EUROPEAN
TURBINE
NETWORK

Industrial Emissions Directive & Best Available Techniques Conclusions

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Introduction

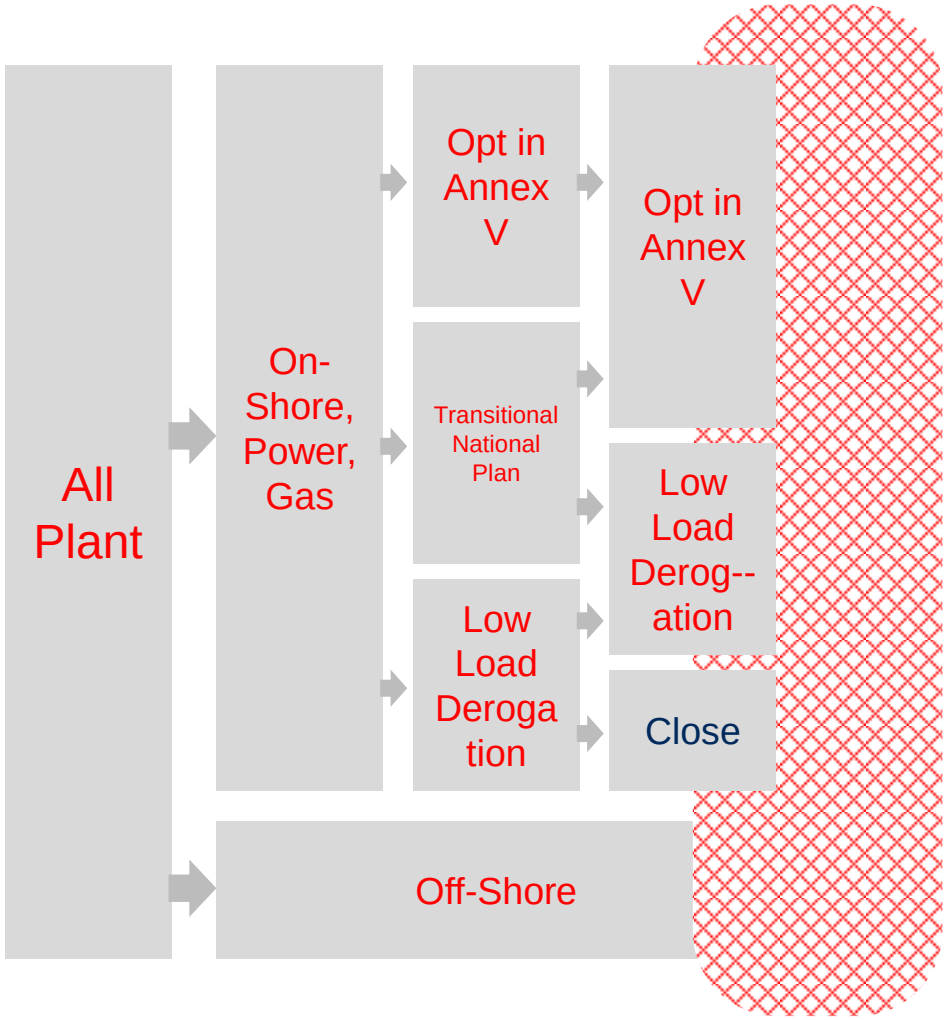
1. IED – What it does, how are different plant treated and what does it mean?
2. Summary of IED Performance Requirements
3. LCP BREF – Why is this important?
4. Summary of LCP BREF Performance Requirements
5. Case studies, three plant types

Acronyms and Abbreviations

- AEL – Associated Emission Level
- BAT – Best Available Techniques
- BREF – BAT Reference
- CEMS – Continuous Emissions Monitoring System
- CHP – Combined Heat & Power
- CO – Carbon Monoxide
- D1 – Draft 1
- DLN – Dry Low NOx
- EIPPCB – European Integrated Pollution Prevention & Control Bureau
- ELV – Emission Limit Value
- IED – Industrial Emissions Directive
- LCP – Large Combustion Plant
- LCPD – LCP Directive
- LFO – Light Fuel Oil
- LLD – Low Load Derogations
- LNB – Low NOx Burners
- MCPD – Medium Combustion Plant Directive
- NECD – National Emissions Ceiling Directive
- NOx – Nitrogen Oxide
- NG – Natural Gas
- NMVOC – Non Methane Volatile Organic Compounds
- O/CCGT – Open/Combined Cycle Gas Turbine
- RH – Reheat
- TNP – Transitional National Plan
- TWG – Technical Working Group
- W/S – Water/Steam

Industrial Emissions Directive – What it does

- Represents a bundling of a number of former directives, most notably the LCP and IPPC Directives.
- Applies some form of regulations to most LCPs.
- LCPs are defined as single units >50MWth, or of aggregated units >15MWth totalling >50MWth.
- “Simplified” depiction of coverage is given here →
- There are a number of categories, some time bounded, others restricted to certain plant types placing performance restrictions on assets.
- The IED sets back-stop emissions.



Industrial Emissions Directive – What it means

- This primarily depends on the type of plant and the proposed or expected running regime.
- Sets Emission Limit Values (ELVs) for GT plant covering NOx and CO.
- Many GT based plant were not regulated under the former LCPD as they pre-date those controls (Nov 2002) – therefore IED draws those into a common framework.
- Consequence of this is that in many cases burner upgrades are being installed to allow flexible operation and achieve the required performance.
- This does create some technical challenges, particularly around definitions of start-up and shut-down, but on the whole does support GT plant in their future role balancing intermittent generation.
- Does not cover efficiency or emissions of carbon dioxide.
- Off-shore plant do not need to meet any ELVs as outlined in the IED.

Industrial Emissions Directive – Plant/Performance Levels

– IED has a clause allowing a higher NOx ELV for existing high efficiency GTs in open and combined cycle operation (Part 1). For new plant this is only available to OCGTs. Supports development of advanced hardware, for example H-class technology.

mg/Nm^3 @ 15% O_2 vol, dry, STP			**NOx**	**CO**
IED – Natural Gas	Existing	Hourly (95% <)	100	200
		Daily	55	110
		Monthly	50	100
IED – Liquid Fuels	Existing	Hourly (95% <)	180	200
		Daily	99	110
		Monthly	90	100
	New	Hourly (95% <)	100	200
		Daily	55	110
		Monthly	50	100

Large Combustion Plant BREF – Why is it important? (1)

- The IED, as well as setting its own limits, requires for all plant under Article 14(3) that:-

  "BAT conclusions shall be the reference for setting the permit conditions".

- The term is further clarified:-

  "*BAT conclusions' means a document containing the parts of a BAT reference document laying down the conclusions on best available techniques, their description, information to assess their applicability, the emission levels associated with the best available techniques, associated monitoring, associated consumption levels and, where appropriate, relevant site remediation measures"*

- Therefore the BAT conclusions become the de facto emissions standard to be considered.

Large Combustion Plant BREF – Why is it important? (2)

- There is uncertainty about the status of derogated plant, if and how the BAT conclusions will be applied. There has been some clarification on this via a Commission FAQ, but the legal status of this is unclear.
- Some BAT conclusions are made and Associated Emissions Levels set for “Emergency Plant”.
- The clauses of the IED excluding off-shore plant from the Annex V ELVs do not exclude plant from the requirement that “*BAT conclusions shall be the reference for setting the permit conditions*”.
- Overall, the back-stop emissions set by the IED are tightened by the implementation of the BAT conclusions.

Large Combustion Plant BREF – Plant impacts?

- The performance associated with the application of BAT, the Associated Emission Level, or AEL, has been concluded for a number of different plant categories, and at a range of values – so more diverse in outcome than the IED.
- New Single Fuel CCGT Plant >600MWth data shown, broadly similar for 50-600MWth range.
- Ranges are markedly different to IED.
- Potentially major impact on plant, capital and operational requirements and flexibility restriction.

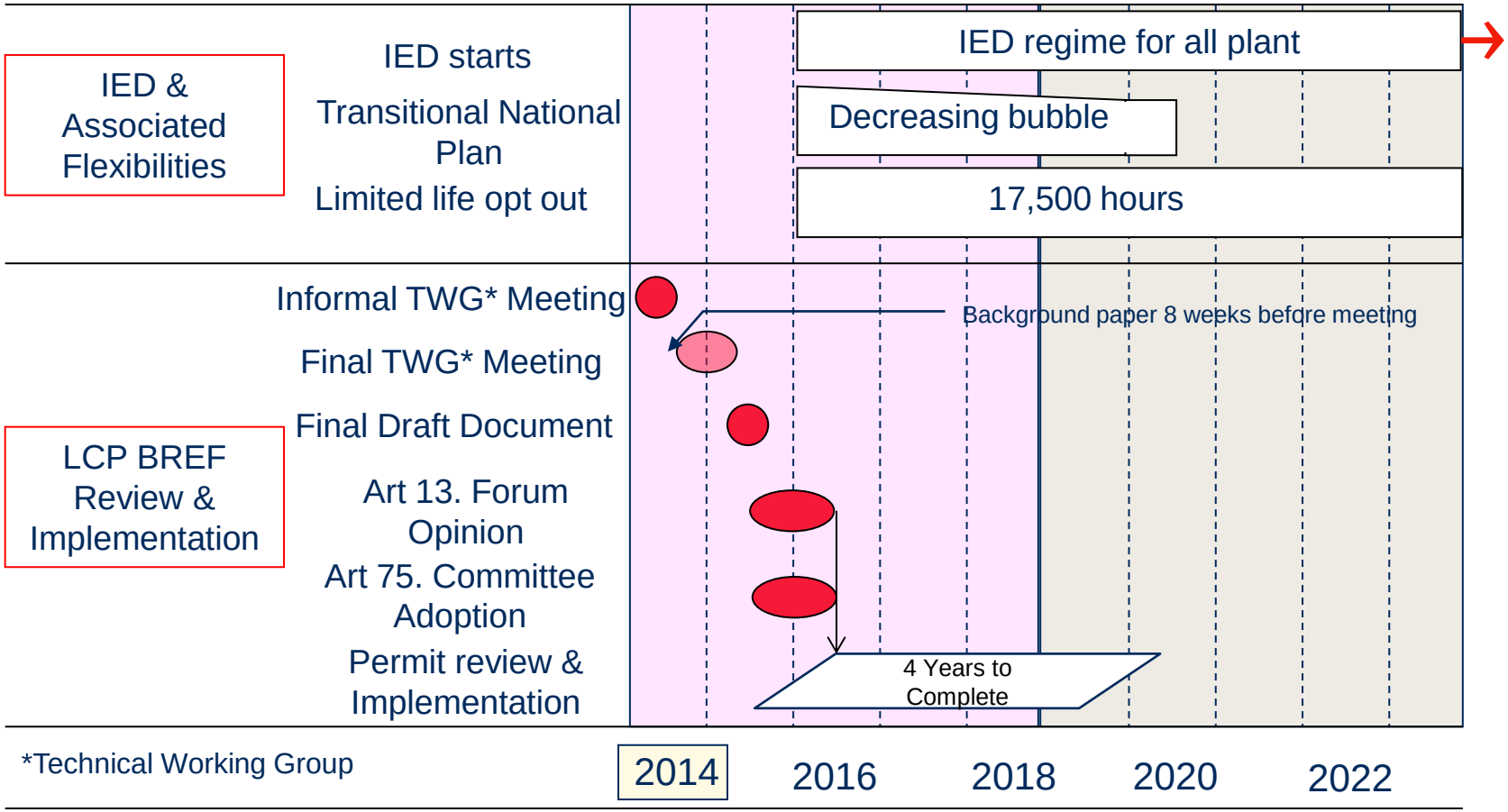
NOx - mg/Nm^3	**IED >70% load**	**D1 BREF**
Hourly	95% < 100	
Daily	55	18-35
Monthly	50	
Annual		10-25
CO - Mg/Nm^3	**IED >70% load**	**D1 BREF**
Hourly	95% < 200	
Daily	110	
Monthly	100	
Annual		1-15

Summary of Potential Operating & Hardware Requirements Arising from D1

CC/GT Plant	
CO CEMS (& for NH3 if SCR, SOx and dust if LFO) Seems to imply SCR expected on LFO plant and some new NG GTs (and some existing?). Oxidation catalysts may be of increased *interest* for GTs if operated flexibly Low NOx burners for auxiliary firing	Monthly analysis of fuel from supplier Potentially increased need for maintenance activities and tuning exercises Leak detection systems Regenerative feedwater heating CCGT
All Plant Types	
There are a range of energy efficiency measures considered "applicable" or "generally applicable". Flue gas condenser on CHP plant Reuse of water by segregating streams Integrate outcome of fuel monitoring in to the control system.	However compliance is assessed it will be without the subtraction of uncertainty. Significant additional monitoring [3] including noise "Advanced Computerised Control system" including "high performance monitoring" Seek to reduce, reuse, recycle, recover Noise reduction programme

- This poses several technical challenges to GT operators.
- Role of GT plant to balance intermittent generation could be compromised by efficiency demands (values and improvement measures), and the CO ranges.
- Major risk to deployment of flexible aero-derivative plant.
- Some of the requirements of the draft may be beyond those where a warranty is available from an equipment supplier.

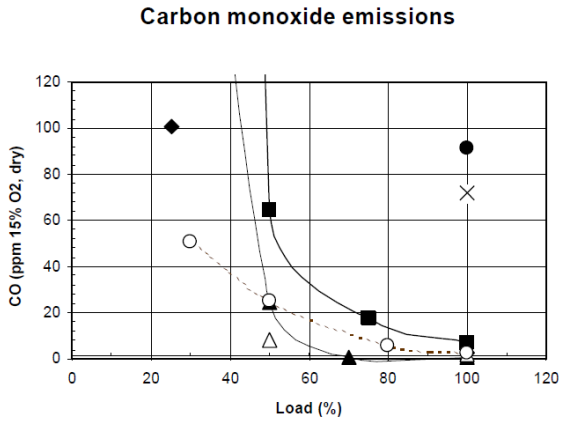
Timeline for BREF Implementation

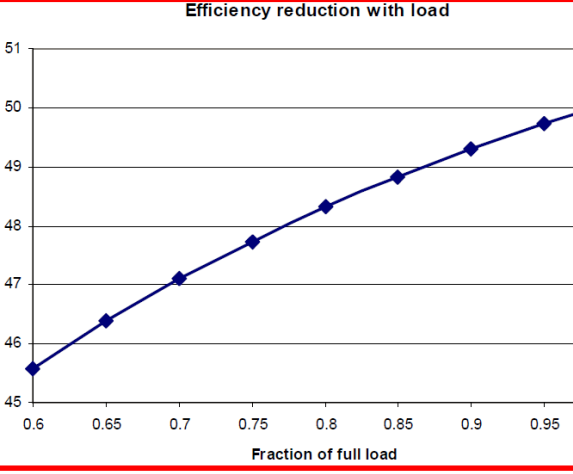


- Further complexity from Air Quality Package, Gothenburg Protocol etc.

Case Study A – Existing Mid-Merit Plant

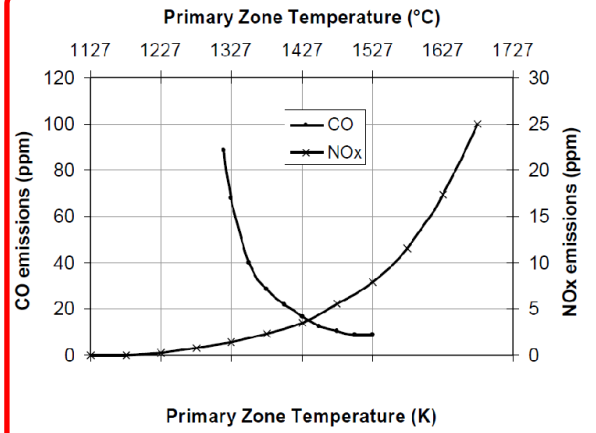
- Expected generation is likely to be very variable year on year depending on production of intermittent renewables.
- Likely to have already invested, or be about to, for IED compliance.
- CO AELs could be a challenge for flexible plant, as well as the proposed efficiency targets.
- Varying regulatory environment makes understanding investment viability hard.
- Risk of limited running provides little opportunity to payback investment.
- Figures taken from Alstom work for UK DTI and D1 BREF.





Case Study B – New Advanced GT

- Modern GTs employ higher firing temperatures to improve efficiency, at the expense of air emissions.
- D1 BREF requires more stringent control of NOx and CO from these plant.
- Appear to inhibit technology roll out.
- Increased project costs (& technical risk), higher risk of failing to payback.



"The Ulrich Hartmann power plant achieves an efficiency level of over 60 percent, which has never been seen before in plants of this type, and is hence setting new standards for efficient and environmentally-friendly electricity production." 15/09/2011

"The operators of the Irsching 4 and 5 power plant units agreed with Tennet TSO GmbH not to close down the highly efficient but presently unprofitable gas-fired power plant units near Ingolstadt within the next three years." 29/04/2013

Case Study C – Distributed "Small" Plant

- There is a major impediment to technology roll-out if warranties cannot be offered for purchased equipment. This is a risk for all plant types.
- Oil fired plant AEL targets very challenging → SCR? What about reagent and Balance of Plant?
- If plant designed to support grid, what of impact from frequent cycling? Not considered in D1?
- Small GTs ideal for load support and fast response in Open Cycle. Could be highest real-world efficiency (lowest system CO_2) technique.

Solar Turbines

PWPS

Summary

Conclusions

- Difficult “web” of forthcoming regulation – especially for onshore assets. Significant uncertainty in when, where and if to invest in upgrades.
- D1 Conclusions go beyond the scope and extent of the IED, and may make integration of intermittent renewables more difficult and costly.
- Potential for threats to security of supply.
- Operators may be forced to buy plant at own risk when they cannot be in receipt of a warranty.
- BREF contains many requirements already captured in, for example, Environmental Management Systems.

Recommendations

- ETN maintains an active engagement with the LCP BREF revision process.
- Maintain dialogue with other sectoral organisations on the topic (i.e. EUTurbines, Eurelectric, International Association of Oil and Gas Producers).
- ETN continues to make its membership aware of developments in this area and potential impact on their plant’s operation.

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