SUSTAINABILITY & CONSENTS

Guidance on Diesel Engine Emissions from Non-Road Mobile Machinery (NRMM) and retrofitting with Diesel Particulate Filters (DPF)

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Contents

1 Purpose

The purpose of this guidance is to provide further information on Crossrail's requirements relating to controlling diesel engine emissions from Non-Road Mobile Machinery (NRMM) and retrofitting with Diesel Particulate Filters (DPF).

2 Scope

The guidance is for contractors undertaking Crossrail's main construction works. It is not intended to provide information for advance works contracts.

The guidance does not amend or supplement the requirements of the Works Information or deal with individual contractual arrangements. Reference to the Works Information should be made in all cases and any questions relating to compliance with the contract requirements should be referred to the Project Manager or his delegate.

3 What are Crossrail's requirements?

Crossrail is required to comply with the Environmental Minimum Requirements. The Construction Code (which forms Annex 1 to the EMR) sets out in paragraph 6.2.1 that the nominated undertaker will…

> *…ensure that the adverse impacts of vehicle and plant emissions are controlled. Measures to be considered …. will include one or more of the following as appropriate and as far as reasonably practicable (b) using low emission vehicles and plant fitted with catalysts, diesel particulate filters or similar devices.*

4 How are these requirements passed on to contractors?

The specific arrangements for each contract are set out in the Works Information Volume 2B Part 21 or amendments of and should be referred to.

The Works Information requires all NRMM to meet with the current or immediately previous European Union (EU) NRMM Emission Directive, staged emissions standards.

In addition, NRMM with a type approval engine Stage IIIA or below, with a power output greater than (or equal to) 37kW, should be fitted with a Diesel Particulate Filter (DPF).

Any NRMM that is compliant with Stage IIIB[1] or Stage IV emissions standards will not need to be retrofitted with a DPF (because emissions of PM are already controlled).

NRMM with a power output below 37kW does not need to comply with the requirements.

5 What is the purpose of the requirement?

Particulate Matter (PM) is a significant problem in London. The UK has national Air Quality Strategy Objectives for PM, which large parts of London already exceed.

[1] EU Stage IIIB engines are also referred to in the US equivalent as 'interim Tier 4' or 'Tier 4i'.

Construction sites can give rise to significant amounts of PM through the use of on-site diesel engines. Diesel exhaust emissions have also been classified as being carcinogenic to humans based on evidence that exposure is associated with an increased risk for lung cancer by The International Agency for Research on Cancer (IARC), which is part of the World Health Organization (WHO).

6 Are there any dispensations?

Under normal circumstances, the requirements set out in (4) above should be followed. Applications for dispensation from the Works Information should be made to the Crossrail Project Manager or their delegate.

Some NRMM may be brought onto site for a very limited time period and fitting of DPF may not be practicable. Where this is so, a dispensation should be requested. For example, any NRMM on-site for less than 30 days will not be expected to comply. Use of stock rotation to avoid the requirement is not allowed.

Dispensation will not normally be granted for NRMM which are pre-EU emission standards models (pre-1999 engines) which might not be suitable for a DPF retrofit. In these cases alternative NRMM should be sourced.

The requirements are for diesel fuelled engines only, any machinery operating on petrol or converted to compressed natural gas (CNG) are exempt from these requirements.

Hybrid engines are not exempt from these requirements. However, the fuel saving benefits are noted and in such cases where Hybrids are seen as an desirable approach a dispensation case would be required to be presented to the Project Manager or his delegate.

7 Is NOx abatement technology required?

NOx abatement technology is not required as part of the requirements set out in (4).

8 How does Crossrail's approach compare to the GLA's approach?

Crossrail's approach to NRMM on construction sites is consistent with the Mayor of London's 'Best Practice Guidance (BPG) for the control of dust and emissions from construction and demolition'.

As part of the update of the BPG, the GLA is considering proposals for controlling NRMM emissions on construction sites. This is anticipated to be detailed in a BPG and enforced through the planning regime.

Crossrail has worked with the GLA to ensure that the current Crossrail requirements do not conflict and only support the proposals of an updated BPG.

9 What is included in Non-Road Mobile Machinery?

In the UK, the legislation governing emissions produced by engines fitted in NRMM is the Non-Road Mobile Machinery (Emission of Gaseous and Particulate Pollutants) Regulations. The directive is intended to cover almost all engines used for mobile applications which are not subject to vehicle approval requirements.

NRMM includes any mobile machine, transportable industrial equipment or vehicle with or without body work, brought onto site to carry out operations for the purpose of construction and is not considered a permanent installation (i.e. it does not require planning permission and is not intended for carrying passengers or goods on the road).

Examples of non-road mobile machinery include, but are not limited to:

- Generators;
- Bulldozers;
- Pumps;
- Construction machinery;
- Industrial trucks;
- Fork lifts;
- Mobile cranes.

Some NRMM may be also have a vehicle tax-disc or road legal status but does not make it exempt from this requirement.

Note that on-road goods vehicles will have to adhere to The London Low Emission Zone.

10 What are EU Emissions Standards and which ones matter?

NRMM Emissions Standards are set by the EU from point of manufacture. They seek to control gaseous and particulate pollutants emitted from NRMM. The emission standards are staged to allow continual improvements.

The Works Information requires all NRMM to meet with the current or immediately previous European Union (EU) NRMM Emission Directive, staged emissions standards[2].

There are several reductions in different pollutants at each EU Staged Standard. The largest staged reduction in PM emissions is between Stage IIIA and Stage IIIB engines[3]; this is the focus of the Crossrail requirement.

Any Stage IIIA engine used on a Crossrail site is therefore required to be retrofitted with a Diesel Particulate Filter (DPF) as detailed in this guidance.

11 What is a Diesel Particulate Filter (DPF)?

A Diesel Particulate Filter (DPF) is a post-exhaust diesel emission control system that is intended to reduce the emissions of particulate matter (PM) from the engine.

Different DPF can have different operating and maintenance regimes and are not typically considered to be a 'one size fits all' technology. A supplier of DPF (for example those listed in the Energy Saving Trust (EST) register) can help advise on the most cost effective and suitable product for a fleet or individual NRMM.

[2] Machines that have been placed on the market under the 'Flexibility Scheme' (which allows set percentages of machines of an older standard to be placed on the market after the implementation date for a higher standard) shall, for the purposes of this guidance be considered only as meeting the older standard.

[3] Emission standards for PM are 0.2 and 0.025 g/kWhr for Stage IIIA and Stage IIIB respectively.

12 Why is Crossrail referring to the Energy Saving Trust NRMM Register?

There are several programmes globally which have similar processes of control for NRMM and corresponding verified DPF including; the Swiss Federal Office of the Environment (FEON) Ordinance on Air Pollutant Control (OAPC) and the Californian Air Resources Board (ARB) Verification Procedure.

The 'Energy Saving Trust Non-Road Mobile Machinery Register' is the current UK/London equivalent which has been around since 2008. The EST Register acts as a 3rd party assurance scheme to help contractors/plant hire/developers choose the correct solutions. The EST Register provides a list of certified companies and devices and the programme provides two main purposes:

- The EST Registration programme ensures that companies have the appropriate background to provide installation of DPF including:
    - Knowledge and compliance with Health & Safety requirements;
    - Knowledge and compliance with Provision and Use of Work Equipment Regulations 1998 (PUWER);
    - Provision of training for installation and maintenance;
    - Supply of DPF 'data logger'; and
    - Provide appropriate warranties and insurance of their products[4]

  The EST Registration programme requires that DPF comply with at least an 85% mass reduction of total PM.
  More details can be found at:
  http://www.energysavingtrust.org.uk/england/Organisations/Certification/Non-Road-Mobile-Machinery-NRMM-certification

13 Can a DPF not on the EST Register be used?

DPFs that are not on the EST register may be used on site, but Crossrail will require evidence that the DPF meets performance standards, through evidence that the DPF has a proven emission certificate from another certification programme.[5]

14 How does a DPF differ from a catalytic convertor?

A catalytic convertor or a diesel oxidation catalyst helps convert emissions of Carbon Monoxide (CO) and Hydrocarbons (HC) into Carbon Dioxide (CO_2) and Water (H_2O). These systems are typically termed 'through-flow' which means the exhaust gases flow though the unit only partially restricted.

A DPF is a 'wall-flow' or 'full-flow' filter which means all exhaust is forced through a filter membrane reducing total PM number and mass.

[4] DPF warranties supplied do not typically guarantee engine or Original Equipment Manufacture (OEM) warranties, see 'What about the warranty of the equipment or engine?'

[5] This would include technology listed under; The FOEN Filter List of tested filter systems and engines that comply with the Ordinance on Air Pollution Control (OAPC) or, Californian ARB Verification Classifications for Diesel Emission Control Strategies, Retrofit Device Verification Database Level 3, or technology approved through the Transport for London (TfL) Low Emissions certification (LEC) process, Emission Stage Phase 4 achieving PM emissions limits Standard C, provided there is a proven record of off-road capabilities..

Some DPF designs combine the use of a 'pre-catalyst' or have a catalyst coating to help the removal process but a catalytic convertor on its own will not reduce PM to the same level of a DPF.

To view a short film on DPF's in the construction industry, visit:

http://vert-certification.eu/index.php?option=com_content&view=article&id=84&Itemid=60

15 Does fitting a DPF make the NRMM noisier or use more fuel?

The DPF supplier will be able to provide details on these questions. Typically the DPF replaces the exhaust silencer and does not affect noise attenuation.

Some types of DPF require a dose of fuel to regenerate and therefore increase fuel consumption by a small degree. For example, the EST Register requires that DPF do not give rise to more than 5% increase in CO_2 emissions; which can be assessed by measurement of CO_2 or reference to the change in brake specific fuel consumption.

In practice, fuel consumption is kept to a minimum through correct maintenance and operation of NRMM. Consumption is affected more by this than any additional increase in fuel consumption utilised by the DPF.

16 What about the Warranty of the Equipment or Engine?

The DPF supplier should provide warranty on the actual DPF along with operator instructions and any training required along with a data logger/back pressure monitoring system.

This will help ensure that the DPF is maintained correctly and operates within the range of the engine requirements and therefore should not affect engine performance or compromise the engine or NRMM warranty.

A supplier of DPF (for example those listed in the Energy Saving Trust (EST) register) can advise on this issue.

17 What about hired NRMM?

Discussions should be held with the Hire Company or Subcontractor to ensure they are aware of the requirements and can supply either Stage IIIB engines or Stage IIIA engines with a DPF that meets the required performance standard.

Hired NRMM should be provided with the necessary training for operators and a valid certification of the DPF installed. This information should be requested from the Plant Hire Company before the NRMM arrives on site

18 Where can I get further information?

Any NRMM being used on Crossrail sites requiring a retrofit should use a DPF which has been verified by an existing verification schemes for more information on available DPF see the following websites.

- The Energy Savings Trust Energy Savings Trust Non-Road Mobile Machinery Register
- http://www.energysavingtrust.org.uk/england/Organisations/Certification/Non-Road-Mobile-Machinery-NRMM-certification The Swiss Federal Ordinance on Air Pollution Control (OAPC) FOEN Particulate Filter List, (VFT3):
    - http://www.vert-dpf.eu/

    - http://www.bafu.admin.ch/partikelfilterliste/index.html?lang=en

- Californian ARB Verification Classifications for Diesel Emission Control Strategies, Retrofit Device Verification Database Off-road Level 3
    - http://www.arb.ca.gov/diesel/verdev/vt/cvt.htm

- Transport for London (TfL) Low Emissions certification (LEC) process, Emission Stage Phase 4 achieving PM emissions limits Standard
    - http://www.tfl.gov.uk/assets/downloads/roadusers/lez/lez-approved-filter-device-list.pdf