The European Association of Internal
Combustion Engine Manufacturers

EUROMOT

Recommendations on Collecting and Evaluating Information on the Environmental Performance of Technologies used in Medium Combustion Plants (MCP) and Energy Efficiency

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EUROMOT, the European Association of Internal Combustion Engine Manufacturers, fully supports gathering information from Member States, plant operators and suppliers, aftertreatment equipment suppliers and other relevant stakeholders.
For that purpose, we would like (a) to make generic comments on MCP-specific issues raised by the respective worksheets of the questionnaire provided by Ricardo, and (b) strongly recommend the data evaluation process to be complemented by taking into account the extensive documentation and background information on engine and aftertreatment technologies and performance that was collected during the recent revision of the UNECE Gothenburg protocol and the review of the LCP BREF by the European Commission - Joint Research Centre.

1. Comments on the questionnaire worksheets

1.1. General – Installation and Supply Chain

Contrary to e.g. Nonroad Mobile Machinery, stationary combustion engine plants are not necessarily provided by one single manufacturer. It is common practice that individual suppliers/OEMs for the engines, for the exhaust aftertreatment systems and for other components are in the supply chain of other companies responsible for the final assembly of components on-site and finally putting the plant into service. Consequently, none of these particular OEMs (Original Equipment Manufacturers) will be in a position to provide a complete and concise response to various areas of interest of the questionnaire.

1.2. Worksheet 2 “Design Layout”

- Under which conditions and operation modes the plants are actually run is in the hands of the operator and not the OEMs. In a number of cases a direct business contact, such as for maintenance between the OEMs and the operators doesn’t even exist, making it a very challenging task to collect, share and verify data and information on the operation.
- In terms of complying with the applicable legal provisions it is the operator who is the responsible and main contact for authorities.
- A potential mix of combustion technologies with individual flue gas treatments (FGT) need to be covered as well. The questionnaire as it stands right now appears to consider only a

layout where multiple combustion systems are discharging into one common FGT and stack.

- Concerns on confidentiality and protection of the data provided might have an impact on the amount of information and the level of detail that is provided on sensitive issues such as cost figures (OPEX, CAPEX).

1.3. Worksheet 3 “Operating Information”

Due to the complexity and individual character of the design, setup and operations of stationary engine combustion plants we consider it difficult to obtain representative and statistically robust feedback on worksheet “3. Operating Information” which would serve the purpose of Ricardo’s survey without the risk of misunderstanding or misinterpretations

1.4. Worksheet 4 “Energy Efficiency”

We doubt whether it is useful to consider responses on energy efficiency for plants which have been designed for emergency standby power or grid stability as the fuel consumption is not key for these applications. The opposite would be found e.g. for natural gas fired CHP plants. We also doubt the value of “efficiency” in cases where technologies will be mixed. Consequently, we recommend considering energy efficiency with a view to the specific application of the respective plant.

1.5. Worksheet 5 “Fuel”

Stationary engines are usually designed and specified by OEMs for operating with a broad range of fuel types and qualities. Whilst we consider the majority of at least high- and medium-speed diesel engines in central Europe to operate on diesel fuel or heating oil, there might substantially less on natural gas or alternative fuels such as biogas and others. In MIS (Micro Isolated Systems)/SIS (Small Isolated Systems) areas heavy fuel oil (HFO) might be an important fuel (besides diesel oil) in many locations. Hence, we believe that there might not be statistically robust information on some of the particular qualities and types of fuel.

1.6. Worksheet 6 “Emissions to Air”

1.6.1. Emergency Back-up and Grid Stabilization

In our experience, most of the diesel engines in central Europe, at least high- and medium-speed, are operated as emergency back-ups or to stabilize the grids operating on low-hour per year schemes. As such they are they do not need to comply with any exhaust emission requirements in most of the EU28 member states. Consequently, we have concerns that there might not be enough data available from engines operating in these applications.

1.6.2. Operation on Small Isolated Systems (SIS) and Micro Isolated Systems (MIS

Some quotes from below mentioned source:[1]

- *“Island generators face specific challenges that may not be immediately obvious to observers more used to continental (mainland) electricity generators. For example, the lack of economies of scale, the restricted fuel choice for island generators, the geographic remoteness from continental infrastructure, the need for flexibility of generating plant to operate with high variations of duty cycle resulting from daily and seasonal variations in the island’s electricity demand, and increasingly, fluctuating input from renewable power sources.*
- *“[…] island diesel generation systems do have significantly higher operating costs than mainland power systems as a result of the small scale and high cost of the fuel, which can be further increased by the need to import to remote locations. The supply of needed reagents for selective catalytic reduction would imply significant costs and logistical*

[1] Eurelectric “Emissions from diesel generation in Small Island Power Systems … “; July 2011, available from: http://www.unece.org/fileadmin/DAM/env/documents/2011/eb/wg5/WGSR49/Informal%20docs/EURELECTRIC-disel_engines_and_Gothenburg_protocol-July_2011.pdf

difficulties for islands. Furthermore, the disposal of used SCR catalyst elements and by products from other secondary abatement techniques (if used) would be problematic and disproportionately expensive for an island."

- *"Islands typically have more fluctuating power demand over both periods than mainland location. On a 24-hour basis, the lack of industrial plants means that overnight power consumption tends to be rather low. Over a yearly period, island generation can fluctuate highly due to seasonal variation in tourism – many islands have a high dependence on the tourist economy. The variability of the load on island diesel plants is likely to increase further in future with an increased share of intermittent renewables in their power systems / the diesel generation will have to rapidly cycled to fill in the gaps in renewable power generation."*

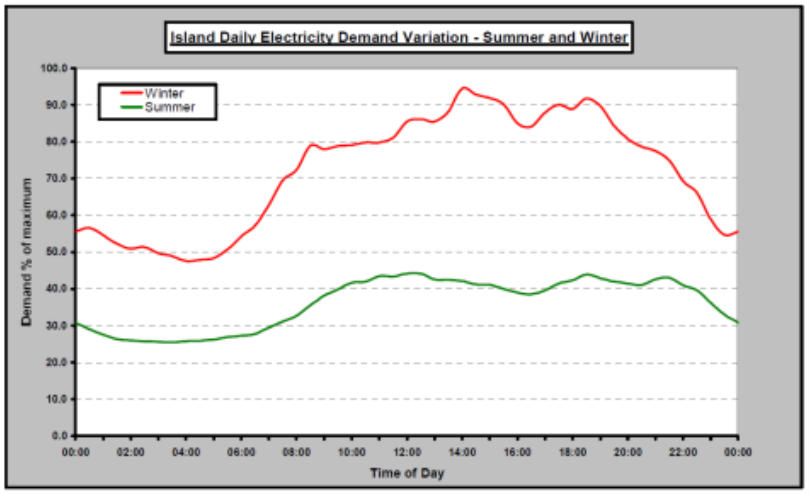

Figure 2: Daily demand fulfilled by island diesel plant – averages for summer and winter

2. Recommendation to review further reference and background material

To enhance the amount of credible and verified information on the characteristics and performance of technologies as well as the technical and economic feasibility of internal combustion engines in stationary applications, EUROMOT would like to encourage reviewing the extensive amount of material created during the following recent regulatory processes:

- the revision of the UNECE Gothenburg Protocol;[2] and
- the review of BAT within the context of the EU Industrial Emissions Directive (LCP BREF).[3]

In the Annex on the following pages the most relevant sources have been listed which are all in the public domain.

[2] http://www.unece.org/fileadmin/DAM/env/documents/2013/air/eb/ECE.EB.AIR.114_ENG.pdf
[3] COMMISSION IMPLEMENTING DECISION (EU) 2017/1442 of 31 July 2017 establishing best available techniques (BAT) conclusions, under Directive 2010/75/EU of the European Parliament and of the Council, for large combustion plants

ANNEX: References

1. Medium Combustion Plants (MCPD) pre-study 2012 documents (AMEC report)

Reference is made to the EUROMOT feedback given on AMEC's 2012 report to the European Commission accompanying their review of smaller combustion plants carried out under the Industrial Emissions Directive.[4]
It was concluded that the proposed PM and NOx limits are beyond BAT, i.e. the VITO report (one of the main background documents) referred to, did not represent BAT for a <50 MW_{th} reciprocating engine power plant.

2. UNECE (United Nations Economic Commission for Europe)

2.1. Gothenburg Protocol
Reference is made to Annex V, Table 4 "Limit values for NOx emissions released from new stationary engines" (gas engines >1 MW_{th}, Diesel engines >5 MW_{th}).[5]

2.2. UNECE Guidance document
Reference is made to "Guidance document on control techniques for emissions of sulphur, NOx, VOC, and particulate matter (including PM10, PM2.5 and black carbon) from stationary sources", dated 23 January 2015.[6]

- Chapter "OO. New Stationary Engines" starting on page 253 containing:
  - information on different stationary (gas and diesel) engine types;
  - information on primary and secondary abatement techniques for NOx, SO2, particulate, CO, (NMHC);
  - some emission figures.
- The statements on page 258 addressing:
  - that DPF (Diesel Particulate Filter) is not viable for bigger stationary diesel engines >5 MW_{th};
  - fuel requirements for DPF.

2.3. Additional information from other UNECE papers

- DF (Dual Fuel) Engines – NOx emission and natural gas quality dependence;[7]
- Costs for SCR systems for stationary engines in a study by EGTEI.[8] See tables 1, 2 and 3 for liquid fired reciprocating engines and the additional costs per MWh_e;
- More information on operating in SIS/MIS can be found under the document quoted under paragraph 1.6.2 of the main text above.

3. EU LCP BREF 2017

The following references are taken from JRC's BAT reference document for LCP of 2017,[9] with combustion plants ≥50 MW_{th}, aggregated by units ≥15 MW_{th} in scope.

[4] https://www.euromot.eu/wp-content/uploads/2017/03/EU_IED_Review_plants_smaller_than_50_MW_2013-01-04.pdf
[5] See ref. under footnote 2
[6] http://www.unece.org/fileadmin/DAM/env/documents/2012/EB/ECE.EB.AIR.117_AV.pdf
[7] See the EUROMOT presentation under:
http://www.unece.org/fileadmin/DAM/env/documents/2011/eb/wg5/WGSR49/Informal%20docs/10_UNECE_WGSR49_EUROMOT_Dual_Fuel_Engine_2011-08-15.pdf
[8] See the EGTEI paper of 2011 under:
http://www.unece.org/fileadmin/DAM/env/documents/2011/eb/wg5/WGSR49/Informal%20docs/17_EGTEI-Cost-stationary-engines-UNECE-06-04-2011.pdf
[9] http://eippcb.jrc.ec.europa.eu/reference/BREF/LCP/JRC107769_LCP_bref2017.pdf

3.1. Energy Efficiency

"General Considerations" (Chapter 10 on page 735): "Energy efficiency levels associated with the best available techniques (BAT-AEELs)": "The net energy output(s) is determined at the combustion, gasification, or IGCC unit boundaries, including auxiliary systems (e.g. flue-gas treatment systems), and for the unit operated ***at full load***", i.e. figures given at design conditions.

3.1.1. Energy Efficiency - BAT-AEELs for HFO and/or gas oil fired reciprocating engines

- See table 10.17 (page 774)
- Note also important approved "Dissenting View Expressed" (Chapter 12, page 857) no. 53 referring to BAT 31 in table 10.17 (page 774):
  - Change the lower end of the net electrical efficiency range for a new HFO- and gas-oil fired reciprocating engine – single cycle to 40 %
  - Change the net electrical efficiency range for the new HFO- and gas-oil fired reciprocating engine – combined cycle to >46.9 %

3.1.2. Energy Efficiency - BAT-AEELs for combustion of natural gas

- See table 10.23 (page 780)
- Note also important approved "Dissenting View Expressed" (Chapter 12, page 858) no. 62 referring to "BAT 40 in table 10.23 (page 780):
  - Expand footnote 6 by adding "These levels may not be achievable in plants burning natural gas fuels with a methane number less than 80;
  - Add a footnote applicable to all BAT-AEELs for gas engines mentioning that "These levels might be negatively impacted in the case of plants equipped with a high voltage transformer;

3.1.3. See also with start from chapter 4 of the EUROMOT Position Paper "*BAT Associated Efficiency Levels*" as of 2014[10] prepared for the LCP BREF subgroup "Task-Force Energy Efficiency"

3.1.4. See also the EUROMOT Position paper "*EUROMOT Comments on Report of task-Force Energy Efficiency - Large Combustion Plants BREF TWG*" as of December 2014[11], including information on e.g. transformer losses.

3.2. Emissions (Chapter 10 of LCP BREF 2017)

3.2.1. HFO and/or gas oil fired reciprocating engines

3.2.1.1. The MCPD emission limits (NOx, SO2 and PM) for a new engine are the same or close to the upper range of the limits set for a big plant, see table 10.18 (NOx, on page 775), table 10.19 (SO2, on page 776) and table 10.20 (dust, on page 777).

3.2.1.2. Note also important approved "dissenting views" in Chapter 12 (page 858) listed below (note also the time limited derogation for the emission limits in regard for SIS/MIS areas up to 01 January 2025 for new and 01 January 2030 for existing liquid fired engines, see page 773):

- No. 54, "BAT 32 Table 10.18" (page 858):
  - Increase the higher end of the yearly and daily NOx BAT-AEL ranges for new plants equipped with SCR and located on remote islands": 240 mg/Nm3 (yearly) and 300 mg/Nm3 (daily)
  - Apply footnotes 1 and 2 also to new plants that cannot be fitted with secondary abatement techniques for techno-economic reasons
- No. 58, "BAT 34 Table 10.19" (page 858):
  - Modify footnote 3 as follows: "The higher end of the yearly SO2 BAT-AEL range is 280 mg/Nm3 and the higher end of the daily SO2 BAT-AEL range is 300 mg/Nm3 if no secondary abatement technique can be applied and apply it both and existing and

[10] https://www.euromot.eu/wp-content/uploads/2017/03/LCP_BREF_BAT_Associated_Energy_Efficiency_Levels_2014-09-15.pdf
[11] https://www.euromot.eu/wp-content/uploads/2017/03/LCP_BREF_TFEE_Report_EUROMOT_comments_2014-12-12.pdf

new plants

- No. 59, “BAT 35 Table 10.20” (page 858):
  - Increase the higher ends of the yearly and daily dust BAT-AEL ranges for new plants: 20 mg/Nm3 (yearly), 30 mg/Nm3 (daily)
  - Increase the higher ends of the yearly and daily dust BAT-AEL ranges for new plants located on remote islands SIS/MIS: 35 mg/Nm3 (yearly), 45 mg/Nm3 (daily)

3.2.2. See also EUROMOT Position Paper “*LCP BREF position for remote areas*” of April 2017.[12] Note that the numbering of split views quoted in this document is different compared to the LCP BREF paper as of December 2017 as the EIPPCB had removed on their own behalf a split view (“on SCR applicability. In above EUROMOT document more background for the change need of the emission limits are given (more background to the approved “dissenting views”).

3.3. General techniques to prevent and/or emissions and reduce consumption (Chapter 3)
Chapter 3.2.2.3.9 on page 212 briefly describes the lean burn concept, used for NOx abatement applied on gas fired SG and DF type gas engines.

If requested, EUROMOT can provide the position papers that elaborate on the background of the “dissenting views” mentioned above.

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[12] https://www.euromot.eu/wp-content/uploads/2018/02/EUROMOT-LCP-BREF-position-for-remote-areas-such-as-MIS-and-SIS-plants-Liquid-fired-reciprocating-engine-plant-2017-04-04.pdf.
Due to an update of the EUROMOT website, the links in that paper changed as follows:
- *New link for footnote /6/: https://www.euromot.eu/wp-content/uploads/2017/03/LCP_BREF_EEB_Maltese_plant_data_EUROMOT_comments_2015-01-23.pdf*
- *New link for footnote /7/: https://www.euromot.eu/wp-content/uploads/2017/03/LCP_BREF_BAT_AELs_for_HFO-fired_engines_2013-09-23.pdf*
- *New link for footnote /8/: https://www.euromot.eu/wp-content/uploads/2017/03/LCP_BREF_BAT_Response_to_CEFIC_comments_2014-11-20.pdf*
- *New link for footnote /9/: https://www.euromot.eu/wp-content/uploads/2017/03/LCP_BREF_EUROMOT_Feedback_Liquid_Fuel_Engines_2015-05-20.pdf*

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