Particulate Emission Monitor Spot Correlations

Camden Power Station
Stacks 1, 2 & 3
May 2011
RPHP147

STACKLABS
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REPORT No.: 2011/06/27 RPHP147
CAMDEN POWER STATION STACKS NO. 1, 2 & 3 PARTICULATE EMISSION MONITOR SPOT CORRELATIONS JUNE 2011.

Herewith the finalised report for the particulate emission monitor spot correlations conducted at Camden Power Station during June 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 at the above numbers, we will gladly assist.

Stacklabs

PH Pretorius

REPORT TITLE	:	CAMDEN POWER STATION STACKS NO. 1, 2 & 3 PARTICULATE EMISSION MONITOR SPOT CORRELATIONS JUNE 2011
REPORT No.	:	2011/06/27 RPHP147
CUSTOMER	:	PROTEA AUTOMATION SOLUTIONS (PTY) LTD
PURCHASE ORDER No.	:	15742
DATE	:	27th June 2011

SUBMITTED BY	:	PH Pretorius Stacklabs

Contents

REPORT SUMMARY

ESKOMôs Camden Power Station, situated in the vicinity of Ermelo, Mpumalanga, requested the spot correlations of three SB100 continuous particulate emission monitors. The SB100 monitors were supplied and installed by Protea Automated Solutions, who in turn contracted Stacklabs, an environmental services company, to conduct the required site specific spot correlations. The spot correlation of the three monitors were completed during June of 2011 and the results thereof have been presented in this report as follows:

Stack No. 1

Average measured particulate concentration = 11.9 mg/Nm^3 dry @ 6% O_2
Correlation equation mg/Nm^3 dry @ 6% O_2 = 2.4722 * mA ï 9.8914 @ (0 to 70 SL)
Correlation coefficient of 0.99
The air flow to gas flow correlation for Stack No. 1 remains as follows:
Total Gas Flow = 0.8811 * Total Air Flow + 168.33
With a correlation coefficient of 0.83

Stack No. 2

Average measured particulate concentration = 63.5 mg/Nm^3 dry @ 6% O_2
Correlation equation mg/Nm^3 dry @ 6% O_2 = 14.2944 * mA ï 57.1242 @ (0 to 500 SL)
Correlation coefficient of 0.99
The air flow to gas flow correlation for Stack No. 2 remains as follows:
Total Gas Flow = 1.812 * Total Air Flow ï 369.3
With a correlation coefficient of 0.95

Stack No. 3

Average measured particulate concentration = 130.5 mg/Nm^3 dry @ 6% O_2
Correlation equation mg/Nm^3 dry @ 6% O_2 = 17.574 * mA ï 70.261 @ (0 to 450 SL)
Correlation coefficient of 0.99
The air flow to gas flow correlation for Stack No. 3 remains as follows:
Total Gas Flow = 1.2532 * Total Air Flow ï 100.5
With a correlation coefficient of 0.99

1. INTRODUCTION

In order to meet the requirements of the South African Air Quality Act No. 39 of 2004 (Reference 1), as well as the ESKOM Standard for Emission Monitoring and Reporting GST 36-742(Reference 2), 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 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, ESKOMôs Camden Power Station, situated in the vicinity of Ermelo, Mpumalanga, installed Sick SB100 continuous particulate emission monitors on their four stacks during the first quarter of 2010. The compliant correlation for the four stackôs monitors was completed during the first half of 2010 and the results thereof were presented in report RPHP123. The 2010 correlations formulae were implemented and used throughout the remainder of 2010 and for the first five months of 2011. During the second quarter of 2011 however, some concerns were raised with regards to the continued validity of the existing correlations and Camden Power Stationôs Management requested that the monitor suppliers arrange for new spot correlations on the four monitors. The monitor suppliers, Protea Automated Solutions, contracted Stacklabs, an independent environmental services company, to conduct the required site specific spot correlations. The spot correlation of three monitors was completed during June of 2011 and the results thereof have been presented in this report.

2. METHOD AND PROCEDURES

The particulate emission measurements were carried out with procedures and equipment that comply with the requirements of ISO 9096 1992 (Reference 3), ISO 12141 (Reference 4) and the VDI 2066 Part 4 (Reference 5). Only quartz filters were used during the spot correlation and only three measurements were completed on each stack. The spot correlation procedures complied in part with the requirements of the Eskom standard GST 36-742, Standard for Emission Monitoring and Reporting, with reference to a ñcorrelation spot checkò The purpose of the standardôs ñcorrelation spot checkò could however not be applied in its entirety due to the following:

- The filter mediums used during the original correlations and the spot correlation were not the same (see discussion).
- The reporting standard during the original correlation and the spot correlation were not the same.
- The original particulate emission monitor settings were not the same as the spot correlation settings.
- The monitor on stack No. 3 had been replaced with a new monitor.
- The maximum range of some of the original correlations was too low for the current emissions.

Eskom personnel were responsible for the setting of the PJFFs 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

Stack No. 1

A total of 3 isokinetic measurements were conducted on stack No. 1 during the 14th of June 2011. The test co-ordinates included are as follows:

Monitor reading [mA]	Monitor reading [%CH]	Measured Emission [mg/Nm^3] dry @ 6% O_2
8.9	30.8	12.3
8.8	29.9	11.8
8.7	29.4	11.5

The particulate emission monitor correlation for stack No. 1 is described by the following formulae:

mg/Nm^3 dry @ 6% O_2 = 2.4722 * mA ï 9.8914 @ (0 to 70 SL)
correlation coefficient of 0.99

The air flow to gas flow correlation for Stack No. 1 is as follows:
Total Gas Flow = 0.8811 * Total Air Flow + 168.33
With a correlation coefficient of 0.83
From analysis of this stackôs air flow to gas flow correlation data, it is evident that the total air flow information as presented for Unit No.1 by the station was incorrect. This correlation will therefore not predict the correct total gas flows for Stack No. 1 and will require correction ASAP.

Stack No. 2

A total of 3 isokinetic measurements were conducted on stack No. 2 during the 21st of June 2011. The test co-ordinates included are as follows:

Monitor reading [mA]	Monitor reading [%CH]	Measured Emission [mg/Nm^3] dry @ 6% O_2
8.52	28.2	66.4
8.27	26.7	63.7
8.53	28.3	60.5

The particulate emission monitor correlation for stack No. 1 is described by the following formulae:

mg/Nm^3 dry @ 6% O_2 = 14.2944 * mA ï 57.1242 @ (0 to 500 SL)
correlation coefficient of 0.99

The air flow to gas flow correlation for Stack No. 2 is as follows:
Total Gas Flow = 1.812 * Total Air Flow ï 369.3
With a correlation coefficient of 0.95

Stack No. 3

A total of 3 isokinetic measurements were conducted on stack No. 3 during the 9th of June 2011. The test co-ordinates included are as follows:

Monitor reading [mA]	Monitor reading [%CH]	Measured Emission [mg/Nm^3] dry @ 6% O_2
11.5	46.6	120.9
11.3	45.7	135.7
11.5	46.9	135.0

The particulate emission monitor correlation for stack No. 1 is described by the following formulae:

mg/Nm^3 dry @ 6% O_2 = 17.574 * mA ï 70.261 @ (0 to 450 SL)
correlation coefficient of 0.99

The air flow to gas flow correlation for Stack No. 3 is as follows:
Total Gas Flow = 1.2532 * Total Air Flow ï 100.5
With a correlation coefficient of 0.99

The detailed results of the correlation measurements for the north stack have been presented in the following Tables:

Tables 1 to 3: Correlation Test Results
Tables 4 to 9: Boiler Parameters
Figures 1 & 2: Particulate Emission Monitor Correlation Graph
Figure 3: Total Air Flow to Gas Flow Correlation Graph

ABBREVIATIONS

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

As mentioned in the introduction of this report, Camden Power Station installed four Sick SB100 continuous particulate emission monitors during the first quarter of 2010. In addition, compliant correlations were completed during the first half of 2010 and the resulting correlation formulae were implemented and utilised until the end of May 2011. During the second quarter of 2011, some concerns were raised with regards to the continued validity of the existing correlations and Camden Power Station's Management requested that the monitor suppliers, Protea Automated Solutions, investigate and confirm the operational status of the particulate emission monitors.

After the completion of Protea Automated Solution's investigation, some of the Camden Management concerns were eliminated, however the indicated emissions remained high and it was decided to verify the actual particulate emissions through an isokinetic survey. Stacklabs was therefore contracted to conduct a series of isokinetic surveys and spot correlation of the particulate emission monitors.

The isokinetic surveys commenced on stack No. 3 on the 9th of June 2011. Here the original monitor was replaced during the Protea Automated Solution's investigation. It was requested that the surveys be conducted utilising quartz filters and that the monitors be set as described in the ESKOM GST 36-742 standard with reference to the 30 % monitor output at full load. The monitor's operating scale was selected to a 0 to 450 Scattered Light (SL) range, which was significantly higher than the 0 to 30 SL range which was selected during the original correlation conducted in March of 2010. An increase in the scattered light scale would indicate an increase in the particulate emissions. It was also noted that the visual appearance of the stack was significantly darker than during the 2010 correlation period. The isokinetic measurements were conducted at a 50% MCR loading, as the plant could not operate at full load. The low plant loading conditions resulted in low gas velocities within the stack, with some points falling below the lower detection limit of 5m/s. The final results of the isokinetic measurements on stack No. 3 supported the monitor's increased indication with measured concentration of 121 to 135 mg/Nm^3 dry @ 6% O_2.

The results obtained from the survey which was conducted on stack No. 1 on the 14th of June 2011 indicated concentrations of 11.5 to 12.3 mg/Nm^3 dry @ 6% O_2. Here the plant loading during the survey was as required with an average output of 94% MCR but despite the high loading, the flow profile remained poor. Even though the average gas velocity was an adequate 10 m/s, several points fell below 5m/s and it was discovered that the flow angle at some points was approximately 50 degrees from the vertical. The result of poor flow profiles may lead to a tendency to under sample during the isokinetic measurements and therewith, as a result of the momentum of the dust particles, to over report on the particulate concentrations. This phenomenon will be less evident at lower concentrations and will be exaggerated at higher concentrations.

The survey that was conducted on stack No. 2 on the 21st of June 2011 was completed at an average boiler loading off 78% MCR. The flow profiles were significantly better than that which were experienced on stacks No. 1 & 3. The average velocity of the three measurements that were conducted during the survey was approximately 9 m/s and here no velocities below 5m/s were measured. The average particulate concentration measured was 63.5 mg/Nm^3 dry @ 6% O_2 at an average monitor output of 8.5 mA. The selected monitor range was 0 to 500 SL. From these results it could be concluded that the emissions on this stack have also deteriorated since the 2010 correlations but not as significantly as on stack No. 3.

As discussed under section 2 of this report, the original correlations conducted in 2010 and the spot correlation of June 2011 cannot be compared directly. Several factors have changed since the completion of the original correlations of which the most significant may be the filter materials that were used. In addition, the reporting standard was also changed from a wet basis to a dry basis with a 6% reference oxygen value. On the monitor side, as indicated, a new monitor was installed on stack No. 3 and the operating ranges were changed on both stacks No. 1 & 3. As any one of these factors could invalidate the previous 2010 correlation, there can be no continued confidence in the values determined from the 2010 formulae and therefore the station has no choice but to temporarily implement the June 2011 spot correlation formulae. It must however be stressed that the spot correlation cannot comply with the requirements of the GST 36-742, VDI 2066, VDI 3950 (Reference 6) or ISO 10155 (Reference 7) standards and that full compliant correlations must be completed on these stacks as soon as possible.

5. RECOMMENDATION

It is recommended that:

5.1. The particulate emission monitor spot correlation as presented in this report be used to determine the particulate emissions emitted from stacks No. 1, 2 & 3 at Camden Power Station as a temporary measure only.

5.2. Full compliant correlations are conducted on Stacks No. 1, 2, 3 & 4 as soon as possible.

6. ACKNOWLEDGEMENTS

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

7. REFERENCES

7.1. South African Air Quality Act No. 39 of 2004.

7.2. ESKOM Standard for Emission Monitoring and Reporting GST 36-742 1086.

7.3. ISO 9096 1992 Stationary source emissions ï Determination of concentration and mass flow rate of particulate material in gas- carrying ducts ï manual gravimetric method.

7.4. ISO 12141 2002 Stationary source emissions ï Determination of mass concentration of particulate matter (dust) at low concentrations ï manual gravimetric method.

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

7.6. German VDI 3950 Part 1, 1994, Calibration of automatic emission measuring instruments.

7.7. ISO 10155 Stationary Source Emissions ï Automated Monitoring of Mass Concentration of Particles - Performance Characteristics, Test Methods and Specification 1995 ï 2002.

Table No. 1
Stack No. 1
Particulate Emission Monitor Correlation
Test Results

Plant		Camden	Camden	Camden
Unit		1 & 2	1 & 2	1 & 2
Location		Stack	Stack	Stack
Test No.		1	2	3
Date	yyyy/mm/dd	2010/05/14	2010/05/14	2010/05/14
Start Time	00H00	12H11	14H03	15H35
End Time	00H00	13H42	15H09	17H00
Load	MW	380	380	380
Gas Temperature	°C	148	151	154
Barometric pressure	kPa (g)	85.4	85.2	84.5
Duct pressure	Pa	-115.0	-140.7	-156.0
Duct pressure	kPa (abs)	85.3	85.0	84.3
Moisture Mass	mg	46.0	79.3	94.0
Moisture	%v/v	5.4	5.4	6.4
Oxygen	%	5.4	5.4	5.3
Nozzle diameter	mm	10.5	10.5	10.5
Sample Time	min	51	60	60
Thimbles used		TA 10	TA 11	TA12
Average Face velocity 30x100	m/s	0.092	0.130	0.128
Total Dust Mass	g	0.0142	0.0221	0.0208
Velocity	m/s	7.8	10.9	10.9
Gas Volume Flow	Am^3/s	759.3	1067.7	1063.5
Gas Volume Flow	Nm^3/s	414.5	576.9	565.5
Gas Volume Flow Dry	Nm^3/s	391.9	546.0	529.4
Gas Volume Sampled	Am^3 (wet)	2.1451	3.5188	3.4811
Gas Volume Sampled	Nm^3 (wet)	1.1708	1.9013	1.8509
Gas Volume Sampled	Am^3 (dry)	2.0284	3.3302	3.2589
Gas Volume Sampled	Nm^3 (dry)	1.1071	1.7994	1.7328
Dust Concentration Corrected for 6% O_2	mg/Am^3 (wet)	6.4	6.0	5.7
Dust Concentration Corrected for 6% O_2	mg/Nm^3 (wet)	11.7	11.2	10.8
Dust Concentration Corrected for 6% O_2	mg/Am^3 (dry)	6.7	6.4	6.1
Dust Concentration Corrected for 6% O_2	mg/Nm^3 (dry)	12.3	11.8	11.5
Dust Concentration	mg/Am^3 (wet)	6.6	6.3	6.0
Dust Concentration	mg/Nm^3 (wet)	12.2	11.6	11.2
Dust Concentration	mg/Am^3 (dry)	7.0	6.6	6.4
Dust Concentration	mg/Nm^3 (dry)	12.9	12.3	12.0
Dust Outlet Dust Flowrate	g/s	5.0	6.7	6.4
Emission Monitor output	mA	8.92	8.79	8.71
Emission Monitor output	%CH	30.8	29.9	29.4
Isokineticity	%	103.2	103.1	102.4

Table No. 2
Stack No. 2
Particulate Emission Monitor Correlation
Test Results

Plant		Camden	Camden	Camden
Unit		3 & 4	3 & 4	3 & 4
Location		Stack	Stack	Stack
Test No.		1	2	3
Date	yyyy/mm/dd	2011/06/21	2011/06/21	2011/06/21
Start Time	00H00	09H35	11H30	13H20
End Time	00H00	10H55	12H45	14H45
Load	%	150	150	150
Gas Temperature	°C	137	138	138
Barometric pressure	kPa (g)	82.5	82.5	82.5
Duct pressure	Pa	-127.0	-122.7	-121.7
Duct pressure	kPa (abs)	82.4	82.4	82.4
Moisture Mass	mg	52.0	50.0	57.0
Moisture	%v/v	5.1	4.6	5.2
Oxygen	%	6.8	6.7	6.6
Nozzle diameter	mm	10.0	10.0	10.0
Sample Time	min	59.9	60.0	60.0
Thimbles used		TA13	TA14	TA15
Average Face velocity 30x100	m/s	0.091	0.093	0.093
Total Dust Mass	g	0.0802	0.0793	0.0751
Velocity	m/s	8.9	9.1	9.1
Gas Volume Flow	Am^3/s	868.0	884.0	889.0
Gas Volume Flow	Nm^3/s	470.5	477.5	480.4
Gas Volume Flow Dry	Nm^3/s	446.7	455.8	455.4
Gas Volume Sampled	Am^3 (wet)	2.4792	2.5302	2.5232
Gas Volume Sampled	Nm^3 (wet)	1.3440	1.3668	1.3634
Gas Volume Sampled	Am^3 (dry)	2.3534	2.4150	2.3919
Gas Volume Sampled	Nm^3 (dry)	1.2758	1.3045	1.2924
Dust Concentration Corrected for 6% O_2	mg/Am^3 (wet)	34.2	32.9	31.0
Dust Concentration Corrected for 6% O_2	mg/Nm^3 (wet)	63.0	60.8	57.4
Dust Concentration Corrected for 6% O_2	mg/Am^3 (dry)	36.0	34.4	32.7
Dust Concentration Corrected for 6% O_2	mg/Nm^3 (dry)	66.4	63.7	60.5
Dust Concentration	mg/Am^3 (wet)	32.3	31.3	29.7
Dust Concentration	mg/Nm^3 (wet)	59.6	58.0	55.1
Dust Concentration	mg/Am^3 (dry)	34.1	32.8	31.4
Dust Concentration	mg/Nm^3 (dry)	62.8	60.8	58.1
Dust Outlet Dust Flowrate	g/s	28.1	27.7	26.4
Emission Monitor output	mA	8.52	8.27	8.53
Emission Monitor output	%CH	28.2	26.7	28.3
Isokineticity	%	98.6	98.7	97.9

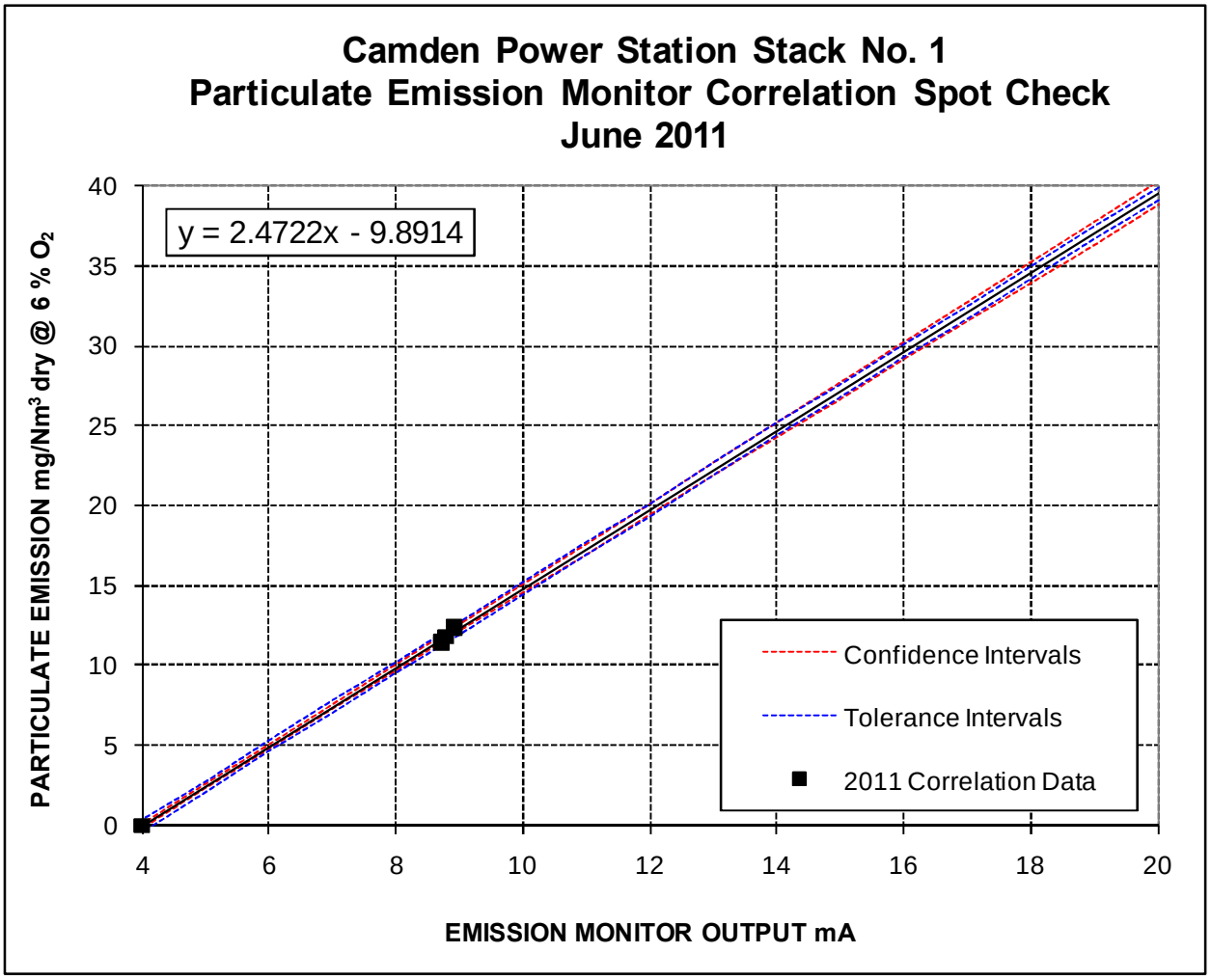
Table No. 3
Stack No. 3
Particulate Emission Monitor Correlation
Test Results

Plant		Camden	Camden	Camden
Unit		5&6	5&6	5&6
Location		Stack	Stack	Stack
Test No.		1	2	3
Date	yyyy/mm/dd	2011/06/09	2011/06/09	2011/06/09
Start Time	00H00	12H47	14H42	16H10
End Time	00H00	14H10	15H52	17H15
Load	MW	200	200	200
Gas Temperature	°C	128	127	127
Barometric pressure	kPa (g)	82.7	82.7	82.7
Duct pressure	Pa	-93.2	-91.3	-90.8
Duct pressure	kPa (abs)	82.6	82.6	82.6
Moisture Mass	mg	51.0	58.0	64.0
Moisture	%v/v	5.2	3.9	4.3
Oxygen	%	8.5	8.2	8.1
Nozzle diameter	mm	12.0	13.0	13.0
Sample Time	min	60	60	60
Thimbles used		TA7	TA8	TA9
Average Face velocity 30x100	m/s	0.084	0.122	0.122
Total Dust Mass	g	0.1221	0.2060	0.2034
Velocity	m/s	5.8	6.6	6.8
Gas Volume Flow	Am^3/s	569.7	648.5	666.6
Gas Volume Flow	Nm^3/s	316.6	361.3	370.6
Gas Volume Flow Dry	Nm^3/s	300.0	347.1	354.5
Gas Volume Sampled	Am^3 (wet)	2.3017	3.3108	3.3056
Gas Volume Sampled	Nm^3 (wet)	1.2789	1.8445	1.8375
Gas Volume Sampled	Am^3 (dry)	2.1811	3.1812	3.1623
Gas Volume Sampled	Nm^3 (dry)	1.2119	1.7723	1.7578
Dust Concentration Corrected for 6% O_2	mg/Am^3 (wet)	63.7	72.6	71.8
Dust Concentration Corrected for 6% O_2	mg/Nm^3 (wet)	114.6	130.4	129.2
Dust Concentration Corrected for 6% O_2	mg/Am^3 (dry)	67.2	75.6	75.0
Dust Concentration Corrected for 6% O_2	mg/Nm^3 (dry)	120.9	135.7	135.0
Dust Concentration	mg/Am^3 (wet)	53.1	62.2	61.5
Dust Concentration	mg/Nm^3 (wet)	95.5	111.7	110.7
Dust Concentration	mg/Am^3 (dry)	56.0	64.8	64.3
Dust Concentration	mg/Nm^3 (dry)	100.8	116.2	115.7
Dust Outlet Dust Flowrate	g/s	30.2	40.4	41.0
Emission Monitor output	mA	11.45	11.31	11.51
Emission Monitor output	%CH	46.6	45.7	46.9
Isokineticity	%	96.0	104.2	101.2

Camden Power Station Stack No. 1
Particulate Emission Monitor Spot Correlation

Plant: Camden PS
Location: Stack No. 1
Monitor information:
Make of Monitor: Sick
Model: SB 100
Serial Number: 10058568
Monitor setting: 0 ï 70 SL
Dates:
Calibration date: 6th June 2011
Correlation dates: 14th June 2011
Correlation Coefficient: 0.99

Operational data:
Operating Range: 0 ï 40 [mg/Nm^3 dry @ 6% O_2]
Limits of validity: [as an hourly average]
Lower limit: 11.5 [mg/Nm^3 dry @ 6% O_2]
Upper limit: 12.3 [mg/Nm^3 dry @ 6% O_2]
Linear function:
E = 2.4722 * x ï 9.8914
where: E = Emission [mg/Nm^3 dry @ 6% O_2]
x = Monitor output [mA]



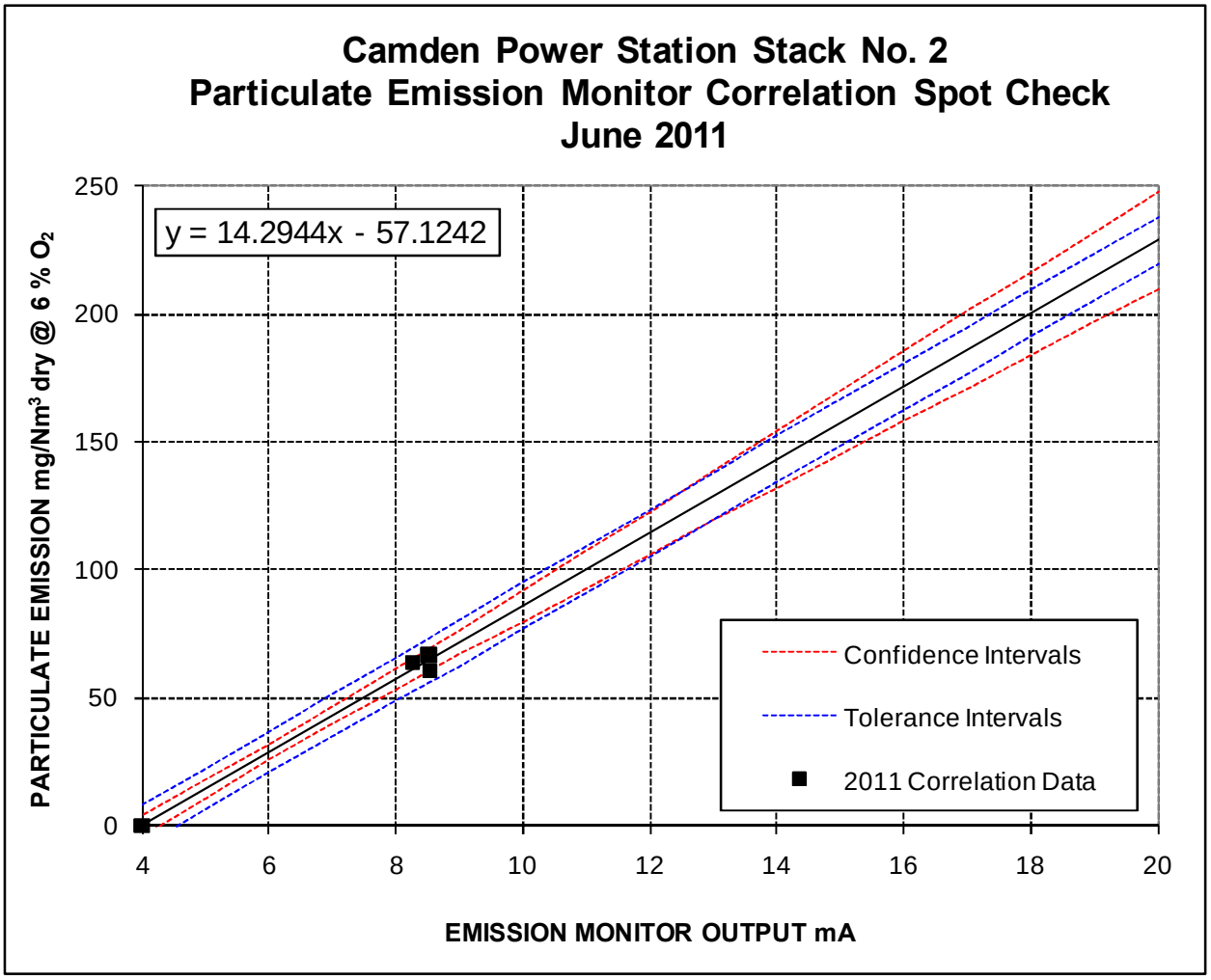
This correlation was produced as described in the German VDI guide with reference to the zero point hypotheses.

FIGURE 1
Prepared by: Stacklabs report No. RPHP147

Camden Power Station Stack No. 2
Particulate Emission Monitor Spot Correlation

Plant: Camden PS
Location: Stack No. 2
Monitor information:
Make of Monitor: Sick
Model: SB 100
Serial Number: 10058565
Monitor setting: 0 ï 500 SL
Dates:
Calibration date: 6th June 2011
Correlation dates: 21st June 2011
Correlation Coefficient: 0.99

Operational data:
Operating Range: 0 ï 229 [mg/Nm^3 dry @ 6% O_2]
Limits of validity: [as an hourly average]
Lower limit: 60.5 [mg/Nm^3 dry @ 6% O_2]
Upper limit: 66.4 [mg/Nm^3 dry @ 6% O_2]
Linear function:
E = 14.2944 * x ï 57.1242
where: E = Emission [mg/Nm^3 dry @ 6% O_2]
x = Monitor output [mA]



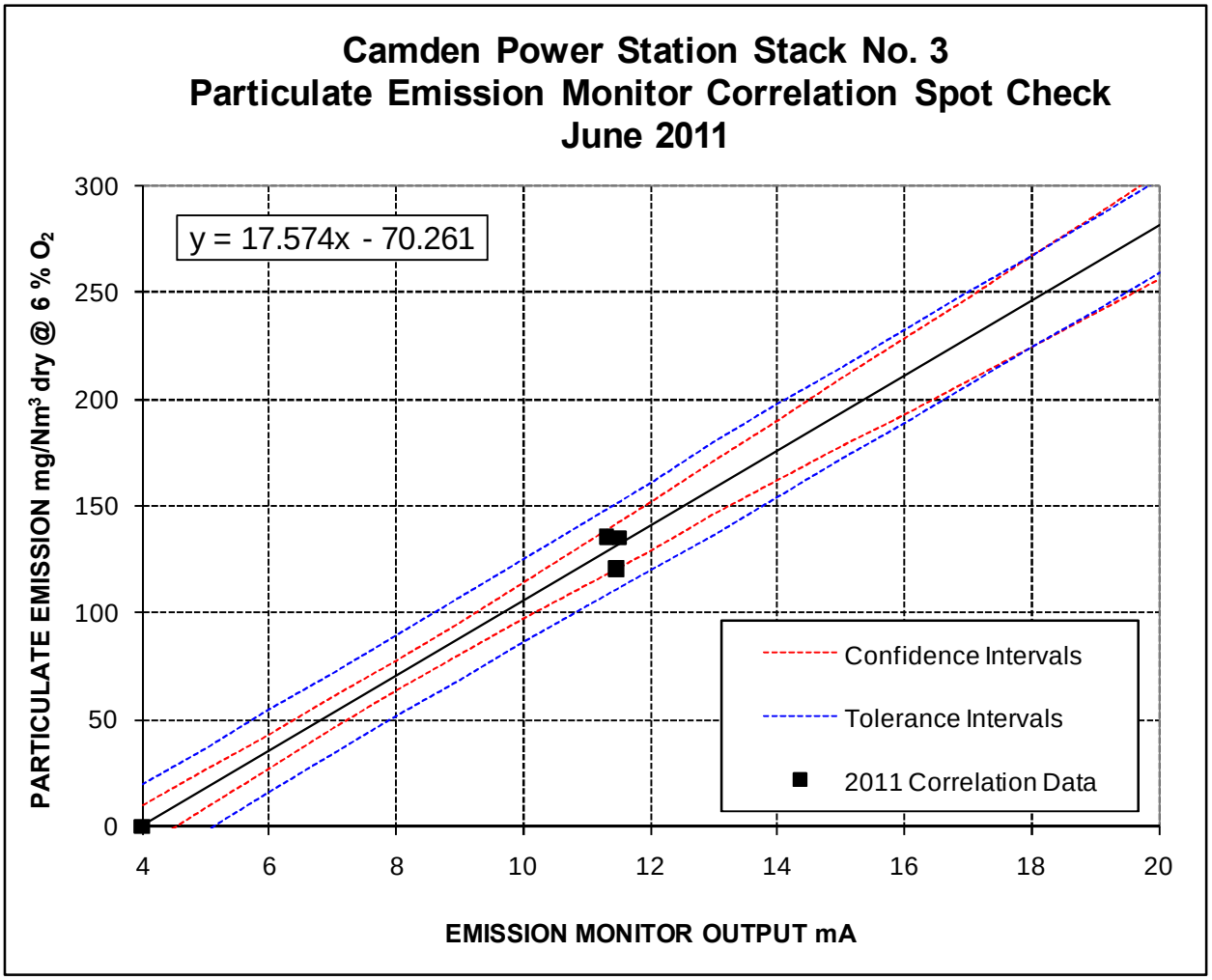
This correlation was produced as described in the German VDI guide with reference to the zero point hypotheses.

FIGURE 2
Prepared by: Stacklabs report No. RPHP14

Camden Power Station Stack No. 3
Particulate Emission Monitor Spot Correlation

Plant: Camden PS
Location: Stack No. 3
Monitor information:
Make of Monitor: Sick
Model: SB 100
Serial Number: 10038613
Monitor setting: 0 ï 450 SL
Dates:
Calibration date: 6th June 2011
Correlation dates: 9th June 2011
Correlation Coefficient: 0.99

Operational data:
Operating Range: 0 ï 281 [mg/Nm^3 dry @ 6% O_2]
Limits of validity: [as an hourly average]
Lower limit: 120.9 [mg/Nm^3 dry @ 6% O_2]
Upper limit: 135.7 [mg/Nm^3 dry @ 6% O_2]
Linear function:
E = 17.574 * x ï 70.261
where: E = Emission [mg/Nm^3 dry @ 6% O_2]
x = Monitor output [mA]



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. RPHP147

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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