Euromot

US EPA Proposed Rule on Standards of Performance for Stationary Compression Ignition Internal Combustion Engines 40 CFR parts 60, 85, 89 et al.

Docket ID No. OAR-2005-0029

The Euromot Position

as of September 2005

The European Association
of Internal Combustion
Engine Manufacturers
President:
Dr Manlio Mattei
General Secretary:
Dr Peter Scherm

Lyoner Strasse 18
60528 Frankfurt/Main

fon 0049 69 6603-1354
fax 0049 69 6603-2354
eMail euromot@vdma.org
web www.euromot.org

EUROMOT
Engine-in-Society

Euromot is the **European Association of Internal Combustion Engine Manufacturers**.

We represent the leading manufacturers of internal combustion engines used in a broad range of nonroad and marine applications (construction, mining and material handling equipment, trucks and buses, agricultural and forestry equipment, commercial marine and seagoing vessels, workboats and pleasure boats, rail traction, lawn/garden and recreational equipment, power generation).

Euromot has been working for many years with international regulatory bodies, eg European Union, the UN Economic Commission for Europe (UN-ECE), the UN International Maritime Organizations (IMO) and the Central Commission for the Navigation on the Rhine (CCNR). In addition, we are seeking an open and fair dialogue with national governments to provide reliable know-how on advanced internal combustion engine technologies in general and, in particular, on the feasibility of environmental as well as cost-effective product regulations. To achieve a pro-active engagement of all stakeholders in international harmonisation of regulations affecting engines and equipment, we coordinate our activities worldwide with trade associations of the non-road and marine industry sector.

For further information about our Association please refer to our Annual Report 2001 or pay us a virtual visit at **http://www.euromot.org** – your bookmark for engine power worldwide.

Introductory remark

On July 11, 2005 US Environmental Protection Agency published the 40 CFR parts 60, 85, 89, et al. "Standards of Performance for Stationary Compression Ignition Internal Combustion Engines; Proposed Rule". The proposed rule applies to all stationary internal combustion engines except combustion turbines and spark ignition (SI) engines. Dual fuel engines in which liquid fuel (typically diesel fuel) is used for CI (Compression Ignition) and gaseous fuel is used as the primary fuel at an annual average ratio of less than 2 parts diesel fuel to 100 parts total fuel on an energy equivalent basis are SI engines. SI engines will be regulated separately later on.

In the proposed rule engines are divided into classes according to the displacement cylinder volumes and engine power. Stationary CI (Compression Ignition) ICE (Internal Combustion Engine) with a displacement ≥ 30 liters per cylinder form an own category in the proposed rule. This is a logical approach, because these big engine types differ considerably from non road engines.

Euromot supports EPA's initiative to minimize air pollution from stationary reciprocating internal combustion engines. In principle, we see the proposed rule as a suitable means to reduce NO_x, PM, CO, NMHC and SO_2 emissions. However, by with the following comments we want to draw your attention to some misperceptions we have found in the proposal for the big engines (≥ 30 liters per cylinder).

Cost effects of the proposed emission Limits

An environmental quality need driven approach seems to be the base for the proposed rule: on page 39870 is stated "The intended effect of the standards is to require all new, modified and reconstructed stationary CI ICE to use the best demonstrated system of continuous emission reduction, considering *costs*, *non-air quality health, and environmental and energy impacts*, *not just with add-on controls*, but also by eliminating or reducing the formation of these pollutants."

In respect of the emission limits stipulated for the ≥ 30 liters per cylinder category engines above principles have not been followed: environmental impact and cost effect have not been evaluated (see text below) and efficient add-on abatement techniques (SCR for NOx, etc.) will always be needed as a consequence of the proposal. In /1/ it is mentioned (based on statistics) that only a small number of big CI ICE are sold per year to the US and therefore one can forecast that the environmental impact of these engines on the total emissions in the USA is small. Therefore, the proposed strict emission limits cannot be justified based on the air quality need. Below some text from the proposed rule are cited:

- Page 39887: "A facility with such large engines will generally have the resources to implement and justify extensive add-on controls".
  Note: A New Source Performance Standard (NSPS) requires sources to control emissions to the level achievable by *best demonstrated technology (BDT),* **considering costs and non-air quality health and environmental impacts and energy requirements** (page 39871).

- Page 39890: "The EPA does not expect there to be any stationary CI ICE with a displacement of 30 liters per cylinder or more and therefore, no emissions or emissions reductions have been estimated."
  Note: In US territories there are several big stationary engine plant references /9/ e.g.: in Puerto Rico a 20 MWe CI ICE plant and in Guam a 2*40 MWe (totally

80 MW_e). Proposed emission limits will raise the electricity produced in these power plants considerably (see /10/ appendix 1 pictures for more information).

- Further on page 39890 is stated: "The EPA does not expect that any stationary CI ICE with a displacement of 30 liters per cylinders or more would be installed in the U.S. and therefore **no** cost have been estimated. Big stationary IC ICE plants have been installed in some US territories and proposed emisson limits would raise the electricity price considerably in these areas when renewing the plant capacity (see/ 10/appendix 1 pictures for typical cost information). This might have impacts on the small governmental jurisdiction area flexibility and have significant adverse effect on the supply of energy. „This would be in contradiction to the „Reculatory Flexibility Act" and „Executive Order 13211: Actions concerning Regulations That Significantly Affect Energy Supply, Distribution or Use" which are in force in US.

On page 39888 is stated that owners and operators of big CI ICE have to demonstrate compliance by first conducting an initial performance test and then establishing parameters to be monitored on a continuous basis. Performance tests (emission monitoring) are to be conducted annually to demonstrate compliance. This is a logical approach and in /11/ in appendix 4, chapter 3. "Alternative approach to CEMS" are listed some process parameters such as intake air humidity recording for NO_x indication, etc. which will support the proposed approach.

Conclusion:

Costs and an environmental quality need approach should be taken into account in order to get the proposed rule to be representative for the BDT principle, now only the LAER (Lowest Achievable Emission Rate) principle is applied. In USA LAER (cost aspect is not considered) is applied in non attainment areas only! No separate emission limits are proposed for the big pre-2007 CI ICE (≥ 30 liters cylinder diameter) plants as for the smaller displacement cylinder categories. Existing pre 2007 big CI ICE plants need to be regulated with separate own emission limits.

Emission Limits

Below the proposed limits are discussed further in detail and it is shown how a cost-effective environmental quality need approach should look like. In our proposal pre-2007 (after 11.07-05) limits should be based on World Bank /4/ and 2007 and later limits shall depend on the expected engine development (analogous to the 10 ≤ displacement < 30 liter group proposed rule: pre-2007 following an international standard and later on stricter limits).

SO_2:

It is said (e.g. on page 39874) that the sulphur content of the fuel is to be max. 500 ppm starting October 1, 2007 and max. 15 ppm from October 1, 2010 (consistent with the non road diesel rule). The non road engines equipped with an emission control device need to be operated on a clean fuel oil. EPA is asking for comments, whether ≥ 30 liter per cylinder CI ICE should be required to use ULSD (Ultra Low Sulfur Diesel) fuel (on page 39891).

Comment:

As stated out in the Euromot paper /1/ no operating experience exists for these big engines (≥ 30 liter per cylinder) with the 15 ppm sulphur oil at the moment and

therefore an alternative limit should be worked out. Use of a ULSD fuel might have impacts on safety, reliability and durability of the stationary engine plant. At the current stage of technology engine manufacturers will not be able to guarantee an engine operation exclusive with ULSD.

In Europe, e.g. according to the European Union (EU) Directive 1999/32/EC /2/ the maximum sulphur content of heavy fuel oil is max. 1 wt-% (equals to 10000 ppm) from 1 January 2003 and in gas oil max.0.1 wt-% (equals to 1000 ppm) from 1 January 2008. These fuels can be used in stationary CI ISE plants without installed flue gas desulphurization installations. According to the EU 2001/80/EC Directive /3/ a max. 0.5 wt-% S (equals SO2: 850 mg/Nm^3 (3 % O_2) = about 280 mg/Nm^3 (15 % O_2)) fuel oil can be used in 50 ... 100 MW_{th} (fuel input) boiler plants.

Proposal:

Big CI ICE plants are designed to operate mainly on heavy fuel oil (HFO) and the use of ultra clean light fuel oils (with different density, viscosity, etc. properties) might cause operation troubles. From the technical point of view the proposed rule needs to be realistic, e.g. an alternative limit for big CI ICE should be equivalent to 500 ppm S oil (tested) usage also after 2010 on US main land.

On page 39899 is mentioned that the fuel limits are not required for the stationary CI ICE in Guam, American Samoa or the Commonwealth of the Northern Mariana Islands. This seems to be based on the existing infrastructure and on an environmental quality need approach, which is reasonable (small governmental jurisdiction area flexibility).

NO_x:

The proposed NO_x-limit is very strict, e.g. on page 39887 it is stated:

- ".. required to install controls on their engines that will reduce NO_x emissions at least 90 percent or limit the emissions of NO_x to 0.4 grams per kW-hour (0.30 grams per HP-hour)."

- "The NOx limit of 0.40 grams per kW-hr is based on the NO_x limits set by both the World Bank and the United Kingdom (UK) regulation for large diesel engines. Capital and operating and maintenance costs associated with SCR are as noted high, however, EPA feels the high cost of SCR is justified when installed and operated with engines of significantly higher size and cost than non-road and other stationary engines."

Comment:

The NO_x limit above of 0.4 grams per kW-hour is equal to about 50 mg/Nm^3 (15 % O_2). The limit is much stricter than in World Bank Guidelines or the UK limits as referred to in the proposal text.

- World Bank /4/ is built on an environmental quality need approach: in non degraded air-sheds the NO_x-limit for CI ICE plants is 2000 mg/Nm^3 and in degraded air-sheds the limit is 400 mg/Nm^3 (15 % O_2) (equals about 3.1 g/kWh).

- In the UK /1/ (see annex 1) the NO_x-limits are:
  - 1300/1400 mg/Nm^3 (15 % O_2) (about 10.1/10.9 g/kWh) (light fuel/heavy fuel oils), plants < 50 MW_{th}
  - 200 … 300 mg/Nm^3 (15 % O_2) (about 1.6 .. 2.3 g/kWh) for oil fired big plants > 50 MW_{th}.

The US EPA proposed limits are about 4 … 40 times stricter than the referred references!

As a result of an extensive R&D work NO_x-emissions from bigger liquid fired CI ICE have been reduced remarkably by primary measures (typically 30 … 35 %) during the last decade compared to previous values. Primary methods are: Low NO_x combustion focusing on optimizing: closing timing of inlet valve, design of fuel injection equipment on the engine, new camshaft, etc. A late fuel injection suppresses the pressure in the cylinder and early inlet valve closing suppresses the in cylinder temperatures, resulting in reduced NOx formation.

The proposed NO_x limit means in practise a need to always install a SCR unit in connection with the engine. SCR needs a reagent aqueous urea/ammonia or pure ammonia to work and lack of the reagent delivery infrastructure in certain areas will make the proper use of SCR impossible.

In order to give an incentive to the industry to develop new cost-effective primary methods and to continue the positive development in the past decade (and not stop the development when expensive/efficient SCR is always needed) the proposed limit should be made more realistic based on e.g. the zoning approach (attainment/non attainment area, mainland US/other areas; see proposal below).

On page 39898 calculation formulas for the conversion from the concentration unit ppm-v to the mass based unit of g/kWh are given. Equation 7 contains an error: when calculating the mass based unit g/kWh the “actual” ppm-v concentration shall be used not the to 15 % O_2 normated value. E.g. if the “actual” (real) oxygen content of the flue gas is 12.5 vol-% (dry) then by using the value given at 15 % O_2 in equation 7 will give an about 30 % too low mass value. Factor 1.912 for converting ppm-v NO_x to mg/Nm^3, indicates Nm^3 to be given at 25 °C (this needs to be mentioned in the text).

Proposal:

In /5/ a comment has been prepared for the EU BREF (Reference Document on Best Available Techniques for Large Combustion Plants > 50 MW_{th}) process and cost impacts of some different NO_x-limits are shown. According to /5/ an environmental quality need driven approach based on BAT (Best Available Technique) for liquid fired CI ICE should give following NO_x-limits:

- urban areas 750 mg/Nm^3 (15 % O_2)
- other areas 1600 mg/Nm^3 (15 % O_2)

combined with emission corrections for highly efficient engines.

Smaller CI ICE stationary power plants should have leaner limits than bigger ones. We therefore propose following limits:

Pre-2007:
According to World Bank /4/.

2007 and later:

Mainland USA

- Attainment areas:
  Plants < 50 MW_e: - urban areas 750 mg/Nm^3 (15 % O_2), (about 5.8 g/kWh)

- other areas 1600 mg/Nm^3(15 % O_2),(about 12.4 g/kWh) with emission corrections for highly efficient engines, see /6/.

Plants ≥ 50 MW_e: - 750 mg/Nm^3 (15 % O_2), (about 5.8 g/kWh)
- with emission correction for highly efficient engines, see /6/.

- Non-attainment areas such as in the proposal.

Other US territories:

- Guam, American Samoa or the Commonwealth of the Northern Mariana Islands, etc. according to /7/.

Particulate:

The particulate limit in the proposed rule (page 39878) for the big CI ICE is set to:

- " … are also required to reduce the PM emissions by 60 percent or more, or alternatively they must limit the emission of PM in the stationary CI internal combustion engine exhaust to 0.12 grams per kW-hour (0.09 grams per HP-hour)."

- On page 39887 is stated: "... The requirement of 60 percent PM control or more is based on the capacities of ESP".

On page 39887 is stated "The PM emission standard of 0.12 grams per kW-hour is based on information provided by vendors of ESP, who indicated that the technology is capable of achieving that level *for oil-fired combustion sources*".

Comment:

The proposed particulate limit of 0.12 grams per kW-hour equals in a concentration unit about 16 mg/Nm^3 (15 % O_2). This is a very strict particulate limit much stricter than the British /1/ and World Bank /2/ limits. The limits in /1/ and /2/ are 50 mg/Nm^3 (15 % O_2) (equals to about 0.38 g/kWh) for stationary big and 100 mg/Nm^3 (15 % O_2) (about 0.75 g/kWh) for smaller CI ICE plants.

In /10/, appendix 1 typical price information is given for an ESP. The ESP is bulky and has a high investment cost. In the BREF document for large combustion installations /8/ on page 356 in paragraph "Abatement of particulate emissions" is stated: "Due to the different temperature and oxygen content of the diesel flue-gas, the electrical properties of the diesel particulates (e.g. resistivity, etc.) *are different compared to particulates from a boiler flue-gas***,** and *proper testing of the ESP (electrical precipitator) is needed to commercial release*."

Only a few CI ICE plants are equipped with ESP to this date and the technical availability of the ESP need therefore to be evaluated case by case. Gathered experience based on oil fired boilers is not giving the right picture.

In /8/ BAT is therefore considered to use of low ash and low sulphur fuel, whenever commercially available. Particulate limits for liquid fired CI ICE are given on page 405 in table 6.47 to max. 50 mg/Nm^3 (15 % O_2) (about 0.38 g/kWh) when fuel is Heavy Fuel Oil (HFO) and max. 30 mg/Nm^3 (15 % O_2) about 0.23 g/kWh) for light fuel oil (LFO). In Europe the particulate measurement method used is in principal similar to US EPA

Method 17. Comparison of particulate measurement methods have shown that different methods will give very different results. E.g. when comparing US Method 17 and Method 5, it has been noted that Method 5 usually gives much higher measurement results. In /11/ in appendix 2 it is recommended to use particulate measurement methods principally similar to US Method 17 instead of a method where exhaust gas has to be cooled dramatically leading to a non-reproducible sampling.

Based on above the particulate limit of 0.12 grams per kW-hour in the proposed rule is thus not representing BDT.

Proposal:

We propose particulate limits in line with the EU BREF document for bigger stationary CI ICE plant stations (> 50 MW), Reason: US EPA have an output based standard. For smaller CI ICE plants the particulate limit should be according the UK approach.

Summary

SO_x-limits should be set out on the base of fuel with 500 ppm S from 2007 on and also beyond 2010. New considerations can be made provided that adequate experiences are available for big engines with a displacement > 30 l/cyl. operating with ULSD.

For the NO_x-limits there should be a differentiation in „Attainment Areas“ (also being subdivided in „Urban Areas“/“Other Areas“) and „Non-attainment“ Areas. High efficient engines should be rewarded by a bonus for the advantage of protecting primary energy resources and reducing emission of greenhouse gases. Euromot has made suitable proposals for that.

Particulate-limits should be realigned to a technology level achievable with engine internal measures using fuels with low ash contents and low sulphur. Euromot has also presented proposals for this.

The use of ESP, hardly experienced on stationary engine plants, can only be considered in particular cases.

However, when examining all these issues cost aspects shall be kept in mind.

Sources

/1/ “US EPA Draft Concepts for NSPS Regulation Applicable to Stationary Diesel-fueled Engines”, The Euromot Position April 2005. See internet: http://www.euromot.org/download/news/positions/stationary/US_EPA_NSPS_regulation_Euromot_Position_290405.pdf

/2/ Directive 1999/32/EC “Reduction in the sulphur content of certain liquid fuels and amending Directive 93/12/EEC”

/3/ Directive 2001/80/EC “Limitation of emissions of certain pollutants into air from large combustion plants”

/4/ World Bank “Thermal Power – Guidelines for New Plants” 1998 http://www.worldbank.org

/5/ "2nd Draft Reference Document on Best Available Techniques for large Combustion Plants", Backup document, Euromot June 2003. See internet www.euromot.org/download/news/positions/stationary/EIPPCB_BREF_backup_document_mar03.pdf

/6/ www.euromot.org/download/news/positions/stationary/EIPPCB_BREF_backup_document_euromot_comments_jun03_table_6_41.pdf

/7/ "Stationary Engine Emission Legislation – Diesel and Gas", The Euromot position November 2004, see internet www.euromot.org/download/news/positions/stationary/Future_stationary_engine_emission_legislation_Nov04.pdf

/8/ Integrated Pollution Prevention and Control (IPPC), Reference Document on Best Available Techniques for Large Combustion Plants, May 2005, European IPPC Bureau. See internet ftp://ftp.jrc.es/pub/eippcb/doc/lcp_final_0505.pdf

/9/ Power-Gen Asia ´96, 17 – 19 September. 1996 Pragati Maidan, New Delhi , India, Conference papers Volume 2 pages: 128 – 151 and 209 – 227

/10/ Emissions to air from engine driven power plants, Euromot 2002 made for the EU BREF process

/11/ CIMAC Recommendation- Standards and Methods for sampling and Analysing Emission Components in Non-autromotive Diesel and gas Engine Exhaust Gases – Marine and land based Power Plant Sources"; CIMAC Working Group on Exhaust Emissions February 2005. The document can be ordered from: http://www.cimac.com/services/Index1-techpaperdatabase.htm .