The European Association of Internal
Combustion Engine Manufacturers

EUROMOT

EUROMOT POSITION

23 September 2013

2011 YEARS Promoting Engine in Society

General Comments regarding draft BREF D1 covering Large Combustion Plants

1. General

This document deals with some fundamental aspects in the LCP BRERF D1 which needs to be corrected. For example, a document such as the LCP BREF which forms the base for future EU LCP emission ruling shall take into account current trends which have a big impact on the future power plant installations.

2. SOx or SO2 ?

In the "definitions" table of chapter 10 /1/ SOx is defined as "***the sum of sulphur dioxide (SO_2) and sulphur trioxide (SO_3) expressed as SO_2***". All limit values including BAT AELs are also given as SOx in the document, this is a big change compared to the current LCP BREF 2006 /5/ and IED /3/ documents where SO_2 is used and NOT SOx for the limit values.

In the Cover Letter "*Consultation on the first draft of the revised Best Available Techniques Reference Document for the Large Combustion Plants" dated 27th of June 2013 is in section "Topics that need special attention*" is stated:

"In addition to the aforementioned general remarks, we would like to draw to your attention to the following issues:

The data on sulphur emissions to air, collected through the questionnaires, are expressed as SOx (being the mixture of SO_2 and SO_3 expressed as SO_2), and not as SO_2. Having been provided with such data and not having received any comment about this pollutant, ***we assume*** *that the provided data indeed* ***represent SOx emissions****. Therefore, the EIPPCB proposes BAT conclusions for SOx emissions to air based on the data collected."*

EIPPCB requests in the same document following concerning above topic: "*Please provide, as part as your comments, your opinion on these two topics that the EIPPCB considers of major importance "*

EUROMOT has studied the obtained field data emission sheets (for the HFO engine plants) carefully, below our observations:

- "Plants 362 – 365" (i.e. Maltese 8 diesel engine unit plant, source for set SOx BAT AELs): "CEMS" is used in context with methods EN 14181, EN 15267-3 and ISO 14956. We want to point out that above EN standards are about quality assurance for automated measurements. EN14181 does not mention anything about methods for different pollutants. EN15267-3 lists reference methods for automated measurement systems and for SO_2 it is EN14791 (see later text). ISO 14956 is merely a quality assurance related standard, it is about choosing the suitable measurement procedure. ("*Air quality. Evaluation of the suitability of a measurement procedure by comparison with a required measurement uncertainty.").*

  Conclusion: There is no reference to SOx as a sum of SO2 and SO3.

- **In many references no or erroneous SOx measurement methods are given**:
  - In plant(s) (428-5 - 428 -10) data field emission data sheets **no** measurement method for SOx is stated at all, only "CEMS" is mentioned !
  - Reference 176 use ISO 7935, CEMS. But ISO 7395 is an **old standard for preparation of calibration gas mixtures only.** ISO 7395 was withdrawn in 1984 and should therefore not be used anymore.
  - **References 429-1 – 429-4 refer to ASTM D3162 (NDIR, periodic measurement, note ASTM D3162 is a measurement method for CO in ambient air !**

- **SO_2 measurements:**
  - References 427-1 – 427-8 refer to EN14791 (and CEMS) which is a measurement method **for SO_2.**

- **References 177 – 181 electrochemical (infrared analyzer, periodic measurements) is probably measuring only SO2 fraction.**

In general **for SO_3 there is no reference method mentioned at all in the (BREF D1) field data gathering sheets.** SO_3 with continuous measurements is very tricky due to reactivity with water. By keeping sampled gas hot throughout a measurement, it could in theory be possible to detect SO_3 and H_2SO_4 with FTIR and thus in theory also with hot-wet NDIR**, although SO3 measurement capability is not a standard offering of most CEMS suppliers,** thus field performance and accuracy is currently not well known at the moment. Site measurements for SO_3 could be done periodically (not CEMS) with various methods (with various losses and results) but none of them are standardized by CEN.

In table 10.21 of section 10 of document /1/ continuous SOx (**SO_2 continuous**, SO_3 periodically) monitoring frequency is demanded. We want to highlight that in oil fired (with a known sulphur content) power plants without FGDs (Flue Gas Desulphurization) units, SO_2 emissions can be biannually measured (between measurements we recommend to determine SO_2 emission by calculations, e.g. according to ISO 8178-1 chapter 7.4.3.7 (a cost-effective, practical and accurate method) instead of continuous measurements (see IED /3/ Annex V, Part 3).

Conclusions regarding SO_2:

- **CEN has set standards only for SO_2 only, and European EN standards lack a standard reference method for SO_3. The field reference emission sheets do not include a single SO_3 measurement and we found only references to methods measuring the SO_2 component.**
- **I.e. the reported emissions in field emission data sheets are only SO_2 and not as SOx sum of SO_3 and SO_2. Therefore EUROMOT strongly recommends that SO_2 component shall be regulated andNOT SOx !**
- **In oil (with known S-content) fired power plants not equipped with FGD the SO_2 emission shall preferable be measured biannually (and between measurements determined by calculations (based on the liquid fuel sulphur content) and not by CEMS, this is also possible according to IED /3/.**

3. Large Combustion Plant Classification

In the kick-off meeting in Seville 25 – 28th of October 2011 it was concluded that the revised LCP BREF should consider when appropriate following sub-categories for the BAT assessment: emergency, peak, mid merit and base loads. It was also amongst all concluded that (see section 3.1):

- Plant and unit sizes such as 15 – 50, 50 – 100, 100 – 300 and > 300 MWth
- Impact of fuel characteristics on emissions
- Purpose of combustion plant
- Local conditions (in terms how they may influence generally performance of some techniques), etc.

should be used in the BAT assessments.

We have reviewed the BREF D1 carefully and conclude that above conclusions are very sparely used or are even non-existent in the document.

LCP plant load classification:

In section 1.1 of the document /1/ is mentioned that LCPs in the electricity supply industry are classified as base load, mid-merit or peak plants.

In the text of section 1.1 are also listed several proposals initiated by the European Commission as in order to abate emissions of greenhouse gases (such as: promoting renewable energy up to 2020 and beyond, etc.) which will have a big impact on the LCP sector. It is also stated: "[..] *because of the high penetration of intermittent renewable (e.g. wind) some plant may be required into the future as back-up to the renewable portfolio and to maintain security of supply. The introduction of substantial amounts of generation, at a much smaller individual scale than most existing plants and in different locations, ….* ***It is clear therefore that the LCP sector is facing a major transformation as it evolves in response to substantial changes in the environmental agenda, whilst maintaining the other objective of delivering secure and affordable energy.***"

In section 10 of the document /1/ "definitions" table the power plant classifications are as:

- Emergency plant/mode: Combustion plant operating less than 500 h/yr
- Peak load plant/mode: Combustion plant operating between 500 and 1500 h/yr
- Mid-merit plant/mode: Combustion plant operating between 1500 and 4000 h/yr
- Base load plant/mode: Combustion plant operating more than 4000 h/yr

However in the BAT conclusions (in section 10 of BREF D1) when taking into account the needed secondary abatement techniques (not even existing for some of the set strict limits) needed for emission compliance, only the base load plant option seems to have been taken into account and other categories are missing. Emergency plants are excepted from some emission limits but not all, this needs correction – should be exempted from all emission limits !

Conclusions:

- A new emission ruling shall take into account the current/future trends in the power generating sector which is not the case now. In Annex 1 we have shown the strongly increased power capacity of renewable (wind and solar) in the EU 27 area during the last decade. Wind and solar capacity have increased sharply and as a consequence a big need of peak load plants (for grid stability) has arisen which will further increase. **Therefore the peak load category shall be inserted as an own new category as done** in the recently finalized Gothenburgh Protocol /2/, this shall be the case for all regulated emission compounds.

- Also in **areas with a restricted infrastructure ("local conditions impact") such as power plants on remote islands shall have own emission limits** because same secondary emission reduction technologies as in the mainland might be technically/economically infeasible, see Gothenburgh Protocol /2/, this shall be the case for all regulated emissions components.

- The proposed BAT emission limits for stationary reciprocating engine plants do not differentiate at all for different plant sizes. In a small plant the relative cost impact of a secondary abatement technique is much bigger than for a big one and will thus have a bigger impact on the feasibility therefore **MWth thresholds need to be inserted for the emission limits**.

4. CEMS (Continuous Emission Monitoring System)

In BREF D1 /1/ section 10 (HFO fired engines) continuous measurements (CEMS) are required for NOx, CO, NH_3 and SO_2. Prerequisites for CEMS is a good existing infrastructure (availability of calibration gases, spare parts, etc), and special trained personnel.

In EUROMOT document /4/ in Annex 1 is described how challenging (**corrosion, filter fouling, lack of competence, etc.**) CEMS might be in a HFO fired diesel engine plant. In the same document in section 4 "Monitoring" challenges with extractive and in-situ based systems are also explained and a recommendation is given to conduct stack measurements biannually and between these measurements to use surrogate measurements. CIMAC paper /6/ appendix 4 supports this approach, some statements:

- "Reciprocating engine can be considered a stable process"
- " .. many technical challenges still have to be resolved before CEM systems for engine applications can be considered a feasible way .."

→ **CIMAC paper recommends use of surrogate monitoring between periodical (e.g. yearly) stack measurements**.

In the above referred CIMAC document appendix 4 some "surrogate" parameters are also given.

IED 2010/75/EU /3/ allows the intermittent measurement possibility in general for all oil (with known S-content) fired plants (without FGDs) in regard of SO_2 and in current BREF 2006 /5/ section 6.5.5.2 table 6.47 BAT monitoring of particulate is "*discontinuous once every 6 month*" recommended. See also Annex 2 for more information. IED 2010/75/EU /3/ has set the threshold for CEMS to minimum 100 MWth, thus smaller plants in general shall have the opportunity to measure emissions intermittently at least once every sixth months.

NH_3 measurement especially in a HFO fired engine plant is very demanding/difficult, NH_3 has a tendency to deposit on particulates, in general single small cold spot may absorb all NH_3 and lead to too low NH_3 results, measurements take a long time, etc. **We are not aware of any ISO or CEN measurement standards for ammonia and thus this should not be required to be measured continuously. Intermittent biannual NH_3 measurements for all gas/HFO fired power plants (if equipped with SCR) should give accurate enough measurement results and be a practical/cost-effective mean.**

For stationary engine plants in remote areas with a weak infrastructure such might be the case on remote islands and for peak load plants intermittent measurement procedures should be allowed for all emissions due to infrastructure/practical/cost reasons.

Conclusions:

In order to have a cost-effective and meaningful regulation following options are to be inserted into the BREF D1 in regard of CEMS:

- The intermittent biannual emission monitoring option should be inserted into the BREF D1 in general for SO_2 for plants without FGD firing oil with known S-content. NH_3 measurement shall be biannually for plants equipped with SCR.
- Plants < 100 MWth shall conduct emission measurements intermittently biannually for all emission compounds and between measurements surrogate measures used.
- Due to technical constraints all emission compounds shall for "remote (such as islands)" or grid peaking plants be intermittently measured (e.g. biannually) and between measurements surrogate measures used.

For more information please contact:

European Association of Internal Combustion Engine Manufacturers – EUROMOT
Paul Zepf, (+49 69) 6603-1752, paul.zepf@euromot.eu
EU Transparency Register ID number: 6284937371-73

ANNEX 1

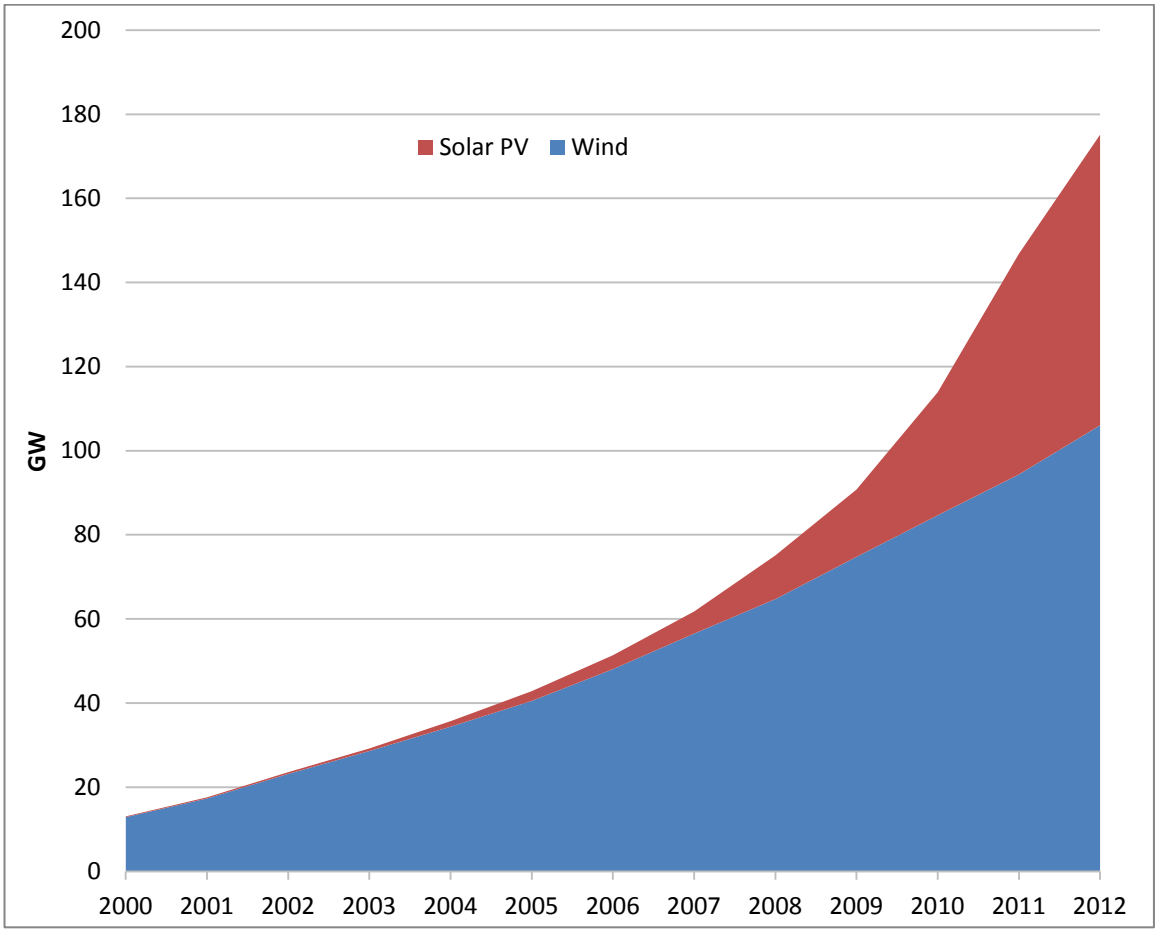
Wind and Solar in EU-27

Below graph is based on following sources:

European Wind Energy Association (EWEA), **European Photovoltaic Industry Assiciation (EPIA)**.

- **Wind in power: 2012 European statistics, February** 2013, **European Wind Energy Association (EWEA)**

- **Market Outlook for Photovoltaics 2013-2017, May 2013, European Photovoltaic Industry Assiciation (EPIA).**



ANNEX 2

In EU reference method EN 13284-1 is used for the gravimetric determination of the particulate emissions. The principle of the gravimetric method is as follows:

A sharp-edged nozzle is positioned in the duct facing into the moving gas stream and a sample flow of the gas is extracted isokinetically for a measured period of time. Isokinetic sampling requires steady state conditions. To allow for non-uniformity of the distribution of particle concentration in the duct, samples are taken at a pre-selected number of stated positions in the duct cross-section. The particulate matter entrained in the sampled gas is separated by a filter medium, then dried and weighted. The particulate concentration is calculated from the weighted particulate mass and the gas sample volume. The oxygen concentration of the exhaust gas is measured simultaneously with the particulate measurement for correction of the measured particulate concentration (at duct conditions) to the reference oxygen conditions stipulated in the environmental norm. The gravimetric method is manual and requires skilled measurement experts and can not be done in a continuous mode.

Smoke density - Determination of opacity and transmission:

Smoke opacity can be measured continuously with optical instruments, but the method does not allow for measurement of particulate concentration in a gravimetric unit such as mg/Nm^3 at 15 vol-% O_2. The optical measurement devices are typically used in big coal fired stations as “alarm” limit detectors only, registering malfunctions of a secondary cleaning equipment such as a dry electrical precipitator or a bag filter.

The principle of the opacity continuous method (smoke density):
The smoke density monitor consists of a light sender and light receiver unit. The units are installed opposite to one another on each side of the flue gas duct. The light transmitted from the source lamp in the light sender is focused and directed in a straight line through the flue gas duct to the receiver on the other side of the duct. The sender and receiver provide output signals which are proportional to the intensity of the transmitted light (I_O) and respectively to the intensity of received light (I). The received light has been attenuated by the flue gas particles in the measurement path.

Transmission is defined as a percentage of received light/transmitted light i.e.:

Transmission (%) = $(I/ I_O)*100$ (1)

The opacity is defined as “light attenuation” i.e.:

Opacity (%) = ((1-(I/ I_O))*100 (2)

The attenuation of the light beam by particle absorption and scattering is described by the Lambert-Beer law:

$I = I_O * e^{-(C*X*S)}$ (3)

where:

I = received attenuated light

I_O= transmitted light

C extinction coefficient (dependent on particle size, shape and density as well as wave length spectrum of the light source)

X = length of the optical measurement path

S = particle concentration

The extinction coefficient (C) varies among others depending on following factors:

- **reciprocating engine types**
- **engine load**
- **fuel type and quality**
- **ambient conditions**
- **etc.**

Consequently it is not a constant value and the same amount of particles can translate to different levels of opacity. This means that opacity of a flue does not correlate 1:1 with the amount of particles and opacity is not a suitable unit to represent the gravimetric amount of particles with any specific accuracy. **The smoke density meter is <u>not</u> aimed to be used for gravimetric particle measurement purposes**.

<u>Conclusions:</u>

For determination of the gravimetric particle concentration at normal steady load conditions in the unit mg/Nm^3 at a given reference O_2-%, the manual method, according to EN 13284-1 or other principally similar methods, should be used. This is praxis in Europe. In our opinion (see above) there are no reliable continuous measurement methods (CEMS) on the market for the gravimetric concentration of particles for the stationary engine plant.

Sites adjunct to suitable infrastructure can in special cases consider continuous opacity measurements as an indicator for particulate emissions as opacity can give an indication of sudden or slow changes in particulate levels. Corrective actions should in any case be supported by actual measurements, e.g. in accordance with EN 13284-1.

Therefore the BAT approach in BREF 2006 /5/ section 6.5.5.2. for dust monitoring "*discontinuous once every 6. month*" (steady, state 85 .. 100 % load of engine) is logical and recommended.

SOURCES

/1/ LCP BREF D1 issued July 2013

/2/ http://www.unece.org/fileadmin/DAM/env/lrtap/full%20text/Informal_document_no_17_No23_Consolidated_text_checked_DB_10Dec2012_-_YT_-_10.12.2012.pdf , see sub headers b and c on page 42.

/3/ IED 2010/75/EU at http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:334:0017:0119:en:PDF

/4/ EUROMOT Position Paper at http://www.EUROMOT.org/download/b7410d61-e2b1-4b8b-93c8-241ec1e0bd1d/WB%20Thermal%20Power%20Plants%20guidelines%202009%2005.pdf

/5/ EU LCP BREF 2006 at http://eippcb.jrc.ec.europa.eu/reference/BREF/lcp_bref_0706.pdf

/6/ CIMAC Recommendation volume 23 (2005) “Standards and methods for sampling and analysing emission components in non-automotive diesel and gas engine exhaust gases - Marine and land based power plant sources”, Document can be ordered from http://www.cimac.com/services/Index1-techpaperdatabase.htm

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