The Medium Combustion Plant Directive – Power Industry Perspective

David Graham and Steve Griffiths
Air Quality & Emissions Show
21 November 2018
We are Uniper

Our operations:

Power Generation
Commodity Trading
Energy Storage
Energy Sales
Energy Services

Where we operate:

40+ countries around the world
4th largest generator in Europe

Employees: 12,000

Power generation, Storage, Services - Europe
Power generation - International
Commodity Trading, Energy Sales

€ 1.7 bn EBITDA
100 years Experience
36 GW Total generation

Main activities:

Gas fired plants 19.2 GW
Coal fired plants 10.5 GW
Energy storage Gas: 8.2 bn m³
Gas pipelines and infrastructure
Regasification
Nuclear plants 1.9 GW
Hydroelectric plants 3.6 GW
Trading
Energy sales (small to large clients, electricity and gas)
Services

Gas pipelines and infrastructure
Trading
Energy sales (small to large clients, electricity and gas)
Regasification

Data: Uniper Annual report 2017
MCPs on IED regulated sites I

The MCPD states the following in relation to the IED:

- The MCPD shall not apply to combustion plants covered by Chapter III or IV of the IED
- The MCPD ELVs apply without prejudice to Chapter II of the IED
- The MCPD permit and registration requirements are considered to be already fulfilled for plants covered by Chapter II of the IED

The IED applies to all plants on a site where the sum of the individual unit thermal ratings is ≥ 50 MW\textsubscript{th}

Chapters I and II of the IED set general provisions for all combustion units on IED sites in terms of obligations to hold a permit, permit requirements and the need to set ELVs on the basis of Best Available Techniques (BAT).

Chapter III of the IED sets minimum ELVs and monitoring requirements for Large Combustion Plants (LCPs) of 50 MW\textsubscript{th} or more. LCPs are defined at the stack level with units of 15 MW\textsubscript{th} or greater aggregated when emitting through a common stack to calculate the total thermal rating of the LCP.

Chapter IV of the IED is specific to waste incineration and waste co-incineration plants.

The LCP BAT Reference (LCP BREF) document sets out BAT Associated Emission Levels (AELs) for units of 15 MW\textsubscript{th} or greater which are part of IED Chapter III plants.
**MCPs on IED regulated sites II**

In practice, for MCPs on IED regulated sites

- There is scope for Member States to decide the regulatory detail
- No requirement to have a separate MCPD permit – in practice it is likely that the MCPD provisions will be added to the IED permit as appropriate
- The MCPD ELVs will apply as a minimum standard
- Where the BAT Reference (BREF) conclusions cover plants in the MCP size range, then the BREF emission limits, if stricter, take precedence

It should be noted that

- The LCP BREF only covers LCPs as defined under the IED. It does therefore not cover units of $<15 \text{ MW}_{th}$ which are part of an LCP or stand alone units within the MCP size range
- MCPs on IED sites which already have limits set are likely to retain those limits where stricter than the MCPD – this includes units $<15 \text{ MW}_{th}$ which are part of an LCP
Overlap with IED Chapter II (Double regulation)

Non IED

IED (chapter II)
\[ \sum \text{rated thermal input} \geq 50 \text{ MW} \]

MCP
Total rated thermal input
1 - 50 MW

LCP (IED chapter III)
Total rated thermal input*
\[ \geq 50 \text{ MW} \]

Scope of LCP BATc

* For the purpose of LCP capacity calculation, units below 15 MW shall not be considered

Courtesy of EDF
## Aggregation Examples

### Defining MCPs and LCPs

<table>
<thead>
<tr>
<th>Plant</th>
<th>Regulated as</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="20MWth" /> <img src="image" alt="20MWth" /></td>
<td>2 x 20 MW$_{th}$ MCPs Both existing</td>
<td>No aggregation of existing plants</td>
</tr>
<tr>
<td><img src="image" alt="20MWth" /> <img src="image" alt="20MWth" /></td>
<td>2 x 20 MW$_{th}$ MCPs 1 existing, 1 new</td>
<td>No aggregation of existing with new plants</td>
</tr>
<tr>
<td><img src="image" alt="20MWth" /> <img src="image" alt="20MWth" /></td>
<td>1 x 40 MW$_{th}$ MCP New</td>
<td>Aggregation rule applies for new plants</td>
</tr>
<tr>
<td><img src="image" alt="10MWth" /> <img src="image" alt="45MWth" /></td>
<td>1x10 MW$<em>{th}$ &amp; 1x 45 MW$</em>{th}$ MCP Both existing</td>
<td>Below IED Ch III threshold of 50 MW$<em>{th}$ due to 15MW$</em>{th}$ minimum for IED aggregation. Subject to IED Ch II as above site threshold of 50MW$_{th}$.</td>
</tr>
<tr>
<td><img src="image" alt="10MWth" /> <img src="image" alt="45MWth" /></td>
<td>1 x 55 MW$_{th}$ MCP New</td>
<td>As above, but subject to MCPD new plant aggregation rule.</td>
</tr>
<tr>
<td><img src="image" alt="10MWth" /> <img src="image" alt="55MWth" /></td>
<td>1 x 55 MW$<em>{th}$ LCP &amp; 1x10 MW$</em>{th}$ MCP</td>
<td>1 unit above IED Ch III threshold. 1 unit below 15MW$_{th}$ minimum for IED aggregation.</td>
</tr>
<tr>
<td><img src="image" alt="20MWth" /> <img src="image" alt="40MWth" /></td>
<td>1 x 60 MW$_{th}$ LCP</td>
<td>Aggregated value &gt; IED Ch III threshold, so regulated as LCP</td>
</tr>
</tbody>
</table>
Emission Limit Values – Boilers/General

- ELVs in mg/m$^3$ at 273K, 101.3 kPa at: 3% O$_2$ for gas and oil fired boilers and 6% O$_2$ for solid fuel fired boilers
- NEW plants

<table>
<thead>
<tr>
<th></th>
<th>Natural Gas</th>
<th>Other Gaseous</th>
<th>Gas Oil</th>
<th>Other Liquid</th>
<th>Solid Biomass</th>
<th>Other Solid</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO$_x$</td>
<td>100</td>
<td>200</td>
<td>200</td>
<td>300</td>
<td>300</td>
<td>300</td>
</tr>
<tr>
<td>SO$_2$</td>
<td>-</td>
<td>35</td>
<td>-</td>
<td>350</td>
<td>200</td>
<td>400</td>
</tr>
<tr>
<td>Dust</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
</tbody>
</table>

- Note that there are numerous derogations in specific sub-categories of thermal rating, fuel type, etcetera (consult the MCPD)
- Natural Gas NO$_x$: IED 100 mg/m$^3$; LCP BREF 10 – 60 mg/m$^3$
- Biomass Dust: IED 20 mg/m$^3$ (> 50 MW$_{th}$); LCP BREF 2 – 5 mg/m$^3$ (< 100 MW$_{th}$)
Package Boiler Emissions (New Plant)

- Emissions are dependent upon boiler design and geometry (confinement)
- New burner–boiler combination can be optimised with low NO$_x$
- Natural Gas: 80 mg/m$^3$ achievable; Gas Oil depends on N content of fuel
- MCPD new plant NO$_x$ ELVs of 100 mg/m$^3$ (Natural Gas) & 200 mg/m$^3$ (Gas Oil) can be achieved if the boiler geometry is reasonably unconfined:

![Three-pass wet back package boiler (high efficiency)](image)

Source: Spirax Sarco
Emission Limit Values – Boilers/General

- **EXISTING plants:** $\geq 1 \text{ MW}_{th}$ to $\leq 5 \text{ MW}_{th}$

<table>
<thead>
<tr>
<th></th>
<th>Natural Gas</th>
<th>Other Gaseous</th>
<th>Gas Oil</th>
<th>Other Liquid</th>
<th>Solid Biomass</th>
<th>Other Solid</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\text{NO}_x$</td>
<td>250</td>
<td>250</td>
<td>200</td>
<td>650</td>
<td>650</td>
<td>650</td>
</tr>
<tr>
<td>$\text{SO}_2$</td>
<td>-</td>
<td>200</td>
<td>-</td>
<td>350</td>
<td>200</td>
<td>1100</td>
</tr>
<tr>
<td>Dust</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
</tbody>
</table>

- **EXISTING plants:** $> 5 \text{ MW}_{th}$ to $< 50 \text{ MW}_{th}$

<table>
<thead>
<tr>
<th></th>
<th>Natural Gas</th>
<th>Other Gaseous</th>
<th>Gas Oil</th>
<th>Other Liquid</th>
<th>Solid Biomass</th>
<th>Other Solid</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\text{NO}_x$</td>
<td>200</td>
<td>250</td>
<td>200</td>
<td>650</td>
<td>650</td>
<td>650</td>
</tr>
<tr>
<td>$\text{SO}_2$</td>
<td>-</td>
<td>35</td>
<td>-</td>
<td>350</td>
<td>200</td>
<td>400</td>
</tr>
<tr>
<td>Dust</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>30</td>
<td>30</td>
<td>30</td>
</tr>
</tbody>
</table>

- Natural Gas: IED 100 mg/m$^3$; LCP BREF 50 – 100 mg/m$^3$
- Biomass Dust: IED 30 mg/m$^3$ ($50 – 100 \text{ MW}_{th}$); LCP BREF 2 – 15 mg/m$^3$ ($< 100 \text{ MW}_{th}$)
- Note that there are numerous derogations in specific sub-categories of thermal rating, fuel type, etcetera (consult the MCPD)
Package Boiler Emissions (Existing Plant)

- Existing non-compliant burner–boiler combination can be retrofit with a new burner system but performance can be sub-optimal
- The most difficult system is the ‘reverse flame’ boiler since this combines tight confinement and difficult aerodynamics
- In most cases, performance close to the new plant ELV may be achieved
- MCPD existing plant NO$_x$ ELVs of 200 – 250 mg/m$^3$ (Natural Gas) & 200 mg/m$^3$ (Gas Oil) can usually be achieved with burner retrofit but…
- In difficult cases, Flue Gas Recirculation (FGR) may be required

Source: Spirax Sarco
ELV Derogations in England & Wales

• 500h exemptions - implemented as a 5-year (existing plant) or three year (new plant) rolling average
• Biomass plants – delayed dust ELVs - not implemented
• District heating – delayed ELVs - not implemented
• Small and Micro Isolated Systems – delayed ELVs - implemented
• Gas compressor stations > 5MW_{th} - delayed ELVs - implemented
Biomass fired boilers

- Dust ELVs of 20 – 50 mg/m³ are difficult/costly to achieve on small plant

<table>
<thead>
<tr>
<th>Technology</th>
<th>Achievable Emission Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multicyclone</td>
<td>~200 mg/Nm³</td>
</tr>
<tr>
<td>ESP (two fields)</td>
<td>&lt; 30 mg/Nm³</td>
</tr>
<tr>
<td>Fabric filter</td>
<td>&lt; 20 mg/Nm³</td>
</tr>
<tr>
<td>Cyclone/Multicyclone + Scrubber</td>
<td>~45 mg/Nm³</td>
</tr>
</tbody>
</table>

Operating hours 5000 h/a
Emission level before the new investment 200 mg/Nm³

Pirhonen L
Particle Emission Reduction
Cost Analysis for Existing 1-20 MW_{fuel} Solid Biofuel
Plants in Finland
June 2014
Emission Limit Values – Gas Turbines (NEW)

- ELVs in mg/m³ at 273K, 101.3 kPa at: 15% O₂
- NEW plants (achievable with DLN for Natural Gas)

<table>
<thead>
<tr>
<th>MCPD ELVs Gas Turbines - New Plant (mg/m³ at 15% O₂ dry, 0°C, 1 atm)</th>
<th>Natural Gas</th>
<th>Other Gaseous</th>
<th>Gas Oil</th>
<th>Other Liquid</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOₓ</td>
<td>50</td>
<td>75</td>
<td>75</td>
<td>75</td>
<td>Only applicable over 70% load</td>
</tr>
<tr>
<td>SO₂</td>
<td>-</td>
<td>15</td>
<td>-</td>
<td>120</td>
<td>40 mg/m³ for biogas</td>
</tr>
<tr>
<td>Dust</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>10</td>
<td>20 mg/m³ for ≥ 1 to ≤ 5MWth plant</td>
</tr>
</tbody>
</table>

- Natural Gas NOₓ:
  IED 50 mg/m³
  LCP BREF 10/15 – 30/35 mg/m³ (CCGT/OCGT)
Emission Limit Values – Gas Turbines (EXISTING)

• ELVs in mg/m³ at 273K, 101.3 kPa at: 15% O₂
• EXISTING plants (achievable with DLN or water injection but significant cost if currently uncontrolled)

<table>
<thead>
<tr>
<th>MCPD ELVs Gas Turbines - Existing Plant</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>(mg/m³ at 15% O₂ dry, 0°C, 1 atm)</td>
<td></td>
</tr>
<tr>
<td>Natural Gas</td>
<td>Other Gaseous</td>
</tr>
<tr>
<td>NOₓ</td>
<td>150</td>
</tr>
<tr>
<td>SO₂</td>
<td>-</td>
</tr>
<tr>
<td>Dust</td>
<td>-</td>
</tr>
</tbody>
</table>

• Natural Gas NOₓ:
  IED 50 – 75 mg/m³ (depending on efficiency)
  LCP BREF 10/15 – 45/50 mg/m³ (CCGT/OCGT)
Emission Limit Values - Engines

- ELVs in mg/m\(^3\) at 273K, 101.3 kPa, 15% O\(_2\) for recip engines
- Engine Emission Limit Values are subject to complex derogations
- For NEW plants, NO\(_x\) ELVs are 95 mg/m\(^3\) for natural gas firing and 190 mg/m\(^3\) for liquid fuel firing
- For EXISTING plants, NO\(_x\) ELVs are 190 mg/m\(^3\) for all fuels.
- SO\(_2\) ELVs apply to engines firing liquid fuels other than Gas Oil and gaseous fuels other than natural gas.
- Dust ELVs apply to engines firing liquid fuels other than Gas Oil
Monitoring Requirements

- Annex III Article 3 states that ‘Measurements shall be required only for (a) pollutants for which an ELV is laid down in this Directive for the plant concerned and (b) CO for all plants.

- It is assumed that no monitoring is required for species for which a plant has an ELV exemption – although the wording is ambiguous, so Member States might have differing interpretations.

- This suggests the following monitoring requirements:

<table>
<thead>
<tr>
<th>Plant fuel type</th>
<th>Species monitored</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural gas or Gas oil</td>
<td>CO and NO_x</td>
</tr>
<tr>
<td>Gaseous fuels other than natural gas</td>
<td>CO, NO_x and SO_2</td>
</tr>
<tr>
<td>Biomass, Other solid fuels or Liquid fuels other than Gas oil</td>
<td>CO, NO_x, SO_2 and Dust</td>
</tr>
<tr>
<td>Gas and liquid fuelled plants under the 500 hour derogation</td>
<td>CO only</td>
</tr>
<tr>
<td>Biomass and Other solid fuel plants under the 500 hour derogation</td>
<td>CO and Dust</td>
</tr>
</tbody>
</table>
Monitoring Issues - timing

• The requirement to provide first measurements within 4 months of the permit being granted could lead to a very large number of individual MCPs requiring measurements within the first four months of 2024 or 2029 (based on the deadlines by which existing plant permits must be granted).

• Early scheduling of measurements, combined with early application for permits should mitigate this risk.

• The detailed requirements need to be defined.
Monitoring issues – minimum flue size

- Depends on velocity

- Specialist equipment required for dust sampling from small flues
Monitoring issues – Nitrogen Dioxide

- Proportion of NO₂ in NOₓ is important for Air Quality – Dispersion Modelling studies (note requirements for certain Specified Generators)
- Difficult to measure NO₂ within the overall NOₓ emission
- Inert sample probe material needed in addition to prescribed sample line materials (PTFE, stainless steel)
- NO₂ reduced to NO in steel probes > 300°C in engine and gas turbine exhausts
- NO₂ is water soluble
- Care needed in the direct measurement of NO₂ and interpretation of engine manufacturers’ data
Conclusions

- Overlap with legislation affecting large sites regulated under the IED
- MCPD ELVs are similar to IED ELVs that apply to larger plant
- MCPD Boiler NO$_x$ ELVs are largely achievable for Natural Gas firing, provided that LNB options are available, apart from the case of overly confined boiler geometries
- MCPD Boiler Dust ELVs require significant (excessive) investments for Biomass firing
- MCPD GT NO$_x$ ELVs are largely achievable for Natural Gas firing providing that DLN or water injection options are available (but large investment if presently uncontrolled)
- Monitoring issues requiring further thought: time-scale of first monitoring; arrangements for small flues (especially Dust); direct NO$_2$ measurement
Thank you!

If you need any further information, please contact: MCPDHelp@environment-agency.gov.uk or
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