[ENERGY / IN DETAIL]

Striving towards a cleaner global environment

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A global requirement today is to find clean and more efficient power production processes. The Kyoto Protocol and IFC/World Bank Guidelines are the reference sources being increasingly used in international business today.

The Kyoto Protocol (first stage 2008 – 2012) and the European Union's (EU) Emission Trading Scheme (ETS) (the first stage began 1 January 2005 with the second stage due to start on 1 January 2008) are aimed at reducing anthropogenic greenhouse gas (GHG) emissions. One means towards the achievement of this target is to utilize energy more efficiently in power production. The World Bank Group continues to update its performance standards on social and environmental sustainability, and the Environmental, Health and Safety (EHS) Guidelines are a part of this package. The EHS Guidelines contain the performance levels considered to be achievable at reasonable cost in new facilities using existing technology.

Leading international investment banks have made an agreement with the IFC (International Finance Corporation, the private sector arm of the World Bank Group) to follow guidelines based on IFC's environmental and social standards and thus adopted the Equator Principles. These principles apply to projects having a capital cost in excess of USD 10 million. Many other financial institutions (via environmental and other policies) are also using the World Bank Group guidelines in addition to national norms in their projects. Consequently, the World Bank's EHS guidelines have in practice become the minimum environmental standard in global power plant projects.

The engine manufacturing industry has in the updating process of the EHS Guidelines been active via Euromot (The European Association of Internal Combustion Engine Manufacturers). The EHS draft papers have been commented upon (drafts were posted by the World Bank/IFC on the internet for a 60 days comment period) in several Euromot Position Papers (also available on the internet). Additionally, a delegation from Euromot met with IFC/Worldbank representatives in Washington during 2007, at which the engine industry gave its' reaction to the Guideline drafts.

THE WORLD BANK GROUP'S ENVIRONMENTAL AND SOCIAL STANDARDS

In February 2006, the International Finance Corporation (IFC) completed a rigorous updating of its standards. The eight performance standards are intended to establish the conditions that the client is to meet throughout the life of an investment, and are listed in Table 1.

Social and environmental considerations are considered integral parts of good business practice, and responsible businesses can create value for all parties involved while helping to promote long-term profitability and investments. Every effort should be made to ensure that investments do not harm people or the environment, and if negative impacts are unavoidable, these should be minimized and mitigated appropriately.

The EHS Guidelines are included in Performance Standard 3. These are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP). Performance Standard 3 asks the client to adopt Best Available control and process Techniques (BAT) that are feasible and cost effective. Aspects to be considered in the choice of pollution abatement control measures are:

Technical feasibility: This considers factors such as local infrastructure, commercial markets, etc. in the selection of control technologies, such as the availability of reagents and water if required by the treatment method, and the local availability of maintenance and other services.

Performance Standard 1:	Social and Environmental Assessment and Management System
Performance Standard 2:	Labor and Working Conditions
Performance Standard 3:	Pollution Prevention and Abatement
Performance Standard 4:	Community Health, Safety and Security
Performance Standard 5:	Land Acquisition and Involuntary Resettlement
Performance Standard 6:	Biodiversity Conservation and Sustainable Natural Resource Management
Performance Standard 7:	Indigenous Peoples
Performance Standard 8:	Cultural Heritage

Table 1. – IFC Performance Standards.

Financial feasibility: The incremental cost of the control technique over the projects' investment, operating and maintenance costs, and whether such incremental cost could make the project non-viable. The used technique should not produce secondary wastes that cannot be accepted (handled) by local environmental capacity and infrastructure.

Operational feasibility: Addresses operational reliability and local conditions, considering the availability of trained personnel with sufficient technical and financial resources.

In other words, the chosen pollution control and process technology is to be practical, cost-effective and suitable for the project within the local context.

ENVIRONMENTAL, HEALTH AND SAFETY (EHS) GUIDELINES

The previous guidelines version was adopted in July 1998. On 30 April 2007, a new updated version of the EHS Guidelines was published on the Internet [1]. These new guidelines were developed as part of a two and half year review process. However, six (out of totally 63) of these guidelines are still in the review/comment stage. In contrast to the previous 'static' document, it is intended that the new EHS Guidelines will be a 'living' document subject to regular updating.

The EHS Guidelines are to be used as a technical source of information during the project appraisal activities. When host country regulations differ from the levels and measures presented in the EHS Guidelines, the project is expected to achieve whichever is the more stringent. If, in view of specific project circumstances, less strict levels are appropriate, a full and detailed justification for any proposed alternative is needed as part of the environmental assessment (EA). In practice, this kind of deviation ("variation") is only possible with certain IFC financed projects.

The new guidelines incorporate the General EHS Guidelines and 62 specific Industry Sector Guidelines. The General EHS and Thermal Power Guidelines are "joint guidelines" and are intended to be used together with relevant industry sector guidelines. Combustion source emission guidelines associated with steam and power generation activities from sources with a capacity of less or equal 50 $MW_{th\ =\ fuel\ input,}$ are addressed in the General EHS Guidelines, and for larger power source (>50 MW_{th}) emissions, in the Thermal Power Guidelines. By this approach, the EHS Guidelines are technique specific with their own technique specific emission limits for boilers, gas turbines and engines in line with present worldwide trends towards progressive regulations.

For power plant projects, the General EHS and Thermal Power Guidelines are the primary reference focus. The Thermal Power Guidelines document is still in the review stage, but is expected to be published for commenting upon in autumn 2007. For some types of project, such as oil pipe pumping stations, other guidelines, notably the Onshore Oil and Gas Development document, will also be of interest.

GENERAL EHS GUIDELINES

The General EHS Guidelines [2] contain numerous cross-cutting environmental, health and safety issues potentially applicable to all industry sectors (during plant construction, operations phase, and plant demolition) such as: stack emissions, ambient air quality, noise, hazardous materials management, etc. It is intended for small combustion processes between 3 MW_{th} and 50 MW_{th}.

Stack emissions

In Table 2 the stack emissions for an engine plant are given. It should be noted that in the General EHS Guidelines, 15% O_2 is used as the oxygen reference point for the emission concentration values. This is the case also in USA, India and the European Union's (EU BREF) Reference Document on Best Available Techniques for Large Combustion Plants document. For a bigger stationary engine, 15% O_2 is close to "actual" conditions and is thus logical. The performance of a secondary flue gas abatement process (if used), is best described if the emission concentration is expressed close to actual conditions.

In contrast to the old guidelines, where the same emission values applied regardless of stationary engine type or the fuel (liquid/gas) in use, in the new General EHS Guidelines the limits are differentiated for different engine types and fuels used. As regards the findings in Table 2:

- PM (particulate) and SO_2 levels reflect quite well the existing fuel infrastructure around the world. Limits can, in most cases, be met by an appropriate liquid fuel choice (primary measure).
- NO_X: For a number of years already, the engine industry has been working intensively to make engines more environmentally friendly, especially concerning NO_X emissions. →

Fuel	PM (Particulate matter)	SO_2 (Sulphur dioxide)	NO_X (Nitrogen oxides as NO_2)
Liquid	50 - 100*	1.5 - 3%*	Bore < 400 mm 1460 - 1600 ** Bore ≥ 400 mm 1850
Gas	N/A	N/A	SG (spark ignited): 200 DF (dual-fuel): 400 GD (compression ignition, gas diesel): 1600

* If justified by project specific justifications (economic feasibility, environmental capacity of site).
** If justified to maintain high energy efficiency.
*** Higher performance levels should be applied to facilities in urban/industrial areas with a degraded air-shed or close to sensitive areas.
Emission guidelines are applicable to plants operating more than 500 hours per year and to those with an annual capacity utilization factor of more than 30 percent.

Table 2. – Stack emissions for engine plants* (unit mg/Nm^3 (15% O_2) or as indicated). Nm^3 is at one atmosphere pressure and 0°C.**

Liquid fuel:

- < 400 mm bore engines: In order to reach the prescribed emission levels for a four-stroke engine, the latest engine development version with enhanced "Miller-concept" (a primary measure with higher pressure ratios) is to be utilized. The NO_X-level of 1460 mg/Nm^3 has a drawback in respect of its higher heat rate compared to the 1600 mg/Nm^3 level. The IFC/World Bank allows the higher NO_X-level if energy efficiency is improved, and the impact of the Kyoto Protocol spirit can thus be seen in this limit. For a two-stroke engine to comply with the set NO_X-level the only option today is to apply a secondary selective catalytic reduction (SCR) technology.
- ≥ 400 mm bore engines: Most current four-stroke engines are to be injection retarded or equipped with a "water addition (wet) method" in order to reach the prescribed NO_X-level. For two-stroke engines a wet method such as a fuel water emulsion system or a direct water injection system is to be used. As a consequence, the heat rate will increase. Future four-stroke and two-stroke engine generations are expected to reach the NO_X-level without an increased heat rate.

Gas:

- SG (spark ignited): The engine is tuned to reach the NO_X-level (lean-burn concept used).
- DF (dual-fuel, low gas pressure): The engine is tuned to reach the NO_X-level (lean-burn concept used).
- GD (high pressure gas (compression ignition) diesel): The engine is tuned to reach the NO_X-level.

- In degraded air-sheds or sensitive areas, secondary flue gas abatement methods, such as the SCR (for NO_X abatement), for instance, might be needed - especially for liquid fired engines. In the Environmental Assessment (EA), the assimilation capacity of the surrounding environment should be evaluated to establish the emissions levels that can be accepted from a power plant.
- Stack emission testing is carried out on an annual basis.

The emission limits in Table 2 give, in general, a good representation of BAT for an engine power plant, taking into account the existing fuel, reagent infrastructures, etc., around the world, and the latest technical developments.

As stated previously, the emission levels given in the General EHS Guideline are only intended for rather small power plants (≤ 50 $MW_{fuel\ input\ =\ thermal}$ => power plant output typically about 20-23 MW_e). The Thermal Power Guideline draft (for bigger power plants > 50 MW_{th}) is still unpublished and its required emission values are not known at this time.

Pollutant	Average time	GLC (ground level concentration), microgram/m3
SO_2	Annual	80
	24-hour*	365
NO_2	Annual	100
PM-10	Annual	-
	24-hour**	150
PM-2.5	Annual	15
	24-hour***	35
Ozone	1-hour**	235 (0.12 ppm)
	8-hour****	157 (0.08 ppm)

* Not to be exceeded more than once per year.
** Not to be exceeded more than 3 times in 3 consecutive years. Ozone level limit applies only in limited areas.
*** 98th percentile of concentrations in a given year, averaged over 3 years.
**** 3 year average of annual 4th highest daily maximum 8-hour concentrations.

Table 3. – US EPA Primary NAAQS (only the most relevant pollutants listed).

Time	Residential, institutional, educational	Industrial, commercial
07:00 – 22:00	55	70
22:00 – 07:00	45	70

Table 4. – Noise level (beyond property boundary (one hour LAeq dB(A)).

Ambient Air Quality (AAQ)

By applying national legislated standards, or in their absence the current WHO (World Health Organization) Air Quality Guidelines or other internationally recognized guidelines (such as the federal US EPA (Environmental Protection Agency) National Ambient Air Quality Standards (NAAQS) or the relevant European Council Directive 1999/30/EC, Directive 2002/3/EC), emissions to the surrounding area should not result in pollutant concentrations that reach or exceed relevant ambient quality guidelines and standards. The federal US NAAQS are shown in Table 3.

The US EPA has also regulated the allowed PSD (Prevention of Significant Deterioration) increments of the emissions. For example, for SO_2 the allowed PSD increment in a class II (almost the entire USA belongs to this class) area is about 25% of the 24-hour value. At the EU level, no general increment rule is given, and the total ground level

concentration (GLC) in an area is to be below the stipulated limit level.

Euromot has recently (June 2007) made known to IFC/WB the problems associated with the general increment rule of 25%, as suggested by IFC/WB in the General EHS Guideline with notable reference to the WHO AAQ Guideline levels. A misinterpretation of this might lead to AAQ levels that are 1800% stricter than comparative levels allowed in the USA. No general "universal" increment rule should be given for application in context with different AAQ Guidelines. Only figures stipulated by the specific AAQ norm should be used (if given). The AAQ Guidelines by WHO are not intended to be strictly applied as a legislative norm without considering local circumstances. Further information regarding these matters can be obtained from documents [3] and [4] given in "internet sources" below.

AAQ levels are cumulative and reflect all polluters in an area, existing topography, weather conditions (wind direction, speed), stack height & configuration, and so on, and need therefore always to be calculated on a case-by-case basis. Stack height should be according to Good International Industry Practise (or Good Engineering Practise (GEP)), this is further described on page 16 of the General EHS Guidelines.

Ground level Concentration (GLC) calculations should be handled by third party environmental experts with sufficiently advanced calculation programmes (in order to get percentiles excluded etc.).

Noise

The current World Bank Thermal Power – Guidelines for New Plants 1988 levels, for the noise level beyond property boundary are maintained. These are shown in Table 4.

Design measures to achieve noise levels include, among other things:

- Silencers on the exhaust gas and inlet air side of the plant.
- Noise absorbing material in the walls and the roof.
- Low noise radiator type.

In the General EHS Guideline, noise limits for various working environments (heavy industry, open offices, control rooms, etc.) are also given. The recommended noise level for control rooms (45-50 dB(A)) is, for example, very strict, and corresponds to the level applied in the control rooms of nuclear power plants. Such strict requirements should not be applied on a stationary (reciprocating) engine power plant, considering the different complexity of such plants and the different risks involved. This has also been commented upon in the Euromot position papers [3] and [4], and a counter proposal of 65-70 dB(A) has been offered.

Liquid effluent limits

In the General EHS Guidelines, no limit values are given for liquid effluent. In the new guidelines, liquid effluent limits can be found in the Industrial Guidelines, and it is expected, therefore, that power plant values will be included in the Thermal Power Guidelines. Euromot has stressed the importance of having smaller power plants with a relative small effluent stream treated more leniently than big thermal power plants [3] and [4].

Other points

It should be noted that the new EHS Guidelines went immediately into effect on April 30, 2007 when they were published, replacing previously published documents in Part III of the Pollution Prevention and Abatement Handbook and on the IFC website. Euromot has, in position papers [3] and [4], referred to this challenge. Some other aspects (such as an interruption of gas supply, etc.) needing clarification are also listed in the above mentioned Euromot papers.

WORK CONTINUES

Euromot's work in commenting upon the EHS Guideline proposals has been interesting and intensive. The co-operation between different engine manufacturers has been constructive, and such industry co-operation is important in order to present third parties with a general common picture of the development status of techniques in this kind of work.

The final version of the General EHS Guidelines as BAT describes an engine power plant rather well. However, some critical items (explained above) remain, and Euromot has recently given feedback on these to the IFC/WorldBank. The updating mechanism of the documents is still unclear.

As previously mentioned, six guideline proposals are still in the comment or review stages. The Thermal Power (for power production plants > 50 MW_{th}) is one of these. This means that there is still a lot of work to be done before the complete World Bank Group EHS Guidelines package is finalized.

Via Euromot the European engine industry actively supports the environmental development work done by WB/IFC, US EPA, EU and other organizations/countries, and brings together the accumulated knowledge of the engine industry in this important work.

INTERNET SOURCES:

[1] http://www.ifc.org/ifcext/enviro.nsf/Content/EnvironmentalGuidelines

[2] http://www.ifc.org/ifcext/enviro.nsf/AttachmentsByTitle/gui_EHSGuidelines2007_GeneralEHS/$FILE/Final+-+General+EHS+Guidelines.pdf

[3] http://www.euromot.org/download/news/positions/stationary_engines/WB_EHS_guidelines_euromot_position_background_paper_290607.pdf

[4] http://www.euromot.org/download/news/positions/stationary_engines/WB_EHS_guidelines_euromot_position_paper_290607.pdf