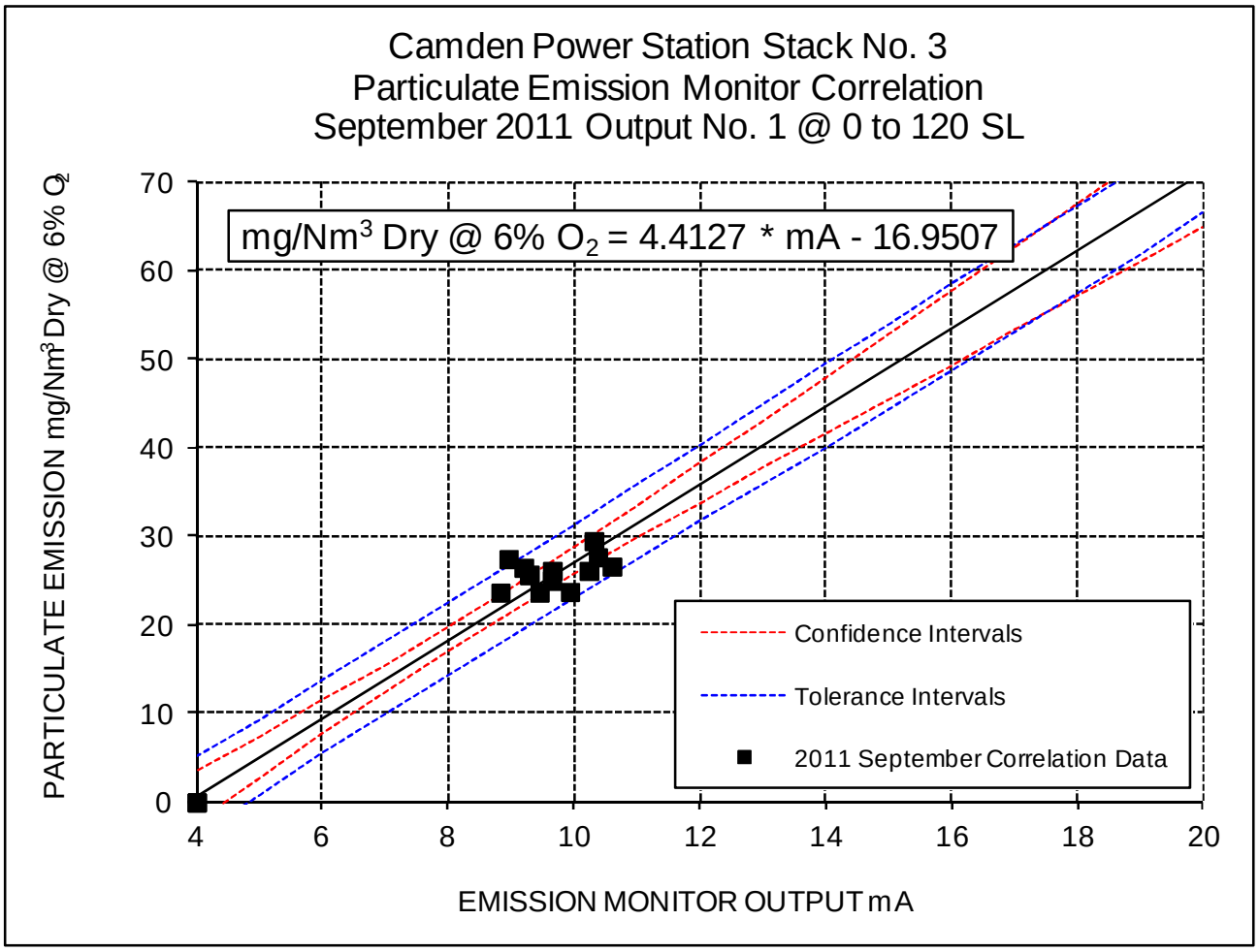
		6 0HNA20 CQ901 XQ01	6 0HLB10 CE201 XQ01	6 0HLB20 CE201 XQ01
		RH AVG O2	LH FD FAN MTR AMPS	RH FD FAN MTR AMPS
	Test No.	%	A	A
Test 1	1	5.16	151.70	164.73
Test 2	2	5.06	151.18	165.02
Test 3	3	4.75	136.65	148.80
Test 4	4	4.98	138.25	150.89
Test 5	5	4.63	136.20	148.91
Test 6	6	5.53	146.04	160.13
Test 7	7	5.69	147.37	161.32
Test 8	8	5.63	147.43	161.94
Test 9	9	6.00	125.83	138.14
Test 10	10	5.82	125.83	138.51
Test 11	11	5.69	126.21	137.73
Test 12	12	7.28	113.68	124.92
Test 13	13	7.23	114.61	126.84
Test 14	14	6.91	115.21	126.68

Camden Power Station Stack no. 3
Particulate Emission Monitor Correlation

Plant: Camden PS
Location: North Stack
Monitor information:
Make of Monitor: Sick
Model: SP100
Serial Number: 10038613
Monitor setting: Output 1 (0 ï 120 SL)

Dates:
Calibration date: n/a
Correlation dates: 14th to 18th September 2011
Correlation Coefficient: 0.98

Operational data:
Operating Range: 0 ï 71.3 [mg/Nm^3 dry @ 6% O_2]
Limits of validity: [as an hourly average]
Lower limit: 23.7 [mg/Nm^3 dry @ 6% O_2]
Upper limit: 29.6 [mg/Nm^3 dry @ 6% O_2]
Linear function:
E = 4.4127 * x ï 16.9507
where: E = Emission [mg/Nm^3 dry @ 6% O_2]
x = Monitor output [mA]
Quartz Filters



This correlation was produced as described in the German VDI guide with reference to the zero point hypotheses.

FIGURE 1
Prepared by: Stacklabs report No. RSL154

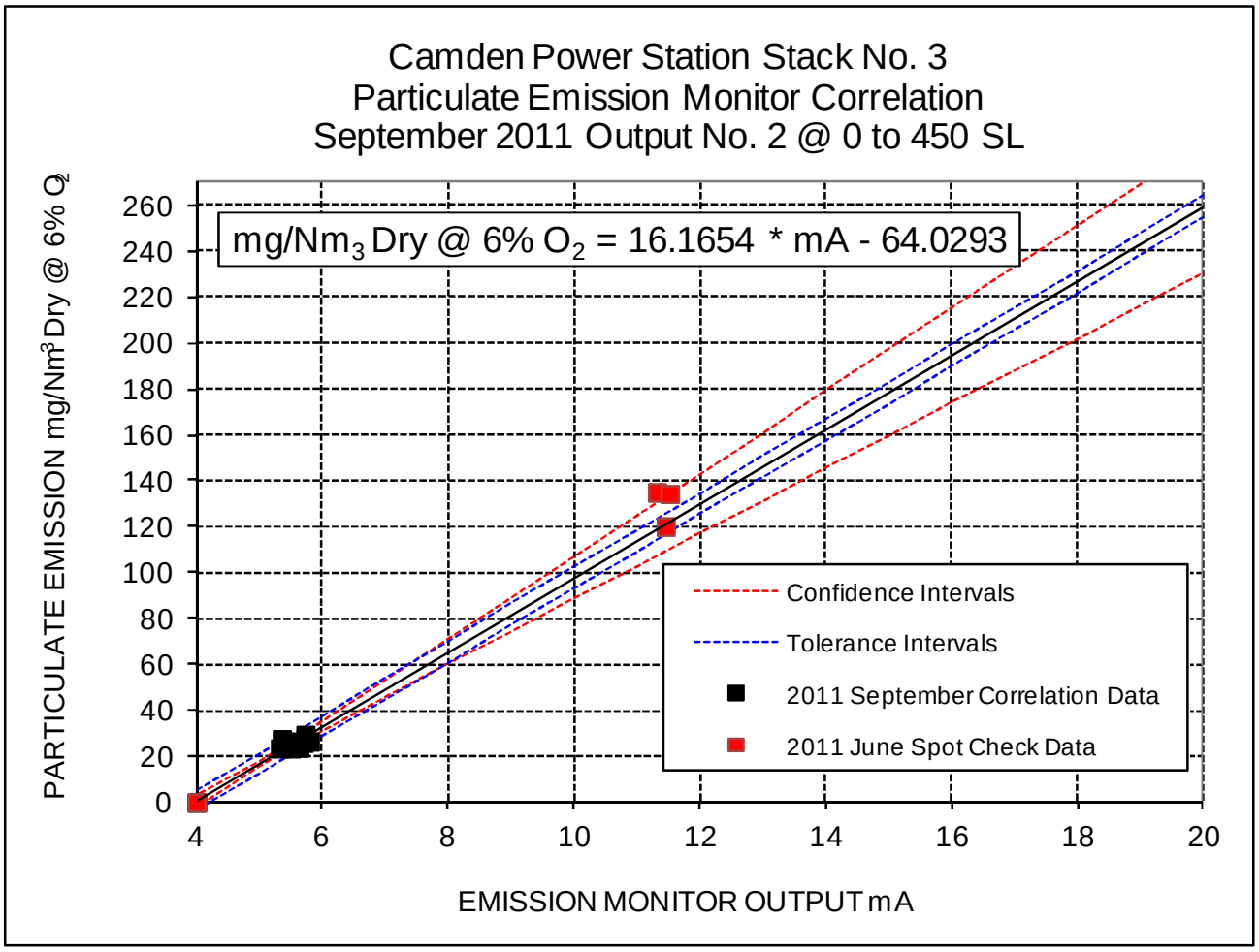
ISO 9096, 12141 & 10155
ISO 9096:2003(E)
Stacklabs ISO #:825268/:2007-05-23 © ISO 2003

Camden Power Station Stack No. 3
Particulate Emission Monitor Correlation

Plant: Camden PS
Location: North Stack
Monitor information:
Make of Monitor: Sick
Model: SP100
Serial Number: 10038613
Monitor setting: Output 2 (0 ï 450 SL)

Dates:
Calibration date: n/a
Correlation dates: 14th to 18th September 2011
Correlation Coefficient: 0.98

Operational data:
Operating Range: 0 ï 259.3 [mg/Nm^3 dry @ 6% O_2]
Limits of validity: [as an hourly average]
Lower limit: 23.7 [mg/Nm^3 dry @ 6% O_2]
Upper limit: 29.6 [mg/Nm^3 dry @ 6% O_2]
Linear function:
E = 4.4127 * x ï 16.9507
where: E = Emission [mg/Nm^3 dry @ 6% O_2]
x = Monitor output [mA]
Quartz Filters



This correlation was produced as described in the German VDI guide with reference to the zero point hypotheses.

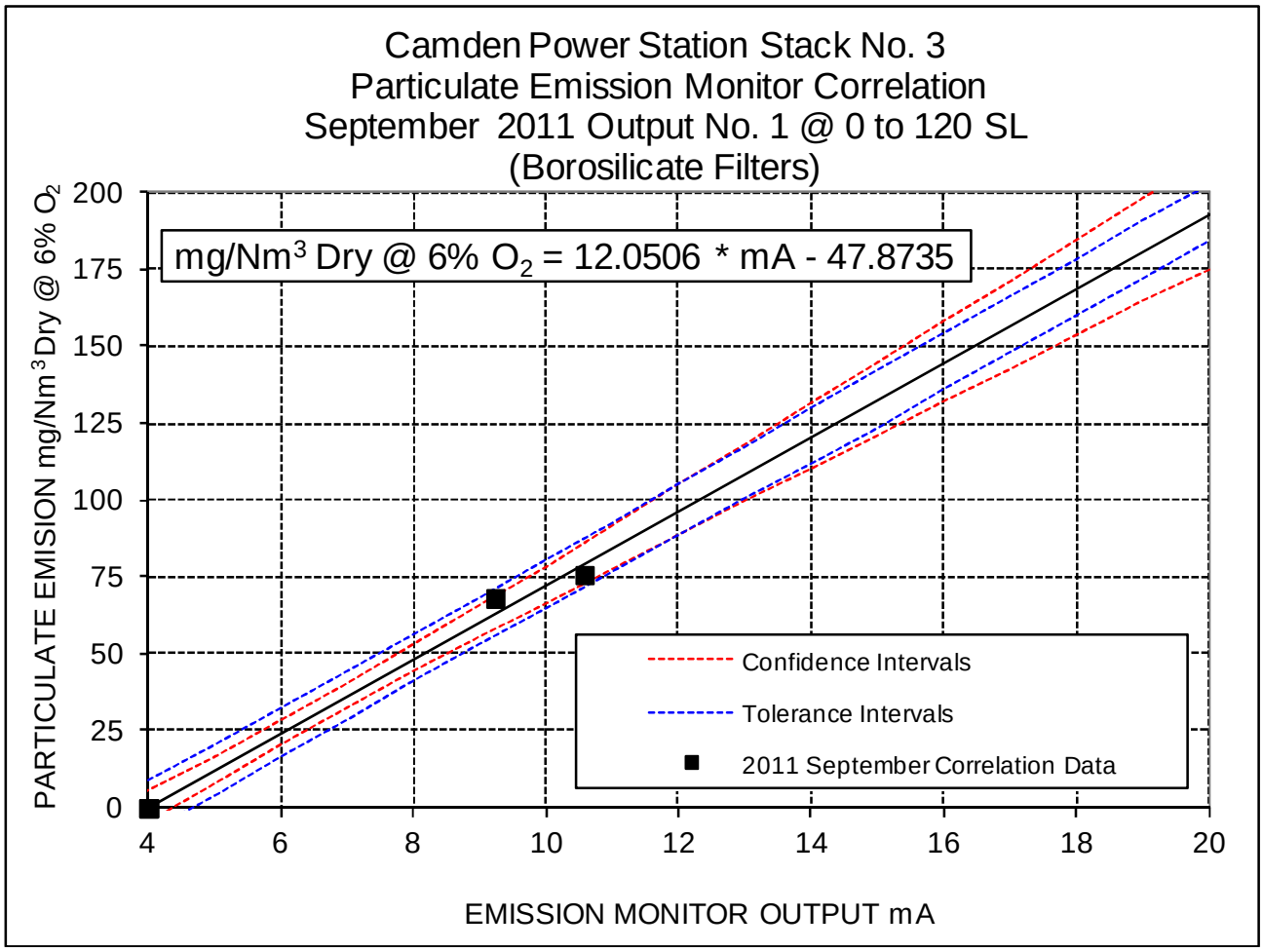
FIGURE 2
Prepared by: Stacklabs report No. RSL154

Camden Power Station Stack No. 3
Particulate Emission Monitor Correlation

Plant: Camden PS
Location: North Stack
Monitor information:
Make of Monitor: Sick
Model: SP100
Serial Number: 10038613
Monitor setting: Output 1 (0 ï 120 SL)

Dates:
Calibration date: n/a
Correlation dates: 16th to 18th September 2011
Correlation Coefficient: 0.98

Operational data:
Operating Range: 0 ï 193.1 [mg/Nm^3 dry @ 6% O_2]
Limits of validity: [as an hourly average]
Lower limit: 68.1 [mg/Nm^3 dry @ 6% O_2]
Upper limit: 75.7 [mg/Nm^3 dry @ 6% O_2]
Linear function:
E = 12.0506 * x ï 47.8735
where: E = Emission [mg/Nm^3 dry @ 6% O_2]
x = Monitor output [mA]
Borosilicate Filters



This correlation was produced as described in the German VDI guide with reference to the zero point hypotheses.

FIGURE 3
Prepared by: Stacklabs report No. RSL154

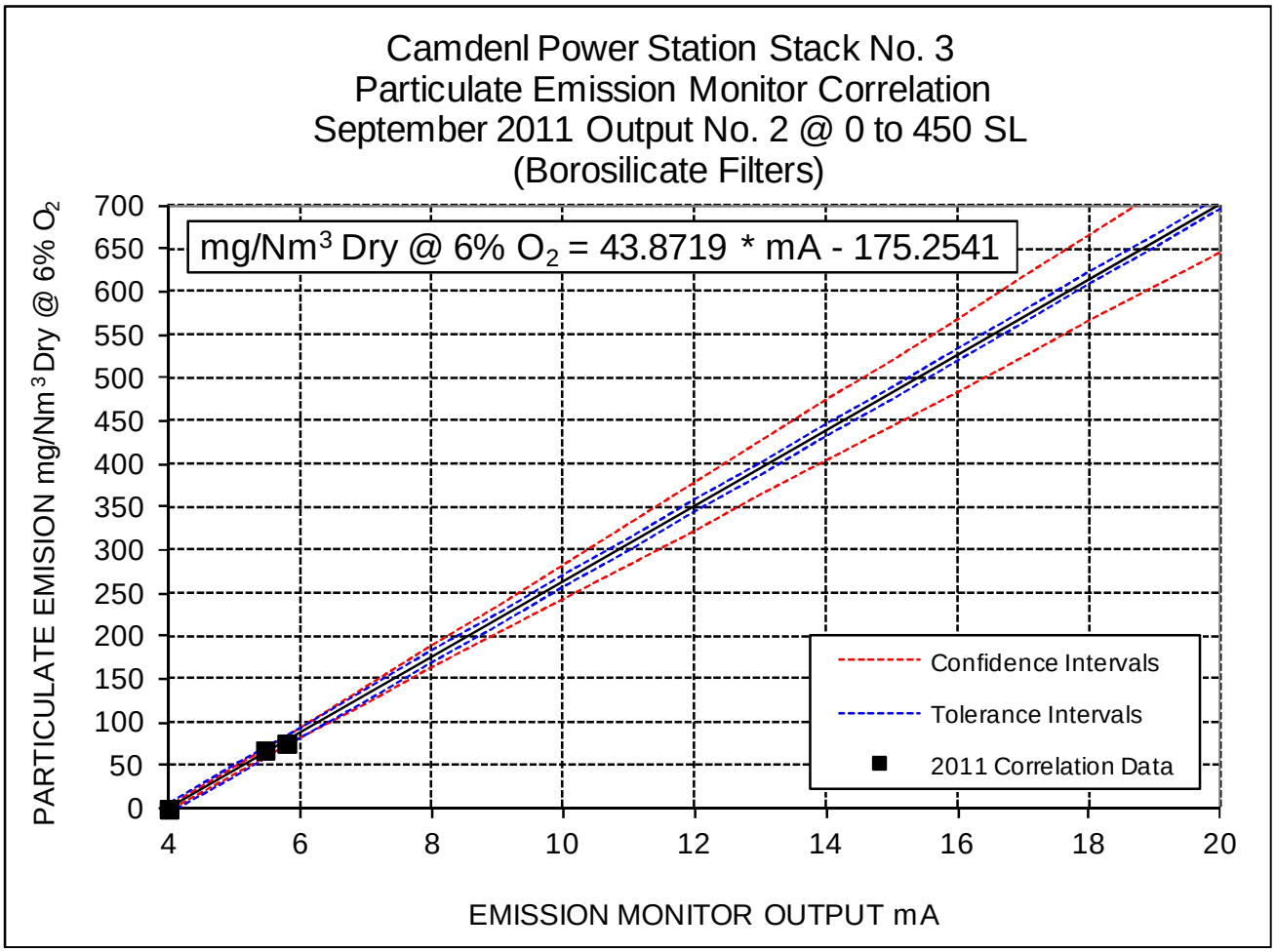
ISO 9096, 12141 & 10155
ISO 9096:2003(E)
Stacklabs ISO #:825268/:2007-05-23 © ISO 2003

Camden Power Station Stack No. 3
Particulate Emission Monitor Correlation

Plant: Camden PS
Location: North Stack
Monitor information:
Make of Monitor: Sick
Model: SP100
Serial Number: 10038613
Monitor setting: Output 2 (0 ï 450 SL)

Dates:
Calibration date: n/a
Correlation dates: 16th to 18th September 2011
Correlation Coefficient: 0.99

Operational data:
Operating Range: 0 ï 702.2 [mg/Nm^3 dry @ 6% O_2]
Limits of validity: [as an hourly average]
Lower limit: 68.1 [mg/Nm^3 dry @ 6% O_2]
Upper limit: 75.7 [mg/Nm^3 dry @ 6% O_2]
Linear function:
E = 43.8719 * x ï 175.2541
where: E = Emission [mg/Nm^3 dry @ 6% O_2]
x = Monitor output [mA]
Borosilicate Filters



This correlation was produced as described in the German VDI guide with reference to the zero point hypotheses.

FIGURE 4
Prepared by: Stacklabs report No. RSL154

ISO 9096, 12141 & 10155
ISO 9096:2003(E)
Stacklabs ISO #:825268/:2007-05-23 © ISO 2003

Camden Power Station Stack No. 3

Air Flow to Gas flow Correlation

Plant: Camden PS
Location: Stack
Monitor information:
Make of Monitor: N/A
Model: N/A
Serial Number: N/A
Monitor setting: N/A
Dates:
Calibration date: N/A

Correlation dates: 14th to 18th September 2011
Correlation Coefficient: 0.99

Operational data:
Operating Range: 350 to 550 Nm^3/s Dry 6% O_2
Limits of validity : [as an hourly average]
Lower limit: 369.6 Nm^3/s Dry 6% O_2
Upper limit: 508.1 Nm^3/s Dry 6% O_2
Linear function:
E = 1.1373 * x ï 7.2616
where: E = Gas Flow [Nm^3/s Dry 6% O_2]
x = Total Air Flow [kg/s]

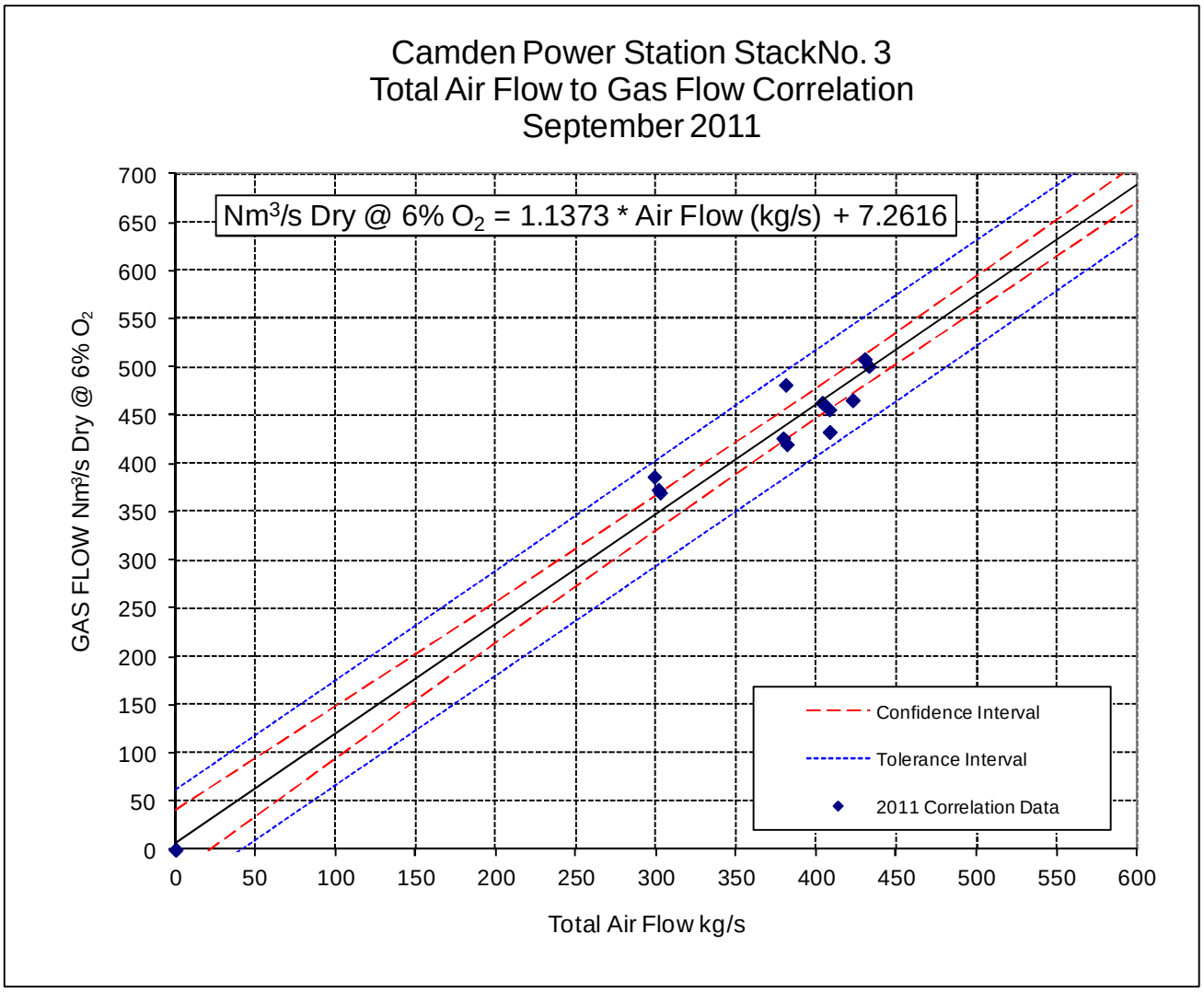


FIGURE 5
Prepared by: Stacklabs report No. RPHP141

ISO 9096, 12141 & 10155
ISO 9096:2003(E)
Stacklabs ISO #:825268/:2007-05-23 © ISO 2003

APPENDIX A

ISOKINETIC DUST SAMPLING PROCEDURES

1. FILTER WEIGHING

Before the test, the filters are prepared. The required amount of filters are marked with a unique number and set out for conditioning in a weighing room of which the humidity and temperature are controlled. After the conditioning period, the filters are weighed and packed for transportation. Reference filters are treated the same as those earmarked for the tests, but not used on site.

After the tests, the used and reference filters are set out again in the laboratory and allowed to condition to the laboratory ambient conditions. The laboratory conditions remain constant, but a small variation in moisture might be reflected by the reference filters, in which case adjustment for the change in moisture may be implemented

2. PRE-TEST PREPARATIONS

On site, the equipment is set up at the measuring location. The inside dimensions of the duct are determined. The number of test points per traverse is determined according to the standards and the sampling probe marked accordingly

2.1. SAMPLING SYSTEM INTEGRITY

A leak check is performed on the impulse lines to ensure measurement integrity.

With each change in filter or any other operation, which might influence the integrity of the vacuum system, a vacuum check is performed. This ensures that only the gas, which entered the nozzle, will be measured by the gas test meter.

3. SAMPLING PROCEDURE

Gas temperature, pressure and velocity head readings are logged at each sampling point. Velocity head readings are updated at intervals of 1 minute. During this time, the computer calculates the orifice flow settings, required for isokineticity and the flow is adjusted accordingly with each update.

Oxygen in the flue gas is measured to determine gas density.

A calibrated orifice flow meter is used to facilitate the adjustment of the sampling flow rate at one-minute intervals. The relevant parameters for flow calculation are entered into the computer. The computer is programmed to determine the flow rate through the orifice in order to achieve isokineticity. A calibrated dry gas test meter is incorporated into the sampling train. This test meter, measuring the actual volume sampled, is used as a checking device at the end of each test to determine the percentage isokineticity.

Moisture is separated from the sampled gases during sampling, using a water trap and silica gel with a blue indicator. The blue indicator turns pink as moisture is absorbed. The accumulated liquid is used after the test to determine the moisture content on a percentage-by-volume basis. This value is again incorporated into the volume of dry gas sampled to determine the concentration of dust in gases at Actual and Normal (sometimes referred to as Standard) conditions.

The uncertainty before the test, about the moisture content in the gas, fluctuation in the gas flows and human error contribute towards the final deviation from 100 % isokineticity.

Filters are weighed directly after each test to determine preliminary results on site.

Relevant plant operating parameters may be logged for future reference purposes. It is usually recommended to take raw product samples during the tests. The content of certain elements in the raw product has specific bearing on ESP performance and is useful for future reference.

8. DISTRIBUTION LIST

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