Worldbank – International Finance Corporation

General Environmental, Health and Safety Guidelines

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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 (UNECE), 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 2003 or pay us a virtual visit at **http://www.euromot.org** – your bookmark for engine power worldwide.

1. Introduction

On August 2, 2006 the International Finance Corporation (IFC) published the first draft of the General Environmental, Health and Safety (EHS) Guidelines /1/ for public comment. This is a part of the update process of the current set of World Bank Guidelines dated 1998 published in the Pollution and Prevention and Abatement Handbook (PPAH) and IFC Guidelines published between 1991 and 2003.

The Guidelines are said to be based on Good International Industry Practise (GIIP) and performance levels in these achievable in new facilities at **reasonable costs by existing technology** (to existing facilities may involve establishment of site-specific targets with an appropriate timetable to achieve these). Use of BAT (Best Available Techniques) which are technical, financial and operational feasible is the target. The performance standards are intended to be applied using expert professional judgement and with an understanding that **site-specific exceptions or variations** (on basis of the results of an Environmental Assessment (EA) in which such variables as host country context, assimilative capacity of the environment and other project factors are considered) may be required to meet the stated objectives and requirements. It is said that the EA process may recommend alternative (higher or lower) levels or measures which, if acceptable to IFC, become project- or site-specific requirements**. The IPPC (Integrated Pollution Prevention and Control) principle taking the whole environmental picture into consideration seems to be the basis.**

The General EHS Guidelines is said to be organized to capture common themes that are applicable to any industrial sector and project. This Guideline and the Industrial Sector EHS Guidelines are designed **to be used jointly**. E.g. emissions of combustion sources with a capacity ≤50 MW_{th} used for heat- (steam, etc.) and power production are addressed in the General EHS Guidelines and other sector specific items in the sector Guidelines. Bigger combustion sources will be addressed in the Thermal Power EHS Guidelines. The draft General EHS Guidelines contains technique specific emission limits (as it is the case in modern environmental legislation worldwide) for different prime mover technologies (engines, turbines and boilers). In the current 1998 Guidelines this is seen only in the "Thermal Power – Guidelines for New plants".

The draft General EHS Guidelines however seems not to consider the differences in infrastructure around the world. The emission levels of noise, stack and ground level emissions are strict without sufficient focus on the consequences (cost-impact, fuel infrastructure, availability of suitable needed technology, existing back-ground levels, etc.).

In this document we have explained our concerns and proposed counter proposals in order to make the General EHS **Guidelines technical and financial feasible and cost effective** on a global level based on GIIP, IPPC and BAT principles.

2. Summary of the main concerns and EUROMOT emission limit proposal

The General EHS Guidelines proposed levels for stack emission (table 1.1.3), ambient air quality (table 1.1.1) and noise levels (tables 1.5.1 and 2.3.1) emissions are not in line with Good International Industry Practise. Factors such as different existing infrastructure, cost effectiveness, etc. seem not to have been considered when stipulating these guideline levels. In the following examples we would like to illustrate our concerns:

<u>Ambient Air Quality (AAQ):</u>

In context with ambient air quality figures percentiles are widely introduced worldwide (e.g. in EU) for the short term values (such as 24-hour, etc.) in order to get statistically more sound standards. Percentiles are now missing in the proposal for most short-term emission levels. The proposed ambient air quality guideline emission levels are set very strict in comparison with the current situation worldwide and have been dramatically strictened in comparison with current WB/IFC Guidelines. The AAQ Guidelines are based on those of World Health Organization (WHO) 2000 except for PM10 and ozone (from WHO global update 2005). WHO has however noted that AAQ in developing countries often far exceed their recommendations and therefore **introduced interim target levels** (in excess of the AAQ Guidelines themselves) to promote a steady progress towards meeting the AAQ Guidelines. Existing National Ambient Air Quality Standards (NAAQS) around the world should also be considered, the proposal is very tight when comparing to NAAQS in many countries such as Brazil, India and USA. Associated costs and benefits should also be considered.

Stack emissions:

SO_2 and particulate emission levels from a liquid fuel fired stationary engine plant are highly dependent on the used (commercially available) fuel composition. In our opinion the proposed emission limits seem more to reflect the situation in Europe and USA. Fuel infrastructure is varying around the world and as a consequence in many countries need of mandatory expensive, bulky secondary flue gas desulphurization (FGD) plants should be the case when implementing the proposed emission levels. A FGD plant is consuming huge quantities of fresh water and producing an end product which needs to be disposed in an environmental acceptable way. **This is however not according to the IPPC nor GIIP principles especially for a smaller power plant.**

Used fuel qualities and engine efficiency have impacts on the NO_x-emission. Operation on light fuel oils (LFO) creates lower emissions compared to heavy fuel oil (HFO) due to the lower fuel nitrogen content, etc. Set emission limits for liquid fuels (in case of oil) represent the latest technology development stage for some diesel engine categories but not for the bigger engine segment. All different engine technologies are not reflected in the proposed NO_x-emission values (e.g. the high pressure gas diesel engine seems to be "forgotten" in gas mode). Also different multi-fuel engine type aspects are missing.

Noise:

Areas are worldwide often divided according to land use e.g. industrialized, commercial or residential. In the present World Bank Guidelines 1998 ("Thermal Power – Guidelines for New Plants") land is classified according to use as residential or industrial/commercial. In the draft Guidelines /1/ **only the residential land use seems to have been the base** when setting the limit values, **which is neither a technical feasible nor a cost-effective approach.** Ambient noise levels have been dramatically reduced in comparison with current Thermal power WB/IFC Guidelines e.g. in an industrialized area (night time) 70 dB(A) → 40 dB(A) or about 20 times. In our opinion this is definitely not according to GIIP.

Other concerns:

It is said in the draft Guidelines **that site-specific exceptions or variations** (on basis of the results of an environmental assessment in which such variables as host country context, assimilative capacity of the environment and other project factors are considered) may be used. But the use of exceptions or variations **is not explained/documented**. As a consequence external parties (others than World Bank/IFC) using the Guidelines are likely to stick to the proposed Guideline levels without any site-specific variation possibility.

Several of above mentioned emission levels are stricter compared to current standards in Europe or USA. We think that this is not a logical approach for Guidelines which are intended to be universal. The varying local conditons around the world should be more taken into account.

In order to fulfil the proposed emission levels use of flue gas secondary abatement technologies such as FGD, Electrostatic Precipitator (ESP) and in some cases even Selctive Catalytic Reduction (SCR) will be necessary in regions where good quality liquid fuels are not commercially available. **The investment costs of the power plant**

will rise considerably typically in the range up to 25-40% (FGD+ESP-case, dependent on the technology chosen) and if SCR is also applied even up to more than 50%. The operation and maintenance costs will also rise as a consequence of the need of secondary abatement technologies (FGD+ESP+SCR). These costs will raise typically in a range up to 25-30% or more. They are highly dependent on the costs of reagent and raw water and end product disposal. All these costs will be seen in the final higher electricity price. One possible consequence of the strict emission limits in /1/ will be that existing old inefficient power plants will get an extended operational lifetime due to the lack of investments in new cleaner and more efficient power plants. This will have a detrimental effect on fragile economics and industrial infrastructures in third world countries.

In the proposal /1/ biofuels offering an alterantive to conventional fuels are not promoted. Separate stack emission limits should be introduced for biofuels, otherwise their use will be limited. Biofuels offer an alternative to produce e.g. electricity in a CO_2 free manner. By growing "own fuels" the local economy will be supported and new job opportunities will be created. These fuels will reduce the fuel price volatility especially for developing countries. Therefore a differentiation in the emission limits between biofuels and conventional fossil fuels should be made to honour the positive impact of biofuels.

In below text above mentioned aspects are discussed and counter proposals (in chapter 3.3 for the ambient air quality, in chapters 4.2 and 4.3 for the stack values and in chapter 5.3 for the noise) based on GIIP are presented. Please see below a **summary of our proposal for the stack emission limits**:

Table 1: *EUROMOT proposal for stack emission limits (in mg/Nm^3 and for 15% O_2)*

Engine type	Fuel	Bore [mm]	NO_x [mg/Nm^3]	PM [mg/Nm^3]	SO_2 [mg/Nm^3]
Compression Ignition (CI)	**Oil**	< 400	1600 In A+B zones: 740	100 In A+B zones: 75	1760 In A+B zones: 1170
		≥ 400 incl. Dual Fuel engines	1850 In A+B zones: 740		
Spark Ignition (SG) + Dual Fuel (DF) + Compression Ignition (CI)	**Gas**	all engines	200 for Spark Ignition engines 400 for Dual Fuel engines 1600 for Compression Ignition engines	-	-
Compression Ignition (CI)	**Biofuel**	< 400 mm	2100	-	-
		≥ 400 incl. Dual Fuel engines	2200	-	-

These **Euromot proposal for stack emission limits** are for 90-100% Maximum Continuous Rating (MCR) load (study state conditions). Please see chapter 4.4 for our proposal of emission bonus.

Furthermore **we recommend for the sulphur content** for:

- "normal" areas 1760 mg/Nm^3 in the exhaust gas. This is equivalent to 3 wt-% sulphur content in the fuel oil.
- "special" areas 1170 mg/Nm^3 in the exhaust gas. This is equivalent to 2 wt-% sulphur content in the fuel oil.

When stipulating new limits a gradual approach shall be followed in order to give sufficient time to the surrounding community e.g. industry for the implementation, e.g. in IMO is currently a disussion going on to stricten the emission limits by 2010.

Euromot is at your command to discuss about above items in order to find cost-effective solutions, taking into account both environmental and economic aspects.

3. Ambient air quality levels (AAQ)

In table 1.1.1 on page 4 of the draft /1/ allowed ground level concentration (GLC) values for SO_2, NO_2, PM-10 and ozone are given. On the same page is given a general rule for the maximum emission increment (portion) from a power plant on the GLC level. The proposed ambient air quality guidelines and increment general rule are very strict (stricter than praxis in Europe and USA). This is further discussed below.

3.1. Emission GLC increment

In the draft proposal /1/ on page 4 is written *"As a general rule, this would be defined as 1 percent of the long-term air quality standards and 20 percent or the short-term air quality standards*".

Below is shortly explained how increments are dealt with in EU and USA.

In annex V of the EU Directive 1999/30/EC /2/ the upper and lower assessment thresholds for ambient air emissions are given. In the Directive assessment thresholds are defined as:

- "Upper assessment threshold" means a specified level, below which a combination of measurements and modelling techniques may be used to assess prescribed ambient-air quality

- "Lower assessment threshold" means a specified level, below which modelling or objective-estimation techniques alone may be used to assess prescribed ambient-air quality

The proposed general rule in the draft /1/ is very tight in comparison to the EU assessment thresholds, e.g. an upper EU assessment threshold for annual NO_2 is 80 % and hourly 70 % (with a percentile) of the limit value. In EU the general procedure when using assessment thresholds is as follows:

- Estimated GLC value is below the lower assessment threshold: modelling of GLC is sufficient.

- Estimated GLC value is between the lower and upper assessment thresholds: modelling in combination with indicative measurements is recommended.

- Estimated GLC exceeds the upper assessment threshold: continuous measurement at stations (number of stations depends of population amount living in the affected zone) is recommended.

In USA land is divided into classes I, II or III. The biggest part of the land belongs to the class II. Allowed Prevention of Significant Deterioration (PSD) increment value of the GLC emission depends of the area (land) class /3/. These US increment values are much higher in comparison to the Guideline /1/ proposed value, e.g. class II: 20 microgram per cubic meter and class III: 40 microgram per cubic meter for the SO_2 annual increment value.

Conclusion: The "general rule" increment levels proposed in the draft /1/ should be omitted. As shown above the "general rule" is much stricter compared to approaches applied in EU or USA.

3.2. Ambient Air Quality Guidelines (AAQG)

The proposed air quality guidelines do not include percentiles, except for the PM-10 24-hour value. The AAQG seems thus to have a "never to exceed" approach. To note is that there are always circumstances of unusual meteorolocigal events so this kind of standard might be violated. Statistical definition (percentiles) is often used in order to make the limit values more useful, e.g. to take care of unusual meteorological events. E.g. EU GLC limit short term values which are close to the WHO levels do have associated percentile values.

In table 2 below the percentiles used in EU are presented:

Table 2: *Short term percentiles used in EU on short-term emissions /4/*

Emission component (microgram per cubic meter)	**Percentile**
SO_2 daily (24-hour) mean: 125	99.2 percentile (max. 3 exceedences a year)
NO_2 1-hour mean: 200	99.8 percentile (max. 18 exceedences a year)
Ozone 8–hour daily mean: 120	Max. exceedences < 25 days a year, averaged over 3 years
Particulate (PM-10) daily (24–hour) mean: 50	90.4* percentile (max. 35 exceedances a year)

*to be met by 1.1 2005

As can be seen besides that percentiles are missing in the draft /1/ also some actual emission level figures are stricter, e.g.:

- PM-10 annual value is the same as the one proposed for EU to be reached by 1st of January 2010

- Ozone: compare proposed 100 microgram/cubic meter to the 120 value.

Cubic meter is not defined for the unit "microgram per cubic meter" in the draft. In EU 293 K and a pressure of 101.3 kPa for the cubic meter is used /2/. This should be added to the text.

Note also that the EU ambient Air Directive /2/ contains following provisions:

- The effect of natural sources on background levels (significantly in excess of normal levels) for the air quality, i.e. in such an area the ambient air concentration values are allowed to be exceeded (justification is needed in order to show that these are due to natural events).

- Macroscale testing (protection of human health): "*Sampling points should in general be sited to avoid measuring small micro-environments in their immediate vicinity. As a guideline, a sampling point should be sited to be representative of air quality in a surrounding area of no less than 200 m^2 at traffic-oriented sites and of several square kilometres at urban-background sites.*"

Note: for protection of ecosystems & vegetation the surrounding area is bigger. In other words measured average ambient air concentrations for a large air-shed are to be compared to the set limit (not a local "small area" concentration peak due to some hill, etc).

- "*Margin of tolerance*": this means the percentage of the limit value by which the **value may be exceeded** according to certain conditions laid down in Directive 96/62/EC. E.g. annual NO_x-limit of 40 micrograms/m^3 exceedance: "*50 % on the entry into force of this Directive, reducing on 1 January 2001 and every 12 months thereafter by equal percentages to reach 0 % by 1 January 2010*".

When working out the 1998 World Bank Guideline Air Quality ("Thermal Power – Guidelines for New Plants") recommendation also other standards than those of EU and WHO seem to have been studied (e.g. US) and a consensus seems to have been made. The proposed ground level concentration values in the draft /1/ are based only on World Health Organization (WHO) data. To note is that the WHO air quality guidelines were first published as Air Quality Guidelines for Europe in 1987, based on evidence from epidemiological and toxicological literature in USA and Europe. **It did not** consider exposure to ambient air concentrations in developing countries and **different conditions in these countries (factors such as high/low temperature, humidity, altitude, background concentrations and nutritional status). WHO has noted that AAQ in developing countries often far exceed their recommendations and therefore introduced interim target levels (in excess of the AAQG:s themselves) to promote a steady progress towards meeting the AAQG:s** /28/. The interim targets are intended as steps in a progressive reduction of air pollution in more polluted areas and are intended to promote a shift from concentrations with acute serious health consequences to concentrations that if achieved would result in significant reductions in risks for acute and chronic effects. In the report /28/ interim values are set for e.g. particulate, ozone, etc. In order to get more reasonable AAQG:s the WHO interim-1 levels also for PM10 and ozone emission species should be used (instead of the present values), i.e.:

- PM10 (mean levels): annual 70 microgram/m^3, 24-hour 150 microgram/m^3
- Ozone (daily maximum 8-hour mean): 160 microgram/m^3

Below some NAAQS (National Ambient Air Quality Standards) limits of India, Philippines, US and Brazil are shown. From these can be seen that these differ considerably from the proposal in /1/.

In table 3 the Indian NAAQS limits for SO_2, NO_2 and PM-10 are presented /5/ (**note** the land use approach):.

Table 3: *Indian National Ambient air Quality Standards (NAAQS) /5/.*

Pollutant	Time weighted average	GLC (micro g/m^3) Industrial Area	GLC (micro g/m^3) Residential Area	GLC (micro g/m^3) Sensitive Area
SO_2	Annual*	80	60	15
	24-hour**	120	80	30
NO_2	Annual*	80	60	15
	24-hour**	120	80	30
Respirable Particulate matter (PM-10)	Annual*	120	60	50
	24-hour**	150	100	75

*Annual arithmetic mean of minimum 104 measurements in a year taken twice a week 24 hourly at uniform interval

**24 hourly values should be met 98 % of the time in a year. However 2 % of the time, it may be exceeded but not on two consecutive days.

In table 4 the Philippine NAAQS limits for SO_2, NO_2 and PM-10 are presented /6/.

Table 4: *Initial set of NAAQS Guideline in Philippines (Nm^3 given at 25 degree C and 760 mm Hg).*

Pollutant	Average time	GLC (micro g/m^3)
SO_2	Annual**	80
	24-hour*	180
NO_2	24-hour*	150
PM-10	Annual**	60
	24-hour*	150
Photochemical oxidants as Ozone	8-hour*	60

* Maximum limits represented by ninety-eight percentile (98 %)

** Arithmetic mean, for PM-10 geometric mean. SO2 and suspended particulate matter are sampled once every six days when using the manual methods. A minimum of twelve sampling days per quarter or forty-eight sampling days each year is required for these methods.

US Primary NAAQS set limits to protect public health, including the health "sensitive" populations such as asthmatics, children and the elderly. In table 5 the US EPA primary NAAQS is shown for SO_2, NO_2, ozone and PM-10.

Table 5: *US EPA Primary NAAQS /7/*

Pollutant	Average time	GLC (micro g/m^3)
SO_2	Annual	80
	24-hour*	365
NO_2	Annual	100
PM-10	Annual****	-
	24-hour***	150
Ozone	1-hour**	235 (0.12 ppm)

* Concentration not to be exceeded more than once per year
** Not to be exceeded more than once per year based on 3 year average of number of concentrations (> 0.12 ppm)
*** 99th percentile for a period of 1 year, averaged over 3 years
**** US EPA issued on September 21 2006 a new standard for particulate. The annual PM10 value was revoked /29/.

In Brazil the primary air quality standard are set for pollutant concentrations, if surpassed may affect the health of the population. In table 6 the Brazil primary air quality standard is shown for SO_2, NO_2, ozone and PM-10.

Table 6: *Brazil primary NAAQS /22/, Nm^3 at 25 degree C and 760 mm Hg*

Pollutant	Average time	GLC (micro g/m^3)
SO_2	Annual	80
	24-hour*	365
NO_2	Annual	100
	1-hour	320
Inhalable particulate (PM-10)	Annual	50
	24-hour*	150
Ozone	1-hour*	160

* Concentration not to be exceeded more than once per year

From above tables can be seen that the proposed ambient air quality limits in the WB/IFC draft /1/ are very strict, many existing standards around the world prescribe higher values.

3.3 Conclusion:

- In order to get statistical more sound Guidelines for the ambient air quality levels percentiles for the short term values are to be inserted. As can be seen from above, this is praxis worldwide
- The GLC values should be for "outside plant fence".
- Existing background levels due to local conditions are to be considered in the rule setting, e.g. effect of natural sources. Average ambient concentration values for a large air-shed should be used when comparing to set limits and a local concentration peak due to e.g. "special" local topography should be omitted.
- The proposed ambient air quality figures are very strict, e.g. the EU proposed PM-10 annual value from the year 2010 is used. Please note also the WHO interim target approach.
- In order to get reasonable Ambient Air Quality Guidelines and taking cost and health benefit aspects into consideration we propose following: make use of a similar area-specific approach as done in India or/and consider introduction of interim-1 WHO limits for ozone and PM10 into the proposed values. By this

way a world wide standard taking into account (both costs and benefits) the difference in infrastructure and other conditions can be worked out.

- The current World Bank 1998 Guideline Ambient air Quality (in “Thermal Power – Guidelines for New Plants”) figures are examples of a successful implementation after considering existing different conditions/praxis around the world (and not only “European” ones). In adopting new ambient air quality standards an appropriate phase-in period is needed which the draft does not consider. A mix of US EPA Primary, Brazilian and Indian NAAQS levels seem to be more suitable for a worldwide approach than the WHO Guidelines.

4.Stack emission levels

4.1 General

In table 1.1.3 each prime mover technique (Engine, Gas turbine and Boiler) has its own specific emission limits. The engine limits are divided according to fuel usage (gas or liquid), but the different engine types have *not* been considered (e.g. the high pressure gas diesel engine seems to be left out).

The different existing fuel infrastructure around the world has not been taking into consideration when a general maximum 1.5 wt-% S figure for the liquid fuel is specified. The fuel composition has the main impact on the SO_2 (sulphur content) and particulate (ash and S- (mainly for HFO), etc. contents) emissions.

The proposed NO_x-limits are also very strict, for bigger diesel engines use of a “water addition” or secondary abatement method such as SCR will in most cases be a must. In many places around the world water resources are scarce and thus a wet method is not an option.

According to the table 1.1.3 in the draft /1/ facilities in urban/industrial areas with a degraded airshed or close to ecological sensitive areas have even stricter limits. Definitions of what is meant with “urban”, “industrial” areas, “close to ecological sensitive areas” and “degraded airshed: A, B types” are needed in order to avoid misperceptions of the standard. To **note** is that the “urban area” definition will be different around the world due to differing local conditions, see e.g. Indian “category A” (“ .. having population more than 10 lakhs ..” (> 1 million)) see definition in /12/.

Some emissions in table 1.1.3 are given in unit mg/Nm^3 (15 % O_2) or g/kWh. The used unit g/kWh is not defined. It is not clear if the unit is for “output or input” heat or “output” electricity. A practical approach is to use emission volume concentrations (such as ppm-v, mg/Nm^3 at a certain reference O_2-concentration) only (and not other units such as g/kWh, which should require a lot of extra measurement work and definitions in order to avoid misperceptions) which means that the emission can be measured directly. Only a simple calculation to the reference O_2-% concentration is needed.

4.2 Engine types and NO_x emission

Stationary medium speed diesel engines which can meet the current “World Bank” NO_x limit of 2000 mg/Nm^3 (15% O_2) are technically comparable to IMO MARPOL Annex VI compliant engines (Annex VI status as valid for engines onboard vessels constructed since 1. January 2000). Often the same engine types (with different specifications) are used in both stationary and marine applications. Hereby it is considered that stationary engines have to meet the “World Bank” limit at site under relevant ambient conditions operated with the provided fuel, whereas the IMO emission limits are under reference conditions (light fuel oil, ambient air humidity correction, etc.).

In IMO is also currently a discussion in progress to stricten the emission limits. Technically feasible with in-engine measures (primary methods only) **is regarded a 20% NO_x reduction for HFO operated four-stroke** engines by 2010, with a fuel increase as a consequence. Furthermore IMO is considering a two step approach (next step in 2015 ?) which would enable reductions consistent with the lead time necessary for development and implementation. /30/.

The draft /1/ proposes (table 1.1.3) for NO_x (as NO_2):

- General: Maximum 1460 mg/Nm^3 (15% O_2)
- Urban/industrialized areas with degraded air-sheds or close to ecologically sensitive area: A: 740 mg/Nm^3 (15% O_2), B: 300 mg/Nm^3 (15% O_2) or 1.6 g/kWh.

Below is in brief described the engine development and factors (engine type, fuel N-content [%], etc.) having impact on the NO_x formation. A comparison to some other world wide standards is also done.

Liquid fuel composition (nitrogen content, etc.) has an impact on the NO_x ("fuel NO_x" part) emission. In document /11/ this can be seen, biofuel oils create a higher NO_x emission than heavy fuel oils and a heavy fuel more than a light fuel oil.

In chapter 2 ot the CIMAC document /8/ some main differences between the engine types (Diesel engine (Compression Ignition CI), Spark Ignition (SG) and Dual Fuel (DF) types) are explained. In some national legislation as in USA /9/ (division into CI (diesel engine); SI (SG and DF)) and Finland /10/ (diesel engine, SG and DF) is done. To be noted is that some of the engines can operate on different fuels (in gas/liquid modes). This should also be reflected in the stipulated emission limits (e.g. a diesel engine in gas mode should have own specific limits). In Euromot document /11/ typical emissions (current and expected emissions from beginning of 2008) of the different engine types operating on various fuels are given.

Engine industry has been working intensively in making the engines more environmental friendly during the years. Please see below the Diesel engine development in brief:

- The first generation low NO_x combustion concept was introduced in the mid of 1990´s and in beginning of year 2000 the second generation was introduced (see picture 1 in appendix 1 /19/ ("NO_x emission development during 1990 – 2000"). The current World Bank "Thermal Power – Guidelines for New Plants" 1998 is an example of a successful step-wise introduction of emission limits. The engine industry was granted a grace period for the development work from July 1998 until July 1, 2000 in order to achieve the 2000 mg/Nm^3 (15 % O_2) NO_x-limit.
- Development work on the diesel engine has continued since year 2000 with the Indian /12/ NO_x-standard of 710 ppm-v (15 % O_2) (equals 1460 mg/Nm^3) and fuel efficiency in focus. NO_x-limit of 710 ppm (15 % O_2) is in force in India since July, 1 2005. It has been seen that the turbocharger is a technical bottleneck. Higher pressure ratios are needed in order to enhance the "Miller-concept" otherwise the fuel consumption increase will be high besides other consequences, especially for the big size engines. Advanced Miller timing requires a high boost pressure (compared to todays´ concept) otherwise the engine power output must be reduced substantially (due to combustion air deficit). Emissions of "unburned" components such as CO, HC and particulate will also increase if sufficient combustion air is not available in the cylinders. A new generation of turbochargers is consequently needed to boost these engines. The development work (engine and turbocharger development) on smaller engines has proceeded about according to the plans, the first generation of a medium sized diesel engine type was released on the market last year. But for the bigger engines the turbocharger development has been slower than expected. In the Miller concept the thermal loading of the engine is increased, especially on part loads. Therefore cooling circuits of the engine might also have to be redesigned with the Miller concept. When decreasing the NO_x to 710 ppm-v (15 % O_2) (this means a reduction of 27% of the NO_x content compared to the current Worldbank value) the fuel consumption (HFO) will typically change as following dependent on engine size with the technique available of today:

- o ≤9 MWe size. 2 … 3 % increase
- o >9 MWe size: 4 .. 6 % increase

LFO contains less nitrogen than HFO and therefore the NO_x-limit of 1460 mg/Nm^3 will be possible to fulfil with a smaller fuel consumption increase than above shown in case of this fuel.

For the proposed stricter NO_x limit (for degraded air-sheds (type A) or ecologically sensitive areas) of 740 mg/Nm^3 (15 % O_2) a SCR is needed in most cases or a very efficient advanced "wet method" is to be applied. Typical performances of "wet methods" can be seen on page 2 of appendix 1 /19/. "Addition of water methods" have so far been used mostly in ship applications and not in stationary power plants. Very efficient advanced wet methods are however still only mostly in the development stage. In many places around the world water is scarce and thus a wet method is not an option.

In order to achieve the proposed NO_x-limit of 300 mg/Nm^3 (15 % O_2) (see case B in table 1.1.3 of the EHS draft guidelines) a SCR (Selective Catalytic Reduction) secondary abatement technique is needed. Please note that the alternative NO_x value 1.6 g/kWh is not properly defined (output value?). If the output approach is assumed it should be equal about 210 mg/Nm^3 (15 % O_2) which is much lower than the given alternative emission concentration value. A SCR is a sensitive method :

- A flue gas minimum temperature (fuel S-% dependent) is needed to avoid salt formation (ammoniumsulphate) on the SCR elements.
- Some trace metals which might be present in the fuel oil act as "catalyst poisons" and deactivate the catalyst
- A soot blowing system should be installed in the reactor containing the catalyst elements

Usage of SCR requires an existing infrastructure (reagent supply, spare parts) and skilled operators. Therefore SCR is not suitable (not GIIP) for many locations around the world. We propose therefore that the NO_x-limit of 210-300 mg/Nm^3 (15 % O_2) (case B: degraded air-sheds or close to ecologically sensitive areas; please note that 210 mg/Nm^3 is equal to 1.6 g/kWh)) should be raised to case A (740 mg/Nm^3 (15 % O_2)) in order to give the plant operator an option to choose an alternative method to SCR.

Above is mentioned that the emission norm of engines in many countries are according to different engine types (technique specific) and used fuels. Below is given an example of a national standard which besides these items also takes the engine size into consideration. In Japan /18/ (see annex 1) engine size is affecting the NO_x-emission limit, e.g.:

- < 400 mm bore engine 950 ppm-v (13 % O_2) = about 1460 mg/Nm^3 (15 % O_2)
- ≥ 400 mm bore engine 1200 ppm-v (13 % O_2) = about 1850 mg/Nm^3 (15 % O_2)

Conclusion:

Liquid fired diesel engines:

In order to take into account the time still needed for the technical development and in order to avoid excessive fuel consumption increase we propose following approaches for the oil fired diesel engine:

a. As a general NO_x-rule for the big engine (≥400mm bore) the Japanese approach as above with a lead time before introduction.

b. For smaller engines we propose the Finnish liquid fuel /10/ NO_x-value of 1600 mg/Nm^3 (15 % O_2).

For the liquid fired DF engine a different NO_x-approach is needed, we propose the same value as in item "a" above. Other liquid fuels such as bio oils should also have own rules (a higher nitrogen content of the fuel leads to a higher NO_x-emission), e.g. see Euromot document /11/ (about 20-25% higher than HFO-NO_x). Otherwise use of biofuels will be restricted. Biofuels offer an alternative to produce electricity in a CO_2 neutral manner. Growing crops ("own fuels") will support the local economy and create new job opprtunities. This will also help to reduce the fuel price volatility problem especially for developing countries.

Above some reasons have been explained why SCR can not be considered to be GIIP at many locations worldwide. Therefore the alternative limit (for B-areas with a degraded airsheds) of 210-300 mg/Nm^3 (210 mg/Nm^3 ≈ 1.6 g/kWh) at 15% O_2 should be raised to 740 mg/Nm^3 (15 % O_2) in order to give the plant operator an option to look for an alternative to SCR.

Gas engines:

Besides fuel usage also engine type should be considered when setting the stack emission limits. Diesel engines can besides on liquid also operate in gas mode (high pressure gas engine) and dual fuel (DF) engines also besides on gas (low pressure gas engine) also in liquid mode. Own specific emission limits (for nitrogen oxides (NO_x)) should therefore be set for gas/oil/other liquid fuel modes diesel, DF and gas fired SG engines in order to take the different techniques into consideration, see Euromot document /11/ for more information.

For the gas fired SG type engines utilizing the lean-burn approach the NO_x limit should be proposed as seen in the draft. For the DF type engine also utilizing the lean-burn approach in gas mode a higher NO_x limit should be considered. We propose to set the limit to 400 mg/Nm^3 (15% O_2). The lean-burn approach is analogous to the dry Low-NO_x combustion concept for the gas turbine. In the lean-burn approach fuel gas and air are premixed before injection to the cylinder and thus a lower combustion temperature is achieved. The consequence is a low NO_x-emission. But an own specific limit for the gas-fired high pressure gas diesel engine e.g. according to the Finnish Guideline /10/ i.e. 1600 mg/Nm^3 (15 % O_2) is needed.

4.3 Available fuel infrastructure versus SO_2 and particulate limits

Various existing legislations worldwide seem to take the existing fuel infrastructure into account. Below are given some examples.

SO_2:

- Europe: According to EU Fuel Directive /13/ (article 3) the maximum sulphur content of heavy fuel oil is restricted to maximum 1.00 wt-% S (after 1 January 2003). However a member state may for some sectors authorize heavy fuel oils with a sulphur content between 1.00 and 3.00 % by mass to be used in part or the whole of its territory provided that the air quality standard for SO_2 is respected. **Note:** In EU BREF (for big plants >50 MWth) /17/ (page 406) primary SO_2 reduction measures are preferred in the engine plant concept.

- USA: According to the US NSPS for CI engines /9/ for displacement ≥30 liters per cylinder CI ICE owners and operators of these engines are subject to a general 500 ppm (0.05 wt-%) S fuel requirement for most areas. Only in Guam, American Samoa and Commonwealth of the Northern Mariana Islands fuel oils with a higher sulphur content such as HFO can be used without need of flue gas desulphurization unit.

- India: In India the available furnace oil is often of high sulphur quality. Furnace Oil (FO) is a widely used fuel in engine installations. In India /15/ furnace oil is an important commodity. In 2002–2003 about in total 8.03 million metric tons were consumed (in power utilities about 488000, industry 4714000 metric tons, etc.). The public sector refineries produced the major share of the consumed FO, imports of furnace oil accounted for about 5–10% ot the total consumption. At source /16/ the composition of FO (furnace oil) is given (max. 4.5 wt-% S and 0.1 wt-% ash). This can also be seen clearly in the Indian emission legislation for diesel engines (>0.8 MWe) /12/, according to the standard in big cities (>1 million habitants (10 lakhs)) a max. 2 wt-% S furnace oil is allowed and in other areas a max. 4.0 wt-% S. Please note that small generator sets <5 MWe in big cities have to use distillated oils (LDO/HSD).

- Brazil: In “normal areas” (Class II and III) Conama /23/ stipulates for oil fired electric generator plants upto 70 MWe capacity a SO_2 limit of 5000 g/millionkcal which equals to about 2.5 wt-% S in the fuel oil (fuel grade OCA1 (max. 2.5 wt-% S) is generally used in these plants).

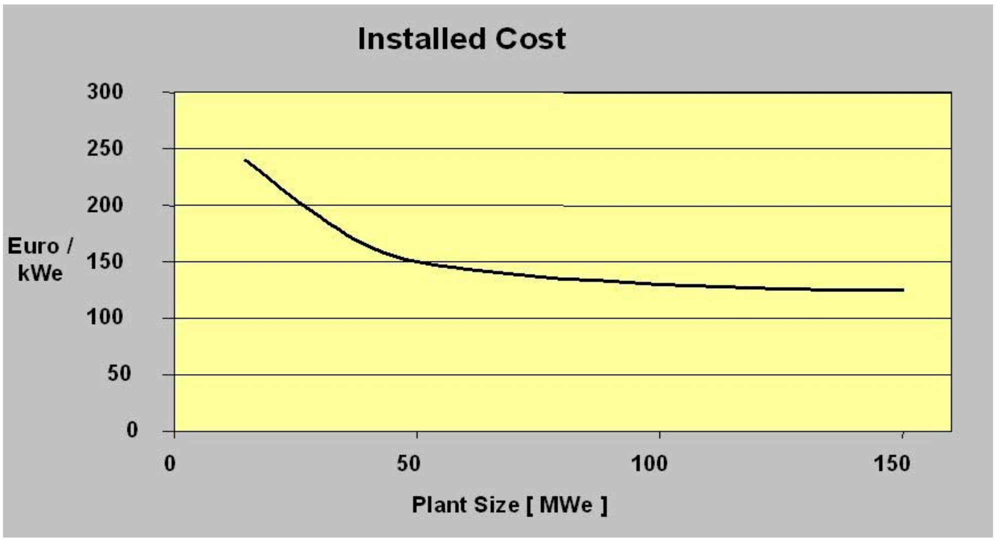
According to a leading worldwide acting classification society called Det Norske Veritas (DNV) /20/ statistics the world sulphur content average of the (180/380 cSt) fuel oil has been 2.69 wt-% S in 2005 compared to 2.67 wt-% S in the year 2001. According to DNV a slow trend towards use of higher viscosity fuels which also contains a higher sulphur residue component is going on and this runs counter to the growing emphasis on lower sulphur contents.

The draft /1/ proposes (table 1.1.3) for SO_2:

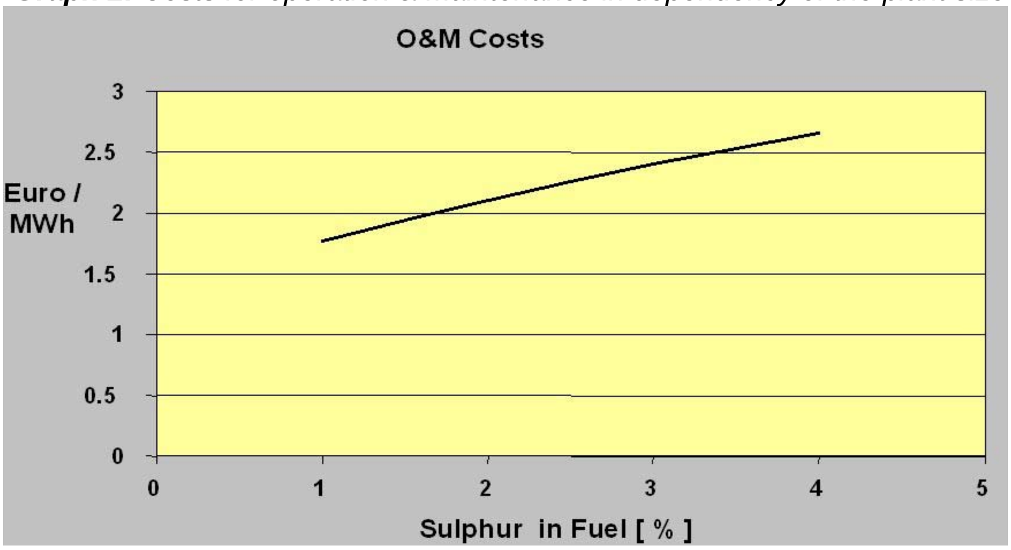
- General: Max. 860 mg/Nm^3 (15 % O_2) or 1.5 % S in the liquid fuel
- Urban/industrialized are with degraded air-sheds or close to ecologically sensitive area (case A): 570 mg/Nm^3 (15 % O_2) or maximum 1 % S in the liquid fuel. In special circumstances (case B) the limit is 280 mg/Nm^3 (15 % O2) SO_2 (is equal to use of an about max. 0.5 % S oil).

In Europe and USA the kind of fuels as required by the proposal /1/ are commercially available but in many parts of the world due to the existing infrastructure they are not e.g. in India. The proposed SO_2 limits will lead to a need to install secondary flue gas desulphurization (FGD) equipment in the small power plant. A FGD consumes a huge amount of good quality (low chlorine, etc.) raw water, a rule of thumb for the water consumption of the scrubber FGD in an engine power plant without heat recovery is in the range of 1.1 m^3/MWhe produced electricity (e.g. a 50 MWe plant FGD should consume about 55 m^3/h of water). **A FGD is therefore not an option in areas which have scarce water resources**. A huge end product amount (liquid or solid dependent on the chosen FGD technology) is also produced which needs to be disposed in an environmental acceptable way. In the follwoing two graphs is shown typical investment and operation & maintenance (O&)M costs for a FGD (calcium carbonate ($CaCO_3$)) as a function of plant size. From the picture can be seen that the investment cost increases strongly with smaller plant sizes than 50 MWe.

Graph 1: *Installation costs in dependency of the plant size*



Graph 2: *Costs for operation & maintenance in dependency of the plant size*



Please note that boilers and reheat is not inlcuded in the analysis. The costs for calcium carbonate amount to 25 Euro/tonne and the costs for the needed water amount to 0.1 Euro/tonne. Please see also document /19/.

Particulate:

The draft /1/ proposes (table 1.1.3) following limit for particulate:

- 50 mg/Nm^3 (15 % O_2) or 0.15 g/kWh for liquid fuel

The unit g/kWh is not defined. It is not clear if it is based on the engine output or the fuel input. If assuming an output approach as in /9/ this value is equal to about 20 mg/Nm^3 (15 % O_2). The proposed emission concentration and mass based figure do not match. Proposed particulate emissions value in g/kWh is much lower than the EU BREF /17/ BAT recommendation for big plants (>50 MWth). Please see below for more information.

Particulate emission is highly dependent of the fuel composition especially in case of using HFO (mainly the ash&S contents). In the Euromot document /19/ particulate emissions dependence of fuel oil composition is shown e.g. in table 1. The proposed particulate limit will lead to a mandatory use of a secondary particulate abatement method in many parts around the world due to the available fuel composition. According to the BREF document /17/ (page 356) secondary particulate equipment is rare in context with diesel engines. In Euromot document /19/ in appendix /1/ are shown typical investment costs of a dry Electrostatic Precipitators (ESP). It can be seen that the costs increase considerably with decreasing engine unit size. It shall also be noted that very few ESP units (existing references mostly installed in big power stations) in context with diesel engines exist and long term operation experience of these are at the moment limited. To be noted is also that many of the existing ESPs installed in the field in context with liquid fired diesel engines have been designed for the particulate outlet value of 50 mg/Nm^3 (15 % O_2). This is much higher limit than the alternative limit proposal 0.15 g/kWh (= about 20 mg/Nm^3).

Based on above it can be concluded that proposed particulate limits in /1/, which will in many cases result in a mandatory use of a secondary particulate abatement technique are not GIIP.

Below some particulate emission recommendations and laws for the engine plant are listed:

- Europe:

  According to EU BREF document /17/ (page 405, table 6.47) BAT (Best Available Technique) particulate conclusion for engines (big plants > 50 MWth, at steady state conditions 85-100% load of the engine) are:

  - Light Fuel Oil (LFO): 30 mg/Nm3 (15 % O_2)
  - Heavy fuel oil (HFO): 50 mg/Nm3 (15 % O_2)

  Small engines units up to 1.3 $MW_{fuel\ input}$ running on low sulphur distillates can be equipped with particulate filters and thus reduce the particulate emission below 20 mg/Nm^3. Please note that "split views" about the BAT conclusion were expressed. See e.g. footnote of table 6.47 on page 405 of the document where also particulate limit value of 100 mg/Nm^3 (15 % O_2) is expressed.

- USA:

  According to the US NSPS for CI engines /9/ the particulate limit for engines with a cylinder displacement of ≥30 l is 0.15 g/kWhe which equals about 20 mg/Nm^3 (15 % O_2). The general fuel oil requirement is <500 ppm sulphur (see also the information about Europe for small engine units operating on low sulphur distillates in the text above). In document /31/ Euromot has commented the US CI NSPS standard (not technical/financial feasible for plants operating on residual fuels, etc.).

- India:

  According to the Indian emission legislation for diesel engines (> 0.8 MW) /12/, particulate limits are (according to fuel in use):

  - Heavy fuel oil (Furnace oil, etc.): 100 mg/Nm3 (15 % O2)
  - HSD/LDO (light diesel oils): 75 mg/Nm^3 (15 % O_2)

- Brazil:

  In "normal areas" (Class II and III) Conama /23/ stipulates for oil fired electric generator plants up to 70 MWe capacity a particulate limit of 350 g/millionkcal which equals about 85 mg/Nm^3 (15 % O_2).

- Japan:

  The particulate limit for diesel engines burning liquid fuel are (please see document /18/:

  - General limit: 100 mg/Nm^3 (13 % O_2) = 75 mg/Nm^3 (15 % O_2)
  - Special Areas: 80 mg/nm3 (13 % O2) = 60 mg/Nm3 (15 % O2)

Conclusion:

Above has been shown that regarding SO_2 and particulate emissions the available liquid fuel composition and existing legislation worldwide are often syncronised (primary abatement measures are preferred). This is in line with the cost-effective Integrated Pollution Prevention and Control Management (IPPC) approach that does not involve switching one form of pollution to another (e.g. use of FGD might contaminate the water supply, windblow dust problems, etc.) and saving of scarce water resources.

The set limits of SO_2 and particulate in the draft /1/ are definitely not representing GIIP for a smaller engine plant (≤50 MWth). The set limits are in line with the EU BREF requirements for big plants (>50 MWth) or even stricter. In the EU area low sulphur/ash liquid fuels are commercially available, but this is not the case in most areas of the world. The consequence should be adaption of expensive, bulky flue gas secondary abatement techniques (seldom used in smaller plants) for simultaneous SO_2 and particulate reduction. An IPPC approach is preferred and **therefore we propose the following:**

- Normal areas: max. 3 wt-% S (1760 mg/Nm^3 (15% O_2)) in the liquid fuel and particulate limit of 100 mg/Nm^3 (15% O_2).
- Area with degraded air-shed (definitions?) urban or sensitive area: max. 2 wt-% S (1170 mg/Nm^3 (15% O_2)) in the liquid fuel. Our proposed particulate limit is 75 mg/Nm^3 (15 % O_2).

4.4 Efficiency

In respect of the Kyoto Protocol spirit fuel efficiencies should be promoted in order to decrease specific CO_2 emissions. The contribution of the high efficiency of engine power plants to reduce CO_2 ("the most important green house gas") is however not honoured by the proposed limits. Therefore it should be logical to introduce efficiency bonuses for all emissions. An efficiency bonus in general should include high efficient single cycles, combined heat and power plants, plants operating on sustainable fuels (biofuels), etc. See e.g. proposal in Euromot document /11/ on page 8 (e.g. for a single cycle >5 MWth engine linear scaling upwards from 40 %). E.g. in UK /21/ efficiency bonuses are granted for efficient engine plants.

4.5 Other aspects

Start-ups and shut-downs of the power plant should be excluded as it is the praxis worldwide. Stack emissions should be measured at steady state high loads, e.g. 85-100% Maximum Continuous Rating (MCR) loads (this is the case e.g. in India /12/) or within 90-100% MCR load USA /9/. Corrective actions are to be taken if maximum emission levels are exceeded for more than 5% of the operating time or the occasion of a plant audit. The objective is to ensure continuing compliance with the emission limits based on sound maintenance and operation.

In order to avoid excessive investments with a limiting enhancing effect on the surrounding environment, following aspect is important:

A derogation from the obligation to comply with the emission limits in the cases where a plant which normally uses gaseous fuels and which would otherwise need to be equipped with an exhaust gas secondary cleaning equipment has to resort exceptionally and for a period not exceeding 10 days except where there is an overriding need to maintain energy supplies to the use of other fuels because of a sudden interruption in the supply of gas.

International emission measurement standards should be used in order to get reproducable and comparable results. In CIMAC /24/ recommended methods (such as ISO 9096, US EPA 17 for particulate measurements, etc.) are presented in annexes 2 and 3. On page 11 in source /1/ in chapter Monitoring is stated data quality: "*monitoring programs should apply internationally approved methods for sample collections and analysis".* The same wording is on page 26 for waste water and water quality measurements. In the Pollution Prevention and Abatement Handbook (effective July 1998) in chapter "Monitoring" approved monitoring methods are given e.g. in table 3 for "stack emissions". These kinds of tables are needed to be added to the General EHS Guidelines in order to avoid deceptions.

5.Noise

5.1 Noise level guidelines (outside project property boundary)

In the draft /1/ is stated*: "Noise impacts should not exceed the levels presented in Table 2.5.1, nor result in a maximum increase in background levels of 3 dB at the nearest receptor location."*

In table 1.5.1 noise levels (very close to each other) are specified only for Urban and Rural areas. It is also stated in the text below the table *“Noise level limits for rural receptors have been reduced to account for reduced human activity in these areas.”*

The current (1998) World Bank “Thermal Power –Guidelines for New Plants” in which different levels for residential/institutional/educational and industrial/commercial receptors are set is preferred as can be seen below. A similar land use approach is followed in many countries e.g. Germany, India and USA (Colorado) (see below). A universal intended rule should be in line with the land use classification approach widely followed world wide in order to be cost-effective.

Table 7: *German noise regulation /25/.*

Zone	Day time	Night time
Industrial	70 dB(A)	70 dB(A)
Trade area	65 dB(A)	50 dB(A)
Central areas, village areas and mixed development areas	60 dB(A)	45 dB(A)
General areas and small housing estate areas	55 dB(A)	40 dB(A)
Populated areas	50 dB(A)	35 dB(A)
Hospitals	45 dB(A)	35 dB(A)

Table 8: *Indian noise regulation /14/.*

Zone	Day time	Night time
Silence zone	50 dB(A)	40 dB(A)
Residential	55 dB(A)	45 dB(A)
Commercial	65 dB(A)	55 dB(A)
Industrial	75 dB(A)	70 dB(A)

Table 9: *USA (Colorado) noise rule /26/.*

Zone	Day time	Night time
Residential	55 dB(A)	50 dB(A)
Commercial	60 dB(A)	55 dB(A)
Light industrial	70 dB(A)	65 dB(A)
Industrial	80 dB(A)	75 dB(A)

The proposed guideline /1/ for noise beyond the property boundary (Day time 50-55 dB(A) and night time 40-45 dB(A)) is considerably stricter than the current one (1998): “Thermal Power – Guidelines for New Plants”. E.g. for an industrial receptor in a rural area (at night time) the current noise limit is 70 dB(A) and the proposed limit is 40 dB(A), thus the new limit is 20 times lower. This is definitely not according to GIIP (nor BAT).

The EHS guidelines content: *”For stationary noise sources the sound level limit, should be expressed as one hour, A-weighted equivalent sound level that results from road traffic or other activity in the vicinity of the receptor location.”*

One hour measurement time is unpractical for a stationary plant. We propose this sentence to be removed. E.g. if there are 12 measurement locations around the power plant, this should give a 12 h measurement and additional time needed to move the equipment between the measurement locations. Power plant noise impact is relatively steady and therefore a 1 minute average will give a representative sample of the noise. Separate 1 minute measurements can be taken to achieve statistical reliability based on 5–15 separate measurements, i.e. measurement period duration at each noise receptor minimum 15 minutes.

The EHS guidelines content: *"Typical monitoring periods may last 48 hours ..".* Proposed noise monitoring approach is unpractical and not according to GIIP, the aim of the measurement should be to find out the new power plant sound impact, see also paragraph above.

5.2 Noise Guidelines (working environment)

Table 2.3.1 gives an impression that more than 85 dB(A) noise level is not allowed in a working place. This is not according to the text in the document before the table. A note to table 2.3.1 should be added e.g. as "Figures given are maximum values, when not using hearing protective devices". Higher noise level is accepted, if hearing protectors are used".

Some noise limits in table 2.3.1 such as for control rooms 45 – 50 dB(A) are too ambitious and not according to GIIP. Difference between the work done in a power control room and an open office should be seen in the targeted noise level e.g. different nature of work: disturbance factors such as speaking on the phone, people amount present, etc. Only by measuring/reducing the background noise level in the control room the working environment will necessary not be improved. E.g. talking might create more disturbance than a standard background noise.

Reducing the sound level in the control room to the same level as prescribed for an open office is neither practical nor a cost effective measure. E.g. in Finland /27/ allowed noise level in control room is 55 dB(A) (class C, which is defined by the Finnish building code) or 60 dB(A) for old buildings.

5.3 Conclusion

Noise standards should be flexible enough to allow for reasonable economic, cultural and social activity, which is unfortunately not the case with the proposal /1/.

In the noise level guidelines (noise beyond the property boundary) **a proper area (land use) classification into residential, commercial and industry (day/nigh time) need to be introduced** as is also the case in most national legislations. The proposed figures are too low (only residential area aspects seems to be considered) and far below current limits in the industrial world.

When comparing the current World Bank "Thermal Power- Guidelines for New Plants" 1998 noise Guidelines to the given examples in chapter 5.1 above, it can be noted that these have many common aspects with many existing national norm such as land use classification and noise levels. Therefore we propose to introduce the current noise limits of the World Bank "Thermal Power- Guidelines for New Plants" 1998 into the new General EHS Guideline.

The general noise limits for working environment are too ambitious. E.g. the noise guideline value of 45-50 dB(A) for control rooms is far beyond current praxis around the industrial world. Based on above a noise level in the control room of 60 dB(A) is more suitable.

6. Other aspects

On pages 6-7 in table 1.1.2 of the draft EHS Guidelines "Illustrative Point Source Air Emissions Prevention and Control Technologies" are presented. We propose that to the table text should be added: "for boiler based plants". Most of the presented NO_x-,

SO_2 and particulate flue gas secondary abatement reduction technologies are either not suitable or have a very different performance in the engine based plant. The following examples shall explain our concerns:

- **Particulate matter**:
  - Filter method (bag house):
    - A “protection reagent” (“pre-coating” of the filter) is needed when burning fuel oil otherwise the filter will clog due to “sticky” particulate in the flue gas.
    - Flue gas cooling is needed in front of the filter. A typical maximum allowed inlet temperature is up to 200 degree C (resp. 250°C with special materials). Flue gas temperature of a bigger liquid fired engine flue gas is typically 300-400°C.
    - Filter unit has a huge size, due to the needed very low air to cloth ratio in the order of 0.6 m/min.
    - The particulate removal capacity of the bag filter is heavily dependent on the formed “cake” on the filter surface. Prerequisite is that the bag filter material is “plastic coated” otherwise the particulate reduction will be lower.
    - A bag filter has a high pressure drop. Therefore a fan is needed in order to compensate for the pressure drop.
    - No sole pure particulate bag filter for an engine flue gas particulate removal has been found from the literature. Some filters has been used in context with FGD.
  - ESP (Electrostatic Precipitator):
    - ESP is relatively new in the engine plant (so far only used in some bigger plants). It is a not well-proven technology as in the boiler plants. The electrical properties of the particulate in the engine flue gas differ due to the high flue gas temperature and the composition of the flue gas from those of a boiler. Due to the different electrical properties of the particulate and the low inlet dust mass concentration (compared to a coal fired boiler plant) the emission reduction rate of the engine ESP expressed in % is only up to about 60-70 % (measured in field tests). With high ash/sulphur liquid fuels typical design emission values after the ESP has been in order of 50 mg/Nm^3 (15 % O_2) (which corresponds to the EU BAT level /17/).
  - Cyclone:
    - Not suitable for engines.
- **SO_2:**
  - Wet secondary FGD technologies such as the NaOH (sodium hydroxide) and $CaCO_3$ based scrubbers have been applied in some few engine plants operating on low grade liquid fuels. The NaOH scrubber (dependent on the fuel S-content and national legislation on by-product disposal, etc.) is due to the investment cost more suitable for smaller plants and the $CaCO_3$ scrubber for bigger plants. The applicable legislation for the disposal of the produced by-product will case by case determine which FGD technology is most suitable for a specific project.
  - Fuel switching:
    - Switching from e.g. heavy fuel oil to natural gas is a primary method for SO_2 reduction, if the natural gas is commercially available at the plant.
- **NOx**:
  - In above text the development of primary methods are shortly presented.
  - In document /19/ some “wet methods” and SCR are shortly presented.

- o SNCR, staged combustion, low NOx burners, low-excess firing (methods presented in the table) are suitable for boiler plants BUT not for engine plants.

7. Conclusions

In this document the draft General EHS Guideline aspects have been discussed. The proposed stack, air quality levels and noise emission levels are set too low. When stipulating new limits a gradual approach shall be followed in order to give sufficient time to the surrounding community e.g. industry for the implementation. A cost-effective worldwide Guideline shall take the difference in existing infrastructure (fuel availability, chemical reagents, water, services, trained personnel, etc.) into consideration, unfortunately this is not the case for the draft /1/. The Kyoto Protocol spirit to reduce greenhouse gas emissions is not seen in the proposal. In some country this is done by introducing emission bonuses for high efficient engine plants (see chapter 4.4).
Possible consequence of the strict emission limits in /1/ might be:

- Existing old inefficient power plants will get an extended operational lifetime due to the lack of investments in new cleaner and efficient power plants. This might have a detrimental effect on fragile economics and industrial infrastructures in third world countries.
- Faced with increased electrical power costs due to very tight General EHS Guidelines some power producers and utilities will be forced to look for an alternative financing outside the IFC environment; financing which helps nations develope to independent states.

In order to make the Guidelines more practical and suitable on a global level, counter proposals are made: In chapter 3.3 for the ambient air quality, in chapters 4.2 and 4.3 for the stack values and in chapter 5.3 for the noise.

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Sources

/1/ Environmental, Health and safety (EHS) Guidelines General EHS Guideline; August 1, 2006 IFC, see internet at http://www.ifc.org/ifcext/policyreview.nsf/AttachmentsByTitle/EHS_Draft_GeneralEHS/$FILE/IFC+DRAFT+-+General+EHS+Guidelines+August+1+2006.pdf

/2/ "Council Directive 1999/30/EC of 22 April 1999 relating to limit values for sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead in ambient air"

/3/ Prevention of Significant Deterioration (PSD) Requirements for New or Modified Sources, August 7, 1980 (and amendments as of June 25 1982 (47FR27561), October 26 1984 (49FR43209), July 12 1985 (50 FR28550), September 9 1986 (51FR32179), November 7 1986 (51FR40675), July 1 1987 (52FR24714), July 14 1987 (52FR26401), October 17 1988 (53FR40655), June 28 1989 (54FR27273)); Trinity Consultants

/4/ "Air Quality Standards, Objectives, Limit and Target Values" (21.03-06) see internet: http://www.environment-agency.gov.uk/commondata/acrobat/aqstd0306_245121.pdf#search=%22%22Air%20quality%20Guidelines%22%20%2BEU%20ozone%22

/5/ "Standards for Liquid Effluents, Gaseous Emissions, Automobile Exhaust, Noise and Ambient Air Quality; Central Pollution Control Board June 1995

/6/ RA 8479 Philippine Clean Air Act of 1999 Implementing Rules and Regulations (IRR); 7 November 2000 Department of Environment & Natural Resources (DENR)

/7/ Practical Guide to Atmospheric Dispersion Modelling, Trinity Consultants Revised April 1993

/8/ Position of the CIMAC WG5 Exhaust Emissions Controls on ""Prime Mover Technique Specific Emission Limits Need Stationary Reciprocating Plant". See internet address: http://www.cimac.com/workinggroups/Index1-working-groups-exhaustemission.htm (see link under "The subgroup of WG5 ...").

/9/ US Environmental protection Agency: "40 CFR parts 60, 85 et al. Standards of Performance for Stationary Compression Ignition internal Combustion Engines; Final rule", July 11, 2006.

/10/ "Paras käytettävissä oleva tekniikka (BAT) 5 – 50 MW:n polttolaitoksissa Suomessa, 2004". See http://www.ymparisto.fi/download.asp?contentid=3708 (Guideline values for BAT in Finland for small stationary engine / gas turbine plants 3 .. 50 MWth) page 102 (in English) tables 29 and 30.

/11/ "Stationary Engine emission Legislation – diesel and Gas", The Euromot Position November 2004, see internet http://www.euromot.org/download/news/positions/stationary_engines/Future_stationary_engine_emission_legislation_Nov04.pdf

/12/ "Emission Standards for Diesel Engines (Engine Rating more than 0.8 MW (800 kW) for Power Plant, Generator Set Applications and other Requirements", Environment (Protection) third Amendment Rules 2002; Ministry of Environment and forests New Delhi the 9th July 2002. See internet: http://www.envfor.nic.in/legis/eia/epr_amd_489.html

/13/ Directive 1999/32/EC "Reduction in the sulphur content of certain liquid fuels and amending Directive 93/12/EEC"

/14/ EPA notification (G.S.R.1063 (E), dated 26th December 1989), India

/15/ “Multi Commodity Exchange of India – Products – Crude Oil Profile”, see internet link: http://www.mcxindia.com/products_Furnaceoil.html

/16/ “Indian Oil: Products Fuels&Feedstock, furnace oil”: See internet at http://www.iocl.com/print-products_fuel_3.htm

/17/ Integrated Pollution Prevention and Control (IPPC), Reference Document on Best Available Techniques for large Combustion Plants, May 2005, Eurtopean IPPC Bureau, see internet http://eippcb.jrc.es/pages/Fmembers.htm please enter the public area and choose document 19

/18/ “Nationwide general limits”

/19/ “Emissions to air from engine driven power plants”, Euromot 2002, see internet: http://www.euromot.org/download/news/positions/stationary_engines/EIPPCB_BREF_euromot_comment_may_02.pdf

/20/ Det Norske Veritas: Fuel Quality Statistics, March 2006 Volume 26 Number 1 DNV Petroleum Services

/21/ “The Environmental Protection act 1990, part 1 (1995 revision), (PG1/5(95): Secretary of State´s Guidance-compression Ignition Engines, 20 – 50 MW Net Rateds Thermal Input.

/22/ Brazil: Resolution/Conama/No.003, published at D.O.U, 08/22/90, section 1, pages 15937 – 15939

/23/ Resolution/Conama/No. 008 published at the D.O.U 12/28/90, Section I, page 25539

/24/ CIMAC Recommendation – standards and Methods for sampling and Analysing emission Components in Non-Automotive Diesel and gas Engine Exhaust Gases – Marine and land baserd Power Plant Sources”; CIMAC Working Group on Exhaust Emissions February 2005. Document can be ordered from http://www.cimac.com/services/Index1-techpaperdatabase.htm

/25/”Sechste Allgemeine Verwaltungsvorschrift zum Bundes-Immissonsschutzgesetz (Technische Anleitung zum Schutz gegen Lärm – TA Lärm). GMBI Nr. 26/1998 pp. 6 - 7, see internet http://www.umweltbundesamt.de/laermprobleme/anlagen/talaerm.pdf#search=%22VSGA%2003%2F2000%22

/26/ “Colorado Noise Statute. 25-12-103-maximum permissible noise levels”. See internet http://www.nonoise.org/lawlib/states/colorado/colorado.htm

/27/ “Finnish Standard Association SFS. Acoustic classification of spaces in buildings, SFS 5907:en. 2004. pages 3, 23

/28/ “WHO air quality guidelines global update 2005”, Report on a working group meeting, Bonn, Germany, 18 – 20 October 2005

/29/ http://www.epa.gov/air/particles/actions.html

/30/ Review of MARPOL Annex VI and the NOx Technical Code, Report of the Working Group: BLG/WP.3; 6. April 2006; IMO Sub-committee on Bulk Liquids and Gases

/31/ "US EPA Standard of Performance for Stationary Compression Ignition Internal combustion Engines Position Paper – September 2006". Available at internet: http://www.euromot.org/download/news/positions/stationary_engines/US_EPA_NSPS_diesel_Euromot_position_final_060906.pdf

ANNEX 1:

Federal Stack Emission Limits for Diesel Engines in Japan ("nation wide general limits").
Stricter limits may be stipulated locally, e.g. in Tokyo max. allowed NOx-value is 114 ppm-v (dry, 13 vol-% O2)

	NO_x	**SO_x**	**Particles**
Diesel Engines (> 50 l/h fuel oil)	950 ppm-v * 1200 ppm-v **		100 mg/Nm^3(all areas) 80 mg/Nm^3 (special areas)

The limits are given at 13 % O_2 (dry gas) for diesel engines, (Nm^3 defined at 273 K, 101.3 kPa).

* Cylinder diameter < 400 mm

** Cylinder diameter ≥ 400 mm

The allowed SO_X level is regulated locally by a total quantity approach (max. SO_2 quantity per time unit (Nm^3/h)).