APPLICATION FOR AN ENVIRONMENTAL PERMIT - THURROCK FLEXIBLE GENERATING FACILITY

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NON-TECHNICAL SUMMARY

Introduction

This document supports the application by Thurrock Power Limited for an Environmental Permit to operate the Thurrock flexible generating facility (TFGF) under the Environmental Permitting Regulations 2016 (as amended). The TFGF operation will have a total thermal input of up to 950 MW under normal operation (96 engines @ 9.896 MW_{th} input, LHV), ultimately providing up to 450 MW (net) of electricity, in high power mode, for export to the grid at times of peak demand. The engines can operate for short periods in high power mode where the thermal input to the engines is 10.8 MW_{th} and the output is 4.838 MW_e. Therefore, the maximum combined capacity of the engines in this mode is approximately 1,037 MW_{th} (96 engines @ 10.8 MW, LHV)

Operation will be limited to 1,500 hours per engine per annum as a 5-year rolling average and with no more than 2,250 hours per engine in any one year.

Site Location

The proposed site, which covers approximately 3.3 hectares, is located on open fields, approximately 1 km east of the edge of Tilbury, Essex. The nearest post code is RM18 8UL and the site is centred at National Grid Reference TQ 66398 76793.

The site is bordered by open fields. To the south lies the existing National Grid Tilbury Substation, the site of the decommissioned Tilbury Power Station and a battery storage site that is under construction, beyond which lies the river Thames, approximately 1.25 km south of the proposed site.

Process Description

Operations

The proposed facility will consist of up to 96 x 4.498 MWe spark ignition reciprocating gas engines and will operate as a peaking plant to provide additional energy security during periods of peak electricity consumption within the UK. The selected engines will be designed to meet the requirements of the Medium Combustion Plant Directive (MCPD)[1].

The engines will have a high-power mode which may operate for short periods only to boost the output from 432 to 450 MW_e, as required. High power mode will be used for up to 15 hours per year.

Natural gas will be delivered to the plant via a new dedicated underground gas supply. The gas will be combusted within the gas engines which will be housed within concrete containers. The electrical output from the plant will be exported to the Transmission Network via step-up transformers.

Cooling for the gas engines will be provided by fin-fan coolers which will operate in a closed-circuit cooling water system.

Management of Activities

An in-house Environmental Management System (EMS) will be in place which will meet the requirements of environmental permitting and broadly follow the EMS standard ISO 14001. The EMS will be underpinned by an environmental policy. All staff and external contractors will be made aware of the environmental policy as part of the induction training and a copy will be made available on site.

Thurrock Power Ltd will also implement a record keeping system on site as part of its management system.

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[1] Directive - 2015/2193 - EN - EUR-Lex (europa.eu)

The plant will be managed and operated by a technically competent and trained workforce. Specific training will be provided to staff responsible for controlling the new gas engines. Clear lines of responsibility will be established, and these will be defined within the management system.

Energy Efficiency

The gas engines selected to provide peaking power are high efficiency gas engines achieving an LHV gross electrical efficiency of approximately 45%. This level of efficiency compares favourably with the efficiency levels for new gas engines as stated in the large combustion plan (LCP) reference document on best available techniques[2], although these engines are Medium Combustion Plant due to the aggregation rules for LCP.

Raw Materials, Water and Waste

The main materials used within the plant will include natural gas for fuel, lubrication oil and ethylene glycol in the cooling system.

Water usage is limited to small volumes of water required for topping-up the closed-circuit cooling water system.

Waste generation from the plant is anticipated to be low and will comprise primarily waste oil and waste from maintenance activities.

Emissions to Air

Emissions to air will result from the combustion of natural gas within the gas engines, which will be released into the atmosphere via 48 dedicated exhaust stacks, each housing two flues. A stack height assessment has been carried out to determine the optimum height for the stacks, which has been determined to be 20 m. The effects on air quality from the peaking plant have been assessed on this basis. The resulting air quality effect of the proposed new and existing engines in operation is considered to be 'not significant' overall.

Detailed dispersion modelling has been carried out for operation of 96 engines over the maximum 2,250 hours over a year at full load and with emissions at MCPD limits. This approach is considered conservative as the facility will be limited to 1,500 hours as a 5-year rolling average with no more than 2,250 hours in any one year. The predicted emissions at sensitive receptors surrounding the plant are below the required air quality standards. The assessment of air quality effects at nearby ecological sites concluded maximum process contributions at nearby Local Wildlife Sites and Sites of Nature Conservation Interest would be well below the critical level. As a result, impacts at these designated conservation sites have been determined to be insignificant.

Emissions to Surface Water, Sewer, Effluent Treatment Plants or Other Transfers off Site

There will be no process water discharges to sewer or surface water. Discharges to water will be restricted to surface water run-off from the roofs, concreted and paved areas etc. and water will flow through the surface water drainage system and attenuation pond before, if necessary, release into the local surface water drainage which ultimately discharges into the Thames. There will be no point source emissions to land or groundwater.

[2] Note the proposed new engines do not fall under large combustion plant requirements however the comparison has been made in the absence of energy efficiency performance benchmarks for medium combustion plant.

Emissions to Land

There will be no emissions to land.

Fugitive Emissions

The primary potential for fugitive releases is associated with the delivery system for natural gas. The delivery system for handling natural gas will be designed to prevent the escape of gas.

The only process waters associated with operation of the new plant are within the closed-circuit cooling water (CCCW) system which contains only a small volume of water. The area containing the fin fan coolers and CCCW circulating pumps will be bunded so the risk of accidental discharge of process waters to controlled waters is minimised.

Storage areas for the lubrication and waste oil storage tanks will be bunded to ensure that, should an accidental spillage occur, the oil remains isolated from drainage systems prior to clean up.

Odour

There will be no significant sources of odour resulting from the operation of the plant as un-odourised natural gas is used at the site.

Noise and Vibration

The gas engines and other ancillary plant on site are sources of noise. However, noise levels from the peaking plant will be mitigated to ensure that the impact to health, the environment and general amenity are minimised. Mitigation measures will include concrete containers to house the engines and stack exhaust silencers. The supporting noise impact assessment indicates that “significant adverse impacts would not occur” on nearby receptors.

Noise impacts will be managed in accordance with a noise management plan which is included within this application (see Appendix F). The noise management plan will form part of the operational management system and will be reviewed and maintained throughout the operational life of the facility.

Best Available Techniques

The application sets out the proposed operating techniques and considers these against BAT and alternative techniques. The proposed techniques are considered to meet BAT and the operation of the proposed facility is not expected to give rise to significant effects to the environment or human health.

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1 INTRODUCTION

1.1.1 This document, and associated appendices, forms the application for an Environmental Permit to operate a gas fired generating facility (TFGF) under the Environmental Permitting Regulations 2016 (as amended). The TFGF operation will ultimately provide up to 450 MW of electricity for export to the grid with all engines operating in high-power mode.

1.1.2 The TFGF will consist of 96 x 4.498 MW_e spark ignition reciprocating gas engines. For short periods of time up to 15 hours per year, the engines may operate in high-power mode, delivering 4.838 MW_e (at LHV), to achieve a short-term electrical output of approximately 450 MW_e. The facility will operate to provide additional energy security during periods of peak electricity consumption within the UK. The combined net thermal input of the TFGF under normal operation is approximately 950 MW_{th}, and under high power mode approximately 1,037 MW_{th}, at LHV. Operation would not be continuous but would run as a flexible back up supply for up to 1,500 hours per engine per annum as a 5-year rolling average and with no more than 2,250 hours per engine in any one year. The selected engines will be designed to meet the requirements of the Medium Combustion Plant Directive (MCPD)[3].

1.2 Site Location

1.2.1 The proposed site is located on open fields southwest of Station Road, approximately 1 km east of the edge of Tilbury, Essex. The nearest post code is RM18 8UL and the site is centred at National Grid Reference TQ 66398 76793.

1.2.2 The site covers approximately 3.3 hectares of open fields and is part of a larger development covering approximately 20 hectares, including a battery storage facility.

1.2.3 The area of the site for the TFGF is bordered by open fields on all sides. To the south of the proposed site lies the existing National Grid Tilbury Substation and the site of the decommissioned Tilbury Power Station, beyond which lies the river Thames, approximately 1.25 km south of the proposed site. A railway line passes approximately 175 m to the north of the site boundary at its closest point.

1.2.4 The closest residential properties are on Church Lane, West Tilbury, approximately 725 m northeast of the site. The built-up residential area of Tilbury is approximately 1 km west of the site.

1.2.5 The sensitive receptors listed within Table 1-1, below are identified in the Environment Agency Nature and Heritage Conservation screening report, included in Appendix H to this report, and the Air Quality Impact Assessment, included as Appendix E to this report, which replicated the receptors considered in the evidence to support the application for planning consent.

Table 1-1: Protected Habitats within Relevant Screening Distances of the Thurrock TFGF Site

Designation	Site
SPA, Ramsar, SSSI	Thames Estuary and Marshes
SPA Ramsar, SSSI	Mucking Flats and Marshes
SPA,Ramsar	Medway Estuary and Marshes
SPA, Ramsar	Benfleet and Southend Marshes
SAC	Peter's Pit
SAC	North Downs Woodland
SSSI	Basildon Meadows
SSSI	Canvey Wick
SSSI	Chattenden Woods and Lodge Hill

[3] Directive - 2015/2193 - EN - EUR-Lex (europa.eu)

Designation	Site
SSSI	Cobham Woods
SSSI	Darenth Wood
SSSI	Grays Thurrock Chalk Pit
SSSI	Great Crabbles Wood
SSSI	Halling to Trottiscliffe Escarpment
SSSI	Hangmans Wood and Deneholes
SSSI	Holehaven Creek
SSSI	Northward Hill
SSSI	Pitsea Marsh
SSSI	Shorne and Ashenbank Woods
SSSI	South Thames Estuary and Marshes
SSSI	Thorndon Park
SSSI	Tower Hill to Cockham Wood
SSSI	Vange and Fobbing Marshes
SSSI	West Thurrock Lagoon and Marshes
SSSI	Langdon Ridge
Local Wildlife Site	Tilbury Power Station
Local Wildlife Site	West Tilbury Hall
Local Wildlife Site	West Tilbury Church
Local Wildlife Site	Low Street Pit
Local Wildlife Site	Tilbury Centre
Local Wildlife Site	Tilbury Marshes
Local Wildlife Site	Broom Hill
Local Wildlife Site	Hob Hill & Sandy Lane Pit, Chadwell St. Mary
Local Wildlife site	Lytag Brownfield
Local Wildlife Site	Goshems Farm

1.2.6 The closest sensitive ecological receptor to the site is West Tilbury Marshes, over part of which the installation will be built, and East Tilbury Marshes. An assessment of ecological impacts resulting from operation of the TFGF has been made for the designated sites.

1.3 The Applicant

1.3.1 The applicant and operator of the TFGF is Thurrock Power Limited and is listed on Companies House with registered number 14888040.

1.3.2 The Directors, and their dates of birth, as listed on Companies House are provided in Appendix A.

1.4 Structure of the Permit Application

1.4.1 This section provides an overview of the proposals. This is supplemented by further details in Sections 2 – 5 as follows:

- Section 2 details the proposed management practices which will be in place at the plant, with specific detail covering:
  - Accident management;
  - Energy efficiency;
  - Efficient use of raw materials and water; and
  - Avoidance, recovery and disposal of wastes.
- Section 3 addresses the operational measures which will be in place to prevent and/or control the environmental effects of the proposal.

- Section 4 identifies the nature of emissions from the TFGF and details the monitoring systems that will be in place.
- Section 5 summarises the conclusions from the detailed assessments undertaken to predict the environmental effects from the TFGF.
- Section 6 summarises the outcome of the detailed assessments of Best Available Techniques (BAT) for the key plant and abatement systems proposed.

1.4.2 The information provided within this application has been set out with due regard to the provisions of the MDPD. Where there are aspects of the operation of the facility that are not specified by the MCPD, although the facility is not a large combustion plant, regard has been given to the provisions of the BAT conclusions for large combustion plant set out in Commission Implementing Decision (EU) 2021/2326[4] of 30th November 2021. Supporting documents, assessments and application forms are provided within the appendices list as set out in the contents page.

[4] Implementing decision - 2021/2326 - EN - EUR-Lex (europa.eu)

2 MANAGEMENT OF ACTIVITIES

2.1 General

2.1.1 An environmental management system (EMS) will be established on site and will cover those elements requiring environmental permitting. The EMS will broadly follow the key requirements of ISO14001. Although not subject to LCP BAT conclusions, as an installation the EMS will also address BAT conclusion general requirement for management systems.

2.1.2 The EMS will be underpinned by an environmental policy. All staff and external contractors will be made aware of the environmental policy as part of the induction training and a copy will be made available on site.

2.1.3 A system of keeping all relevant records including, but not limited to, the following will be developed and implemented prior to commissioning:

- Records of incidents, accidents and emergencies including details of follow-up.
- Monitoring records, including those required by the environmental permit; and
- Any other record to be kept as part of the permit.

2.1.4 Systems will be developed and implemented for undertaking audits, reporting of environmental performance, objectives, targets and programmes for future improvements.

2.1.5 Prior to commencing commissioning of the TFGF, all key EMS systems will be in place.

2.2 Operations and Maintenance

2.2.1 Management systems will be put in place to ensure that those operations which have the potential to give rise to significant environmental effects are controlled. These systems will not only cover normal running but will also address abnormal operation and start-up and shutdown of the TFGF.

2.2.2 Planned maintenance routines will be established to ensure all key plant components which have the potential to affect the environmental performance of the facility remain in good working order. Maintenance routines will draw on manufacturer's recommendations, modified as appropriate by operational experience during the lifetime of the TFGF. Maintenance will be carried out by contractors in accordance with the operator's maintenance requirements.

2.3 Competence and Training

2.3.1 All subcontractors working on the site will be subject to a competency assessment carried out by a third-party company under the supervision of the operator. In addition, where any subcontractor has any operational input to the site, they must fulfil any relevant obligations under the EMS.

2.3.2 Training will be provided to the subcontractor at the beginning of their contract term in the form of the site induction process. The subcontractor, in turn, will be responsible for training their own personnel and providing records of such training to the operator. This will include all maintenance staff carrying out routine maintenance at the facility.

2.3.3 Training will ensure that all staff are aware of relevant elements of the EMS including relevant operational procedures and the requirements of the environmental permit when issued. Induction procedures will be established for the identification and provision of training and updated knowledge for all personnel engaged in activities affecting environmental performance.

2.3.4 Records of training will be stored and maintained. As a minimum, records will include details relating to the date, type of training and training provider.

2.4 Organisation

2.4.1 A draft organogram for the TFGF is provided in Appendix G to this document and indicates the main lines of responsibility. Roles and responsibilities will be clearly defined within the management system.

2.4.2 The plant will be remotely operated but an average of 6 to 8 personnel are likely to be present on the wider site, which incorporates a battery storage facility, each day to carry out routine checks and inspections. Maintenance is likely to be scheduled in campaigns/batches. There will be a greater contractor presence during these times.

2.4.3 The plant will be available for 24 hours a day, 365 days per year, subject to the limit on operating hours to 2,250 hours in any one year and 1,500 hours per year over a 5-year rolling average.

2.4.4 Further details on specific aspects of the management systems for the facility are provided in the following sections.

2.5 Accident Management

2.5.1 An Accident Management Plan (AMP) will be established prior to commencing operation of the proposed TFGF. The AMP will detail those actions required in the event of an emergency or accident/incident. This will include small incidents such as minor spills and leaks and complaints, as well as major incidents such as fire. In particular, a system for recording and allocating appropriate follow-up for accidents, incidents and non-conformances will be established prior to operation.

2.5.2 The site is remotely controlled and under normal day to day operation will be controlled via feedback from the automatic control system and visual monitoring of the site via the CCTV camera system.

2.5.3 Fire and gas detection and suppression systems, including smoke detectors and gas isolation, will be installed in each generator enclosure. These systems will link to the main control room (offsite) to alert the local engineer of an issue, who will respond directly and will then call the Fire and Rescue Service to attend if necessary.

2.5.4 There will be a link to a local support team in the event of an issue onsite, e.g. intruder alarm or an emergency (e.g. fire). Documented procedures will be in place which set out management measures should such an event occur including contacts details for local support.

2.5.5 To support this application, an initial Environmental Risk Assessment (ERA) is provided in Appendix C. The ERA includes an assessment of potential accident risks. This will be reviewed prior to commencing operation and maintained as part of the AMP throughout the operational life of the facility.

2.5.6 As part of the design process, the proposals will be subject to detailed HAZOP/HAZID with a view to minimising safety, health and environmental risks.

2.6 Site Security

2.6.1 The site will be surrounded by a combination of security fencing, including padlocked manual gates. Additional security will be provided by CCTV and intruder alarms.

2.7 Energy Efficiency

2.7.1 The following section provides information on energy consumption and basic energy efficiency measures, for the TFGF. The gas reciprocating engines proposed to be installed will have an electrical efficiency of circa 45.4%, at LHV, when operating at 100% rating.

Basic Energy Requirements

2.7.2 Table 2-1 below provides a breakdown of the energy requirements of the TFGF.

Table 2-1: Energy Consumption by Source

Energy Source	Annual Energy Consumption	
	Delivered MWh	Primary MWh
Natural Gas (usage during operation at maximum rating, assuming 96 engines operating for 1,500 hours, at LHV)	1,425,024(1)	1,425,0254
Electricity demand when the facility is not operating(3)	18,150(2)	43,560(4)

(1) Based on data from Jenbacher, gas consumption @100% rating (9.896 MW per engine) and 1,500 hours average operation for 96 engines.

(2) Based on maximum parasitic load of 2.5 MW over the period during which the engines will not be running, i.e. one year less 1,500 hours average operation.

(3) Note that the parasitic load of 10.0 MW is supplied by the facility during operation.

(4) Primary Energy factor of 2.4 taken from the Environment Agency Horizontal Guidance Note, H1

2.7.3 The table above provides details on the energy consumption associated with gas delivered to the TFGF for the purpose of generating electricity and therefore is technically not consumed by the facility, it is simply converted to electrical output. A maximum of circa 10.0 MW of electricity will be associated with the parasitic load during operation, for start-up and shutdown periods and during non-running hours. Compared to usage associated with natural gas to generate energy the energy consumption of the plant is considered insignificant.

Operations and Maintenance

2.7.4 Operational procedures will be developed for the TFGF. These procedures will incorporate measures aimed at ensuring the TFGF operates efficiently and safely. Site maintenance and housekeeping systems will also be developed for the TFGF, and relevant plant will be included within a preventative maintenance schedule.

Energy Management Policy

2.7.5 Energy management will form an integral part of the TFGF management systems. Systems will be developed to ensure that measures are in place to minimise energy use as far as possible. Training programmes will be in place to ensure that operational and maintenance staff are aware of relevant procedures for ensuring energy efficiency.

2.7.6 Efficiency parameters will be monitored, and energy minimisation features will be applied to all major energy uses where appropriate. On-site electricity usage will be minimised as far as possible within the constraints of the process optimisation.

CHP Ready Assessment

2.7.7 Although the TFGF will be a new combustion power plant in excess of 50 MW capacity, under EA guidance[5] the preparation of a CHP-Ready Assessment and Cost Benefit Analysis is not appropriate due to the limited operating hours and irregular and unplanned operating times of the installation which will be operated as a peaking plant.

[5] CHP Ready Guidance for Combustion and Energy from Waste Power Plants

2.7.8 Article 26 of the Energy Efficiency Directive (Directive (EU) 2023/1791)[6] exempts peaking plant planned to operate under 1,500 hours per year as a rolling average over a period of five years. TFGF meets this criterion.

Building Services

2.7.9 Energy requirements for the TFGF will be low with minimal heating and lighting requirements. Energy efficient lighting will be used where possible.

Efficient Use of Raw Materials

2.7.10 Raw material requirements for the TFGF will be limited in number. The main materials used within the TFGF will include natural gas for fuel, ethylene glycol for the cooling circuits, and lubrication oil. Table 2-3 provides details of raw materials, expected usage, storage and potential environmental effects.

2.7.11 The gas engines will combust natural gas only. A typical composition for natural gas is provided within Table 2-2. Compared to alternative fossil fuels, natural gas has the advantage of being cleaner to handle and burns with no soot or solid residues produced. Furthermore, in terms of environmental benefits, there are fewer emissions to air associated with natural gas in comparison with other fossil fuels, and there is a reduced potential for accidents associated with storage. Gas will be supplied by National Grid via the National Transmission System and will be delivered via a new pipeline to the gas reception and pressure reduction station, which is shown in Plan 2 in Appendix B.

Table 2-2: Typical Natural Gas Specification

Compound	Typical Mole (per cent)
Nitrogen	2.22
Carbon Dioxide	0.29
Methane	93.23
Ethane	3.24
Propane	0.67
Butane	0.26
Pentane	0.09
Total Sulphur	<0.001
Net Calorific Value	28 MJ/m^3
Gross Calorific Value	40.1 MJ/m^3

2.7.12 The current design includes for 6 lubrication oil tanks of 7,000 litres each, which will require occasional topping up. Lubrication oil will be delivered in intermediate bulk containers (IBCs) which will be placed on portable bunds before being connected to the oil storage tanks for transfer of the oil. No other additional chemicals will be stored at the TFGF.

2.7.13 The TFGF will utilise a closed-circuit cooling water (CCCW) system which will utilise a water / glycol mix and consequently the area containing the fin fan coolers and CCCW circulating pumps will be bunded.

[6] Directive (EU) 2023/1791 of the European Parliament and of the Council of 13 September 2023 on energy efficiency

Table 2-3: Raw Material Consumption for TFGF

Raw Material	Nature	Expected Usage (approx.)	Storage	Fate	Environmental Effects	Alternatives
Natural Gas	Natural Gas	(up to circa 150,048,000 Nm^3)(1)	No natural gas will be stored on site. Gas connection will supply plant.	Combusted within gas engines.	Various emissions to air. Potential impacts arise through acidification, vegetation and health effects and global warming.	There is no back-up fuel provision for the engines. However, the engines have been selected because they can be adapted to run on a hydrogen/natural gas mix.
Lubricating Oil	Refined hydrocarbon with additives	Up to 130 tonnes/annum	Stored in 6 No. 7 m^3 bunded tanks(2). Bund will have capacity for 110% of the stored oil volume	Used primarily within gas engines and discharged as waste oil for disposal	Harmful to aquatic organisms. May cause long-term adverse effects in the aquatic environment. Not readily biodegradable.	No practical alternative. There is a choice of supplier, but quality is specified by engine manufacturer.
Ethylene glycol	Water glycol mixture (37% glycol)	Closed loop system, would only be topped up following a leak, or drained and replaced periodically.	None stored. Quantity limited to CCCW inventory = 151,350 litres of ethylene glycol water mixture in the cooling systems.	Contained within the CCCW system and in the event of a leak within a roof bund.	Under normal operations there will be no associated emissions from the CCCW system.	

(1) Based on average 1,500 operating hours per annum and gas volume of 1,042 Nm^3/hr at maximum rating.

(2) Subject to detailed design

Water Use

2.7.14 As stated in paragraph 2.7.13, a CCCW system will be installed which has no associated process discharge under normal operation. No process waters will be generated by the plant, hence there will be no associated process water releases to surface water or sewer from the TFGF.

2.7.15 No fire-fighting water will be stored, details of fire detection and suppression systems are provided in paragraph 2.5.3 and fire management procedures will be included within the AMP.

2.8 Avoidance, Recovery and Disposal of Wastes

2.8.1 It is anticipated that waste generation during operation of the TFGF will be low, primarily resulting from maintenance activities. Waste generation will be from the following limited sources: used gas engine air intake filters; separated oil or sludge from oil/water separators; and used lubricating oils.

2.8.2 Waste oil will be collected in 6 waste oil storage tanks, each of 5 m^3 (5,000 litre) capacity. The waste oil storage tanks will be compliant with the Oil Storage Regulations[7] including secondary containment to contain 110% of the tank contents. Waste oil will be transferred to IBCs for

[7] SI 2001/2954. The Control of Pollution (Oil Storage) (England) Regulations 2001

collection from site for reprocessing or appropriate disposal. During transfer of waste oil, IBCs will be placed upon temporary bunds.

2.8.3 Disposal of wastes generated will be incorporated within maintenance contracts. All contractors carrying out maintenance on the plant will be responsible for wastes generated from their activities. The operator will be supplied with copies of records of waste removed from the site and associated recovery/disposal routes.

2.8.4 Waste minimisation audits will be carried out in accordance with the permit requirements. The audit will aim to minimise raw material consumption and therefore prevent the generation of waste.

3 OPERATIONS

3.1 Overview of TFGF Proposals

3.1.1 The proposed facility will consist of 96 x 4.498 MW_e spark ignition reciprocating gas engines and will operate to provide additional energy security during periods of peak electricity consumption within the UK. The combined net thermal input of the TFGF is approximately 950 MW_{th} (96 x 9.896 MW_{th} engines in normal power mode, at LHV). Operation will not be continuous but will run as a flexible back up supply for up to 2,250 hours in any one year and no more than 1,500 hours per year as a rolling 5-year average.

3.1.2 The engines will be capable of operating in high power mode, with an electrical output of 4.838 MW_e, for up to 15 hours per year to meet a total electrical output of approximately 450 MW_e, if required.

3.2 Fuel and Raw Material Supply, Storage and Handling

3.2.1 Natural gas will be delivered to the TFGF via a new gas pipeline to be built to intercept the existing high-pressure National Grid gas national transmission system (NTS). Fuel gas will be supplied via on-site reception equipment consisting of safety isolation valves, filters, pressure regulation, metering and distribution piping as required.

3.2.2 Within the TFGF there are dedicated lubrication oil storage tanks located within a bunded containment area. The 6 No. lubricating oil, of 7,000 litres each, and 6 No. waste oil tanks, of 5,000 litres each, will comply with oil storage regulations[8]. The tank bunds will be designed to hold 110% of the tank content. The lube oil tanks will only be re-filled whilst a maintenance engineer from the engine Maintenance Contractor is on site to oversee the delivery. All delivery staff and maintenance engineers will be trained and will hold contact details for the remote monitoring centre to alert operatives in the event of an incident. Contact details will also be held local to the filling point.

3.2.3 An Ethylene glycol/water mixture will be used in the cooling circuits. In the event that a cooling circuit requires a top-up, or a spillage is identified, the engine Maintenance Contractor will be responsible for overseeing this and notifying the Operator of any spillage incident and actions taken in accordance with the incident reporting system.

3.2.4 Should a loss of pressure be detected in an individual CCCW, a valve on the roof will automatically be closed to create a bund on the roof which will prevent glycol from contaminating rainwater run-off.

3.2.5 There will be no other raw materials to be used by the TFGF.

3.3 Combustion of Fuel and Power Generation from TFGF

3.3.1 The spark ignition reciprocating gas engine generator sets will be housed within individual enclosures. Each gas engine will have an air intake system, combustion chamber, an exhaust system and an electrical generator, together with common auxiliary plant.

3.3.2 The air intake system will feature filters to remove any contamination present, such as dirt, dust or grit, which could damage or reduce efficiency of the plant.

[8] SI 2001/2954. The Control of Pollution (Oil Storage) (England) Regulations 2001.

3.3.3 Within the engines, gas and combustion air are ignited by means of a spark plug. As the burning mixture of fuel and air expands, a piston is pushed transferring energy released from combustion to an engine flywheel, from which a connected alternator is used to generate electricity.

3.3.4 Clean combustion technology will be incorporated as detailed in section 4.1.

3.3.5 Automatic monitoring and control systems will be in place to control the combustion process to ensure that emissions from combustion are consistent with the emission limit values in place for the engines. The control systems will be able to monitor various aspects of operation including efficiency and fuel use over the full range of ambient and fuel conditions.

3.3.6 The exhaust system for the gas engines will have a silencer and ducting to convey the hot gases from the engines to 48 exhaust stacks each housing two flues. The 96 flues will be designated as release points A1 – A96.

3.4 Transformer

3.4.1 The electricity generated will be exported to the Grid via three step-up transformers. The transformers will be located outside the permit boundary within individual bunded bays.

3.5 Cooling System

3.5.1 The CCCW system will comprise the main fin fan cooler, CCCW pump, system header tank, associated pipework and valves.

3.5.2 The CCCW system will be closed-loop filled with a 37% glycol/water mix and a corrosion inhibitor added. Top up of the glycol will be by a make-up connection to an IBC as required. The IBC will be brought to site for the system top-up and subsequently removed when complete.

3.5.3 The number of fans to be operated at one time will be dependent on the number of engines in operation, ambient weather conditions and the engine operating temperature at the time. This will be controlled to minimise the plant's electrical energy usage.

3.5.4 The noise assessment provided within Appendix F has assessed the potential for noise generation on site, including noise from operation of the fin fan coolers.

3.6 Start up and Shut down Procedures

3.6.1 The facility will be capable of rapid start up when generation is required and a controlled shut down after use. The expected definitions of the start-up and shut-down periods are given below:

- "Engine Start-up Period" means the time from receipt of an instruction to start the gas reciprocating engine, synchronisation with the respective electrical network, up to the time when the engine achieves a state of steady electrical load.
- "Engine Shut-down Period" means the time from receipt of an instruction to stop the gas reciprocating engine, rejection of engine load and isolation from the respective electrical network up to the time the gas reciprocating engine ceases to rotate.

3.7 Commissioning

3.7.1 A commissioning plan will be developed for the TFGF to outline the commissioning and associated monitoring activities. Commissioning will include the following:

- Tests to ensure that the TFGF output and efficiency meets the guaranteed values,
- Tests to ensure that the TFGF operates safely across the full load range across a range of operating parameters,

- Tests to ensure that the TFGF operates reliably throughout a pre-determined set of handling trials designed to simulate real world operation and dispatch scenarios,
- Tests to ensure that the emissions to air from the TFGF meet the guaranteed values,
- Tests to ensure that the noise emissions from the TFGF meet the guaranteed values,
- Various other tests of the TFGF equipment to confirm the functionality and safety of the plant.

4 EMISSIONS AND MONITORING

4.1 Emissions to Air

4.1.1 Emissions to air from the TFGF will result from exhaust gases generated from combustion of natural gas within the gas engines. Natural gas is considered to be a clean fuel compared to alternatives and the primary air pollutants of concern from the gas engines with the potential to impact on human health are NO_x and CO. The effects from NO_x emissions to air also need to be considered in relation to potential impacts at ecological sites including effects from deposition.

4.1.2 The 48 stacks, each housing two flues will each be 20 m in height. This stack height has been subject to a stack height assessment to ensure the selected height provides adequate dispersion and represents BAT (see Appendix E). The positions of the stacks are indicated on Plan 2 in Appendix B.

4.1.3 The combined thermal input of all 96 engines is greater than 50MW but, under aggregation rules, the site is not a Large Combustion Plant. Therefore, Medium Combustion plant controls and emission limit values apply. The emissions from each engine will comply with the ELV for NO_x of 95 mg/Nm^3[9].

4.1.4 Combustion technology will be utilised to minimise generation of pollutants, with the use of control systems in place to ensure that emissions are within the emission limits stated for the TFGF.

4.2 Emissions to Land

4.2.1 There will be no emissions to land associated with operation of the TFGF.

4.3 Emissions to Surface Waters and Sewer

4.3.1 No process waters will be generated by operation of the TFGF; hence there will be no associated process water discharge to surface water or foul sewer from the TFGF.

4.3.2 Surface water run-off from the TFGF (roofs, roads, hard standing, etc.) or from washing of equipment will be collected within a drainage system which drains to an attenuation pond and swales within the installation.

4.3.3 The attenuation pond lies at slightly lower elevation than the drainage ditch to which it will discharge, as necessary. Discharge from the attenuation pond will, therefore, be controlled by a pump located at the attenuation pond outfall (emission point W1). The swales will flow into surface water drainage ditches at emission points W2 and W3. Emission points are shown on Drawing 2

4.3.4 The existing network of land drains into which surface water run-off will be discharged ultimately flow into the river Thames.

4.4 Emissions to Groundwater

4.4.1 The TFGF will not include any point source emissions to ground or groundwater.

4.5 Fugitive Emissions to Air

4.5.1 Management systems will be in place at the TFGF to ensure that the risk from fugitive emissions to air is minimised, for example through regular inspection and maintenance of plant. Protection systems will include automatically triggered safe plant start-up and emergency shut-down in the

[9] Reference conditions for normalised concentration are 273.15K, 101.3 kPa, dry and 15% oxygen.

event of major faults in equipment. Scheduled maintenance of natural gas containment systems will be extended to incorporate the TFGF, to minimise the risk of fugitive emissions of gas to air.

4.5.2 It is anticipated that fugitive emissions of odour will not be significant for the TFGF. The site uses unodourised natural gas which means there is no potential for odour from this source.

4.6 Fugitive Emissions to Surface Water or Sewer

4.6.1 The only process waters associated with operation of the peaking plant relate to the CCCW system. The area containing the fin fan coolers and CCCW circulating pumps will be bunded so the risk of accidental discharge of process waters to controlled waters is minimised.

4.6.2 In terms of potential contamination from oils stored on site, the lubrication oil storage tanks and waste oil storage tanks will be bunded to ensure that should an accidental spillage occur, the oil remains isolated from drainage systems prior to clean up.

4.7 Noise and Vibration

4.7.1 An assessment of the noise effects from the peaking plant has been included within Appendix F and a summary of its conclusions is presented here.

4.7.2 The main sources of noise from the peaking plant would be those associated with combustion, including the gas engines, exhaust stacks and fin fan coolers. No significant vibration effects are anticipated to result from operation of the TFGF.

4.7.3 The gas engine exhaust stacks will be fitted with silencers, the engines will be installed within individual concrete enclosures. Acoustic enclosures will be provided for other mechanical equipment.

4.7.4 The results of the noise assessment carried out for the facility can be summarised as follows:

- The design of the facility will incorporate in design mitigation measures to minimise noise levels to the lowest reasonably practicable level.
- The BS 4142:2014 assessment indicates that raised sound levels may be expected during the daytime or evening and night-time periods with all engines operating at maximum load.
- However, the assessment concludes that “significant adverse impacts would not occur”, due to:
  - Low Rating Levels and resultant ambient sound levels not noticeably changing or being of a magnitude likely to increase the risk of annoyance in external amenity areas or sleep disturbance.
  - The risk of adverse impact during night-time periods being significantly reduced as, for only around 88 hours of the night-time period (23:00 to 07:00 hours) over the course of a year, would the facility be likely to be operational, i.e. 3% of the night-time period on average. Also, Rating Levels would often be lower than considered, reflecting the reduced power demand.
- On the basis that significant adverse impacts would be avoided, and adverse impacts minimised, the proposed development would comply with the ‘Noise Policy Statement for England’ (NPSE), which sets out the long-term overarching vision of Government noise policy.

4.8 Monitoring and Reporting of Emissions

Emissions to Air

4.8.1 The gas engine stacks will incorporate suitable sampling ports for monitoring of emissions which will be designed in accordance with EA Monitoring stack emissions: measurement locations guidance [10].

4.8.2 Periodic monitoring will be carried out, measuring NO_x, CO, Oxygen and water vapour. This will be undertaken in accordance with appropriate methodologies for sampling as set out in EA Guidance "*Monitoring stack emissions: techniques and standards for periodic monitoring*" (formerly Technical Guidance Note M2[11]).

4.8.3 Periodic monitoring will be carried out on a rolling programme to demonstrate compliance with emission limits. Due to the large number of gas engines, periodic monitoring of all 96 gas engines annually is impractical. It is, therefore, proposed that emissions from one third of the engines (32 engines) are monitored each year, which means that all engines will be monitored every three years in line with MCPD requirements.

4.8.4 Given the identical nature of the engines, it is proposed that emissions for the whole site may be extrapolated from the sample of engines monitored each year, allowing for differing hours of operation.

4.8.5 Records will be kept of all emissions testing results and operating hours for each engine. Monitoring of releases to air will be controlled as part of the EMS.

Emissions monitoring for releases to air will be undertaken as set out in

4.8.6 Table 4-1.

Table 4-1: Summary of Monitoring of Emissions to Air

Pollutant	Emission Point	Monitoring Method	Monitoring Frequency	MCERTS certified?
NO_x	A1-96	BS EN 14792	One third of flues annually	Yes
CO	A1-96	BS EN 15058	One third of flues annually	Yes
Oxygen	A1-96	BS EN 14789	One third of flues annually	Yes
Water vapour	A1-96	EN 50379-2	One third of flues annually	Yes

4.8.7 Monitoring results will be corrected to standard references conditions and reported to the EA, as required by the permit.

4.8.8 Emission limits to air will be regarded as having been complied with where monitoring data confirms that emission values do not exceed the limits specified in the permit, over the corresponding monitoring period at specified reference conditions.

Emissions to water and land

4.8.9 Water discharges will result from rainwater surface run-off from roofs, roads and concrete surfaces, but there will be no process water discharges associated with the TFGF. Rainwater will be collected either in the site attenuation pond or in swales on the northern and western sides of

[10] Monitoring stack emissions: measurement locations - GOV.UK (www.gov.uk)

[11] Environment Agency (2017), Technical Guidance Note (Monitoring) M2, Monitoring of stack emissions to air, version 12, August 2017

the peaking plant. Prior to the release of water from either the attenuation pond or the swales a visual assessment will be carried out to ensure no presence of an oil film.

4.8.10 There will be no discharges to land from the TFGF.

Process Monitoring

4.8.11 Key process monitoring will be carried out to monitor the plant performance including, energy consumption (natural gas and electricity), hours of operation for each engine and power generated. These performance parameters will be reported on an annual basis, in keeping with the permit.

4.8.12 The plant performance and equipment will be continuously monitored, and a system will be in place to optimise performance.

5 IMPACTS

5.1.1 To support this application a number of environmental assessments have been performed. The full details of these assessments are appended to this application and a reference to the full assessment is given where relevant below.

5.2 Emissions to Air

5.2.1 An air quality impact assessment has been undertaken to support this application and full details of the assessment are reported in Appendix E – Air Quality Impact Assessment

5.2.2 Emissions to air from the TFGF will result from exhaust gases generated from combustion of natural gas within the gas engines. As natural gas is a clean fuel, the primary air pollutants of concern from the gas engines with the potential to impact human health are NOx and CO.

5.2.3 The approach to the assessment of emissions from the exhaust stacks has involved the following key elements:

- Establishing the background Ambient Concentration (AC) from consideration of Air Quality Review & Assessment findings and assessment of existing local air quality through a review of available air quality monitoring and Defra background map data in the vicinity of the proposed site.
- Quantitative assessment of the operational effects on local air quality from the proposed stack emissions utilising a “new generation” Gaussian dispersion model, ADMS 5.
- Assessment of Process Contributions (PC) from the TFGF, and assessment of resultant Predicted Environmental Concentrations (PEC), taking into account cumulative impacts through incorporation of the AC.

5.2.4 Dispersion modelling was undertaken using ADMS 5, a version of the ADMS (Atmospheric Dispersion Modelling System) which calculates the mean concentration over flat terrain, whilst allowing for the effect of plume rise, structures, complex terrain and deposition.

5.2.5 Several meteorological parameters were required for the dispersion modelling, including wind speed, wind direction, cloud cover and temperature. Dispersion model simulations have been performed using five years of data from Gravesend, between 2013 and 2017. The Gravesend meteorological station was closed in 2018 so this is the most recent data available.

5.2.6 The effect of terrain and wake effects from surrounding structures has been incorporated into the dispersion model. Surface roughness of terrain has also been incorporated with a surface roughness length of 0.5 m assigned to represent the average surface characteristics across the study area. This surface roughness length is typical of parkland and open suburbia. This is unchanged from the original DCO assumptions.

5.2.7 Dispersion modelling has been undertaken for a worst-case scenario assuming that all the gas engines operate for 2,250 hours per year which represents the largest total number of operational hours considered as part of this assessment. It was also assumed that emissions of NO_x would be 250 mg/Nm^3 at the reference conditions of dry, 0°C, 5% O_2, which equates to the ELV of 95 mg/m^3 at the MCPD reference conditions of dry, 273.15°K, 101.3 kPa and 15% O_2. CO concentrations are based on manufacturers data which indicate a CO concentration of 390 mg/Nm^3 at MCPD reference conditions.

5.2.8 The effects of the proposed development have been assessed at the façades of local existing receptors. All human receptors have been modelled at a height of 1.5 m, representative of typical head height. The same receptors were used as in modelling the air quality assessment for the DCO application.

5.2.9 Emissions from the TFGF have been assessed against relevant Air Quality Assessment Levels (AQALs). Long-term (annual-mean) NO_2 has been modelled for comparison with the relevant annual mean objective of 40 μg/m^3. For short-term NO_2, the objective is for the hourly-mean concentration to not exceed 200 μg/m^3 more than 18 times per calendar year, equivalent to the 99.79th percentile of hourly NO_2. There is no long term Environmental Assessment Level (EAL) for CO, therefore CO concentrations have been compared with the short term 8-hour mean EAL of 10,000 μg/m^3. Note that CO also has a hourly mean EAL of 30,000 μg/m^3, however the comparison presented in the AQ assessment has used the more conservative 8-hour mean EAL.

5.2.10 Modelling has assumed a 70% conversion of NO to NO_2 for annual average NO_2 concentrations. Justification of the conversion factors is provided within the Air Quality Assessment.

Stack Height Determination

5.2.11 The stack height selected for the optimum dispersion of pollutants from the exhaust stacks is determined to be 20 m, based on the Stack Height Determination in Appendix E to the AQ Impact Assessment. This height has been identified as the height at which the wake effect of nearby structures is overcome.

Dispersion Modelling Assessment Results

5.2.12 The results show that the maximum short-term PC at the receptors considered in the assessment is 59% of the relevant EAL for NO_2. The maximum short-term PEC at receptors is 89% the EAL. However, the modelling represents a worst-case scenario of all engines operating together at maximum output for 2,250 hours per year, the maximum hours that they will operate. In reality the engines will operate for up to 1,500 hours per year as a rolling 5-year average. Furthermore, the emissions have been modelled at the MCPD emission limit. Actual emissions are expected to be below the ELV. As such, the short-term NO_2 impacts, based on modelling across the grid, are not considered to be significant.

5.2.13 The predicted long-term PC exceed 1% of the EAL at certain receptors. However, the maximum long-term PEC are below the EAL at every location.

5.2.14 On this basis, the impact of NOx emissions to air can be screened out as insignificant.

5.2.15 The predicted PCs for CO exceed 10% of the EAL at some locations but when the PC is added to the background concentration the PEC for CO does not exceed 100% of the EAL and the impact of CO emissions can be screened out as not significant at all receptors.

5.3 Assessment of Impacts at Ecological Receptors

5.3.1 An assessment of air quality impacts for nearby ecological receptors has been made and can be found within the Air Quality Assessment within Appendix E.

5.3.2 In line with EA guidance for air impact screening for conservation areas[12], the assessment has considered the impacts from the installation in terms of NO_x concentrations, nutrient nitrogen deposition and acid deposition for the ecological sites identified within the EA habitats screening as listed in Table 1-1.

5.3.3 The assessment has determined the Critical Loads for both Nutrient Nitrogen Deposition and Acidification and compared these to the PC resulting from the operation of the installation following

[12] Environment Agency (2016), Screening for protected conservation areas. Available at: https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit#screening-for-protected-conservation-areas

variation. Critical Loads are the quantity of pollutant deposited below which significant harmful effects on sensitive elements of the environment do not occur.

5.3.4 For NO_x at ecological receptors, the impacts were screened out as insignificant.

5.3.5 The assessment has concluded that, using professional judgement, the resulting air quality effects on human and ecological receptors are considered to be 'not significant' overall.

5.4 Emissions to Water and Sewer

5.4.1 No process waters will be generated from the operation of the gas engines; hence there will be no process water discharge to surface water or foul sewer from the plant.

5.4.2 Surface water drainage, including surface water run-off from the plant (roofs, roads, hard standing, etc.), will flow into the surface water drainage system. This drainage system incorporates oil separation and retention facilities. The drainage system discharges into an attenuation pond which is isolated by a penstock valve to prevent uncontrolled discharge.

5.4.3 In the event that water needs to be discharged from the attenuation pond to local surface water drainage channels, which ultimately discharge into the Thames, a visual assessment of the attenuation pond water to check for evidence of oil or grease and tests for the presence of glycol will be undertaken prior to discharge.

5.4.4 The discharge point is referenced as point W1 on the site plan.

5.5 Noise

5.5.1 A Noise Impact Assessment (NIA) has been carried out and is included with this application as Appendix F – Noise Impact Assessment.

5.5.2 The main sources of noise from the generating station would be those associated with combustion, including the gas engines, exhaust stacks and fin fan coolers. Since natural gas will be delivered through pipelines, vehicle movements to the facility will be infrequent, hence noise from these sources will be insignificant.

5.5.3 Noise emissions from the facility will be controlled through the application of noise control methods/techniques, including housing the gensets in concrete enclosures, attenuation of the genset air inlets and outlets, and silencers fitted to the genset exhausts.

5.5.4 The gas engine exhaust stacks will be fitted with silencers, the engines will be installed within concrete containers, and noise from the fin fan coolers will be controlled by design. The assessment considers the facility to have applied all appropriate preventative measures to minimise noise pollution, in particular with the application of 'best available techniques' (BAT), in accordance with the Environmental Permitting Regulations.

5.5.5 The noise assessment supporting this application has been carried out on a conservative basis to represent worst case conditions. It concludes that significant adverse impacts would not occur.

6 BAT ASSESSMENT

6.1.1 The following section provides supporting information for the selection of the following:

- Combustion technique and operating hours (this includes consideration of NOx performance, ammonia and global warming potential (GWP)).
- Stack configuration.
- Control of emissions to air (not included in the assessment of combustion technology above).
- Cooling system.

6.1.2 The proposed engines are medium combustion plant for which there is currently no defined BAT requirements. Therefore, in reviewing BAT for the proposed new engines consideration has been given to Best Available Techniques for combustion plant operating in the balancing market - Final report. Reference number 37641C001Ri4 (June 2016) (the DECC BAT Report) as well as emissions performance established by the MCPD. The pre-application advice note included as Appendix H identifies matters to be considered within the BAT assessment and these issues are all covered under the various headings below. Although not directly applicable to the TFGF, where relevant reference to the LCP BAT Reference (BRef) Document and associate BAT Conclusions[13] is made.

6.1.3 The DECC BAT Report is appended as Appendix I to this document.

6.2 Selection of Combustion Technique and Operating Hours

6.2.1 The proposed engines are being installed to provide fast responding peaking plant to generate electricity for export to the grid. Available technologies considered within this section are gas turbines and gas engines. An alternative option is use of diesel compression ignition engines however, implementation of this combustion method would result in a wider range of pollutants generated from combustion, including SO_2 and particulates and greater emissions of NOx. Furthermore, there would be additional requirements for diesel storage (and associated increased potential for accidents), as well as a greater number of vehicle movements on site for fuel delivery. For these reasons, implementation of diesel compression ignition engines has been ruled out from further consideration. Selection of the fuel to be burned and the selection of natural gas over other fuels for power generation have previously been discussed in section 2.

6.2.2 The primary BAT issues associated with combustion plant, specifically peaking plant, are ability to meet demand for electricity, control of emissions to air and energy efficiency. Consideration of emissions to air is detailed in the next section.

6.2.3 Fundamentally, the operating nature of peaking plant requires rapid response times and therefore short start up times. Combined cycle gas turbines have significantly longer start-up times compared to gas engines and consequently cannot provide the rapid response that gas engines offer. The use of open cycle gas turbines does not support the highest levels of efficiency, with efficiencies significantly lower than those of modern gas engines as well as having longer start-up times. Consequently, the preferred technology to provide peaking plant duty is spark ignition reciprocating gas engines.

6.2.4 The TFGF has been designed to provide a rapid and flexible response to demands on the national grid. Therefore, a larger number of smaller engines has been selected to meet that flexibility of demand and response time. Furthermore, the DECC BAT Report identifies a negative correlation between start-up time and the environmental performance of the plant. Therefore, plant with a

[13] LCP Bref BAT Conclusions - Implementing decision - 2021/2326 - EN - EUR-Lex (europa.eu)

rapid start-up and shut-down time helps to further minimise emissions from a facility that is designed to accommodate frequent short run times in response to demand on the Grid.

6.2.5 The proposed gas engines have an efficiency of circa 45.4% measured on an LHV basis. The LCP BAT Conclusions[14] , indicates that for new gas engines an electrical efficiency of 39.5% to 44% is BAT. The efficiency of the proposed engines to be installed is above the upper end of the BAT range. Gas engine technology does not require supplementary process water for operation.

6.2.6 Overall, the use of gas engines is considered to be BAT when considered for use at the proposed peaking plant. Whilst it is recognised that other modes of operation with alternative technologies can provide energy efficiency benefits, these alternatives cannot provide the necessary flexibility required for a peaking plant, where rapid start up times are necessary to ensure security of energy supply. The units proposed exceed BAT levels for energy efficiency benchmarks for this type of technology.

6.3 Control of Emissions to Air

Emissions of Nitrogen Oxides

6.3.1 Various methods are available for controlling emissions to air from the proposed new gas engines, both primary measures which focus on controlling the process to avoid emissions resulting from the combustion process and secondary measures, which are end-of-pipe measures to abate emissions prior to release to air.

6.3.2 Table 6-1 summarises to options for controlling emissions of NO_x from new balancing gas engines, as set out in the DECC BAT Report. The proposed engines will incorporate an enhanced lean burn system that uses a special combustion chamber configuration for more efficient combustion and directly links power output, boost pressure, fuel temperature and corrects engine parameters to ensure the engine permanently meets the required nitrogen oxide emission level.

6.3.3 This type of enhanced lean burn technology is considered to be BAT for spark ignition gas-fired reciprocating engines, according to the DECC BAT Report.

6.3.4 Application of BAT for this type of engine is expected to result in emissions of NO_x in waste gases at <95 mg/m^3 (at 15% oxygen), i.e., within the MCPD emission limit for this type of engine.

6.3.5 SCR also has the potential to mitigate NOx emissions. The operation of SCR requires the use of a catalyst (which requires periodic replacement) and reduces the energy efficiency of the plant as a whole. In particular, the use of a catalyst in SCR systems requires operation across an optimum temperature window. The DECC BAT Report concludes that SCR is not BAT for the engines to be used at TFGF on the basis of economic and technical feasibility.

6.3.6 The air quality assessment has concluded that emissions to air from the proposed facility are not significant both in terms of effects on human health and on ecological receptors. This was based on worst case emissions at the ELV of 95 mg/m^3 (at 15% oxygen) over 2,250 hours per year at maximum load.

6.3.7 Given there are no significant air quality effects associated with the proposed peaking plant using lean burn technology, BAT for NO_x control for the peaking plant is, therefore, considered achieved through the incorporation of lean burn techniques to avoid NOx generation. Further, operation to the MCPD emission limit is also considered BAT, this is consistent with BAT guidance for combustion plant operating in the balancing market which concludes that for plant operating 500-

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1,500 hours[15] per annum nothing more stringent that the ELVs under IED and MCPD will apply (MCPD limits apply to the TFGF).

Table 6-1: Examples of best available techniques for NO_x control from new balancing gas engines

Technique	BAT
Unabated	Not recommended
Lean Burn	Potential option under certain hours of operation
Enhanced Lean Burn	BAT option

Emissions of Carbon Monoxide.

6.3.8 LCP BAT Conclusion number 44 states that BAT for controlling CO emissions is to ensure optimised combustion and/or to use oxidation catalysts. Control and management of combustion conditions within the proposed gas engines, including performance monitoring, process control techniques and suitable maintenance regimes, will be in place to minimise CO emissions.

Other Emissions to Air

6.3.9 The LCP BREF acknowledges that emission of dust and SO_2 associated with combustion plant burning natural gas are very low without the need for plant level controls to be applied. On this basis further consideration of abatement/controls for these pollutants is not considered necessary.

Dispersion of Emissions

6.3.10 The proposed stack height of 20 m above ground level has been subject to a stack height assessment and dispersion modelling to demonstrate that emissions will be adequately dispersed such that the effect on human health and sensitive ecological receptors will not be significant has been carried out.

6.3.11 A total of 48 stacks is proposed, each housing two flues. All stacks and flues will discharge vertically upwards with no obstruction to the flow of emitted waste gases.

6.3.12 The stacks are, therefore, considered to meet BAT.

6.3.13 An Air Quality Impact Assessment is included as Appendix E to this document.

Emission Monitoring

6.3.14 Monitoring of emissions is proposed on a rolling annual basis to demonstrate compliance with the emission limit value (ELV) for Oxides of Nitrogen (NO_x) of 95 mg/m^3 as set out in Annex 2 of the Medium Combustion Plant Directive. Further detail is provided in Section 4.8.

6.3.15 Annual monitoring is also proposed on the same basis for emissions of carbon monoxide (CO), plus water vapour and oxygen content for reference purposes. Given that the engines and flues are identical, the proposed monitoring frequency of one third of flues each year complies with the requirements of the MCPD and monitoring methods are aligned with those set out in EA monitoring guidance[16]. On this basis the proposed monitoring is considered to meet BAT.

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[15] Note in this respect reference to 1,500 hours per annum relates to a 5 yearly rolling average with no more than 2,250 hours in any one year.

[16] Monitoring stack emissions: techniques and standards for periodic monitoring (Monitoring stack emissions: techniques and standards for periodic monitoring - GOV.UK (www.gov.uk))

6.4 Noise Emissions

6.4.1 Noise and vibration issues are common with the operation of combustion plant but with effective mitigation measures these noise effects can be controlled. For the proposed engines the noise assessment has predicted that with appropriate mitigation no significant effects will occur. A noise management plan has been produced which sets out how the facility will manage noise from operation of the TFGF throughout the operational life of the facility.

6.4.2 Noise controls will meet the requirements of BAT 17 of the LCP Bref, including:

- Housing engines within concrete enclosures.
- Installing silencers in flues.
- Operating a schedule of routine maintenance and inspection of all plant.

6.4.3 The noise assessment concludes that the techniques applied for noise control minimise noise emissions as far as reasonably practicable and in this regards the TFGF has applied all appropriate preventative measures to minimise noise pollution, in particular with the application of 'best available techniques' (BAT),

6.5 Energy and Resource Efficiency

6.5.1 Gas turbines have previously been discounted as BAT for this facility. In terms of thermal efficiency, the next most efficient technology, according to the DECC BAT Report, is Enhanced Lean Burn gas reciprocating engines. As noted in Section 6.2 the efficiency of the proposed engines is above the higher end of the BAT efficiency range for gas engines as set out in the LCP BAT conclusions.

6.5.2 As discussed in Section 6.2, the selected engines require no water supply and will produce no process water to be disposed of.

6.5.3 Having a dedicated mains gas supply to the site means that fuel will not be delivered by road, thus further reducing the overall environmental impact of the facility.

6.5.4 The engines and auxiliary plant will be subject to a schedule of routine checks, inspections and maintenance to ensure that the facility operates efficiently.

6.6 Meeting Future Energy Demands

6.6.1 The target for net zero UK carbon emissions by 2050 has now been set. To achieve this ambitious target alternatives to natural gas for energy generation are high on the agenda, with hydrogen and green ammonia very much under consideration.

6.6.2 Once fully commercially available, hydrogen is well suited to combustion within the proposed engines. Although current proposals are based on burning natural gas, once hydrogen fuel becomes available, the selected engines could readily switch to burning these alternative fuels subject to certain retrofit modifications.

6.7 Selection of Cooling System

6.7.1 A number of types of cooling system could be employed for this type of facility which include the following air or water-cooled methods:

- Once-through river water,
- Evaporative cooling tower,
- Hybrid cooling tower;

- Fin-fan coolers.

6.7.2 As highlighted within the EU BREF for industrial cooling systems[17], there is a balance of environmental considerations when considering the cooling option to be employed and that any of the methods below may be considered BAT, depending on circumstance. All of the above options have their relative advantages and disadvantages for their operation as detailed within Table 6-2.

Table 6-2 - Comparison of cooling systems

Cooling System	Advantages	Disadvantages
Once through cooling	Lower energy consumption Low noise impact Low visual impact	Possible fish kill Possible thermal release effect in water course Biofouling Biocide discharges
Evaporative cooling tower	Lower Energy Consumption	High visual impact Water consumption Chemical treatments for biohazard control and scale/corrosion control
Hybrid Cooling	Lower water use than conventional wet cooling systems Can achieve no visible plume	Possible noise impacts Higher energy consumption than conventional wet cooling systems
Fin-fan coolers	No aqueous discharge Lower visual impact No water consumption	Possible noise impacts Higher energy consumption

6.7.3 The TFGF is located close to the River Thames, which could potentially provide a source of water for water cooling systems. This would require a new water abstraction licence. In addition, as the gas engines would not operate continuously, settlement and siltation within a once through cooling system could cause operational problems, leading to blockages in the condenser/heat exchanger. This would result in increased maintenance costs and reduced cooling efficiency and could potentially affect reliability of the system. Furthermore, pumping water over a kilometre from the river would entail an energy cost and impact on energy efficiency of this option.

6.7.4 A further result of the hours of operation could be problems surrounding biological control (for example for legionella) and issues of fouling, which would result in additional costs and issues for maintenance.

6.7.5 A new evaporative cooling tower system would experience similar problems, with biological control issues and corrosion or scale formation becoming a risk as a result of the plants operating hours. These issues would likewise result in higher maintenance costs. In addition, the control regime may require re-circulation at times when the plant is not operating. This would result in an energy penalty.

6.7.6 Evaporative cooling can have good energy performance, and those without mechanical draught systems have lower noise effects. However, water usage, chemical dosing and discharges are the highest of the cooling options available.

6.7.7 Hybrid systems are available and while they have lower energy consumption than a fin-fan cooling option, they do not achieve the significant energy efficiency benefits that once-through cooling offers. Noise effects from hybrid systems are similar to fin-fan coolers but they introduce additional environmental effects associated with water consumption, use of treatment chemicals and from associated aqueous discharges.

[17] https://eippcb.jrc.ec.europa.eu/sites/default/files/2019-11/cvs_bref_1201.pdf

6.7.8 As a result of the above considerations, it has been concluded that water cooling systems would not be technically feasible or practicable at the Thurrock TFGF and these methods have been discounted from further evaluation.

6.7.9 Fin-fan coolers have no significant water consumption. Hence, they are suited to the site location and operational profile and will not result in additional effluent discharges. Furthermore, they have a lower visual impact when compared with evaporative techniques together with lower associated storage requirements.

6.7.10 Whilst fin fan coolers can give rise to greater noise impacts, the noise assessment carried out has concluded that the noise effects from the site will not result in significant noise impacts to health or amenity, with appropriate mitigation methods in place.

6.7.11 It is recognised that the fin-fan cooler option has a higher energy demand than other cooling options. However, the energy consumption by the fin-fan coolers will not have a material impact on the overall energy efficiency for the project.

6.7.12 On the basis of the above, fin-fan coolers within a CCCW system are considered BAT for providing cooling to the gas engines at this site.

REFERENCES

1. Medium Combustion Plant Directive (MCPD): Directive - 2015/2193 - EN - EUR-Lex (europa.eu)
2. MCPD Implementing decision - 2021/2326 - EN - EUR-Lex (europa.eu)
3. SI 2001/2954. The Control of Pollution (Oil Storage) (England) Regulations 2001
4. Environment Agency (2017), Technical Guidance Note (Monitoring) M1, Sampling requirements for stack emission monitoring, version 8, August 2017
5. CHP Ready Guidance for Combustion and Energy from Waste Power Plants
6. Directive (EU) 2023/1791 of the European Parliament and of the Council of 13 September 2023 on energy efficiency
7. Environment Agency (2017), Technical Guidance Note (Monitoring) M2, Monitoring of stack emissions to air, version 12, August 2017
8. Monitoring stack emissions: measurement locations - GOV.UK (www.gov.uk)
9. MCPD Annex 2 https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32015L2193#d1e32-15-1
10. Environment Agency (2016), Screening for protected conservation areas. Available at: https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit#screening-for-protected-conservation-areas
11. Commission Implementing Decision (EU) 2021/2326 of 30 November 2021 establishing beat available techniques (BAT) conclusions, under Directive 2010/75/EU of the European Parliament and of the Council for large combustion plants. (Publications Office (europa.eu))
12. EU BREF for Industrial Cooling Systems https://eippcb.jrc.ec.europa.eu/sites/default/files/2019-11/cvs_bref_1201.pdf

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APPLICATION FORMS

Appendix B
PLANS

Appendix C
ENVIRONMENTAL RISK ASSESSMENT

Appendix D
SITE CONDITION REPORT

Appendix E
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Appendix F

NOISE IMPACT ASSESSMENT AND NOISE MANAGEMENT PLAN

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Appendix J
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APPLICATION FOR AN ENVIRONMENTAL PERMIT - THURROCK FLEXIBLE GENERATING FACILITY

Supporting Information

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