Monitoring Quick Guide 2

version 1.0

SM-QG-02 Selecting Continuous Emission Monitoring systems (CEMs) for installations falling under the Waste Incineration Directive (WID)

1. Scope

This note describes the continuous monitoring requirements for installations falling under the Waste Incineration Directive (WID, 2000/76/EC). It covers the requirements for continuous emission monitoring systems (CEMs), and applies to both incineration and co-incineration installations.

2. Practical Guidance

2.1 Continuous monitoring guidance

The Scottish Environment Protection Agency typically requires operators of installations with WID permits to monitor continuously the following determinands (but see section 2.2).

- Particulate matter (PM)
- Total organic carbon (TOC)
- Sulphur dioxide (SO_2)
- Nitrogen oxides (NO_x)
- Carbon monoxide (CO)
- Hydrogen chloride (HCl)

The Scottish Environment Protection Agency may also require the following determinands to be monitored continuously, depending on specific circumstances.

Determinand	Justification
Nitrous oxide (N_2O)	If the installation uses fluidised beds in the combustion chamber, and / or there are indications that N_2O emissions may be significant.
Ammonia (NH_3)	If the installation uses ammonia injection to control NO_x emissions, then the operator may be required to monitor for ammonia slip.
Hydrogen fluoride (HF)	If there is sufficient fluorine in the waste material, such that the incineration process creates HF.

Additionally, operators are required to continuously measure so-called *peripheral* determinands, which include oxygen, moisture (if the gaseous monitors do not measure on a dry-basis), temperature and stack-gas pressure. Peripheral determinands are needed to correct the emissions of pollutants to standard conditions to allow comparison with the emission limit value (ELV).

2.2 Exemptions

The operator may be allowed to perform periodic measurements of one or more of the following determinands instead of installing CEMs, if it can be demonstrated that the emissions limit values (ELVs) for these determinands will not be exceeded.

- HF
- SO_2
- HCl

2.3 Performance requirements of CEMS

The WID specifies performance requirements for CEMs in four ways:

- The application of international and national standards for monitoring, such as CEN and ISO standards.
- Availability requirements for data reporting.
- Specifications for accuracy and precision, through uncertainty budgets expressed as 95% confidence intervals.
- Compliance with BS EN 14181.

Certification Schemes such as the Environment Agency of England & Wales Monitoring Certification scheme (MCERTS) or the German TUV/UBA certification scheme apply the requirements of international and national standards to CEMs, such as the QAL1 and QAL3 requirements of BS EN 14181. Therefore certified CEMs must meet the requirements for the (i) applicable determinands and (ii) appropriate ranges. The range requirement assures that the CEMs, once installed, will meet the required uncertainty budgets.

2.4 Range requirements for certified CEMS

Certified CEMs have their performance expressed as a percentage of a certified range. Therefore in simple terms, the lower the certified range, the better the accuracy, precision, stability and resolution of the CEM. Ideally the certified range for a CEM for WID installations must be not more than 1.5x the daily average ELV. The table below shows some examples of typical daily average ELVs and the corresponding certified ranges for CEMs.

Determinand	Daily average ELV, $mg.m^{-3}$	Certified range, $mg.m^{-3}$
NO_x[1]	**200**	**0 – 200 $mg.m^{-3}$**
SO_2	**50**	**0 – 75 $mg.m^{-3}$**
CO[2]	**50**	**0 – 75 $mg.m^{-3}$**
PM	**10**	**0 – 15 $mg.m^{-3}$**
TOC	**10**	**0 – 15 $mg.m^{-3}$**
HCl	**10**	**0 – 15 $mg.m^{-3}$**
NH_3[3]	**10**	**0 – 15 $mg.m^{-3}$**
HF	**1**	**Any available**

[1] NO_x limits are expressed as emissions of NO_2, whereas the waste gas will be mostly NO_x, so operators may measure NO alone and then express the results as NO_2 using a conversion factor (see Section 2.7). The requirement for certified ranges takes this conversion into account.

[2] Some fluidised bed WID sites have carbon monoxide derogation for the ELV as 100 mg/m^3 hourly average

[3] Although there is not an ELV for NH_3, a value of 10 $mg.m^{-3}$ is given for practical purposes.

2.5 New and existing CEMs

New CEMs shall meet the above requirements for ranges, in that the certified range must not be higher than those listed the table above. CEMs with such certified ranges can typically measure higher ranges. Sometimes manufacturers have a second, higher certified range as extra assurance. Those which do not have a higher certified range will require more linearity checks on site to assure the capability of the CEMs to measure higher ranges.

If existing CEMs do not meet the above requirements for ranges, then there is a greater chance that they may not meet the required performance specifications, as a lower certified range means a lower uncertainty, and hence better performance. However, in order to give operators the benefit of the doubt, especially in borderline cases, operators may continue to use such CEMs to the ends of their design lives so long as the CEMs meet the QAL2 and QAL3 requirements specified in BS EN 14181.

2.6 Application of BS EN 14181

The QAL1 requirements of BS EN 14181 are initially applied through certification of CEMs. Operators will need to perform a QAL2 test:

- At least every three years.
- After significant changes to the process which affect the emissions.
- After significant changes to the CEMs, which affect calibration.

Additionally, operators have to perform an Annual Surveillance Test (AST) at yearly intervals between each QAL2 test, and apply a QAL3 procedure. The QAL3 procedure is a means of checking the stability and precision of the CEM, through regular zero and span checks. The results of such zero and span tests must be plotted and analysed using control charts.

2.7 Monitoring of nitrogen oxides

The WID specifies ELVs for NO_x as total NO_x expressed as NO_2. The NO_x will comprise mostly NO, plus a small proportion of NO_2 and possibly some N_2O for specific types of application. For practical purposes, operators may measure NO alone provided that they can demonstrate that the proportion of NO_x does not exceed a specified amount, and then express the results as total NO_x as NO_2.

For example, if the NO_x does not comprise more than 5% NO_2, then:

- To convert to total NO_x as NO_2, for the NO portion of the emissions – multiply by the ratio of the molecular weight of NO_2 over the molecular weight of NO, i.e. (46/30) = 1.53.
- To convert to total NO_x taking into account the maximum proportion of NO_2 (e.g. 5%), divide by the ratio of 100% over 95%, i.e. 0.95.

There are currently no certified N_2O CEMs available to operators, therefore if the operator is required to measure N_2O, then as there are no certified CEMs available, the operator may use any system capable of measuring N_2O so long as its performance has been validated using a Standard Reference Method (SRM).

2.8 Availability requirements for CEMs

2.8.1 Availability and data validity

The WID specifies availability requirements for the CEMs; for a daily average value to be valid, an operator may discard no more than five half hourly average values in any day due to malfunction or maintenance of a CEM. This includes periods when the CEMs are out of calibration or conducting zero and span checks.

Without prejudice to the requirements of Clause 13(4) of the WID, the operator may discard no more than ten daily average values per year due to malfunction or maintenance of the CEM.

Further guidance on valid CEMs data is being developed by SEPA and will be published in due course

3. Further information

3.1 Quick Guides

- SM-QG-01 Selecting continuous emission monitoring systems (CEMs)
- SM-QG-03 Selecting continuous emission monitoring systems (CEMs) for installations falling under the Waste Incineration Directive (WID)
- SM-QG-04 Monitoring under the WID when CEMs are not available
- SM-QG-12 Selecting ranges on CEMs

3.2 Environment Agency Technical Guidance Notes

- TGN M2 – Monitoring of stack emissions to air
- TGN M20 – Quality assurance of continuous emissions monitoring systems

4. Feedback

Any comments or suggested improvements to this note should be e-mailed to Duncan Stewart at duncan.stewart@sepa.org.uk.

5. Acknowledgments

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