Monitoring Quick Guide 10

Version 3, Issued: June 2015

RM-QG-10 Auditing Protocol to assess compliance of reports produced for EN 14181, Quality Assurance of Automated Measuring Systems (AMS)

1. Scope

This Quick Guide describes a procedure for assessing test reports produced to demonstrate compliance with the reporting requirements in the Environment Agency Method Implementation Document (MID) for EN 14181, which is now incorporated into TGN M20 as Annex A.

2. Procedure

2.1 Background

The Environment Agency and UKAS (in coordination with Natural Resources Wales) have developed an accreditation scheme for test laboratories that perform the QAL2 and AST procedures specified in EN 14181. The accreditation scheme is applied through the MCERTS scheme for manual stack-emissions monitoring and the requirements for the scheme are specified in the MID for EN 14181. Any test laboratory wishing to perform QAL2 or AST exercises must be accredited to the MID for EN 14181.

2.2 Requirements for QAL2 and AST test-reports

Appendix 1 of TGN M20 specifies the format for reporting the results of the functional tests specified in Annex A of EN 14181, whilst Appendix 2 of TGN M20 specifies the contents and their order for test reports for QAL2 and AST exercises. These requirements are mandatory.

2.3 Audits of test reports

Each test report is assessed against the requirements of Appendices 1 and 2 in TGN M20, and the evidence of compliance is noted on the forms at the end of this document: Form A for the main body of the report; and Form B for the functional tests.

Non-compliances are noted in the right-hand column and labelled sequentially, together with a description of the non-compliance. A more detailed description is included in a summary of the findings, recorded on Form C. Non-compliances are classified as *Major* or *Minor*. The following are major non-compliances:

- Missing data in the report, e.g. where there is evidence of a selective use of data, or an insufficient number of samples (unless justified in the report).

- Incorrect calculations.
- Several related non-compliances which show a pattern, e.g. several missing parts of the report.
- Evidence of a lack of understanding of the workings of the CEMs and peripheral determinands.

All other non-compliances are classified as minor. An observation is an example of where the test laboratory can improve its reporting procedures.

If a test laboratory produces a report with one or more major non-compliances, then the test laboratory will need to correct the non-compliances, take steps to prevent them from happening again, and then re-issue the report.

If a test laboratory produces a report with one or more minor non-compliances, then the test laboratory will need to correct the non-compliances and take steps to prevent them from happening again. The test laboratory does not have to re-issue the report, but may choose to do so. If there are any observations in test reports, then we recommend that the test laboratory addresses them, but this is not essential.

2.4 Pre and post-assessment

When Natural Resources Wales receives a QAL2 or AST report for assessment, the appointed assessor shall notify the test laboratory under assessment. Following the assessment, the assessor shall send the draft report to the test laboratory for comment and right of reply. The test laboratory will then have typically two weeks to respond, unless stated otherwise. During holiday periods, the test laboratory will have a longer period to respond.

Any comments and responses by the test laboratory will be considered and the report amended if applicable. The final report is then issued, filed and a copy sent to the test laboratory and the Regulatory Officer responsible for the installation stated in the report. If there are any major non-compliances, then the test laboratory will be required to reissue the report and send copies to the assessor at Natural Resources Wales, the Regulatory Officer, and to the process operator.

3. Further information

Environment Agency, Technical Guidance Note M20.
https://www.gov.uk/government/publications/m20-quality-assurance-of-continuous-emission-monitoring-systems

4. Feedback

Any comments or suggested improvements to this note should be e-mailed to Andy Collins at Andrew.Collins@naturalresourceswales.gov.uk

5. Acknowledgements

Content based on Environment Agency Monitoring Quick Guide 10, used with permission.

Form A - BS EN 14181 QAL2/~~AST~~ Report Check Form

Consultant	**CES Environmental Instruments Ltd (CESEI)**
Operator	**Uskmouth Power Limited (Simec)**
Installation name	**Uskmouth Power Station (Unit 13, Line 10 – O_2)**
Permit number	**LP3131SW**
Date of Report	**15 February 2016**
Report version number	**Version 1**
Job reference number	**EI/6891**

Details/items to be checked	Checked	Comments
Section 1 Executive Summary and title pages		
Section 1A		
Operator name, address and primary contact	✓	
Type of process	✓	
Installation name	✓	
Permit number	✓	
Dates of the tests	✓	
Date and version number of the report	✓	
Test laboratory name, address, tel number, email address and UKAS ref number	✓	
Report author	✓	
Report approver	✓	
Section 1B		
AST or QAL 2	✓	**QAL2**
Stack designation	✓	**Unit 13, Line 10**
Determinands	✓	**Oxygen**
Value for 'a' in calibration function	✓	**0.814**
Value for 'b' in calibration function	✓	**1.011**
Valid calibration range based on calibrated CEMs data from the QAL 2	✓	**0-9.64%**
Valid calibration range based on calibrated CEMs data from the AST	N/A	N/A
Extrapolated range based on reference materials	✓	
Pass or fail statement for the variability test	✓	**Pass**
Pass or fail statement for the acceptance test (AST)	N/A	N/A
Statement to confirm calibration function remains valid when no adjustments are made to CEMs	✓	
Section 1C		
Deviations from SRMs and reasons	✓	**None**
Deviations from BS EN 14181 and reasons	✓	**None**
Impacts on results	✓	**N/A**
Actions required	✓	**N/A**

Section 2 Information on installation and provisions for monitoring		
2.1 Regulatory information		
2.1.1 Operator name	✓	
2.1.2 Installation name	✓	
2.1.3 Installation address	✓	
2.1.4 Sector for the installation	✓	
2.1.5 Permit number	✓	
2.1.6 Date of the last QAL2 / AST	✓	
2.1.7 Determinands and emission limit values	✓	
2.2 Operational Information & monitoring provisions	✓	
2.2.1 Process type and variations		
Continuous or batch	✓	**Continuous - but does not explicitly say so**
Expected emissions and variations	✗	**NC1: No information on these aspects of Process type and variations within this section of the report.**
Other factors affecting the results	✗	
Review of historical data	✗	
Provisions to deal with low readings	✗	
Checks on CEMs reading zero	✓	**A surrogate zero point was used in the calculation of the QAL2 function**
2.2.2 Type of fuel		
Fuel used during the tests	✓	**Coal**
Types & proportions of fuels for co-incineration	N/A	N/A
2.2.3 Abatement		
Type of abatement & affects on emissions	✓	**Flue Gas Desulphurisation (FGD), low NOx burners & Bag Filter. Product from FGD process is conditioned with water and either sold or disposed of.**
2.3 Monitoring provisions for periodic monitoring		
2.3.1 Stack and sampling ports		
Rectangular or round stack	✓	**Rectangular**
Dimensions/diameter of stack	✓	**2700mm * 1990 mm**
Location of sampling ports	✓	
Number of sampling ports	✓	**4 * 4inch BSP ports next to each other**
Diagram / photos of emission points, platform	✓	**Both**
2.3.2 Platform and site provisions		
Safe, with adequate space & weather protection	✓	
Safe access to CEMs	✓	
Adequate supplies of reference materials, tools, & spares	✓	**Tools and tests gases transported to site by test engineers, no supplies left/available on site.**
Facilities to introduce reference materials	✓	
Degree of compliance with MID 15259	✓	**Sample platform meets requirements of EA TGN M1 and MID 15259**
2.3.3 Provision for representative samples		

Grid measurements compliant with MID 15259	✓	**Previous grid measurements have shown gaseous homogeneity is fulfilled (according to MID 15259). Would be useful to have an official reference to this testing (and dates).**
Ratio of highest to lowest flow rates	✓	**Single Point Sampling only (as testing for gaseous species)**
2.4 Continuous emission monitoring systems		
2.4.1 Types of CEMs		
Type e.g. cross duct, in-situ or extractive	✓	**Cross-Duct**
Brand	✓	**Opsis**
Model	✓	**O2000 Oxygen Analyser**
Certification range	✓	**0-25%**
Principle	✓	**Zirconia**
Location of sampling / measurement	✓	**Unit 13 Line 10**
Statement of QAL 1 compliance	✓	**Manufacturer's statement of QAL1 compliance (MCERTS) in Appendix 4.**
Is moisture measured or calculated	✓	**States no moisture measurement in this section, but moisture values present in CESEI and client measured data.**
2.4.2 Types of monitoring for peripheral determinands		
Temperature & pressure. Are they recorded	✓	**Temperature and Pressure (and moisture) were data logged during extractive testing.**
Section 3 Information about the monitoring campaign		
3.1 Details of test laboratory staff		
Name, MCERTS reg number, level, expiry date	✓	**All test laboratory staff were either Level 2 (team leader) with relevant technical endorsements, or accompanied by a team leader when on site.**
3.2 Standard reference methods		
Determinand	✓	**Oxygen**
SRM standard applied	✓	**BS EN 14789**
Type and principle	✓	**Zirconia Cell**
Operational range	✓	**0-25%**
Certification range of instrumental methods	✓	**0-25%**
Uncertainty	✓	**Maximum allowable uncertainty – 10%**
UKAS accreditation	✓	**UKAS & MCERTS Accreditation**
Section 4A Monitoring data and calculations Section 4A for QAL 2, section 4B for AST		
A4.1 Table 4.1 Raw monitoring data		
Start & end times of each pair of data	✓	
Raw CEMs results	✓	
Stack/CEM peripheral determinands. Temperature, pressure, oxygen, moisture	✓	
Raw SRM results	✓	
SRM peripheral determinands. Temperature, pressure, oxygen, moisture	✓	
SRM results expressed under the same conditions as the CEMs results	✓	
A4.2 Table 4.2 Standardised monitoring data		
Standardised CEM results (STP)	✓	

Standardised SRM results (STP)	✓	
A4.3 Plot 1		
Time series of standardised CEM v SRM data	✓	
A4.4 Elimination of outliers	✓	
A4.5 Determination of procedure A or B	✓	**Method A used**
A4.6 Data used to determine calibration function		
SRM & CEMs results expressed the same	✓	
Raw CEM results	✓	
A4.7 Determination of calibration function	✓	
A4.8 Calculation of calibrated CEM values		
Raw CEMs values	✓	
Calibrated CEM values at stack conditions	✓	
Peripheral determinands for CEMs	✓	
Calibrated CEMs values standardised	✓	
A4.9 Plot 2		
x – y plot of CEMs v SRM data at conditions measured by CEM	✓	
Calibration function, including R^2 value for method A	✓	**Y = 0.814 + 1.011x. R2 value = 0.93**
A4.10 Data used for variability/acceptance tests		
Calibrated CEMs values standardised	✓	
SRM values standardised	✓	
Difference between each pair of values	✓	
Difference minus average of differences	✓	
Difference minus average of differences squared	✓	
A4.11 Calculations of variability/acceptance tests		
Calculations set out as per BS EN 14181	✓	
The variability test	✓	
Statement of results	✓	
A4.12 Plot 3		
x – y plot of calibrated standardised CEM data v standardised SRM data	✓	
Indication of the valid calibration range	✓	
Extrapolation of the valid calibration range using surrogates	✓	
Parallel lines included. 95% CI of daily ave ELV	✓	
Section 4B Monitoring data and calculations - AST		
B4.1 Raw monitoring data		
Start & end times of each pair of data	N/A	N/A
Raw CEMs results	N/A	N/A

Stack/CEM peripheral determinands. Temperature, pressure, oxygen, moisture	N/A	N/A
Raw SRM results	N/A	N/A
SRM peripheral determinands. Temperature, pressure, oxygen, moisture	N/A	N/A
SRM results expressed under the same conditions as the CEMs results	N/A	N/A
B4.2 Table 4.2 Standardised monitoring data		
Standardised CEM results	N/A	N/A
Standardised SRM results	N/A	N/A
B4.3 Plot 1		
Time series of standardised CEM v SRM data	N/A	N/A
B4.4 Elimination of outliers		
B4.5 Data used to calculate calibrated values		
Raw CEM values	N/A	N/A
Original calibration function from previous QAL2	N/A	N/A
Calibrated CEM values at stack conditions	N/A	N/A
Peripheral determinands for CEMs	N/A	N/A
Calibrated CEM values, standardised	N/A	N/A
Standardised SRM values	N/A	N/A
B4.6 Data used for variability test		
Calibrated CEMs values standardised	N/A	N/A
SRM values standardised	N/A	N/A
Difference between each pair of values	N/A	N/A
Difference minus average of differences	N/A	N/A
Difference minus average of differences squared	N/A	N/A
B4.7 Variability test and acceptance test		
Calculations set out as per BS EN 14181	N/A	N/A
The variability test	N/A	N/A
The acceptance test	N/A	N/A
Statement of results	N/A	N/A
B4.8 Plot 2		
x – y plot of calibrated standardised CEM data v standardised SRM data	N/A	N/A
Indication of the valid calibration range	N/A	N/A
Parallel lines included. 95% CI of daily ave ELV	N/A	N/A
Extrapolation of valid calibration range, using surrogates, if applied	N/A	N/A
Section 5 Results of the functional tests		
5.1 Results of functional tests	✕	**NC2: Reference is made to the functional tests, but the actual results not included within this report. Also names of person performing and witnessing functional tests not included within this section.**
5.2 Information on test personnel		
Name of person/s performing the functional tests	✕	

Name of person witnessing the tests where applicable	✕	

Notes:

No other additional notes to what has been observed in the Comments sections of Part A of this report.

Checked by	**A Collins**	Date	**10/06/2016**

Form B - EN 14181 Functional-Tests Report Check-Form

Consultant	**CES Environmental Instruments Ltd (CESEI)**
Operator	**Uskmouth Power Limited (Simec)**
Installation name	**Uskmouth Power Station (Unit 13, Line 10 – O_2)**
Permit number	**LP3131SW**
Date of Report	**15 February 2016**
Report version number	**Version 1**
Job reference number	**EI/6891**

Details/items to be checked	Checked	Comments
1. Alignment and cleanliness (Non extractive CEMs)		
Internal check of the CEM		**No information included within report**
Cleanliness of the optical components		
Flushing air supply		
Obstructions in the optical path		
Alignment of the measuring system		
Internal check of optical surfaces for contamination		
2. Sampling Systems		
Sampling probe		**No information included within report**
Gas conditioning systems		
Pumps		
All connections		
Sample lines		
Power supplies		
Filters		
NOx converter (If applicable) – Date and results of last efficiency test		
General condition of sampling system		
3. Leak testing		
Leak test of entire sampling system		**No information included within report**
4. Zero and span check		
Reference zero and span materials shall be used to verify the corresponding readings of the CEM		**No information included within report**
Non extractive CEMs – zero and span checks to be performed using a reference path free of flue gas		

5. Linearity (AST only)

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. DCS values should be included in the instrument service report.		**No information included within report**
Linearity of the CEM's response shall be checked using 5 different reference materials including a zero concentration		
The reference material with zero concentrations, as well as the reference materials with 4 different concentrations, shall have a verifiable quantity and quality		
For gaseous reference materials, the 4 reference materials can be obtained from different gas cylinders or can be prepared by means of a dilution system from a single gas concentration		
Reference materials concentrations shall be approximately 20%, 40% , 60% and 80% of the range of the short term emission limit. The dry test reference material shall be applied to the inlet of the CEM		
CEMs are tested using the following concentrations in a randomised sequence		
Reference material with zero concentration		
Reference material concentration approximately 20% of the short term ELV		
Reference material concentration approximately 40% of the short term ELV		
Reference material concentration approximately 60% of the short term ELV		
Reference material concentration approximately 80% of the sort term ELV		
Reference material with zero concentration		

After each change in concentration, the first instrument reading shall ordinarily be taken after a time period equal to at least 3 times the response time of the CEM. At each reference material concentration at least 3 readings shall be made, 6 readings shall be taken at zero. The time period between the start of each of the 3 readings shall be separated by at least 4 times the response time.
The test lab 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 lab 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. 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 (AST only)

A test shall be undertaken if the process gases to be monitored contain components that are known interferences, as identified during QAL 1 and there is a failure of the QAL2 or AST which could be due to interferences		N/A

7. Zero and span drift (Audit) (AST only)

The test lab 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 chart		N/A

8. 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.		**No information included within report**
9. Service report		
Document reference for work instruction for the type of work being undertaken		**No information included within report**
Instrument manufacturer		
Instrument type		
Instrument model		
Instrument serial number		
Operating principle		
Operating range		
Certification details		
Compliance with MCERTS inc certificate number		
Location		
Date and time when the work was undertaken		
Equipment used – type, serial numbers, calibration dates		
Gases used – certificate numbers, expiry dates, binary / mix		
NOx-converter efficiency-test, if applicable		
Calibration and linearity data as required by EN 14181		
Logged data for period of calibration and linearity. Lab shall provide an explanation if there are gaps in the data		
Name and signature of service engineer		

Checked by	A Collins	Date	10/06/2016

Form C – Report Summary

AUDIT REPORT	No: **EI/6891 Unit 13 Line 10 O2 QAL2 (Uskmouth Power Station)**

Select (x) the Audit type below:

Data Verification	X

or

On Site	

Audit of:

Purpose of Audit:

To verify the **QAL 2**/AST report, **EI/6891 Unit 13 Line 10 O2 QAL2**, Specifically:

- To ensure the supporting data used to perform the QAL 2/AST procedure is fit for purpose.
- To ensure the derived calibration functions are correct.
- To verify the CEM meets the required uncertainty allowances.

Scope of Audit:

- A check of emission reporting criteria against those stated in the permit
- Review of MCERTS QAL 2/AST report
- Review of results from the functional tests

Auditors/Verifiers:	Auditee:
A Collins (NRW)	**CESEI Ltd** **Uskmouth Power Station (Simec)**

Report completed by: **A Collins (NRW)** Date: **10/06/2016**	Distribution: **Gareth Richards (NRW)** **Jiping Shi (NRW)** **Can be distributed to Operator Uskmouth Power Station (Simec) and Consultant (CESEI Ltd)**

1. Summary

The audit assessed the report for compliance with the requirements of EN 14181 (2014), and the Method Implementation Document (MID) for EN 14181, version 3 June 2015.The findings from the exercise comprise:

2. Required actions

Review NRW's comments, and address where applicable.

3. Non-compliances:

3.1 Major non-compliances

None recorded

3.2 Minor non-compliances

Two minor non-compliances were found within this QAL2 report.
NC1 Section A, 2.2.1. Missing information within this section on Process Type and Variations.
NC2 Section A, Part 5. Reference is made to the functional tests, but the actual results not included within this report. Also names of person performing and witnessing functional tests not included within this section.

4. Observations

Section A of Report is comprehensive and thorough but some sections contain missing information, which should be addressed for future QAL2 (and AST) reports. However, despite references to them, none of the functional tests section appear to have been included within the overall report?

5. Review of results from the Functional Tests

Functional Tests, and associated sections of the report, do not appear to have been included within the overall report. This should be looked at and rectified.