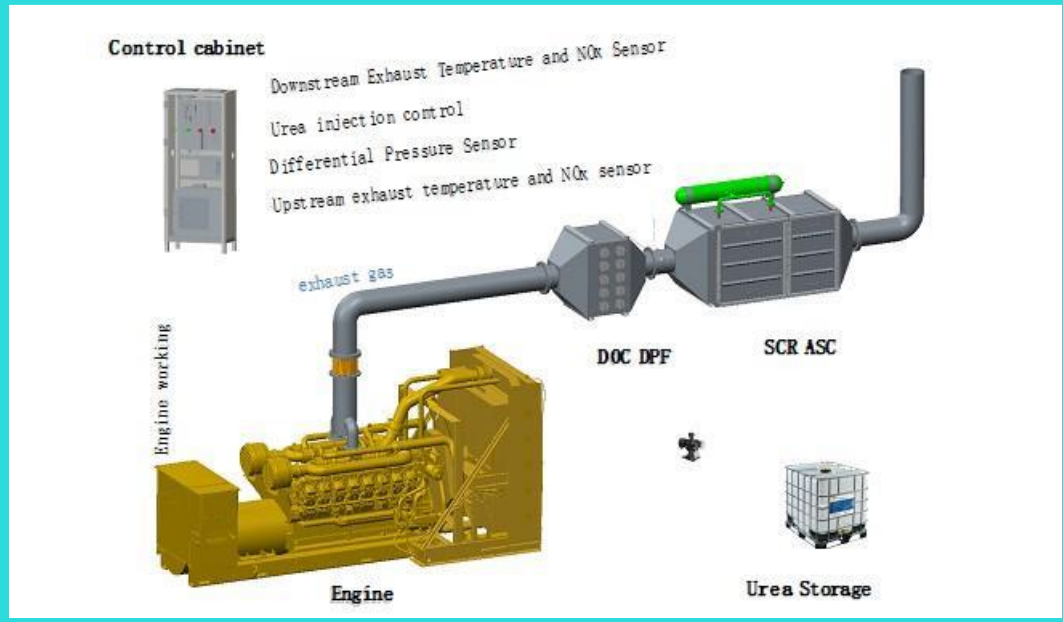

GBF
Testing a Fixed Speed Engine Abatement System under EST Retrofit Scheme.
Green Biofuels
Power Electrics
Emissions Analytics
2021
Gd+

Background

- Provides significant volumes of GD+ HVO to Generator Hire Companies in the UK
- Changes in legislation requiring Stage V compliance indicated an opportunity for retrofit solution for fixed speed generators
- GBF and Power Electrics had knowledge and experience that suggested a solution could be designed, manufactured and meet the Stage V requirements
- Rationale was to provide a commercially viable retrofit system that encouraged the sale of low emission, low carbon fuels

System Design

- System uses a DPF and SCR and an in house developed software to manage an Adblue dosing system
- System designed to be optimized to EN15940 fuels but also able to meet Stage V / EST requirements on EN590
- System design key attributes:
  - Smallest size possible
  - Target a solution that can fit “within the canopy” of a generator
  - Lowest cost of production



Challenges of measurement

- EST prescribed measurement equipment to meet PEMS definition; focus on definition rather than ability to measure accurately at required levels
- Calibration of PEMs equipment challenging when equipment designed to measure vehicle emissions with rapid variations in load
- Specialist equipment which isn't PEMS is more suitable for measurement of Fixed Speed engines measuring constant loads with significantly higher gas flows
- Calibration of equipment is key issue and challenge
- Use of Span Gases to calibrate
- Calculated v Actual measurement methodology
- Don't believe it was recognized that the levels of emissions required to be measured were so low they fell within the margin of error of measurement for the equipment

Ga *missions – N_2O and CH_4*

A prime from MRU Instruments will be used for the measurement of N_2O H. This is a nd flue gas emission analyser using a Non-Dispersive Infrared (NDIR for long time rements of large engines and turbines.

Particle emissions

For particulates, a Sensors Condensation Particle Number (CPN) was used. It uses a heated line to deliver a sample to the catalytic volatile particle remover, which then dilutes the aerosol, and counts the particles by butanol condensation.

The CPN continuously measures condensation particle number, allowing for second-by-second data acquisition during for real world PEMS testing.

Further details can be located at: http://www.sensors-inc.com/Products/SEMTECH/CPN.

seous emissions – CO, CO_2, NO & NO_2

A SEMTECH-LDV from Sensors, Inc was used to measure gaseous emissions. A flow tube is mounted on the exterior of the test vehicle at the end of the tailpipe to measure total flow independently of the vehicle's systems.

The analyser measures CO, CO_2, NO and NO_2 gases and works in conjunction with a conditioning system to analyse conditioned sampled gases. The gas module incorporates Non-Dispersive Ultraviolet (NDUV) and Non-Dispersive Infrared (NDIR) benches.

Further details can be found at: http://www.sensors-inc.com/Products/SEMTECH/LDV.

Manufacturer	Model	Power (kVA)	Engine (litres)	Size	Regulatory Stage	Engine
Perkins	ElectropaK	110	4.4		EU IIIA	Perkins 1104D-E44TAG2

Figure 1 - PEMS setup for static generator testing

Measured Emissions

Constant Speed					
Mode Number	1	2	3	4	5
Torque %	100	75	50	25	10
Speed	Rated Speed				
Type D2 weighting factors	0.05	0.25	0.30	0.30	0.10

- Particulates
- NOx
- EST requirement for NO2 not a Stage V requirement
  - Retrofit required to meet higher standard than new build

Summary analysis

Overall results under the NRMM Retrofit Programme are as follows:

	Maximum permitted limit	Test result
Primary emissions		
Nitrogen oxides (NO_x)	0.400 g/kWh reduction >90%	0.174 g/kWh reduction of 94.8%
Nitrogen dioxide (NO_2)	0.080 g/kWh	0.009 g/kWh
Particle Number (PN)	1×10^{12} #/kWh	0.001×10^{12} #/kWh
Secondary emissions		
Nitrous oxide/methane (N_2O+CH_4 as CO_2e)	< 5% of CO_2	0.6% of CO_2
Carbon dioxide (CO_2)	< 4% increase	1.9% increase

Emissions Analytics and GBF

- Challenging first exchanges
- Confidence in each other developed during process
- Everybody learnt during process
- Nobody individually had sufficient knowledge of the challenges of being able to measure emissions at the levels required with the equipment specified

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