EUROPEAN
TURBINE
NETWORK

FEEDBACK FOR INTERIM LCP TWG MEETING

Seville, Spain

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Contents

- Data Analysis
- Sustaining BAT Associated Emission Levels
- Operating Modes
- Start-Up/Shut-Down
- Liquid Fuel Firing
- Energy Efficiency

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Data Analysis

- The ETN IED Working Group Shares the concerns of other TWG Members, such as EUTurbines and Marcogaz that it is not clear or transparent how analysis has been undertaken and conclusions derived.
- These analysis inconsistencies have led to unreasonable emissions limits (AELs) limits being proposed for both new and in-service units that will have a major detrimental impact on the functioning of the market.
- In broad terms we agree with the concerns raised by EUTurbines
- **Proposal - set up a sub-group to cover Data Evaluation including members from Operator and Supplier parties. Make data analysis process steps clear.**

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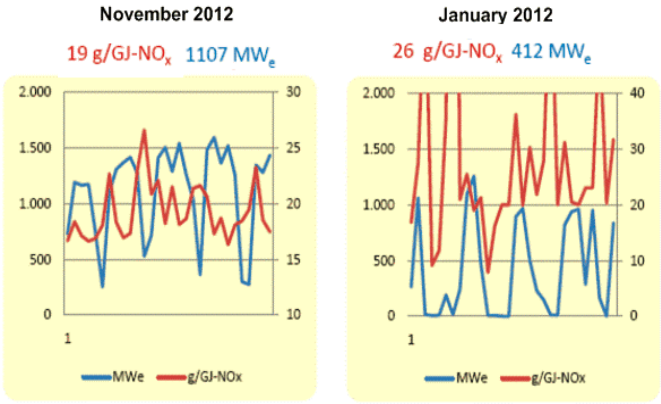
Sustaining BAT Associated Emission Levels

- CCGT and GT plant provide reliable, clean generation to the portfolio. However during the normal operating cycle plant performance can degrade between maintenace activity. Guarantee test data will not be sustained in the long term.
- Tighter limits will require more of these interventions, increasing costs and reducing availability.
- Based on North American experience typical warranty NOx levels are quoted →
- Full load AELs of 50 mg/Nm^3 NOx and 40-100 mg/Nm^3 CO are consistent with BAT warranty practice and also allow combustor designs to achieve good low power emissions and a lower electricity and gas network wide total emission rate when operating flexibly to support intermittent renewables and uncertain gas demand.
- **Proposal - Operators should not be forced to buy plant at own risk when they cannot be in receipt of a warranty. Hence AELs of 50 mg/Nm^3 NOx and 40-100 mg/Nm^3 CO should be retained. H Class technology may struggle to achieve 50mg/Nm^3 so this should be considered separately.**
- **Proposal – SCR is not BAT unless local air quality requires it.**

Available Warranty (NOx mg/Nm^3)		
Supplier	GT	NOx mg/Nm^3 @ 15% O_2 vol, dry
Alstom	GT24	52
Siemens	SGT6 5000F	52
GE	LMS100 PA	52
Solar	Titan 130	31-78
P&W	FT8-1	52
RR	RB211	52

Operating Modes and Existing Units

- The flexibility and efficiency of GT plant is key to their choice for deployment to balance intermittent generation and provide stability.
- They are critical in providing the fast response required to support renewables.
- As noted in the LCP BREF, flexible operation has a major impact on emissions to air of NOx (see figures).
- Due to quenching effects, or combustor design (depending on GT type) turndown by its nature leads to higher CO.
- Neither of these factors are adequately covered in BREF D1.
- A number of proposals for in-service units are uneconomic and may result in increased emissions (e.g.AELs for Emergency units)
- **Proposal – CO be required to be monitored for combustion QA purposes (unless local air quality requires otherwise), but overall net emission be managed via the Emissions Trading Scheme compliance process.**
- **Proposal – NOx AEL be derived based on load and size classes (function of revised data analysis)**
- **Proposal – In-service Emergency Units, and those under IED derogations, should be excluded and AELs for other in-service units should be at higher levels than proposed, following a review of the data analysis.**



LCP BREF Figure 3.21

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Start-Up/Shut-Down

- Allied to the concerns on operating mode is the impact of frequent start-up and shut-down of units, as is required in the modern electricity grid.
- This process frequently entails, by definition, passing through the areas where CO and NOx emissions are at their highest. This is a particular concern where a plant coming on load during the latter part of the day could be in breach of a daily limit based on a calendar day.
- **Proposal – BAT AELs apply above 70% load, in common with IED ELVs.**

Liquid Fuel Firing

- ETN do not believe the AELs proposed for liquid fuel GTs are appropriate.
- For NOx, ETN believe a 90mg/Nm^3 AEL is appropriate based on the experience to date and Technology Readiness Level for large combustion turbines. For smaller units this should be 120 mg/Nm^3.
- Better performance cannot be guaranteed by vendors.
- New plant range to drive development beyond the achievable 90/120 mg/Nm^3 AEL – but not intended to stop deployment.
- SCR deployment on these plant is minimal and due to problems with ammonium bisulphate leading to catalyst and boiler fouling that technique cannot be considered BAT [EPRI].
- **Proposal – SCR is not BAT for LFO GTs**

mg/Nm^3 @ 15% O_2 vol, dry, STP			NOx	CO*
D1	Existing	Daily	30-250	
		Annual	<90	6-60
	New	Daily	20-40	
		Annual		6-60
Proposal	**Existing****	**Daily**	**90/120 - 250**	**Annual 100**
	New**	**Daily**	**50 - 250**	**Annual 100**

*see also proposal on Operating Modes regarding CO limits

**depending on unit size

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Energy Efficiency

- The LCP BREF proposes efficiency ranges for plant. However, efficiency is already controlled, in effect, via the emissions trading scheme.
- Furthermore, flexible GT plant able to respond quickly are critical to the penetration of inermittent wind to the grid. These allow an overall reduction of the system-wide CO_2 emission, though they themselves may not be as efficient in real-world operation as at baseload.
- It is appropriate for efficiency to be considered in the LCP BREF chapters, but to set BAT Conclusions on it will lead to at best double regulation and at worst competing negative pressures on grid stability, if less flexible fast acting plant available.
- **Proposal – efficiency be considered in the relevent BREF chapters, but not be included in BAT Conclusions.**
- **Proposal – high firing temperature, high efficiency GTs should benefit from similar flexibility on AELs as allowed in IED.**

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Summary

- **Proposal - set up a sub-group to cover Data Evaluation including members from Operator and Supplier parties. Make data analysis process steps clear.**
- **Proposal - Operators should not be forced to buy plant at own risk when they cannot be in receipt of a warranty. Hence AELs of 50 mg/Nm^3 NOx and 40-100 mg/Nm^3 CO should be retained. H Class technology may struggle to achieve 50mg/Nm^3 so this should be considered separately.**
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Liquid Fuel mg/Nm^3 @ 15% O_2 vol, dry, STP			NOx	CO*
Proposal	**Existing****	**Daily**	**90/120 -250**	**Annual 100**
	New**	**Daily**	**50 -250**	**Annual 100**

*see also proposal on Operating Modes regarding CO limits
**function of unit size

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Supporting Information

- CO and the Emissions Trading Scheme
- Water Injection
- Plant Operation

CO and the Emissions Trading Scheme

- LCP BREF proposes annual CO AEL. Via the fuel oxidation factor the Emissions Trading Scheme also controls carbon emissions on an annual basis.
- This leads to triple regulation of CO via ETS, the IED and the LCP BREF.
- ETS incentivises reduction in CO and IED provides an environmental safety net of a minimum standard. Therefore there is no need to set an AEL for CO for any class of plant.
- CO monitoring does still aid the operator in managing the quality of combustion and plant condition – so for Combustion Turbines CO monitoring (but not an AEL) can represent BAT, depending on operating hours.

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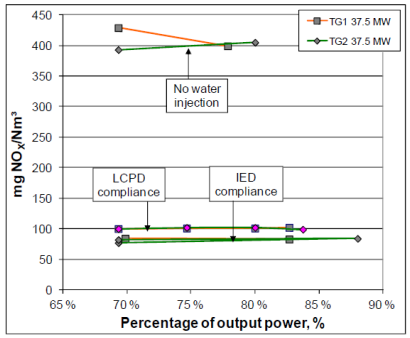
Water Injection

- For many turbine models water injection is the only truly “available” means of emissions control from liquid fuel fired Gas Turbines.
- Liquid fuel fired turbines in isolated systems rely on this approach.
- It allows higher loads through power augmentation – critical in emergency situations.
- Water injection can achieve around 90 mg/Nm³ @ 15 % O_2. Presented data is from site trials →
- Aiming for too ambitious NOx reduction increases CO and will ultimately lead to damage through combustion dynamics.



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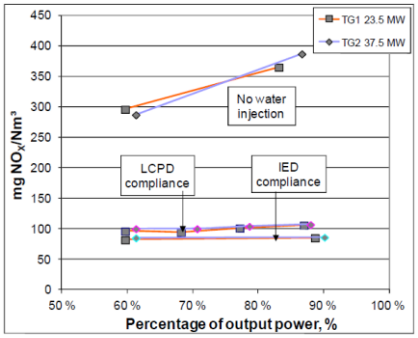
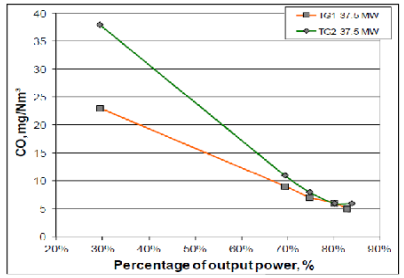


Punta Grande



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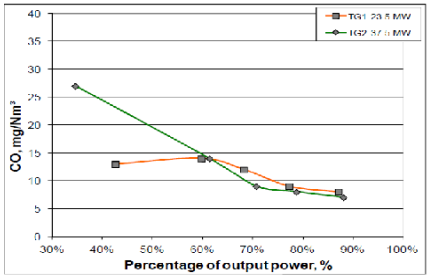

Punta Grande

- Recent tests of combustors in controlled laboratory conditions by Enel at the Sesta test facility showed 50mg/Nm³ could not be achieved and further R&D is required.

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Plant Operation

- The growth in renewable generation in many countries requires CC/GT plant.
- For example, in Spain wind energy leads to volatility in demand from the grid of 2,000 MW/hour, approximately equal to two (inflexible) nuclear plant.
- In the coming years, gas turbine in open cycle and the majority of CCGTs will be required to provide auxiliaries services (i.e. primary, secondary and tertiary response) as well as greater two-shifting or double two-shifting.

Contact

Sign up for free subscription on the ETN website

Chaussée de Charleroi 146-148/20, 1060 Brussels, Belgium

Tel: +32 (0)2 646 15 77 info@etn-gasturbine.eu

www.etn-gasturbine.eu