

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 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 by NRW with permission.

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

Consultant	RPS Consultants	
Operator	RWE Generation UK plc	
Installation name	Aberthaw Power Station (Unit 7)	
Permit number	RP3133LD	
Date of Report	5 th October 2016	
Report version number	Version 1	
Job reference number	FTBS 29312	
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	✓	Coal-fired Power Station
Installation name	✓	
Permit number	✓	
Dates of the tests	✓	7-9 March 2016
Date and version number of the report	✓	Version 1
Test laboratory name, address, tel number, email address and UKAS ref number	✓	
Report author	✓	
Report approver	✓	
Section 1B		
AST or QAL 2	✓	AST/QAL2
Stack designation	✓	Unit 7
Determinands	✓	
Value for 'a' in calibration function	✓	
Value for 'b' in calibration function	✓	
Valid calibration range based on calibrated CEMs data from the QAL 2	✓	
Valid calibration range based on calibrated CEMs data from the AST	✓	
Extrapolated range based on reference materials	✓	For QAL2 only
Pass or fail statement for the variability test	✓	All parameters pass
Pass or fail statement for the acceptance test (AST)	✓	All parameters passed test of calibration function acceptance.
Statement to confirm calibration function remains valid when no adjustments are made to CEMs	✓	
Section 1C		
Deviations from SRMs and reasons	✓	No deviations from SRM
Deviations from BS EN 14181 and reasons	✓	No deviations from EN 14181.
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	✓	LCPD
2.1.5 Permit number	✓	
2.1.6 Date of the last QAL2 / AST	✓	March 2015 AST – Procal 1 &2, SICK OMD 41 March 2015 QAL2 – SICK GM32
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 – Coal Fired Power Station
Expected emissions and variations	✓	Minimal variation expected once operational at maximum load.
Other factors affecting the results	✓	None
Review of historical data	✓	Possible low level emissions from Sulphur Dioxide.
Provisions to deal with low readings	✓	Use values from linearity checks to derive calibrated range.
Checks on CEMs reading zero	✓	
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 & effects on emissions	✓	Flue Gas Desulphurisation & Combustion Control
2.3 Monitoring provisions for periodic monitoring		
2.3.1 Stack and sampling ports		
Rectangular or round stack	✓	Round
Dimensions/diameter of stack	✓	Stack Diameter of 6m
Location of sampling ports	✓	Unable to access one of the four ports, so platform isn't technically compliant to TGN M1.
Number of sampling ports	✓	4 sampling ports, but only 3 accessible due to orientation of ports in relation to stack windshield.
Diagram / photos of emission points, platform	✓	Both diagram and photo
2.3.2 Platform and site provisions		
Safe, with adequate space & weather protection	✓	Both CEMs cabinet and probe located inside windshield, and are thus in spacious, clean and waterproof environment.
Safe access to CEMs	✓	Stairways to the relevant levels.
Adequate supplies of reference materials, tools, & spares	✓	Yes
Facilities to introduce reference materials	✓	No facilities present to introduce reference materials. However this is not an issue as CEMS operate on cross duct principles (IR and forward scatter, depending on the determinands).
Degree of compliance with MID 15259	✓	Complies with MID 15259 – homogeneity testing report (for Units 7,8 & 9) has been carried out (by RWE npower

		technical services team in March 2010) and documented (reference number JUA2389/R/10/81047/11).
2.3.2 Provision for representative samples		
Grid measurements compliant with MID 15259	✓	
Ratio of highest to lowest flow rates	✓	Compliant flow rates with ratio of max to min velocity less than 3:1
2.4 Continuous emission monitoring systems		
2.4.1 Types of CEMs		
Type e.g. cross duct, in-situ or extractive	✓	Cross Duct and In-Situ
Brand	✓	SICK, Procal and ABB
Model	✓	Contained within Report.
Certification range	✓	Contained within Report.
Principle	✓	Contained within Report
Location of sampling / measurement	✓	All sampling/measurement for CEM and SRM obtained from monitoring platform.
Statement of QAL 1 compliance	✓	Yes
Is moisture measured or calculated	✓	Measured (by FTIR)
2.4.2 Types of monitoring for peripheral determinands		
Temperature & pressure. Are they recorded	✓	No information given on temperature & pressure. However, later in report both parameters appear to be measured by Particulate Matter CEM, but not by SO ₂ or NO _x CEMS. Could be clearer.
Section 3 Information about the monitoring campaign		
3.1 Details of test laboratory staff		
Name, MCERTS reg number, level, expiry date	✓	All test consultancy staff of the relevant level, with relevant technical endorsements held
3.2 Standard reference methods		
Determinand	✓	All determinands measured using the correct and up to date standard reference methods (SRM), with MCERTS certified analysers with appropriate certified & operational ranges.
SRM standard applied	✓	
Type and principle	✓	
Operational range	✓	
Certification range of instrumental methods	✓	
Uncertainty	✓	
UKAS accreditation	✓	Yes UKAS accreditation for Particulates analysis only (gases sampling does not require any analysis). All pollutants are MCERTS accredited for monitoring method.
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	✓	
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	✓	
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	✓	All parameters passed
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	✓	
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	✓	
B4.2 Table 4.2 Standardised monitoring data		
Standardised CEM results	✓	
Standardised SRM results	✓	
B4.3 Plot 1		
Time series of standardised CEM v SRM data	✓	
B4.4 Elimination of outliers		
B4.5 Data used to calculate calibrated values		
Raw CEM values	✓	
Original calibration function from previous QAL2	✓	
Calibrated CEM values at stack conditions	✓	
Peripheral determinands for CEMs	✓	
Calibrated CEM values, standardised	✓	
Standardised SRM values	✓	
B4.6 Data used for variability test		
Calibrated CEMs values standardised	✓	
SRM values standardised	✓	
Difference between each pair of values	✓	
Difference minus average of differences	✓	
Difference minus average of differences squared	✓	
B4.7 Variability test and acceptance test		
Calculations set out as per BS EN 14181	✓	
The variability test	✓	
The acceptance test	✓	
Statement of results	✓	
B4.8 Plot 2		
x – y plot of calibrated standardised CEM data v standardised SRM data	✓	
Indication of the valid calibration range	✓	
Parallel lines included. 95% CI of daily ave ELV	✓	

Extrapolation of valid calibration range, using surrogates, if applied	✓	
Section 5 Results of the functional tests		
5.1 Results of functional tests	✓	All CEMS passed functional tests
5.2 Information on test personnel		
Name of person/s performing the functional tests	✓	SICK (P Burgess & R Jones) and Parker/Procal (M Findley) Engineers
Name of person witnessing the tests where applicable	✓	RPS Consultants

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	22/12/2016
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Form B - EN 14181 Functional-Tests Report Check-Form

Consultant	RPS Consultants
Operator	RWE Generation UK plc
Installation name	Aberthaw Power Station (Unit 7)
Permit number	RP3133LD
Date of Report	5 th October 2016
Report version number	Version 1
Job reference number	FTBS 29312

Details/items to be checked	Checked	Comments
1. Alignment and cleanliness (Non extractive CEMs)		
Internal check of the CEM	✓	All carried out as per MID 14181, with optics cleaned on SICK OMD CEM.
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	✓	All carried out as per MID 14181.
Gas conditioning systems	✓	
Pumps	✓	
All connections	✓	
Sample lines	✓	
Power supplies	✓	
Filters	✓	
NOx converter (If applicable) – Date and results of last efficiency test	N/A	Direct reading of NO and NO2
General condition of sampling system	✓	
3. Leak testing		
Leak test of entire sampling system	N/A	Procal – N/A although differential pressure noted as OK SICK (OMD & GM32) – N/A
4. Zero and span check		
Reference zero and span materials shall be used to verify the corresponding readings of the CEM	✓	Zero Checks: Procal – Yes SICK (OMD 41) – Yes – although based on the use of filters SICK (GM32) – Yes, although based on the use of filters Span checks:

		SICK (GM32) – Span value of filters not stated, though analyser response recorded SICK (OMD41) - Span values recorded as mA signals
Non extractive CEMs – zero and span checks to be performed using a reference path free of flue gas	✓	Procal, & SICK GM 32 analysers are in situ type and therefore there is as such, no ‘full system’.
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.	✓	
Linearity of the CEM's response shall be checked using 5 different reference materials including a zero concentration	✓	Yes – Procal, SICK OMD 41 (based on use of filters) No – SICK GM32
The reference material with zero concentrations, as well as the reference materials with 4 different concentrations, shall have a verifiable quantity and quality	✓	Procal – Yes SICK – Yes – although based on the use of filters SICK (GM32) - N/A
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	✓	Procal – Yes SICK – Used 8 points using filters SICK (GM32) - N/A
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	✓	Gas Divider used to generate reference material.
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 short term ELV	✓	
Reference material with zero concentration	✓	Nitrogen or Synthetic Air
<p>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.</p> <p>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.</p> <p>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.</p>		
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	N/A. (Only required in the event of a failure of the QAL2/AST)

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.	✓	Procal – Yes SICK (OMD 41) – Yes SICK (GM 32) – No	
9. Service report			
Document reference for work instruction for the type of work being undertaken	✓	See Service Reports relating to each CEM instrument. Most information is contained in each service report, with some minor omissions on different instruments relating to: <ul style="list-style-type: none"> • Time when work was undertaken • Availability of Equipment numbers and gas certificates • Availability of logged data during calibration/linearity. 	
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	N/A		
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	22/12/2016

Form C – Report Summary

AUDIT REPORT	No: FTBS29312/ RWE-UK/ABERTHAW PS/V1 QAL2/AST (Unit 7 2016)				
<p>Select (x) the Audit type below:</p> <table border="1" data-bbox="193 439 799 477"> <tr> <td>Data Verification</td> <td><input checked="" type="checkbox"/></td> </tr> </table> <p>or</p> <table border="1" data-bbox="193 508 799 546"> <tr> <td>On Site</td> <td><input type="checkbox"/></td> </tr> </table> <p>Audit of:</p>		Data Verification	<input checked="" type="checkbox"/>	On Site	<input type="checkbox"/>
Data Verification	<input checked="" type="checkbox"/>				
On Site	<input type="checkbox"/>				
<p>Purpose of Audit:</p> <p>To verify the QAL 2/AST report, FTBS29312/ RWE-UK/ABERTHAW PS/V1 QAL2/AST (Unit 7 2016), Specifically:</p> <ul style="list-style-type: none"> • 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. 					
<p>Scope of Audit:</p> <ul style="list-style-type: none"> • 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 					
<p><u>Auditors/Verifiers:</u></p> <p>Andy Collins (NRW)</p>	<p><u>Auditee:</u></p> <p>RWE Generations UK plc RPS Consultants</p>				
<p>Report completed by:</p> <p>Andy Collins (NRW)</p> <p>Date: 22/12/2016</p>	<p>Distribution:</p> <p>Tony Leakey (NRW) Operator (RWE) Test Consultant (RPS Consultants)</p>				

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 list:

2. Required actions

No required actions contained within this audit, just comments and observations from NRW.

3. Non-compliances:

3.1 Major non-compliances

None recorded

3.2 Minor non-compliances

None recorded

4. Observations

Comprehensive and thorough QAL2/AST monitoring report by RPS Consultants.

5. Review of results from the Functional Tests

It is considered that the requirements of the BS EN 14181 specification for the functional tests (BS EN 14181, Annex A) were met.

Acknowledgements

Content based on Environment Agency Monitoring Quick Guide 10 Version 3, Issued: June 2015: Auditing Protocol to assess compliance of reports produced for EN 14181, Quality Assurance of Automated Measuring Systems (AMS) - used by Natural Resources Wales (NRW) with permission.

Further Information

More Guidance regarding compliance with EN 14181 (EA TGN M20 and EA MID EN14181) can be found at the following Source testing Association and GOV.UK webpages (Environment Agency Technical Guidance Notes):

<http://www.s-t-a.org/Files%20Public%20Area/MCERTS-MIDs/MID14181.pdf>

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/438593/LIT_6841.pdf