WP 4.1.1 State of the art and future trends
Environmental legislation

A REVIEW OF THE EU ENVIRONMENTAL LEGISLATION AND EMISSION MONITORING

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APPENDIXES

A REVIEW OF THE EU LEGISLATION AND EMISSION MONITORING

1. The Directive on industrial emissions

The Directive on industrial emissions (IED) 2010/75/EU has been adopted on 24 November 2010 and published in the Official Journal on 17 December 2010. It has entered into force on 6 January 2011 and has to be transposed into national legislation by Member States by 7 January 2013. Existing activities with a total rated thermal input exceeding 50 MW shall follow IED from 6 January 2014. IE directive will replace directives presented in Table 1.

Table 1. *Directives replaced by IED* .

DIRECTIVE	NAME	ACRONYM
2008/1 /EU	concerning integrated pollution prevention and control	IPPC
2001/80/EU	on the limitation of emissions of certain pollutants into the air from large combustion plants	LCP
2000/76/EU	on the incineration of waste	WI
78/176/EEC	on waste from the titanium dioxide industry	TiO
82/883/EEC	on procedures for the surveillance and monitoring of environments concerned by waste from the titanium dioxide industry	
92/112/EEC	on procedures for harmonizing the programmes for the reduction and eventual elimination of pollution caused by waste from the titanium dioxide industry	
1999/13/EU	on the limitation of emissions of volatile organic compounds due to the use of organic solvents in certain activities and installations	VOC

New IE directive changes on emission monitoring:

1) Presents lower emission limit values
2) Clarifies roles of the BAT reference documents
3) Updates the list of polluting substances

IED combines several directives and emphasizes role of the BAT reference documents. As before IED, emission monitoring directions and guidelines have been defined by directives, standards, national laws and national permits. With combined IE directive it is easier to apply common definitions in emission monitoring. For example, European IPPC Bureau has given recommendations for the future work and one considered task is to improve the harmonisation of data handling.

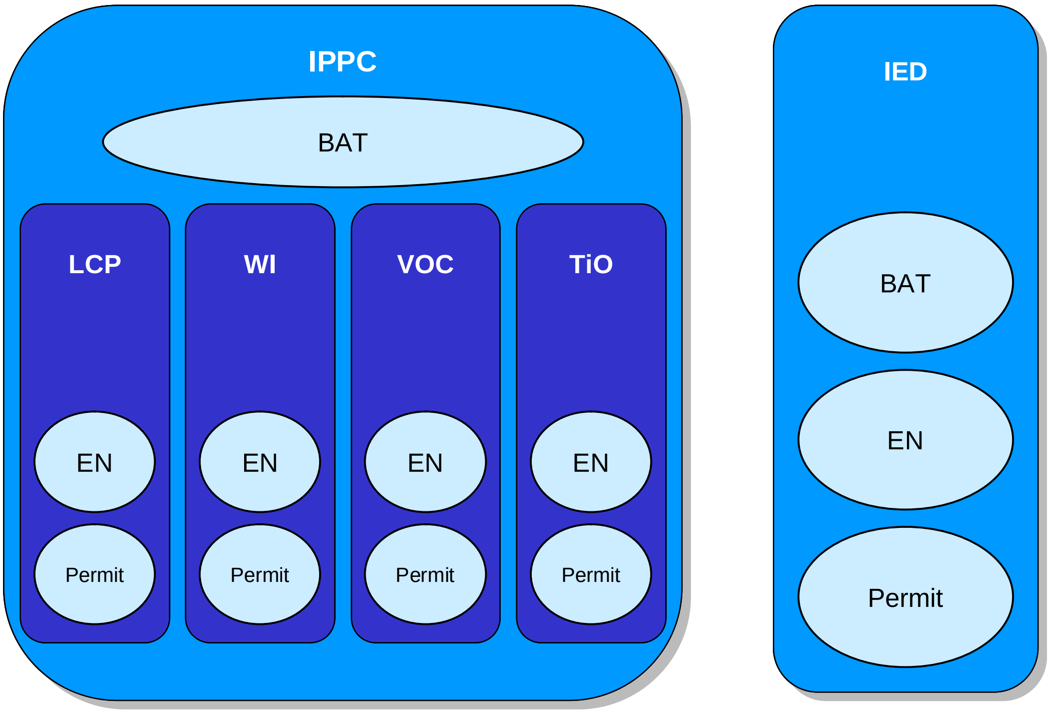

Figure 1. *IED combines guidance for emission monitoring.*

IE directive covers combustion plants which have thermal capacity over 50 MW and waste incinerations. IED also covers the titanium dioxide industry and emissions of volatile organic compounds due to the use of organic solvents. The National legislations may have the additional obligations for smaller boiler units such has in Finnish legislation. Decision of the Council of State 445/2010 for the energy production unit thermal input capacity under 50 MW is described shortly in chapter 6. IED also sets targets for smaller combustion plants: ”The Commission shall, by 31 December 2012, review the need to control emissions from the combustion of fuels in installations with a total rated thermal input below 50 MW”.

Basically IED sets emission limit values lower than directives before have done. The new obligation covers as well existing as forthcoming activities. Existing activities will have slightly lighter obligations. “Existing” permits cover combustion plants which have been granted a permit before 6 January 2013 or plants are put into operation no later than 6 January 2014. Emission limit values (ELVs) are given by:

- Polluting substances
- Date of the granted permit
- Plant type
- Thermal input capacity
- Fuel

This allocation follows LCP and WI directives. Table 2 presents an example of the emission limit values for 100 – 300 MW_{th} biomass fuel combustion plant which will be put into operation on 2015.

Table 2. *IED and LCP emission limit values: biomass 100 – 300 MW, start-up on 2015.*

mg/Nm3	dust	NO_x	SO_2
LCP	30	300	200
IED	20	200	200

Appendix I describes ELV changes for different LCP units according to Finnish legislation (national LCP decision). /38/

2. BAT conclusions

“BAT conclusion” means conclusion which is based on the best available techniques at the moment. IE directive emphasizes the role of the BAT reference documents. BAT conclusions will be crucial part of the granted permits. Earlier LCP directive just gave some references to IPPC directive and general obligations of BAT techniques which may lead to lower limit values than LCP directive presents. IE directive is more precise: Commission shall organise an exchange of information and, where necessary, update BAT reference documents. Member States shall ensure that the competent authority follows or is informed of developments in best available techniques and of the publication of any new or updated BAT conclusions and make that information available to the public concerned (§19). The competent authority shall set emission limit values that do not exceed the emission levels associated with the best available techniques. Furthermore, IED article 16 says the monitoring requirements shall, where applicable, be based on the conclusions on monitoring as described in the BAT conclusions. Within four years of publication of decisions on BAT conclusions all the permit conditions for the installation concerned are reconsidered and, if necessary, updated.

Because BAT conclusions are more flexible to update than whole directive, granted permits follow quicker best available technique than before. Several industrial sectors have specific BAT conclusions as called BREF documents (Reference Document on Best Available Techniques).

Special information regarding emission monitoring is included in these BREF documents:

- General Principles of Monitoring (2003, update started 2010)
- LCP (2006, update started 2010)
- Waste Incineration (2006)
- and several industrial sector documents as:
  - Best Available Techniques in the Pulp and Paper Industry, Annex III Monitoring of discharges and emissions (2001)
- and national BREF documents such as:
  - The Use of Best Available Techniques (BAT) Reference Document for Waste Incineration in Finland (2006)
  - Best Available Techniques (BAT) in Small 5-50 MW Combustion Plants in Finland (2006)
  - Finnish Expert Report on Best Available Techniques In Large Combustion Plants (2001)
  - Best available techniques (BAT) Production of biogas in a Finnish operating environment (2009).

BREF General Principles of Monitoring (2003) is a general guidance for planning monitoring and permits. There are no specific technical methods or criteria for monitoring described. Instead monitoring BREF describes:

- Appropriate quality assurance and control requirements include reliable, comparable, consistent and auditable measurements. Comparability is achieved by the use of standards and skilled personnel.
- Importance of the Quality control and periodic checks by an external accredited laboratory. Methods and criteria are described in permits, standards and directives.
- Authorities approve data processing, reporting, storing of data, availability of measurements and reporting of the exceptional emissions. There are, at the moment, no formal generic rules for identifying, handling, and reporting of exceptional (due to failures etc.) emissions in European Member State countries.

- Some monitoring and reporting options are described for fugitive and diffuse emissions.

For the future, some recommendations are set in BREF reviews. The main idea is the harmonisation of monitoring procedure throughout Europe. In order to further improve harmonisation, the following items need to be considered /10/:

- how to decide monitoring frequency
- data handling methodologies
- compliance assessment procedures
- values under the limit of detection
- comparability of data

When IE directive entered into force IED presented emission limit values same level as BAT conclusions were at their upper limits. The BAT documents present emission limit values as a range of typical values for each technology. Lower limit values are clearly lower than IE directive ELVs. Ranges are presented in Figures 2 - 4. The lowest limit values are very challenging for monitoring methods. Chapter 5 gives an example of the significance of emission limit value for measurements.

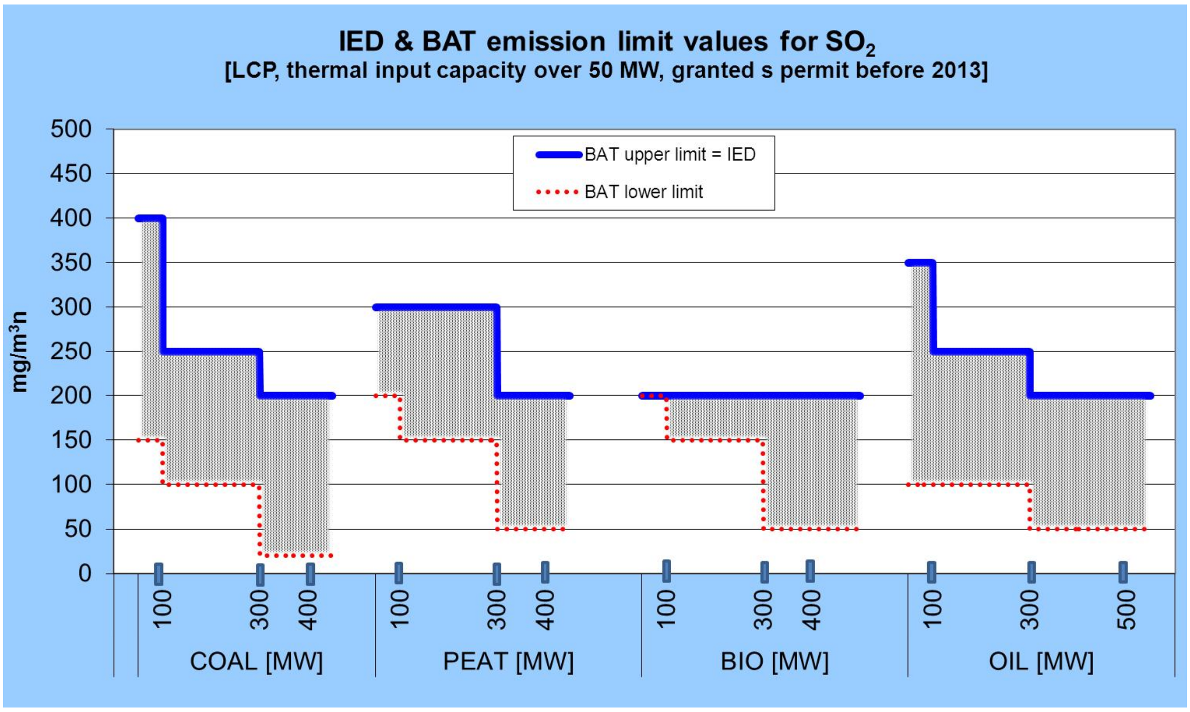

Figure 2. *IE directive emission limit values for SO_2 and BAT ranges (according to LCP BREF).*

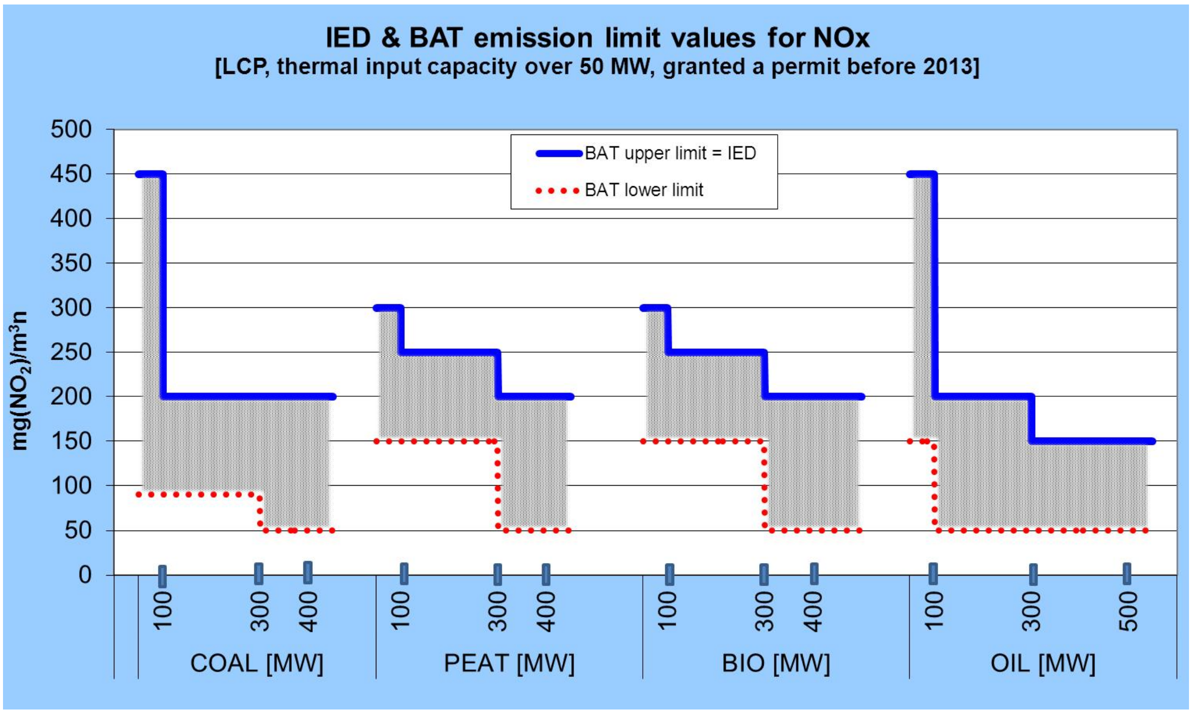

Figure 3. *IE directive emission limit values for NO_x and BAT ranges (according to LCP BREF).*

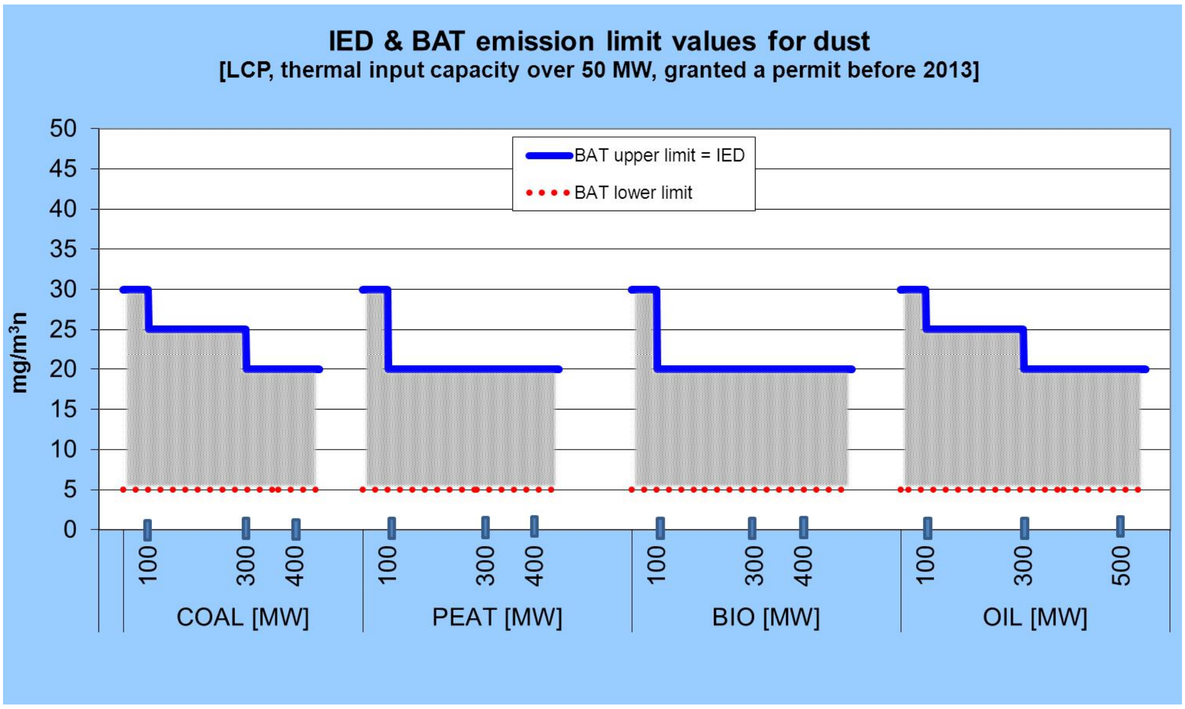

Figure 4. *IE directive emission limit values for dust and BAT ranges (according to LCP BREF).*

3. Further details of the IE concerning the emission monitoring

IE directive harmonises and combines several directives throughout Europe. It does not anymore describe national emission limit values, targets or exceptions. However, the competent authorities may apply specific well-grounded regulations in certain limits.

Several new polluting substances are introduced: CO_2, asbestos, cyanides, chlorine, as well as substances and mixtures which have been proved to possess carcinogenic or mutagenic properties or properties which may affect reproduction via the air. Still, there are no limit values given for all of listed pollutions. Emission limit values of greenhouse gases (e.g. CO_2) shall not be set in permits unless it is necessary to ensure that no significant local pollution is caused.

For combustion plants firing coal or lignite, the emissions of total mercury shall be measured at least once per year.

It is important pay attention to the terms “the continuous measurements” and “the continuous monitoring” in IED. The direct measurement of substances is quite clear but continuous monitoring may also base on indirect measurements and process data. “The Continuous monitoring” leaves more space for defining e.g. sample frequency than “the continuous measurements” defined by certain standards. For example, installations producing titanium dioxide concern following regulation: the monitoring of emissions into air shall include at least the continuous monitoring of chlorine, dust, sulphur dioxide and sulphur trioxide form certain processes. For all of them emissions limit values are also defined.

SCR (Selective Catalytic Reaction) is one potential technique for reducing nitrogen oxides in combustion plants. This may lead to greater emissions of ammonia, sulphur trioxide and acid mist. IED does not predict this at all. /11, 36/ In EU Association for Emission Control by Catalyst (AECC) have taken up similar conversations concerning diesel fuels, SCR technology and emissions./37/

IED presents tighter rates of desulphurisation for combustion plants. As before IED, these rates concern only plants firing indigenous solid fuel and these rates must be applied by Member States.

Continuous measurement for carbon monoxide (CO) is needed for gas fired combustion plants when thermal input capacity is over 100 MW.

IED adopt regulation from WI §10 point 5:” The competent authority shall determine the location of the sampling or measurement points to be used for the monitoring of emissions.” Locations and measurement points are defined in CEN standards and BAT documents.

Further details concerning emission and calculations:

- When waste is incinerated or co-incinerated in an oxygen-enriched atmosphere, the results of the measurements can be standardised at an oxygen content laid down by the competent authority reflecting the special circumstances of the individual case.
- Emission limit values for CO and NO_x are defined for gas turbines (including combined cycle gas turbines (CCGT)) using light and middle distillates as liquid fuels.

As soon as appropriate measurement techniques are available within the European Union, the Commission shall set the date from which continuous measurements of emissions into the air of heavy metals and dioxins and furans are to be carried out /1, §48/.

The emission limit value for hydrogen fluoride (HF) remains 1 mg/m^{3}n for waste incineration plants. Required uncertainty also remains < 40% (of the 95 % confidence intervals). This is very challenging especially for continuous monitoring. Even ELV for hydrogen chloride 10 mg/m3n (± 40%) requires very sophisticated measurement technique.

Approved measuring and monitoring methods remain unchanged. Sampling and analysis of relevant polluting substances and measurements of process parameters as well as the quality assurance of automated measuring systems and the reference measurement methods to calibrate those systems shall be carried out in accordance with CEN standards. If CEN standards are not available, ISO, national or other international standards which ensure the provision of data of an equivalent scientific quality shall use. This means that:

1) The reference measurements must follow the CEN reference standard methods.
2) The emission monitoring from titan dioxide production /1, §70/ must follow the CEN reference standard methods (or other which provide equivalent scientific quality).
3) The automated measuring systems must follow CEN quality assurance standards.

CEN has not published standard for determination of mass concentration of Hydrogen fluoride and Sulphur trioxide discharged from installations producing titanium dioxide.

According to IED, automated measuring systems need comparison measurements at least once a year. This definition is equal with EN 14181standard where three different Quality Assurance Levels (QAL1, QAL2, and QAL3) are defined to achieve this objective. These Quality Assurance Levels cover the suitability of an AMS for its measuring task (e.g. before or during the purchase period of the AMS), the validation of the AMS following its installation, and the control of the AMS during its on-going operation on an industrial plant. An Annual Surveillance Test (AST) is also defined. AST testing shall be performed every year for large combustion plants and for waste incinerators and extensive QAL2 testing shall be performed every 3-5 years (frequency depends on the national decisions. In Finland, QAL2 tests are performed every 3 years for WI and every 5 years for LCP). When QAL2 is performed, AST is not needed at the same year. The competent authority may also consider additional tests.

The introduction chapter (39) of the IE directive proposes following: “implementing powers should be conferred on the Commission to establish detailed rules on the determination of start-up and shut-down periods”. The update procedure for the LCP BREF document is going on and this updated version may also describe new rules for these periods /20/. Similar rules are expected to be included in the rest of the BREF documents while this is more or less open question at the moment. In Finland, permits consist the monitoring plan where the operator describes e.g. rules in the reporting of emission, control failures, start-up and shut-down periods. Equal rules would harmonise emission reporting and functional designing of the automated control systems. Via harmonisation it is also possible to develop descriptions of the exceptional emissions.

In IED averaging period of the continuous measurement depends on the fuel and the combustion type. Reporting may be based on hour, half an hour or 10 minutes averaging. 48 hour reporting does not exist in IED as it was described in LCP directive. Appendix III presents summary of the output data requirements.

4. Directions and guidelines for the emission monitoring

The Directives, national laws, national decisions, standards and permits describe criteria for emission monitoring:

1) Methods and techniques
2) Sampling
3) Monitoring ranges
4) Averaging and reporting period
5) Continuous / manual sample / indirect or direct process calculations
6) Performance
    a. Response time
    b. Detection limit
    c. Lack of fit
    d. Repeatability
    e. Drift
        1. Zero drift
        2. Span drift
    f. Sensitivity to ambient conditions
    g. Sensitivity to interfering substances
    h. Overall uncertainty
7) Comparison measurements (quality control)
8) Functional tests (quality control)
9) Calibration (quality control)
10) Availability of the emission monitoring
11) Reporting

Each document describes general guidelines for monitoring. Only directives and regulations describe concrete emission limit values. Standards describe criteria for performance and quality (Fig. 5).

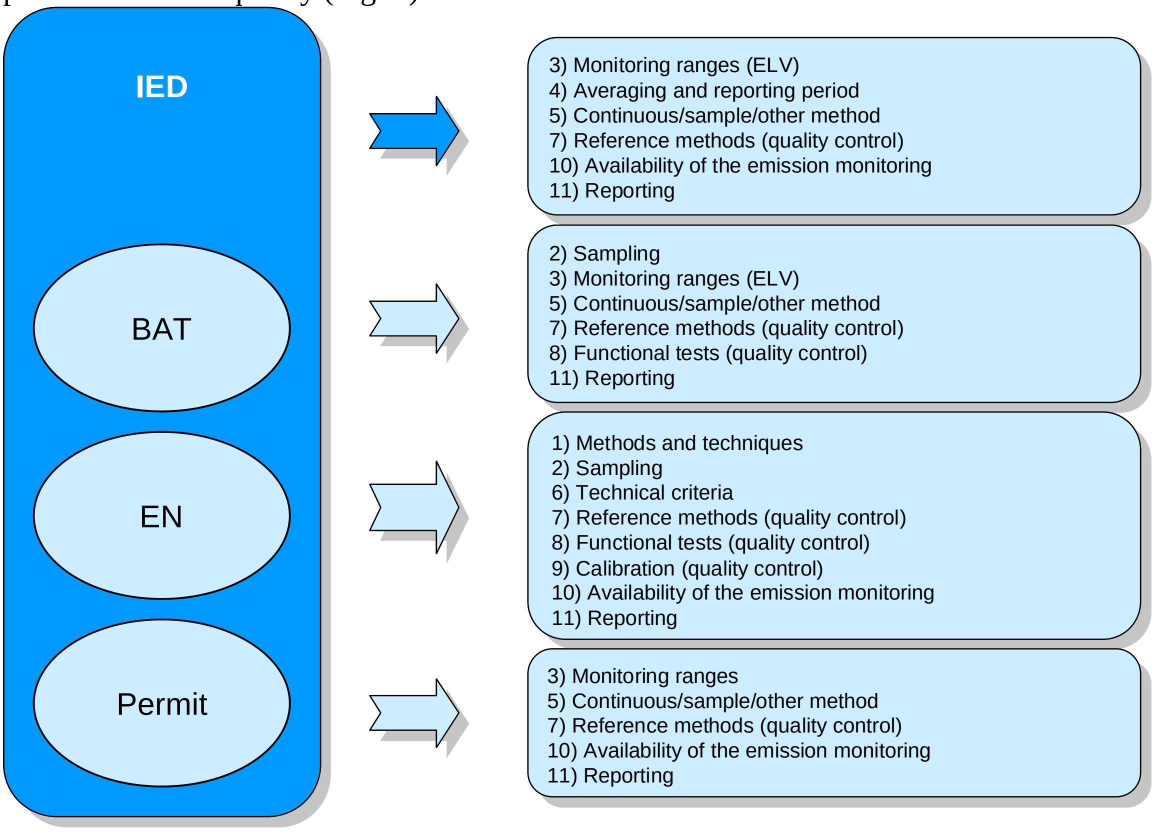

Figure 5. *Sources of criteria for emission monitoring.*

The technical performance criteria for emission monitoring have been described in standards. The most of these criteria are directly connected to emission limit values. Low emission limit values mean lower detection limits and smaller overall uncertainties. Still, monitoring ranges could be wider than before if also exceptional emissions are measured as BAT documents suggest. This could be done by evaluation of the process data or using dual ranges: normal emission range and exceptional emission range.

Requirements for emission monitoring differ according to the purpose of the monitoring:

1) The Automated measuring systems (AMS)
2) The Standard reference methods (SRM)

Performance criteria depend on the applied standard. Several AMS standard methods for emission from stationary sources have been published. However, IE directive or BAT documents do not require certain method for AMS. Any chosen AMS method must fulfil quality standards (e.g. EN 14181) and this has to be verified by reference method. This way IE directive does not exclude certain AMS methods or techniques. On the other hand, reference methods must be in accordance with CEN standards or be validated as equivalent methods. Furthermore, the competent authority may consider supplementary demands in permit.

The EN 15267 standard sets quality criteria for AMS and the EN 14956 standard describes uncertainty calculation for AMS. Acceptable limits for AMS uncertainty are described in IED and permit. Quality and uncertainty requirements for SRM are described in reference method standard.

The EN 14181 standard covers a quality assurance for automated measuring systems. It describes comparison procedure between AMS and SRM. Standard does not take into account SRM uncertainty separately when AMS calibration results are reported. SRM results are presented as if their measurement uncertainty would be “zero”. Actually, calibration curve for AMS includes uncertainty of the reference method. That is the reason why operator’s official emission report also includes uncertainties from SRM. When SRM fulfils standard reference method criteria and comparison fulfils EN 14181 criteria, quality of the reported emission is accepted.

4.1 Automated measuring system (AMS)

Accepted uncertainty for automated measuring systems (AMS) is described in directives and permits. Standards define calculation procedures for uncertainty and refer to regulations when emission limit value is needed. The quality assurance standard of AMS (EN 14181) refers to LCP and WI directives where uncertainty limits are set. Limits are expressed as percentage values at the emission limit value level (the values of the 95 % confidence intervals). Based on this uncertainty limit and emission limit value, the actual uncertainty limit concentration value (mg/m^{3}n) is calculated (Figure 6).

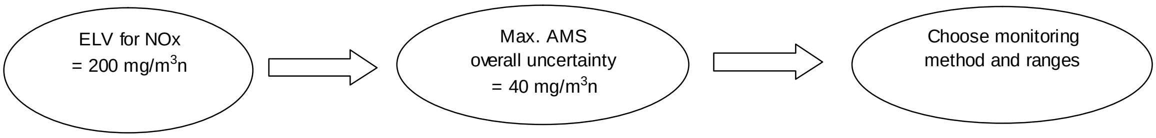

Figure. 6. *Connection between emission limit value and monitoring method.*

Table 3 presents LCP, WI and IE directive uncertainty limits for AMS. There are no changes in uncertainty values but when emission limit values get tighter, the overall uncertainty (expressed as concentration) respectively set higher quality requirements for monitoring.

Table 3. *Uncertainty of emission limit values for automated measuring system (the values of the 95 % confidence intervals of a single measured results shall not exceed the following percentages of the emission limit value).*

	LCP	**WI**	**IED**
Carbon monoxide		≤ 10 %	≤ 10 %
Sulphur dioxide	≤ 20 %	≤ 20 %	≤ 20 %
Nitrogen oxide	≤ 20 %	≤ 20 %	≤ 20 %
Dust	≤ 30 %	≤ 30 %	≤ 30 %
Total organic carbon		≤ 30 %	≤ 30 %
Hydrogen chloride		≤ 40 %	≤ 40 %
Hydrogen fluoride		≤ 40 %	≤ 40 %

Evaluation of the suitability of AMS is defined in standard EN 15267. The total uncertainty of the AMS determined from the tests according to EN 15267 standard should be at least 25 % below the maximum permissible uncertainty specified e.g. in *applicable regulations*. A sufficient margin for the uncertainty contribution from the individual installation of the AMS is necessary to pass QAL2 and QAL3 of EN 14181 successfully /19/. In this context “applicable regulation” uncertainty is considered to be IED uncertainty.

Narrow range is one generally used option to accomplish better absolute uncertainty of the AMS. Chosen monitoring range has to be wide enough to cover emission levels during normal operation. Suitability evaluation standard EN 15267 defines valid range’s upper limit: waste incinerators <1.5 x ELV and large combustion plants <2.5 x ELV. Standard also defines monitoring ranges to be two times valid range. This means e.g. waste incinerators monitoring range should be 3 x ELV. /19/

The relative importance of exceptional emissions has increased as normal process emissions have been reduced to low levels. Exceptional emissions form an integral part of the monitoring requirements in permits (e.g. Finnish authority granted permit n:o 24/2010/1, chapter 50). At the moment, there are no formal generic rules for identifying, handling, and reporting of exceptional emissions in European Member State countries. Exceptional emission concentrations often exceed the measurement range of the equipment, or they may not be monitored if the source is being monitored discontinuously. When continuous monitoring is possible, it is the easiest way to follow this obligation. Otherwise emissions have to be calculated or estimated. The Monitoring BREF document describes example of two ranges monitoring: “in critical cases two measurement systems can be installed at the same point but working different measurement ranges that are calibrated according to the concentration ranges predicted under normal conditions and exceptional circumstances”. Some measurement systems have a feature for programming two measurements ranges. When lower range is exceeded system changes to the upper range. Nevertheless what technique is used both ranges must be calibrated. Certification standard of automated measuring systems EN 15267 defines requirements for additional ranges:

> “If a manufacturer wishes to demonstrate performance over one or more supplementary ranges larger than the certification range, some limited additional testing is required over all the supplementary ranges.”

This definition could be applied in regulation or in permits. If dual monitoring ranges are used for exceptional emission reporting both ranges should be tested and calibrated. Though, the test requirements for secondary range may be a little lighter. At the moment directive does not recognize additional ranges or testing procedures for them. Permits may include particular requirements for controlling these exceptional emissions if the operator has included additional ranges in the monitoring plan and these are approved by the authority.

The operator defines monitoring method, equipments and measurement ranges in the monitoring plan. The competent authority approves the permit including proposed monitoring plan. If this is strictly followed, this could lead to another additional requirement: when ranges are changed, new approving decision is needed.

The quality assurance of automated measurements (EN 14181) covers also functional tests for AMS. These are a simple pass or reject tests. Functional test results are not directly included in emission calculation. Approved test means monitoring system fulfils functional quality requirements. Reported emission is measured by AMS and then corrected with calibration function determined by QAL2 procedure. When emission monitoring fulfils standard criteria, then quality of the monitoring is also according to IE directive. IED also sets requirements for availability, data handling and reporting. The Commission encourages harmonisation of monitoring procedures throughout Europe. IE directive and The Monitoring BREF propose the following items need to be considered in the future:

- monitoring frequency
- data handling methodologies
- compliance assessment procedures
- values under the limit of detection
- comparability of data and data production chain

4.2 Standard reference method (SRM)

Overall expanded uncertainty for standard reference methods are defined in EN reference standards /2/:

- NO_x: < 10 % of the daily emission limit values (EN 14792)
- CO: < 6 % of the daily emission limit values (EN 15058)
- SO_2: < 20 % of the daily emission limit values (EN 14791)
- O_2: < 6 % (relative) of the measured concentration (EN 14789)
- H_2O: < 20 % (relative) of the measured concentration (EN 14790)

Overall uncertainty consists of several partial standard uncertainties and many of them are defined according to the monitoring range. Usually the more narrow range is selected the better absolute uncertainty is achieved. If there is a risk to fail quality requirements one option is to change to a lower monitoring range. However, SRM range must be wide enough to have a representative comparison.

EN 14792 reference standard describes the chemiluminescence method to determine the $NO/NO_2/NO_x$ concentrations in flue gases. For example, the minimum performance characteristics of the SRM's detection limit is ≤ ± 2,0 % of the range. This is combined together with several other characteristics to have overall combined uncertainty. The overall uncertainty shall be lower than 10 % at the daily emission limit value. As well as AMS also chosen SRM monitoring range is connected directly to regulation and permits.

Chapter 5 presents detailed example how ELV effects on overall uncertainty.

4.3. Flow and velocity monitoring

Generally emission limit values are defined as a concentration in flue gas. The most of the emission monitoring methods outputs are already concentrations in certain conditions. Therefore, flow or velocity measurements are not needed for monitoring the limit value. Velocity monitoring is needed when specific mass emission is reported or when process energy efficiency is measured. The European Pollutant Release and Transfer Register (E-PRTR) provides yearly emissions to be reported. Then emissions have to be calculated either by velocity monitoring or by energy and mass balance calculations. /27,28/

The emission limit values for volatile organic compounds (VOC) are defined as a concentration and a specific mass emission, like g/h or g/m^2. Technical provisions relating to installations producing titanium dioxide defines emission limit values for sulphur dioxide and sulphur trioxide. These limit values are (calculated as SO_2 equivalent) 6 kilograms per tonne of titanium dioxide produced as an annual average. This kind of emission monitoring needs flow gas velocity measurements, consumption monitoring and/or production volume data.

Automated flow monitoring methods are for example:

- Ultrasonic stack flow meters
- Annubar (differential pressure) measurement
- Vortex
- Thermal mass flow meter
- Automated Pitot methods
- Estimates and calculations based on process data

The manual flow measurements are quite easy to execute but still relatively accurate methods. They also have demonstrable metrological traceability to national or international primary standards. Therefore, these methods are chosen to be standard reference methods. To be used as a Standard Method, the user shall demonstrate that the overall uncertainty of the method, expressed with a level of confidence of 95%, is less than 5% of the measured flow rate or 1 m/s, whichever is the greater /23/. ISO 10780 states that Pitot tubes calibrated according to the procedure given will have an accuracy of 3% for velocities in the region 5 m/s to 50 m/s /35/.

The direct manual SRM for velocity are Pitot methods /21,30/:

- L Type
- S Type
- 3D Type

The direct manual SRM for volumetric flow are tracer methods /30/:

- based on transit time or
- based on stable dilution

For flow monitoring IE directive sets criteria only for quality assurance and for standard reference method. IED does not set any uncertainty requirements for AMS flow monitoring. Standard drafts for “manual and automatic determination of velocity and volumetric flow” propose uncertainty performance criteria <10% for manual method /23/. The Quality assurance standards EN14281 and EN 15267 set performance criteria for AMS monitoring. These are presented in Table 4.

Table 4. *Performance criteria for AMS monitoring gas flow in field tests according to EN 15267. /19/*

Performance characteristic	**Performance criteria**
Determination coefficient of calibration function, R^2	≥ 0,80
Response time	≤ 60 s
Minimum maintenance interval	≥ 8 days
Zero drift within maintenance interval	≤ 2%
Span drift within maintenance interval	≤ 4%
Availability	≥ 95%
Reproducibility, R_f	≤ 3,3%

Flow monitoring is challenging task even in good conditions. Several examples of comparison measurements between accredited emission measurement laboratories proves this very well /24,25,26/:

- 16 laboratories took a part in comparison measurements in Sweden 2007. Four laboratories had results which differed 10 – 15% from average. Rest of the laboratories were below 10%. Average velocity was 140 000 m^3/h and location was power plant’s chimney (Ø 1.8 m).
- Seven laboratories took a part in comparison measurements in Finland 2010.All of the laboratories had results which differed 10% from average. Average velocity was 0.67 m^3/h (NTP, dry) and location was test laboratory in Lahti (Ø 0.35 m).
- Eight laboratories took a part in comparison measurements in Finland 2005. All of the laboratories had results which differed 20% from average. Average velocity was 50-85 m^3/h and location was power plant’s chimney (Ø 2.5 m).

UK's National Physical Laboratory (NPL) survey study /35/ highlights few issues concerning flow measurements with Pitot tubes:

- Steady state conditions. The tube must be in thermal equilibrium because temperature differentials will have an effect
- Standards provide a large number of conditions that have to be met to enable measurements to be carried out. How many of these are met in real conditions?
- Nearly all digital pressure meters used in the UK are used at the extreme low end of their range, leading to the potential for large uncertainties.
- Manometers are often calibrated under very different conditions from those found in use, and there are potential issues with user bias.

However, Pitot tubes are capable of giving adequate flow measurements, under certain stack conditions, provided care is taken in their use.

Because many locations are very challenging places for monitoring, harmonisation and code of practice is needed. Flow and velocity monitoring have economic value in emission trading, process controlling, research and statistics. EU standard workgroup have been preparing new CEN flow standard. Purpose for this standard is to develop the quality assurance of automated emission measurements. If emissions are monitored in the future, as predicted, not as a concentration but as a total emission in specific time period, best practice for flow measurements is also needed for this purpose. /22,23/

Flow measurements at the moment in Europe /34/:

- In the E-PRTR there is no special requirement for flow and thus, it can be either measured or calculated or estimated. However, in the Netherlands it is required that all WI installations shall have continuous flow measurement.
- Denmark: AMS for flow is not required by the legislation. However, nearly all the installations have them. Reason is NO_x tax. Plants can also pay according to the information about the fuel etc but in order to pay lower tax, flow need to be measured continuously.
- Germany: AMS for flow required at LCP and WI´s
- France: Flow can be either measured or calculated from process parameters
- Sweden: NO_x tax but however, typically 90 % of all 400 installations are calculating their flows. Annually a test house needs to check the measurement uncertainty of the calculation by manual flow measurements and ± 15 % of difference is allowed. It is more common to calculate the flow and this will continue also in the future.

5. The Emission Limit Value and standard reference method (SRM)

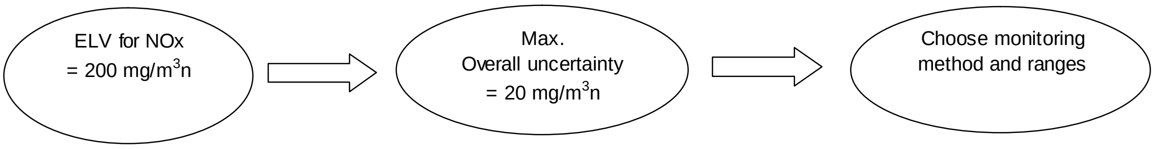

Fig. 7. *Connection between emission limit value and monitoring method.*

Maximum allowed uncertainty for the emission monitoring is calculated from the emission limit value (ELV). The ELV for each activity is defined in permit. Depending on the purpose of the monitoring, the uncertainty is calculated according to standard or directive. IE directive sets uncertainty requirements for automated measuring systems (AMS) as well as standards sets requirements for standard reference methods (SRM). For example EN 14792 standard reference method for NO_x defines that maximum uncertainty shall not be more than 10% of the daily emission limit value. This covers only the equipment, sampling and output data. Uncertainty sources may also be such as location of the sampling point and whole data handling chain.

Permit may define, for example, NO_x emission limit value as:

200 mg/m^{3}n

When maximum allowed overall uncertainty is 10% of the emission limit value, the maximum uncertainty concentration will be in this case:

$\leq \pm$ 20 mg/m^{3}n

This value defines also largest monitor range where the uncertainty limit is still fulfilled. If this is not possible at any ranges, the SRM monitor have to be changed to an analyser which fulfils 10% criteria.

Table 5 presents an example of the uncertainty budget and performance criteria for certain NO_x monitoring method. The overall uncertainty has been calculated when monitoring range is set as 200 mg/m^{3}n.

Table 5. *Example of performance characteristics of NO_x analyser, range 200 mg/m^{3}n. /14/*

Performance characteristics		Performance criteria	Results laboratory and field tests	
Response time	$u(Corr_{fit})$ ≤	200,0	120	s
Detection limit	≤±	2,0	1,3	% of the range
Lack of fit	≤±	2,0	0,7	% of the range
Zero drift	$u(Corr_{0,dr})$ ≤±	2,0	0,01	% of the range /24h
Span drift	$u(Corr_{s,dr})$ ≤±	2,0	1,0	of the range /24h
Sensitivity to				
the sample volume flow	$u(Corr_{s,vf})$ ≤±	1,0	1,0	% of the range
atmospheric pressure	$u(Corr_{apress})$ ≤±	3,0	1,6	% of the range/2 kPa
ambient temperature	$u(Corr_{temp})$ ≤±	3,0	1,0	% of the range/10K
electric voltage at span level	$u(Corr_{volt})$ ≤±	2,0	0,12	% of the range/10V
Interferents	Total ≤±	4,0		% of the range
NH_3	$u(Corr_{NH3})$		0,75	ppm
CO_2	$u(Corr_{CO2})$		-2,6	ppm
Converter efficiency	$u(\eta)$ ≥	95,0	98	%
Repeatability at zero	≤±	1,0	0,65	% of the range
Repeatability at span	$u(Corr_{rep})$ ≤±	2,0	0,8	% of the range
Calibration gas	$u(Corr_{adj})$ ≤±	2	2	%

Combined uncertainty for NO_x measurement:

NO_x $u(C_{NOx,ppm}) = \sqrt{(\Sigma\ u_i^2)}$ = 4,2 ppm

= 8,5 mg/m^3

Overall uncertainty (with a level of confidence of 95 %):

$U(C_{NOx,mg/m3})$ = 17,0 mg/m^3,

This is below criteria $\leq \pm$ 20mg/m^3n

→ **Method and range are acceptable.**

In this example, the monitoring range 200 mg/m^3n has an acceptable uncertainty. SRM range shall be chosen in order to achieve representative comparison in normal operation. When SRM range is too small, the calibration function for AMS is not valid.

6. Decision of the Council of State 445/2010 for small boilers

National legislation may define additional requirements for combustion plants emission monitoring. In Finland, for example, Decision of the Council of State 445/2010 for environmental requirements of the small combustion plants thermal input capacity under 50 MW has been published year 2010. This decision will apply to all small boilers since 2018. All new combustion plants having a start-up after 1 June 2010 shall follow decision immediately. This decision follows generally national BAT document “Best Available Techniques (BAT) in Small 5-50 MW Combustion Plants in Finland” published in 2003 /16/. One difference is between units of the emission limit values: BAT defines emission in mg/MJ when decision defines them in mg/m^3n.

Table 6 presents an example of the emission limit values for dust, NO_x and SO_2 (new combustion plant, biomass, thermal input 20 MW):

Table 6. Emission limit values for a new 20 MW_{th} combustion plant according to 445/2010.

mg/Nm³	dust	NO_x	SO_2
Vna 445/2010	40	375	200

According to the decision the operators shall:

- Prepare monitoring plan.
- Have continuous measurements for oxygen, temperature and carbon monoxide.
- Carry out periodical measurements.

Solid fuel or oil firing new combustion plants shall have continuous opacity measurements for dust.

Periodical emission measurements shall be arranged every 2-5 years (depending on the fuel) for dust and NO_x. According to decision: ”Periodical measurements for NO_x are always performed with continuous methods” (which is actually only available method for NO_x). The testing laboratories performing the measurements shall have an accredited quality assurance system.

The operator shall publish yearly report for the competent authority, where following total emissions are reported:

- Sulphur dioxide
- Nitrogen oxides
- Dust
- Carbon monoxide which is generated from fossil fuels
- Carbon monoxide which is generated from bio fuels
- In addition, reports of the other existing emission monitoring

For small combustion plants the emission monitoring is essential, since there is no requirement for continuous measurement.

This decision does not cause any extra requirements to emission monitoring technique, methods or accredited laboratories. For operator and competent authorities decision brings new requirements for emission monitoring.

In the future, IE directive may also describe requirements for small boilers. The Commission shall, by 31 December 2012, review the need to control emissions from the combustion of fuels in installations with a total rated thermal input below 50 MW /1, §73/.

7. Carbon capture and storage (CCS) emission monitoring

IE directive describes requirements for geological storage of carbon dioxide. There is no requirement for emission monitoring of CCS.

According to IPCC Special Report on Carbon dioxide Capture and Storage /18/ depending on the combustion and the flue gas purification technique, carbon capture has an increasing effect on emissions. Based on reports analysis, ammonia monitoring may be anticipated due to carbon capture. Increasing NO_x emission leads to re-estimation of existing emission limit values or further investments on SCR techniques (depending on which policy leads to greatest benefit).

Table 7. *CO_2 capture and storage effect on emissions. / 18, table 3.5 /*

Atmospheric emissions with CCS	Pulverized coal-fired plant		Integrated gasification combined cycle		Natural gas combined cycle	
	rate *kg/MWh*	increase	rate *kg/MWh*	increase	rate *kg/MWh*	increase
CO_2	107	-87 %	97	-88 %	43	-89 %
SOx	0,001	-100 %	0,33	18 %	-	
NOx	0,77	31 %	0,1	11 %	0,11	22 %
NH_3	0,23	2200 %	-		0,002	from 0

In addition, there may be interest in monitoring of amine concentrations. This could be advantageous to CCS process development.

Emission monitoring needs may occur also through whole process chain: from the capture to the transportation and storage.

8. Conclusions

The Directive on industrial emissions 2010/75/EY (IED) has entered into force on 6 January 2011. IE directive will replace seven previous emission directives and emphasizes the role of the BAT reference documents. The monitoring requirements shall, where applicable, be based on the conclusions on monitoring as described in the BAT conclusions.

Compared to the earlier directives, IED emission limit values are lower throughout. This means tighter requirements for the emission monitoring and the reference methods. The performance of the emission monitoring is defined by the overall uncertainty. The uncertainty expressed in concentration of certain emission substance is calculated at the emission limit value. Absolute accuracy of the method depends generally on the chosen measuring range. Continuous measurements may be challenging at the very low concentrations and uncertainties.

New obligations for emission monitoring and needs for performance monitoring are:

- For combustion plants firing coal or lignite, the emissions of total mercury shall be measured at least once per year.
- Obligation for sulphur trioxide (SO_3) monitoring at the installations producing titanium dioxide
- Need for sulphur trioxide (SO_3) monitoring at the SCR installations for process development and control
- Need for ammonium and amine monitoring at the CCS installations

As soon as appropriate measurement techniques are available within the Union, the Commission shall set the date from which continuous measurements of emissions into the air of heavy metals and dioxins and furans are to be carried out.

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/3/ 2008/1 /EU concerning integrated pollution prevention and control

/4/ 2001/80/EU on the limitation of emissions of certain pollutants into the air from large combustion plants

/5/ 2000/76/EU on the incineration of waste

/6/ 78/176/EEC on waste from the titanium dioxide industry

/7/ 82/883/EU on procedures for the surveillance and monitoring of environments concerned by waste from the titanium dioxide industry

/8/ 92/112/EEC on procedures for harmonizing the programmes for the reduction and eventual elimination of pollution caused by waste from the titanium dioxide industry

/9/ 1999/13/EU on the limitation of emissions of volatile organic compounds due to the use of organic solvents in certain activities and installations

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/12/ EN 14181:2004-07 Stationary source emissions – Quality assurance of automated measuring systems

/13/ EN ISO 14956:2002-08 Air quality – Evaluation of the suitability of a measurement method by comparison with a stated measurement uncertainty (ISO 14956:2002)

/14/ EN 14792:2005-11 Stationary source emissions – Determination of mass concentration of nitrogen oxides (NO_x) – Reference method: Chemiluminescence

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/16/ Jukka Jalovaara, Juha Aho, Eljas Hietamäki ja Hille Hyytiä. Best Available Techniques (BAT) in Small 5-50 MW Combustion Plants in Finland. Finnish Environmental Institute. 2003. ISBN 952-11-1489-4(PDF)

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/27/ Mari Saarinen, Eeva Punta ja Auli Kostamo. Metsäteollisuuden päästöjen raportointi Euroopan päästö- ja siirtorekisteriin. Ympäristöministeriön raportteja 13 /2007. Ympäristöministeriö Toukokuu 2007. 978-952-11-2693-2 PDF.

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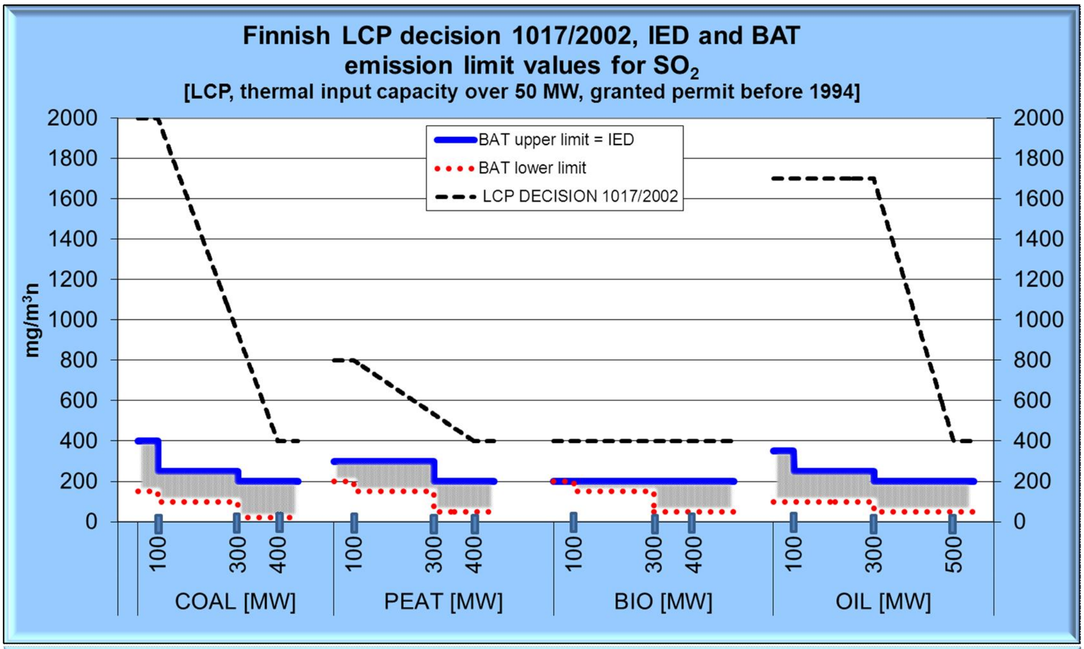
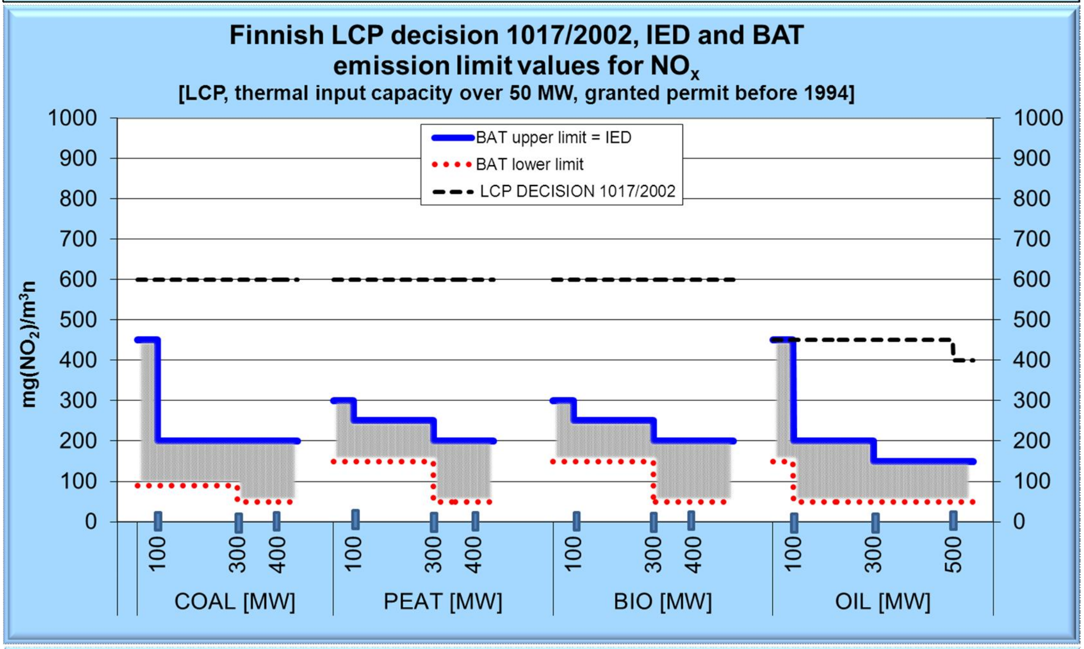
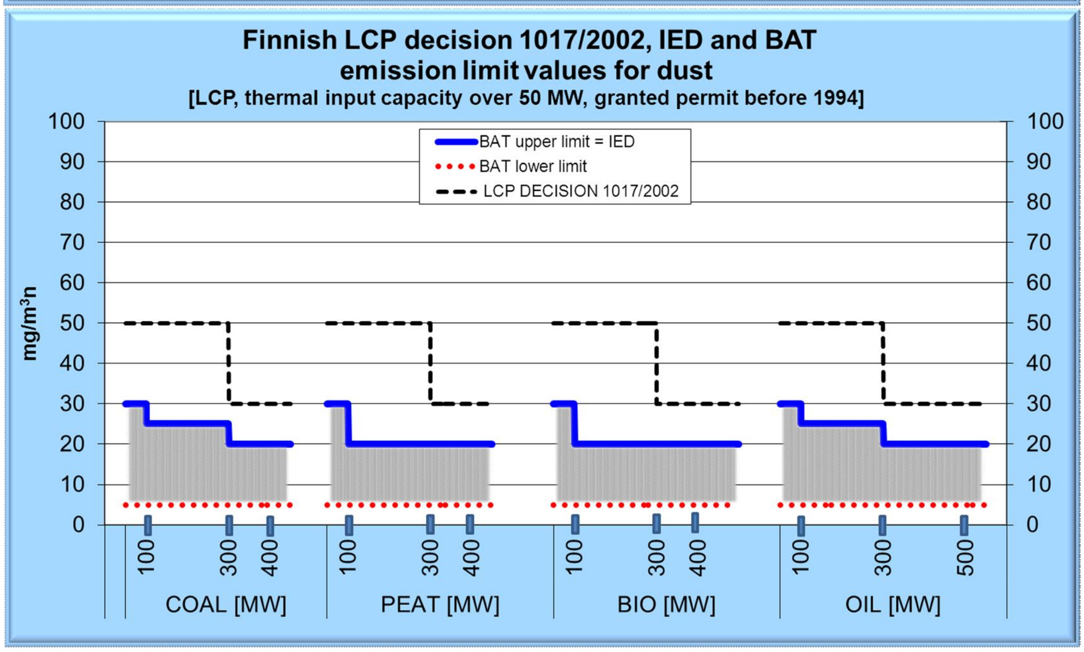

Finnish LCP decision 1017/2002, IED and BAT
emission limit values for SO_2
[LCP, thermal input capacity over 50 MW, granted permit before 1994]
mg/m³n
BAT upper limit = IED
BAT lower limit
LCP DECISION 1017/2002
COAL [MW]
PEAT [MW]
BIO [MW]
OIL [MW]


Finnish LCP decision 1017/2002, IED and BAT
emission limit values for NO_x
[LCP, thermal input capacity over 50 MW, granted permit before 1994]
mg(NO_2)/m³n
BAT upper limit = IED
BAT lower limit
LCP DECISION 1017/2002
COAL [MW]
PEAT [MW]
BIO [MW]
OIL [MW]


Finnish LCP decision 1017/2002, IED and BAT
emission limit values for dust
[LCP, thermal input capacity over 50 MW, granted permit before 1994]
mg/m³n
BAT upper limit = IED
BAT lower limit
LCP DECISION 1017/2002
COAL [MW]
PEAT [MW]
BIO [MW]
OIL [MW]

Values in the table are the overall lowest and the highest values presented in the Industrial Emission Directive. Limit value ranges for each activity are specified in IED according to capacities, fuels and date of the granted permit.

IED / Air polluting substances		Units	Limit values		Min mean value
			min	max	period
	Nitrogen monoxide (NO) and nitrogen dioxide (NO_2),	mg(NO_2)/m^3n	50	500	h (½ h WI)
	Sulphur dioxide (SO_2)	mg/m^3n	4	1000	h (½ h WI)
	Sulphur trioxide (SO_3)	mg/m^3n	500		h
	Carbon monoxide (CO)	mg/m^3n	50		h (10 min WI)
	Total dust	mg/m^3n	5	150	h (½ h WI)
	Hydrogen fluoride (HF)	mg/m^3n	1		day & ½ h
	Hydrogen chloride (HCl)	mg/m^3n	10		day & ½ h
	Carbon dioxide (CO_2)	%			
	Total organic carbon (TOC)	g/m^2, kg/h	10		day & ½ h
	Asbestos	mg/m^3n			
	Cyanides	mg/m^3n			
	Carcinogenic or mutagenic substances	mg/m^3n			
			5	40	"at any time"
	Oxygen (O_2)	%	3	15	
	Water vapour content	%			
	Temperature	^oC			
	Pressure	bar			
	The rates of desulphurisation	%	80	97	month
	Temperature of the combustion gases	oC	850		
Heavy metals					
	Cadmium and its compounds, expressed as cadmium (Cd)	mg/m^3n	0,05		30 min - 8 h
	Thallium and its compounds, expressed as thallium (Tl)	mg/m^3n	0,05		30 min - 8 h
	Mercury and its compounds, expressed as mercury (Hg)	mg/m^3n	0,05		30 min - 8 h
	Antimony and its compounds, expressed as antimony (Sb)	mg/m^3n	0,5		30 min - 8 h
	Arsenic and its compounds, expressed as arsenic (As)	mg/m^3n	0,5		30 min - 8 h
	Lead and its compounds, expressed as lead (Pb)	mg/m^3n	0,5		30 min - 8 h
	Chromium and its compounds, expressed as chromium (Cr)	mg/m^3n	0,5		30 min - 8 h
	Cobalt and its compounds, expressed as cobalt (Co)	mg/m^3n	0,5		30 min - 8 h
	Copper and its compounds, expressed as copper (Cu)	mg/m^3n	0,5		30 min - 8 h
	Manganese and its compounds, expressed as manganese (Mn)	mg/m^3n	0,5		30 min - 8 h
	Nickel and its compounds, expressed as nickel (Ni)	mg/m^3n	0,5		30 min - 8 h
	Vanadium and its compounds, expressed as vanadium (V)	mg/m^3n	0,5		30 min - 8 h
Dioxins					
	2,3,7,8 — Tetrachlorodibenzodioxin (TCDD)	ng/m^3n	0,1		6 - 8 h
	1,2,3,7,8 — Pentachlorodibenzodioxin (PeCDD)	ng/m^3n	0,1		6 - 8 h
	1,2,3,4,7,8 — Hexachlorodibenzodioxin (HxCDD)	ng/m^3n	0,1		6 - 8 h
	1,2,3,6,7,8 — Hexachlorodibenzodioxin (HxCDD)	ng/m^3n	0,1		6 - 8 h
	1,2,3,7,8,9 — Hexachlorodibenzodioxin (HxCDD)	ng/m^3n	0,1		6 - 8 h
	1,2,3,4,6,7,8 — Heptachlorodibenzodioxin (HpCDD)	ng/m^3n	0,1		6 - 8 h
	Octachlorodibenzodioxin (OCDD)	ng/m^3n	0,1		6 - 8 h
Furans					
	2,3,7,8 — Tetrachlorodibenzofuran (TCDF)	ng/m^3n	0,1		6 - 8 h
	2,3,4,7,8 — Pentachlorodibenzofuran (PeCDF)	ng/m^3n	0,1		6 - 8 h
	1,2,3,7,8 — Pentachlorodibenzofuran (PeCDF)	ng/m^3n	0,1		6 - 8 h
	1,2,3,4,7,8 — Hexachlorodibenzofuran (HxCDF)	ng/m^3n	0,1		6 - 8 h
	1,2,3,6,7,8 — Hexachlorodibenzofuran (HxCDF)	ng/m^3n	0,1		6 - 8 h
	1,2,3,7,8,9 — Hexachlorodibenzofuran (HxCDF)	ng/m^3n	0,1		6 - 8 h
	2,3,4,6,7,8 — Hexachlorodibenzofuran (HxCDF)	ng/m^3n	0,1		6 - 8 h
	1,2,3,4,6,7,8 — Heptachlorodibenzofuran (HpCDF)	ng/m^3n	0,1		6 - 8 h
	1,2,3,4,7,8,9 — Heptachlorodibenzofuran (HpCDF)	ng/m^3n	0,1		6 - 8 h
	Octachlorodibenzofuran (OCDF)	ng/m^3n	0,1		6 - 8 h

DAHS Output Data Requirements /29/
Based on the IED, LCPD, WID directives and the E-PRTR regulation

Examples: A14.4b = Article 14, Point 4, Chapter b)
AxVI8(1.1b,d) = Annex VI, Point 8, Chapter 1.1, Items b and d.

Average Calculations

	LCP	WID	E-PRTR	IE
Calculate validated 10-minute average		A11.10d (CO) AxVe		AxVI3(1.5) AxVI8(1.1d)
Calculate validated half-hourly average		A11.10b A11.11		AxVI3(1.5) AxVI3(1.2) AxVI8(1.1b,d)
Calculate validated hourly average	A14.4b	AxVe (CO for fluid. bed)		AxV4(1d)
Calculate validated daily average	A14.4a	A11.10a A11.11		AxV4(1b,c) AxVI8(1.1a,d)
Calculate 48-hourly average	A14.1b			
Calculate monthly average	A14.1a			AxV4(1a)
Validated daily averages determined from hourly average values minus the confidence interval	AxVIIIa.6			AxV3(10) AxVI8(1.2)
Periods of start-up and shut-down shall be disregarded	A14	AxVe (CO)		AxVI4(1)
Periods of start-up and shut-down shall be disregarded if no waste is being incinerated		A11.11		AxVI8(1.2)
Periods of abatement breakdown, disruption to low sulphur fuel supply or gas interruption shall be disregarded	A14			AxV4(1) AxVI8(1.2)
Two or more separate new plants with common stack treated as one unit	A2.7			A29

Percentile Calculations

	LCP	WID	E-PRTR	IE
Calculate percentile of validated 10-minute averages over 24 hours		A11.10d AxVe		AxVI8(1.1d)
Calculate percentile of validated half-hourly averages over calendar year		A11.10b A11.10d (CO) AxVe		AxVI8(1.1)
Calculate percentile of validated hourly averages over calendar year	A14.1b			AxV4(1d)
Calculate percentile of validated daily averages over calendar year		A11.10a		AxVI8(1.1)
Calculate percentile of 48-hourly averages over calendar year	A14.1b			

DAHS Output Data Requirements /29/
Based on the IED, LCPD, WID directives and E-PRTR the regulation

Examples: A14.4b = Article 14, Point 4, Chapter b)
AxVI8(1.1b,d) = Annex VI, Point 8, Chapter 1.1, Items b and d.

Mass Release Calculations	LCP	WID	E-PRTR	IE
Calculation of mass release excluding start-up and shut-down	A4.3			
Calculation of mass release including start-up and shut-down			A5.4 AxII	
Determination of SO2, NOx and Dust emissions; when continuous monitoring is used add up mass of each pollutant emitted each day on basis of volumetric flow rates of waste gases.	AxVIIIb			A72(3d)

Reliability Calculations	LCP	WID	E-PRTR	IE
Invalid day is any day with more than 3 hourly average values invalidated due to malfunction or maintenance of continuous measurement system.	AxVIIIa.6			AxV3(9)
Invalid day is any day with 5 or more half-hourly average values invalidated due to malfunction or maintenance of continuous measurement system.		A11.11		AxVI8(1.2)
Up to 10 invalid daily averages per year may be discarded	AxVIIIa.6	A11.11		AxV3(10) AxVI8(1.2)

Other Calculations	LCP	WID	E-PRTR	IE
Calculation of operating hours	A4.4 A5.1 AxVIa			A72(3d)
Duration of unabated operation	A7.1			A37
Duration of ELV exceedance		A13.3		A46
Duration of unabated operation/ELV exceedance in a year	A7.1	A13.3		AxV4 AxVI9
Desulphurisation rate = quantity of sulphur not emitted / quantity of sulphur in fuel	A2.4			A3(27)
Desulphurisation rate calculated on calendar or rolling monthly basis	A14.3			AxV6
Multi-fired unit ELVs calculated by fuel-weighting each fuel ELV (at planted rated thermal input) by the thermal input of that fuel and aggregating over the period.	A8.1			A40
ELV calculation for firing crude-oil refining residues based on ELV of each fuel	A8.2			A40 AxV7
Calculation of co-incineration ELVs		AxII		A42 A46 AxVI3 AxVI4

1. European Standards (EN) and Draft European Standards (prEN)

1.1 Responsibilities of CEN/TC264 "Air quality"

The focus areas of CEN/TC264 standardisation committee are
- methods for air quality characterization of emissions, ambient air, indoor air
- gases in and from the ground and deposition
- in particular measurement methods for air pollutants (for example particles, gases, odours, micro organisms)
- methods for the determination of the efficiency of gas cleaning systems.

Excluded from the focus of CEN/TC264 are:
- the determination of limit values for air pollutants
- workplaces and clean rooms
- radioactive substances

The status of different documents is described below:
- EN = European Standard
- prEN = proposal for an European Standard
- TS = Technical Specification, not a standard, non-normative document
- TR = Technical Report, not a standard, normative document

It must be noted that since TS- and TR- documents are not standards, the EU Member Countries can have their own procedures/standards for these purposes. Otherwise, in EU Member Countries it is mandatory to use EN-standards if they are available. And therefore, national standards must be revoked as soon as new CEN-standard exists. In case, EN-standards do not exist, it is allowed to use ISO-standards if they exist. If not, national standards are allowed to be used. However, it must be ensured that the data will have equivalent scientific quality when other than EN-methods are used.

1.2 Existing EN-standards

Below is a list of existing standards based on the situation dated on 10.6.2011

Standard reference	Title	Directive (Citation in OJEU)
EN 1911:2010	Stationary source emissions - Determination of mass concentration of gaseous chlorides expressed as HCl - Standard reference method	2001/80/EC (No) 2000/76/EC (No)
EN 1948-1:2006	Stationary source emissions - Determination of the mass concentration of PCDDs/PCDFs and dioxin-like PCBs - Part 1: Sampling of PCDDs/PCDFs	94/67/EC (No) 89/369/EEC (No) 89/429/EEC (No)
EN 1948-2:2006	Stationary source emissions - Determination of the mass concentration of PCDDs/PCDFs and dioxin-like PCBs - Part 2: Extraction and clean-up of PCDDs/PCDFs	94/67/EC (No) 89/369/EEC (No) 89/429/EEC (No)
EN 1948-3:2006	Stationary source emissions - Determination of the mass concentration of PCDDs/PCDFs and dioxin-like PCBs - Part 3: Identification and quantification of PCDDs/PCDFs	94/67/EC (No) 89/369/EEC (No) 89/429/EEC (No)

Standard reference	Title	Directive (Citation in OJEU)
EN 1948-4:2010	Stationary source emissions - Determination of the mass concentration of PCDDs/PCDFs and dioxin-like PCBs - Part 4: Sampling and analysis of dioxin-like PCBs	
EN ISO 9169:2006	Air quality - Definition and determination of performance characteristics of an automatic measuring system (ISO 9169:2006)	
EN ISO 11771:2010	Air quality - Determination of time-averaged mass emissions and emission factors - General approach (ISO 11771:2010)	
EN 12341:1998	Air quality - Determination of the PM 10 fraction of suspended particulate matter - Reference method and field test procedure to demonstrate reference equivalence of measurement methods	1999/30/EC (No) 96/62/EC (No)
EN 12619:1999	Stationary source emissions - Determination of the mass concentration of total gaseous organic carbon at low concentrations in flue gases - Continuous flame ionisation detector method	94/67/EC (No)
EN 13211:2001	Air quality - Stationary source emissions - Manual method of determination of the concentration of total mercury	94/67/EC (No) 2001/997 (No)
EN 13211:2001/AC:2005	Air quality - Stationary source emissions - Manual method of determination of the concentration of total mercury	94/67/EC (No) 2001/997 (No)
EN 13284-1:2001	Stationary source emissions - Determination of low range mass concentration of dust - Part 1: Manual gravimetric method	94/67/EC (No)
EN 13284-2:2004	Stationary source emissions - Determination of low range mass concentration of dust - Part 2: Automated measuring systems	94/67/EC (No) 2001/997 (No)
EN 13526:2001	Stationary source emissions - Determination of the mass concentration of total gaseous organic carbon in flue gases from solvent using processes - Continuous flame ionisation detector method	94/67/EC (No)
EN 13649:2001	Stationary source emissions - Determination of the mass concentration of individual gaseous organic compounds - Activated carbon and solvent desorption method	94/67/EC (No)
EN 13725:2003	Air quality - Determination of odour concentration by dynamic olfactometry	
EN 13725:2003/AC:2006	Air quality - Determination of odour concentration by dynamic olfactometry	
EN 14181:2004	Stationary source emissions - Quality assurance of automated measuring systems	89/369/EEC (No) 89/429/EEC (No) 88/609/EEC (No)

Standard reference	Title	Directive (Citation in OJEU)
EN 14385:2004	Stationary source emissions - Determination of the total emission of As, Cd, Cr, Co, Cu, Mn, Ni, Pb, Sb, Tl and V	94/67/EC (No) 2001/997 (No) 89/369/EEC (No) 89/429/EEC (No)
EN 14789:2005	Stationary source emissions - Determination of volume concentration of oxygen (O2) - Reference method - Paramagnetism	94/67/EC (No) 89/369/EEC (No) 89/429/EEC (No) 88/609/EEC (No)
EN 14790:2005	Stationary source emissions - Determination of the water vapour in ducts	94/67/EC (No) 89/369/EEC (No) 89/429/EEC (No) 88/609/EEC (No)
EN 14791:2005	Stationary source emissions - Determination of mass concentration of sulphur dioxide - Reference method	94/67/EC (No) 89/369/EEC (No) 89/429/EEC (No) 88/609/EEC (No)
EN 14792:2005	Stationary source emissions - Determination of mass concentration of nitrogen oxides (NOx) - Reference method: Chemiluminescence	94/67/EC (No) 89/369/EEC (No) 89/429/EEC (No) 88/609/EEC (No)
CEN/TS 14793:2005	Stationary source emission - Intralaboratory validation procedure for an alternative method compared to a reference method	
EN 14884:2005	Air quality - Stationary source emissions - Determination of total mercury: automated measuring systems	94/67/EC (No) 2000/76/EC (No)
EN ISO 14956:2002	Air quality - Evaluation of the suitability of a measurement procedure by comparison with a required measurement uncertainty (ISO 14956:2002)	
EN 15058:2006	Stationary source emissions - Determination of the mass concentration of carbon monoxide (CO) - Reference method: Non-dispersive infrared spectrometry	94/67/EC (No) 89/369/EEC (No) 89/429/EEC (No)
EN 15259:2007	Air quality - Measurement of stationary source emissions - Requirements for measurement sections and sites and for the measurement objective, plan and report	
EN 15267-1:2009	Air quality - Certification of automated measuring systems - Part 1: General principles	2001/80/EC (No) 2002/3/EC (No) 2000/76/EC (No) 2000/69/EC (No) 96/62/EC (No)
EN 15267-2:2009	Air quality - Certification of automated measuring systems - Part 2: Initial assessment of the AMS manufacturer's quality management system and post certification surveillance for the manufacturing process	2001/80/EC (No) 2002/3/EC (No) 2000/76/EC (No) 2000/69/EC (No) 96/62/EC (No)

Standard reference	Title	Directive (Citation in OJEU)
EN 15267-3:2007	Air quality - Certification of automated measuring systems - Part 3: Performance criteria and test procedures for automated measuring systems for monitoring emissions from stationary sources	
EN 15445:2008	Fugitive and diffuse emissions of common concern to industry sectors - Qualification of fugitive dust sources by Reverse Dispersion Modelling	96/61/EC (No)
EN 15446:2008	Fugitive and diffuse emissions of common concern to industry sectors - Measurement of fugitive emission of vapours generating from equipment and piping leaks	96/61/EC (No)
CEN/TS 15674:2007	Air quality - Measurement of stationary source emissions - Guidelines for the elaboration of standardised methods	2001/80/EC (No) 2000/76/EC (No) 96/61/EC (No)
CEN/TS 15675:2007	Air quality - Measurement of stationary source emissions - Application of EN ISO/IEC 17025:2005 to periodic measurements	2001/80/EC (No) 2000/76/EC (No) 96/61/EC (No)
EN 15859:2010	Air Quality - Certification of automated dust arrestment plant monitors for use on stationary sources - Performance criteria and test procedures	
CEN/TR 15983:2010	Stationary source emissions - Guidance on the application of EN 14181:2004	
EN ISO 20988:2007	Air quality - Guidelines for estimating measurement uncertainty (ISO 20988:2007)	
EN ISO 21258:2010	Stationary source emissions - Determination of the mass concentration of dinitrogen monoxide (N2O) - Reference method: Non-dispersive infrared method (ISO 21258:2010)	
EN ISO 23210:2009	Stationary source emissions - Determination of PM10/PM2,5 mass concentration in flue gas - Measurement at low concentrations by use of impactors (ISO 23210:2009)	
EN ISO 25139:2011	Stationary source emissions - Manual method for the determination of the methane concentration using gas chromatography (ISO 25139:2011)	
EN ISO 25140:2010	Stationary source emissions - Automatic method for the determination of the methane concentration using flame ionisation detection (FID) (ISO 25140:2010)	

1.3 EN-standards under preparation

Below is a list of standards under preparation based on the situation dated on 10.6.2011

WI number	Project reference	Title	Current status	Foreseen date of availability
00264122	prEN 12619	Stationary source emissions - Determination of the mass concentration of total gaseous organic carbon - Continuous flame ionisation detector method	Under Approval	2013-09
00264134	prEN ISO 13199	Stationary source emissions - Determination of total volatile organic compounds (TVOC) in waste gases from non-combustion processes - Non-dispersive infrared method equipped with catalytic converter (ISO/DIS 13199:2011)	Under Approval	2013-01
00264120	prEN 13649	Stationary source emissions - Determination of the mass concentration of individual gaseous organic compounds - Active carbon and solvent desorption method	Under Approval	2013-01
00264133	prEN ISO 13833	Stationary source emissions - Determination of the ratio of biomass (biogenic) and fossil-derived carbon dioxide - Radiocarbon sampling and determination	Under Approval	2013-01
00264095	prEN ISO 16911-1	Air Quality - Measurement of stationary source emissions - Manual and automatic determination of velocity and volumetric flow in ducts - Part 1: Manual Method	Under Drafting	2013-11
00264096	prEN ISO 16911-2	Stationary source emissions - Manual and automatic determination of velocity and volumetric flow in ducts - Part 2: Automated measuring systems	Under Drafting	2013-11
00264128		Stationary source emissions - Sampling and determination of hydrogen chloride content in ducts and stacks - Infrared analytical technique	Under Drafting	2013-01