Environmental Permit Application

Best Available Techniques and Operating Techniques LON1, Feltham

SF LHR Limited

Unit 4, Westgate Industrial Estate, Staines Rd, Feltham, TW14 8RS

Prepared by:

SLR Consulting Limited

Floor 3, 86 Princess Street, Manchester, M1 6NG

SLR Project No.: 410.064891.00001

Client Reference No: 64891

25 April 2024

Revision: FINAL

Making Sustainability Happen

Revision Record

Revision	Date	Prepared By	Checked By	Authorised By
DRAFT	7 March 2024	S Abram	P Wright	P Wright
FINAL	25 April 2024	S Abram		S Abram
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Basis of Report

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1.0 Introduction

SLR Consulting Ltd (SLR) has been instructed by SF LHR Limited (the Client) to prepare a bespoke environmental permit (EP) application for the client owned and operated data centre facility (LON1) located on Staines Road, Feltham, UK, TW14 8RS.

Electricity for operation of the data centre is provided from connections to the local electricity transmission network; however, given the nature of data centres and their requirement to have an available energy supply at all times, the data centre also incorporates a number of diesel-fired standby generators (SBGs).

The EP will incorporate a total of 11 SBGs. The SBGs will provide power to the data centre in the event of an emergency situation such as a brown-out or black-out of the local electricity transmission network where there are fluctuations or loss of the electrical power provided by the network. On occurrence of such an event, there is the potential for a delay between fault detection and initial operation of the SBGs; on-site battery arrays will provide a temporary uninterruptible power supply in order to cover such delays and the potential for a loss/reduction in the power supply to on-site equipment.

The SBGs, in accordance with the manufacturer requirements, will be subject to planned maintenance and testing. There are currently no agreements in place for the elective generation of electricity for commercial export to the electricity grid and the SBGs do not operate in Triad avoidance.

The aggregated total combustion capacity for the site will be 64.46 MWth based on the following:

- 5 x Caterpillar 3516b SBGs (existing SBGs, installed before 20th December 2018), each with a rated thermal input of 5.26MWth; and
- 6 x Kohler KD3500-E SBGs (proposed new SBGs), each with a thermal rated input of 6.36MWth.

The SBGs will be fuelled with diesel, however hydrogenated vegetable oil (HVO) may be used as an alternative fuel for the 6 proposed SBGs. For the purpose of this EP application, the air emissions risk assessment has been based on the use of diesel fuel.

The 6 new SBGs will have selective catalytic reduction (SCR) abatement to reduce emissions of oxides of nitrogen (NO_x) to air.

This Best Available Techniques and Operating Techniques document (BATOT) is submitted on behalf of the Client, to support the EP application for the data centre. This report is an integrated document which describes both the operating techniques that are implemented at the site with respect to operation of the diesel SBGs to ensure compliance with guidelines and demonstrates that BAT will be employed.

For the purpose of this BATOT, key technical standards in the following documents have been referenced:

- Develop a management system: environmental permits guidance, 03 April 2023;
- Risk assessments for your environmental permit guidance, 31 August 2022;
- Emergency backup diesel engines on installations: best available techniques (BAT), 23 August 2023;
- Best Available Techniques: environmental permits, February 2016;
- Data Centre FAQ, Draft Version 21.0 to TechUK for Discussion 15/11/22; and
- Specified generator: comply with permit conditions, 28 December 2022.

2.0 Pre-Application Advice

Enhanced pre-application advice was sought from the EA; this was via a call (Microsoft Teams) on 9th November 2023. During the meeting the EA confirmed the following:

- That a bespoke EP application for a Section 1.1 Part A(1)(a) burning any fuel in an appliance with a thermal rated input of 50 megawatts or more is required.
- Directly associated activities are limited to the storage of raw materials and surface water drainage.
- The application fee (£19,882) and the supporting documents required for the EP application.
- Confirmation of the standards and guidance relevant to the EP application for the data centre.

The EA also provided a Habitats Screening Report and the Data Centre FAQ TechUK v11 110520 BAT guidance document.

A copy of the EA enhanced pre-application advice letter (reference EPR/GP3928SW/P001) is presented in Appendix A.

3.0 Regulated Activities

The data centre will comprise in total a rated thermal input of 64.47 MWth. Testing of the SBGs (either routinely or following maintenance) will be undertaken at up to 100% of full load.

This EP application (including the associated modelling studies and risk assessments) has been prepared on the basis of 11 SBGs:

- 5 x Caterpillar 3516b SBGs (existing SBGs), each with a rated thermal input of 5.26MWth; and
- 6 x Kohler KD3500-E SBGs (new SBGs), each with a thermal rated input of 6.36MWth.

3.1 Schedule 1 Activities

Combustion activities that require an EP are defined in Part 2, Schedule 1 of the EPR:

- Section 1.1 Part A(1)(a) burning any fuel in an appliance with a rated thermal input of 50 or more megawatts.

The EPR clarify that:

"…where two or more appliances with an aggregated rated thermal input of 50 or more megawatts are operated on the same site by the same operator, those appliances must be treated as a single appliance with a rated thermal input of 50 or more megawatts."

The SBG provision includes for a level of redundancy to the SBG system such that, even in a worst-case blackout scenario, only the required number of SBGs would start up to deliver the required electrical IT load for the data centre; the number of operational SBGs at the time of a blackout would be dependent on the extent of the blackout. However, it is noted that, without specific physical controls preventing operation of an SBG, the thermal input of all SBGs is required for determining the capacity of the site. Therefore, the capacity of the data centre in total will be 64.47MWth based on:

- 26.3 MWth (5 x Caterpillar generators at 5.26MWth each); and
- 38.16 MWth (6 x Kohler at 6.36MWth).

3.2 Stationary Technical Unit (STU)

The definition of a STU is not included in the EP Regulations. However, the EA *'RGN 2 Understanding the meaning of regulated facility'* (May 2019) states:

"The essence of a "technical unit" is that it can carry out the Activity, or Activities, on its own. This means that the technical unit must include enough plant and machinery to allow the Activity to take place in a controlled manner for a sufficient period of time for the operation to reach it designed or intended output."

Each SBG could be considered as an STU (for the purposes of combusting fuel) however, in accordance with A2.5 of RGN 2:

"If there are two or more STUs on the same site they will be treated as a single STU if they are technically connected and one of the following criteria is met:

a) they carry out successive steps in an integrated industrial activity;
b) one of the listed activities is a Directly Associated Activity (DAA) of the other; or
c) both units are served by the same DAA.

In the event of a worst-case blackout scenario of the local transmission system, potentially all the SBGs in the data centre will be operated to deliver the required IT load. In the event of operational redundancy in case of engine failures or SBGs under maintenance, the remaining SBGs will be operated to the required load, but this can only be identified at that time. Therefore, the operation (under emergency) of individual SBGs is linked to the 'availability' of other SBGs, and all SBGs in the data centre are thus considered to be technically connected.

Fuel storage for the SBGs, and the SCR abatement systems are considered to be DDAs. In addition, surface water drainage from the service yard area where the SBGs and fuel storage are located is also considered as a DAA.

Discussion of the DAAs at the site are provided in section 3.3.

3.3 Directly Associated Activities

Schedule 1, Part 1 Regulation 2(1) of the EP Regulations provides that a DAA is an operation that, in relation to any other activity:

- has a technical connection with the activity;
- is carried out on the same site as the activity; and
- could have an effect on pollution.

As stated in A2.19 of RGN 2, a DAA must "serve" a STU. Therefore, a DAA will normally be something that would not be in place if the STU was not present on-site. A2.22 continues that there are four types of technical connection with a STU including *"…input activities concerned with the storage and treatment of inputs into the stationary technical unit."*

A2.11 of RGN-2 states:

"Storage facilities may be technically connected. […] Stores at the same location are normally technically connected, and as their operation can give rise to pollution, either locally or at the Activity, they are likely to be DAAs."

In addition to the above, it must also be clear how a DAA may affect emissions from the data centre. Incorrect storage of a raw material/fuel, or the discharge of contaminated surface water could cause off-site releases of these substances.

Therefore, the SCR abatement systems, the storage of fuel oil and AdBlue (for the SCR abatement systems) and surface water drainage from the permitted Installation area are considered to be DAAs of the ‘combustion’ STU for the data centre.

4.0 Data Centre Location

The data centre is located to the west of Feltham town centre on Staines Road (A30), Feltham, UK, TW14 8RS, at approximate national grid reference (NGR) TQ 07523 73102. Access to the data centre is off Staines Road.

The surrounding area to the data centre is predominantly open land and industrial and commercial properties in all directions of the site.

Table 3-1: Surrounding Land Uses

Boundary	Description
North	Agricultural fields and industrial developments including an inert landfill (Homers Farm) containing a reservoir.
East	Industrial and commercial properties, open land with residential properties lying beyond.
South	Industrial and commercial property, Bedfont Lakes Country Park and open land.
West	Residential and mixed commercial and industrial properties with reservoirs and open land lying beyond.

Residential properties lie to the east and west of the site boundary, with the nearest residential property being located approximately 190m west of the site. The nearest industrial and commercial properties are Mapcargo International, located adjacent (northeast) to the site boundary and Phoenix Air Cargo located adjacent to the east.

The nearest surface water feature is a series of lakes approximately 175m south of the site, and Bedfont Lakes Country Park is located approximately 450m southeast. The closest area of woodland is located approximately 188m east and Noah’s Ark/ Masjid Nuh/ ASCC Mosque is situated approximately 233m northwest of the site.

Regarding European/International Sites, there are nine Special Protection Areas (which are also RAMSAR sites) within a 10km radius of the site. The closest is Southwest London Waterbodies located approximately 1,510m west of the site boundary. In addition, there is one Special Area of Conservation within a 10km radius of the site boundary: Windsor Forest & Great Park situated circa 9,000m to the west of the site.

There are national sites of ecological importance located within 2km of the site boundary, specifically Bedfont Lakes Country Park (Local Nature Reserve) which is located approximately 450m southeast and Staines Moor (Sites of Special Scientific Interest (SSSI)) located approximately 1500m west.

With respect to cultural heritage, there are several Grade II listed buildings within a 2km radius of the site, to the northeast, southwest and northwest, with “The Farm (Mr Bennett)” being the closest at approximately 720m northeast. The closest Grade II* listed building is Lord Knyvett’s Adult Education Centre which is located approximately 1,900m northwest of the site.

Three scheduled monuments are also located within 2km and are as follows:

- Romano-British site 910m west of East Bedfont parish church (approximately 557m north);
- Part of a causewayed enclosure, 632m north-east of Mayfield Farm (approximately 618m northeast); and

- Schoolhouse, Lord Knyvett's (approximately 1,845m northwest)

The following drawings accompany this EP application for the site:

- Drawing 001 – Site Location
- Drawing 002 – Site Layout and Emission Points; and
- Drawings 003A and B – Site Setting.

5.0 Feltham Data Centre

The data centre site consists of 1 data centre building. Currently there are a total of 5 existing SBGs (Caterpillar 3516b SBGs) located externally to the building; The Client plans to install an additional 6 SBGs (Kohler KD3500-E SBGs), also to be located externally to the data centre building. The thermal rated input (MWth) of the SBGs is summarised in Table 5-1.

Table 5-1: Generating Capacity of the SBGs

SBG Reference	SBG Model	Existing (operational prior to 20 December 2018) or New (operational after 20 December 2018)) SBG	Thermal Rated Input (MWth)	Total Thermal Rated Input (MWth)
1,2,3,4,5	Caterpillar 3516b	Existing	5.26	26.3
6,7,8,9,10,11	Kohler KD3500-E	New	6.36	38.16
Total				64.46

5.1 Staffing

The data centre operates 24 hours 365 days a year. The data centre will have the following employees (these figures are approximate):

- 9 site-based staff; and
- Minimum of 1 staff member on site at any one time.

5.2 SBG Selection and Resilience Configuration

The data centre comprises a number of customer suites. The data centre has been designed to ensure the maximum number of SBGs per data centre suite are installed to service potential clients and to ensure resilience.

For the proposed installation of the Kohler SBGs at the data centre, a smaller number of slightly larger SBGs will be installed. The SBGs have been selected based on the customer demand electrical load for each customer suite. This incremental approach ensures that:

- The SBGs are operated at their optimal design capacity, as operating diesel SBG sets at low loads (i.e. underloading) for extended periods of time can potentially impact uptime and engine life; and
- That only the necessary minimum number of SBGs will be operated to deliver the required electrical load for each suite, this allows for the required number of SBGs to be run dependant on the failure/emergency scenario. In the event of a reduction in electrical power delivered from the National Grid, only the minimum number of SBGs would automatically start up that are necessary to service the customer suites.

This approach will result in the reduced consumption of diesel fuel and hence generation of less emissions to air from the SBGs.

As part of the annual maintenance programme, testing of the SBGs throughout the year for short periods of time is required. To minimise the mass emission rate to air of combustion emissions and potential adverse impacts on air quality, one SBG at a time is tested. Additionally, each of the proposed 6 Kohler SBGs will have SCR abatement to reduce NO_X emissions generated as a result of the combustion of fuel.

The existing Caterpillar models are the 3516b engines. The manufacturer specification states these engines are optimised for reduced emissions and fuel use. Based on standby power rating the NO_x emissions (nominal emissions) are 1,813mg/Nm_3 (@ 5% oxygen). As stated in the Data centre FAQ, there is no minimum appropriate for existing SBGs, however the Caterpillar generators accord with the 2g-TA LUFT emissions standard of 2,000mg/m^3 (@5% oxygen) (refer to the SBG manufacturer specification provided in Appendix B for details on emissions).

The proposed Kohler models will be KD3500-E engines. The manufacturer specification states these engines are emissions optimised EPA Tier 2 compliant. As stated in the Data centre FAQ, Tier II USEPA is the minimum appropriate for new SBGs.

The Data Centre FAQ also requires NO_X emissions for new SBGs to not exceed 2,000mg/m^3. The 6 proposed SGBs, even though Tier II USEPA compliant, do exceed this emission threshold when operating at loads of approximately 100% (3,174mg/Nm^3 @5% oxygen) but less than 2,000mg/m^3 at 75% (1,920mg/Nm^3) (refer to the SBG manufacturer specifications provided in Appendix B for details on emissions). To ensure that the 2,000mg/m^3 emission threshold is not exceeded, SCR abatement will be installed on each of the 6 new SBGs, which will reduce NO_x emissions to less than 2,000mg/m^3. The SGBs are therefore considered to be compliant with BAT.

The resilience configuration of the SBGs providing for the electrical load demand of a site (i.e. the data centre building and installed IT equipment) is referred to using ‘n’, where ‘n’ is the specified MWe rate delivered by a SBG unit. The EA Data Centre FAQ states that 2n is the exemplar (i.e. twice as many SBGs as required are installed). The resilience arrangement at the Feltham data centre is summarised below:

- The 5 existing Caterpillar SBGs which serve data centre data halls A, B, C, D and E, have an n+1 arrangement (3 x SBGs in 3-to-make-2 distributed redundant supply to existing UPS / critical loads (n+1 arrangement), and 2 x SBGs supply to the mechanical loads (n+1 arrangement)).
- The 6 proposed Kohler SBGs for data centre data halls F, G and H will have an n+2 arrangement, configured as a block redundant system.

The n+1 configuration (i.e. an additional SBG added to support a single SBG failure or required maintenance) and n+2 configuration (i.e. an additional 2 SBGs added to support a SBG failure or required maintenance) allows for a level of redundancy to the SBG system such that, even in a worse case blackout scenario, only the required number of SBGs needed to meet the electrical load demand would be run; the operational capacity of the SBGs at the time of a blackout would be dependent on the extent of blackout. Furthermore, in the event of failure of an SBG, the correct number of remaining SBGs will in an emergency event provide the required load. The n+1 and n+2 configurations offer resilience and minimises the risk of disruption in service to the data centre’s clients.

The existing and the proposed SBGs will in an emergency outage situation be automated via the data centre’s automatic PLC control signals which are monitored by the building management system (BMS). In the event of a reduction in electrical power delivered from the National Grid, the BMS phase failure relay automatically starts-up the required number of SBGs necessary to service the data halls; this configuration allows for the required number of SBGs to be run dependant on the failure scenario. This results in the reduced consumption of diesel fuel and hence generation of less emissions to air from the SBGs.

5.3 SCR Abatement

Each of the proposed 6 Kohler SBGs will be supplied with SCR abatement to reduce NO_X emissions generated as a result of the combustion of fuel; the SCR abatement will be designed to reduce NO_X emissions to meet the Medium Combustion Plant Directive (MCPD) emission limit of 190 mg/Nm^3 (@ 5% oxygen).

The SCR abatement system will be located on top of each of the proposed SBGs within the container unit. Each SCR system will have an AdBlue (35% urea in water solution) tank; this tank will be a separate compartment of the diesel storage belly tank; this compartment will provide storage for 2,500l of AdBlue.

Each SCR reactor will use AdBlue to reduce NO_x emissions in the SBG combustion emissions. Each reactor will have an upfront AdBlue mixer pipe which houses the AdBlue injectors used to inject/atomize the AdBlue into an ammonia gas before entering the SCR reactor. The dosing system, which will be fully automated, will be capable of dosing up to 60 l/h.

The SCR systems will be powered by the same diesel fired engine (Kohler KD3500-E) that will be installed within the SBG container unit.

5.3.1 Ammonia Slip

The Ammonia Slip Catalysts (ASC) on each SCR abatement system will be located downstream of the SCR catalyst. The catalyst prevents any ammonia gas from exiting the tailpipe should there be any excess ammonia gas present that is not used in the catalytic reaction across the SCR catalysts to reduce NO_X. The supplier has guaranteed that there will be no ammonia slip. Refer to documentation presented in Appendix C

5.4 Reliability Data

The magnitude of risk posed by operation of the SBGs (other than for SBG testing) is strongly linked to the reliability of the provision of electricity from the local transmission network.

The data centre is designed to provide the maximum reliability of the electrical power supply to the on-site systems that are critical for operation of the site as a data centre. The data centre is designed to Uptime Institute Tier III standard, ensuring the required level of resilience to ensure maximum uptime for critical IT infrastructure.

The electricity supply arrangements include:

- Two 11kV supplies to the on-site DC sub-station; either of these feeds can serve the ‘customer load’. On completion of the planned upgrade works, the two 11kV feeds will be replaced with one 22kV utility supply.

Currently, the two 11kV supplies are from SSEN sub-station STANWELL 33/11, transitioning to one 22kV supply from SSEN sub-station East Bedfont 132/22kV. There have been no black or brown outages at the Feltham data centre in the previous two years.

The UPSs are arrays of batteries that can provide power, almost instantaneously, in the event of a loss of electrical input to them. The data centre has battery arrays which provide sufficient protection to the supply of electrical power to the ‘customer load’ whilst the SBG(s) are started. These arrays provide almost instantaneous power in the event of a loss of electrical input to them, providing sufficient protection to the supply of electrical power to the ‘customer load’ whilst the SBGs are started.

The site operates its electrical supplies on an automatic basis such that in the event of fluctuations in (or loss of) the electrical supply to the site, where such events could negatively impact operation of the site's data centre function, these are detected and the relevant response (e.g. UPS start-up followed by the start-up of SBGs, if required) is automatically deployed by the data centre BMS.

This infrastructure design (current and future) provides the required reliability for each customer suite, and to provide the required reliability and resilience for the data centre and its customers. The electricity supply arrangement for the data centre is illustrated in drawing *WW-PVT-RJPC004-ESD-001-Electrical Single Line Diagram Rev P02*, which shows the planned 22kV upgrade electrical distribution, as presented in Appendix E.

5.4.1 Technical Standards

The data centre site is/will be designed and operated in accordance with the relevant sections of the following key guidance:

- Develop a management system: environmental permits guidance, 03 April 2023;
- Emergency backup diesel engines on installations: best available techniques (BAT), 23 August 2023;
- Best Available Techniques: environmental permits, February 2016; and
- Specified generator: comply with permit conditions, 28 December 2022.

In addition, the site is operated in accordance with *Data Centre FAQ, Draft Version 21.0 to TechUK for Discussion 15/11/22* with respect to standby operation. It is noted that this guidance is draft, however, for the purposes of this application, this guidance is considered to represent the current EA position of BAT for data centre back-up generation systems.

Operation of the SBGs (other than for maintenance and testing) will commence in the event that electricity is not available from the local transmission network (e.g. brown- or black-out) or on internal failure of electrical supply (e.g. transformer failure, UPS problem).

The SBGs on-site will also be operated for maintenance and testing purposes. Each SBG will operate for less than 50 hours per annum and will not be subject to the emission limit value (ELV) for NO_X (190mg/kg).

The emissions from the site will be estimated using emissions factors, as discussed in Section 7.0.

5.4.1.1 Emergency Operation

Emergency operations are taken to include unplanned hours required to come off grid to make emergency repair of electrical infrastructure associated within the data centre itself.

Given the short start-up and shutdown times for diesel engines, the SBGs are regarded, for the purposes of determining operating hours, as commencing operation at the first fuel ignition. This is taken to include the shorter periods of plant 'overlap' when engines provided as redundancy are started as a precautionary measure before final customer load is reached with the optimum/minimum number of SBGs.

In the event of emergency operation of the SBGs, the Operator will notify the EA in accordance with the requirements as stated in the EP.

6.0 Operating Regime

6.1 SBG Scheduled Operating Regime

During planned maintenance and testing the SBGs will each be typically operated for less than 50 hours per year.

The planned maintenance and testing regime for the SBGs is scheduled to ensure that the impact on air quality as a result of the fuel combustion emissions is minimised.

The planned operating regime for the SBGs (i.e. testing and maintenance) at the data centre is presented in Table 6-1.

Table 6-1 Planned SBG Testing Regime

Annual Testing Regime	Detail	Annual Operation Time Per SBG
Monthly off-load test (off load)	One SBG tested at a time for 5 minutes per month. Test completed during a weekday, typically in the morning.	1 hour
Annual load bank test (100% load)	One SBG tested at a time for 2 hours per SBG once a year. Test completed during a weekday, during business hours (i.e. between 8am-6pm).	2 hours
Total per SBG per year		**3 hours**
Overall total (11 SBGs)		**33 hours**

Based on the hours in Table 6-1, the overall operational hours for planned maintenance and testing per year for all 11 SBGs will be 33 hours (based on 3 hours per SBG).

The scheduled maintenance and testing regime for each SBG will be significantly below the 50-hour testing regime for SBGs which are used purely for a stand-by emergency role as stated in the EA Data centre FAQ.

Routine testing and maintenance of the generators will be completed by suitably experienced and trained data centre facilities management staff and an appointed subcontractor, as required. During maintenance and testing data centre facilities management staff and the subcontractor, if relevant, will:

- Visually check for smoke from SBG exhausts. If any black, or white smoke, is noted this will be reported for further investigation.
- Ensure that the SBGs are operated for the minimal amount of time to complete the required maintenance requirement/test (maintenance and testing of the SBGs will be completed in accordance with manufacturer requirements to ensure optimal performance and efficient combustion); this approach minimises both fuel consumption by the SBGs and generation of combustion emissions to air.

Furthermore, to limit the generation of emissions to air, as stated in this BATOT, the routine testing and maintenance regime ensures that individual SBGs are subject to planned maintenance and testing at any one time. The PPM and testing regime at the data centre will be managed via a PPM software system.

7.0 Emissions

7.1 Emissions to Air

The Air Quality Risk Assessment (SLR Ref: 410.064891.00001 AERA) predicts for:

- Operation of the SBGs for planned maintenance and testing, that significant impacts are considered unlikely on the identified sensitive receptors;
- Commissioning of the 6 proposed SBGs (KD3500-E), that significant impacts are considered unlikely on the identified sensitive receptors; and
- Operation of the SBGs under an emergency (brown- or black-out) scenario modelled at 72 hours, that adverse impacts are considered unlikely at all but three locally designated sites. This assumes the emergency outage is >24 hours, which is considered an unlikely occurrence.

Refer to the Environmental Risk Assessment for further information (410.064891.00001 ERA).

7.1.1 Emissions Factors

In order to estimate the total annual emissions of NO_x to air from the site, emissions factors have been developed from the peak fuel consumption rate and the resultant 'worst case' emissions discussed in the Air Quality Risk Assessment (SLR Ref: 410.064891.00001 AERA).

The proposed emissions factors, calculated based on the emission rates is stated in the AERA and the planned testing and maintenance hours presented in Table 6-2 (3 hours per SBG), are presented in

.

Table 7-1 NO_x Emissions Factors for Annual Reporting

	Emission Factor (kg emissions)	
	Caterpillar 3516b (6 SBGs) No SCR Abatement	**Kohler KD3500-E (5 SBGs) with SCR Abatement**
NO_x Emissions Rate (g/s)*	1.86	0.29***
NO_x (as NO_2) per SBG**	160.7	25.06
NO_x (as NO_2) per total number of SBGs	804.0	150.0

* - emission rate sourced from the SLR AERA.
** - based on 3 hours planned maintenance and testing per SBG per year
*** - NO_x Emission (g/s) per exhaust with SCR, time weighted for the 5-minute test

7.2 Emissions to Sewer

The data centre has separate foul and surface water drainage systems. The drainage to foul sewer will consist of sanitary foul water (sinks, toilets, cleaning water, etc.); operation of the data centre will not result in the generation of trade effluent.

There are no discharges to foul sewer within the service yard area where the SBGs are/will be located. All run-off from this area will drain to the on-site surface water drainage system prior to off-site discharge via a Class 1 full retention interceptor to on-site soakaways, as detailed in section 7.3.

7.3 Emissions to Water

The surface water drainage system at the data centre will accept surface water runoff from the area where the SBGs, along with runoff from the building roof area and other hard surfaced areas of the wider site.

Surface water run-off from the area where the SBGs and the fuel road tanker off-loading area will be located will drain to the on-site surface water drainage system. This drainage is directed to one of three soakaways prior to which it passes via an oil interceptor (Class 1 full retention interceptors).

The surface water point source discharge points into these three soakaways are referenced as SW1, SW2 and SW3, the locations of which are indicated on Drawing 002 Site Layout and Emission Points.

The interceptors are fitted with an audible alarm system for oil levels, which connect to the data centre BMS. In the event of an unplanned release of fuel, the alarm will notify key data centre staff of the issue, via the BMS.

Commented [SA1]: SF LHR - please confirm if correct?

Commented [LA2R1]: No automatic closure device

Commented [LA3R1]: Initially inspection appears to be class 1 interceptors

The drainage plan for the data centre is provided in Appendix F.

The interceptors are subject to monthly inspections and are emptied and subject to integrity testing on a regular basis.

Procedures will be developed and included within the site's environmental management system (EMS) for the management of surface water runoff and for the management and maintenance of the interceptors; relevant staff will be suitably trained in these procedures.

7.4 Emissions to Land

The data centre will have no point source emissions to land.

7.5 Fugitive Emissions

Significant fugitive emissions, odours and noise are not anticipated in respect of operation of the data centre SBGs either during testing or during full emergency operation.

A summary of the storage arrangements for fuel is provided in sections 8 and 12.

The data centre operator will maintain procedures for fuel delivery and for spill response, and relevant operating personnel will be provided with spill response training. Additionally, the requirement for regular inspections of the data centre site will be included in the site's EMS and maintenance procedures.

7.6 Noise and Vibration

As the SBGs will be operated intermittently for maintenance and testing purposes only, and for emergency back-up purposes in the unlikely event of brown or black out scenarios, it is considered that there would be low impact as a result of operation of the SBGs at the proposed data centre.

A Noise Assessment has been completed for this EP application by SLR (report reference 403.064625.00001 Feltham Data Centre Permit Noise Assessment).

The assessment concluded that noise rating levels would not have an adverse impact on the nearest noise receivers.

8.0 Resource Use and Efficiency

8.1 Types and Amounts of Raw Materials

The raw materials to be used at the site are:

- Diesel fuel oil: each SBG will require (when providing 'standby' power):
  - Caterpillar 3516b (5.26 MWth): up to 543 litres per hour (at 100% load).
  - Kohler KD3500-E (6.36 MWth): up to 707.5 litres per hour (at 100% load).
- Lubricating oil: to be used in the engines and other mechanical equipment. Occasional top up or replacement will be required during scheduled or forced maintenance periods only.
- The lubricating oil for the SBGs will be stored within the engines and manually topped up during servicing by an appointed service contractor.
- AdBlue for the SCR abatement systems serving the 6 new Kohler SBGs: 62 litres per hour (at 100% load) per SCR System. Based on six SCR abatement systems, and the planned maintenance programme of 3 hours per SBG, the estimated annual usage will be circa 1,116 litres.

The BAT objective with regard to raw materials is achieved by the appropriate design, operation and maintenance of the SBGs to ensure the lowest possible consumption rate of fuel; by the selection of least hazardous materials; and by the provision of appropriate storage methods.

The SBG engines are designed for the combustion of diesel fuel oil and HVO, this being the fuel recommended/specified by the engine manufacturers. The fuel will have a low sulphur content.

In addition, the lubricating oil may have alternatives, however the type of oils used are limited to those recommended/specified by the engine manufacturers.

A typical composition of diesel fuel oil is shown in Table 8-1: Typical Diesel Fuel Oil Specification.

Table 8-1: Typical Diesel Fuel Oil Specification

Chemical	Typical % (mass basis)
Carbon	89.7
Hydrogen	10.2
Sulphur	<0.1

AdBlue is circa 32.5% urea in water. The abatement systems in the Kohler KD3500-E engines are designed for the use of this chemical to reduce NO_x emissions to air as a result of the combustion of diesel/HVO fuel in the SBGs. There is no alternative chemical for use in the proposed abatement.

Cogeneration (Combined Heat and Power)

The provision/implementation of combined heat and power (CHP) is not applicable as the SBGs will each operate for substantially less than 500 hours per annum for the provision of emergency power generation; each engine will inherently only operate for a small fraction of the year (typically <5 hours per year for planned maintenance and testing).

8.2 Fuel Storage

The diesel fuel storage arrangements are summarised below.

Based on a total of 11 SBGs (5 existing (each with 2,700 litre capacity) and 6 new (each with 17,000 litre capacity)), and three existing 45,000 litre below ground bulk tanks, a total maximum of 250,500 litres of diesel can be stored at the data centre.

Further details on the fuel storage arrangements are provided section 12.0 Best Available Techniques.

8.2.1 Existing Generator Day Tank Diesel Storage

The five existing SBG container units at the data centre are located in the service yard, as indicated on Drawing 002 submitted with the EP application.

Diesel for these SBGs is stored in day tanks located within the SBG container units. The container unit provides 110% containment for the day tank.

The Caterpillar 3516b SBGs day tanks each have a capacity of 2,700 litres.

8.2.2 Below Ground Diesel Storage Tanks

There is also bulk storage of diesel at the data centre in three below ground bulk tanks (Bulk Tank 1, 2 and 3); these bulk tanks serve the days tanks of the five existing SBGs. Each bulk tank has 45,000 litres capacity. The diesel is automatically pumped from the bulk tanks directly to the existing SBG day tanks. The location of the bulk tanks is shown of Drawing 002 submitted with this EP application.

The bulk tanks, which are located below ground level within a concrete lined chamber, are fitted with the following:

- A tank level gauge located at the ground level tank fill point (the BMS also indicates the tank level);
- High high/high and low low/low level alarms connected to the BMS; and
- A leak detection alarm (external tank skin alarm) connected to the BMS.

The delivery pipework from the bulk tanks to the five existing days tanks runs above ground in a concrete lined pipe duct. The delivery pipework does not have leak detection but is subject to weekly inspection to check pipework integrity.

8.2.3 Proposed Generator Belly Tank Diesel Storage

Fuel for the proposed Kohler SBGs will be stored in individual belly tanks located beneath the SBG in the container unit. The belly tanks will be designed and constructed in accordance with BS799-5:2010 Oil Burning Equipment Carbon Steel Oil Storage Tanks. The belly tanks will be integrally bunded to provide 110% containment.

Each belly tank for the Kohler KD3500-E SBGs has a capacity of 17,000 litres and will be fitted with:

- A tank level gauge connected to the BMS;
- High high/high and low low/low level alarms connected to the BMS;
- A pressure delivery overfill prevention valve; and
- Leak detection alarm connected to the BMS.

The proposed SBGs are configured in stacked pairs, with three at ground level and three on the upper gantry level. Due to the height of the SBGs on the gantry it will not be possible to rely on the pumping capabilities of the fuel delivery vehicle. To fill the upper SBG belly tanks a fuel transfer system will be designed within the proposed ground level SBGs to transfer fuel from the lower belly tank to the upper belly tank during fuel refilling only.

A fill cabinet will be mounted onto each SBG container to enable the SBG belly tanks to be filled directly by a fuel delivery tanker. The new fill cabinets for the proposed SBGs will have three separate fill points and fuel delivery lines for the dedicated filling of each new SBG pair. The fuel delivery pipework will run above ground and will be double walled with leak detection based on pressurisation levels in the interstitial space between the pipework walls.

8.3 AdBlue Storage

The AdBlue (urea) for the SCR systems serving the 6 proposed SBGs will be stored in each SBG container unit in a separate compartment of the diesel storage belly tank; this compartment will provide for 2,500l AdBlue storage. As described previously, the belly tanks will be integrally bunded, providing 100% containment. The AdBlue compartment will be provided with the following protection measures:

- Overfill protection (mechanical valve);
- High, High High, Low Low, Low alarms which will be connected to the BMS; and
- Leak detection which will alarm to the BMS.

The delivery pipework from the new fill point cabinet on each SBG container unit (as described above) to the AdBlue storage compartment of the belly tanks will be above ground double walled pipework with leak detection which will alarm to the BMS.

The AdBlue tanks will be subject to regular preventative maintenance to minimise the risk of leaks.

8.4 Energy Efficiency

8.4.1 Climate Change Agreement

The operator will not be a participant to a Climate Change Agreement (CAA). Energy management techniques will be implemented via the operator’s EMS.

8.4.2 Energy Efficiency Directive (EED)

The EED exempts “those peak load and back-up electricity generating installations which are planned to operate under 1,500 operating hours per year as a rolling average over a period of five years”.

Based on the planned maintenance and testing schedule, in total the SBGs at the data centre will be operated for less than the 1,500 hour threshold, as summarised in Table 6-1. For the purpose of this EP application, the data centre is therefore exempt from the EED requirements and an assessment of energy efficiency in accordance with the Reference Document on Best Available Techniques for Energy Efficiency, February 2009, is not required.

8.4.3 Energy Management

The management of energy will form an integral part of the EMS. Energy use will likely form one of the key environmental aspects, and within the EMS measurement and reduction targets will likely be established.

Minimising energy use and developing good housekeeping techniques will form part of staff training.

8.4.4 Measures for the Improvement of Energy Efficiency

The SBGs will be subject to regular maintenance and inspection that will include ensuring the engines are optimised to minimise the heat rate (energy consumption) whilst maintaining the relevant emissions standards.

Energy recovery is not reasonably practicable for engines with such small anticipated operational hours, however, as part of the EMS, assessment of the data centre's energy usage will be undertaken with a view to identifying measures to reduce energy consumption, where possible.

8.4.5 Energy Usage

Operation of the SBGs will be for emergency back-up. The approximate efficiencies of the SBGs (under the provision of 'standby' power) at the data centre is summarised below:

- Caterpillar 3516b: 38%
- Kohler KD3500-E: 44%

The overall efficiency of the site, under this scenario and generating 52.16 MWe, will be approximately 42%.

8.5 Water Minimisation

There will be no consumption of water associated with the SBG combustion activities at the site.

8.6 Waste Minimisation

The site will inherently not produce significant amounts of waste. Waste oil will be generated at the site as a result of SBG maintenance. SBG maintenance will be undertaken in accordance with a maintenance contract by an appointed third party specialist. Waste oil generated during maintenance will be removed from site by the appointed maintenance contractor.

Waste oil will be managed off-site. In accordance with the waste hierarchy, the operator will seek to ensure that the waste oil is subject to re-use, avoiding the need for disposal. The operator will ensure that waste oil will be removed from site by a suitably permitted waste management contractor.

It is anticipated that waste oils (EWC 13 02) from the SBGs at the data centre will be less than 5m^3/4.5 tonnes per annum.

9.0 F Gases

Fluorinated gases (F-gases) will be used at the data centre:

- The primary cooling of the data hall heat source will be via air cooled water chillers which will utilise refrigerant R134a.
- The data centre office block will be provided with comfort cooling which will utilise refrigerants R410a and R407c.

Units containing refrigerants will be subject to regular maintenance and leak testing; these requirements will be included in the site's PPM system. Maintenance and testing will be undertaken by an approved external specialist contractor; copies of the certificates of the engineers qualified to install, maintain and service refrigeration equipment will be maintained on file by the operator.

The operator will maintain an F-gas register for the data centre. The register will detail each refrigerant-containing unit, the make, model and serial number, refrigerant type and charge, the global warming potential (GWP), carbon dioxide equivalent (CO_2e kg), maintenance/leak test frequency and refrigerant used per year.

Leak detection and maintenance records will be maintained and will include details of the quantity of refrigerant used to recharge the units, date of recharge and leak re-test for those assets where leaks are identified.

10.0 Management Systems

The data storage services at the data centre site will be managed in accordance with the following standards, or suitable equivalent standards:

- ISO/IEC 27001:2013 that specifies the requirements for establishing, implementing, maintaining and continually improving an information security management system.
- ISO9001:2015 that specifies the requirements for establishing, implementing, monitoring, managing and improving quality throughout the organisation.

In addition, an environmental management system (EMS) will be in place, as detailed in section 10.1.

10.1 Environmental Management System (EMS)

The operator will develop an EMS in line with the requirements of the international standard ISO14001:2015, or a suitable equivalent standard. The EMS will include the policies, management principles, organisational structure, responsibilities, standards/ procedures, process controls and resources in place to manage environmental protection across all aspects of the business.

The EMS will place particular importance on:

- Reducing risks to the environment to a level that is as low as reasonably practicable using best available techniques;
- Integrating EMS responsibilities within line management;
- A commitment to personnel environmental awareness and competence;
- The ongoing monitoring and review of environmental performance; and
- A commitment to working to achieve continuous improvement in environmental performance.

Policy

The EMS will include an Environmental Policy which clearly defines the operator's commitment to continual improvement and to developing objectives and targets aimed at preventing pollution and improving environmental performance. The Policy will be reviewed annually by top management and communicated to all employees.

Organisation

The operator will establish and maintain documented procedures for identifying and recording environmental aspects for all its activities and services. Where significant, the environmental aspects will be considered in the development, implementation and maintenance of the EMS. These will also be considered when introducing new or modified activities and services. The operator will also document in the EMS the process for the setting, managing and reviewing environmental objectives and targets.

The operator will document in the EMS the structure and responsibility within the organisation. Senior management will have overall responsibility for the provision and maintenance of an effective EMS Policy and improvement programme and will ensure that the requirements of the EMS are addressed in all management and business decisions.

The operator will maintain an internal audit programme for periodic internal audits of environmental documents, procedures, implementation and compliance status to determine whether the EMS conforms to planned arrangements, and to determine whether it has been appropriately implemented and maintained in accordance with its Environmental Policy.

Environmental Aspects Evaluation

The environmental significance of the site activities will be determined by means of environmental aspects evaluation. The operator will identify the aspects and impacts (direct and indirect) relevant to its activities, highlighting which substances, activities or incidents related to the aspects that could potentially have a harmful effect on the environment. Any substance, activity or incident that has the potential to cause harm, or under the worst case scenario has a high-risk of potential to harm will be identified as being 'significant'.

The operator's main activities will be identified and recorded, for example in an aspect and impact register; evaluation of these aspects and impacts and the associated implications will be recorded. Environmental aspects will be considered under the following conditions:

- Normal operation (i.e. standard operating procedures and conditions);
- Abnormal operation (i.e. standard operating procedures but non-standard conditions); and
- Emergency conditions.

Aspects which are identified as being 'significant' will be managed by establishing operational controls, process, procedures, training and monitoring activities such audits. The operator's management team will be responsible for reviewing aspects and impacts defined as being significant. All staff will be responsible for working in accordance with procedures relating to environmental compliance.

Environmental Risk Assessment

Environmental risk assessments, together with the environmental aspect evaluation, will inform routine management system (MS) procedures for the management of risks under normal circumstances, and emergency plans to mitigate impacts under abnormal circumstances. Such assessments will cover the implications of material storage, fuel transfer, drainage and site security.

Environmental risk assessments will be carried out:

- Under normal operating conditions;
- Under potential abnormal/emergency conditions;
- For existing equipment;
- For existing material storage;
- Before a new substance is introduced;
- Before the installation of new plant on-site; and
- Before existing plant is modified.

All significant risks will be recorded, for example in an aspect and impact register.

The operator will require and will encourage full and open reporting of all environmental incidents, including near misses. Staff will be encouraged to report environmental incidents and problems which may result from (inter alia) the following factors:

- Pollution incidents;
- Potential incidents;
- Breaches of legislation;
- Supplier non-compliances;
- Contractor non-compliances;

- Non-compliances identified during audits; and
- Management system non-compliances.

Additionally, contractor personnel will be informed of the need to report incidents.

Monitoring, Control and Change Management

The primary mechanism that will ensure operational control to minimise adverse environmental risks will be the aspect and impacts register. Processes and procedures will address each significant aspect and generate the information and data necessary to monitor adequately the environmental performance of the data centre and develop an understanding of performance so as to identify faults, opportunities for improvement and to optimise maintenance routines.

The EMS will provide for the controlled implementation of changes which may have environmental implications, to ensure any environmental risks posed by a proposed change will be adequately managed.

Change control will include consideration of the proposed change requirement, identification of the potential environmental implications, measures required to minimise the potential environmental impacts and the responsibility for resolution and a timescale. Change control will include consideration of (inter alia):

- Legal obligations;
- Results of routine monitoring activities;
- Changing commercial circumstances;
- Improvement targets;
- Review of the environmental aspects, which will include risks from climate change;
- Complaints or suggestions from the public;
- Staff suggestions; and
- Non-compliances.

Accident Prevention and Management

The operator will develop systems for managing accidents or incidents. Risks as a result of activities undertaken, or proposed to be undertaken, at the data centre will be considered and documented, for example in an environmental aspect and impact register and via risk assessments. The environmental aspect and impact register will be updated to include requirements of the EP.

The following will also be developed:

- A Disaster Recovery Plan to counteract potential interruptions to its business activities and to protect critical business processes from the effects of major failures of information systems or disasters. Risk assessments will be undertaken to ensure that the Disaster Recovery Plan has appropriate controls in place; and
- A Business Continuity Plan (BCP), which will detail emergency/accident procedures and incident management responsibilities, including management of significant pollution incidents and fire. The plan will include contact numbers for key company personnel and emergency services.

Training

Environmental training will be provided; this will be for both general awareness and job-specific training.

The site will be managed by a sufficient number of staff, who have the competencies to operate the site. In accordance with the EMS:

- All staff will have clearly defined roles and responsibilities;
- Records will be maintained of the knowledge and skills required for each post;
- Records will be maintained of the training undertaken and relevant qualifications obtained by staff to meet the competence requirement of each post; and
- Operations will be governed by standard operating instructions.

Each individual's knowledge and skills will be assessed and matched against the needs of the job position. Additional experience and/or training requirements necessary to enable an individual to undertake their assigned role will be identified, prioritised and planned.

Training records will be maintained and training needs regularly reviewed.

All contractors will be given appropriate training prior to the commencement of any works or services.

Review and Audit

The operator recognises that continuous improvement requires the ongoing appraisal of EMS and Environmental Policy in order to ensure that they remain effective, in line with developing best practice and relevant to the business as a whole. An annual management review of the EMS will be undertaken to ensure that it remains appropriate and effective at controlling environmental performance and to identify any areas where opportunities exist for improvement.

The EMS and site activities will be internally audited at least annually, either by site staff with suitable audit experience and / or training or by a suitably qualified and experienced third party.

Where corrective action is identified as being required, through audit (or otherwise), which for example involves modifications to plant and equipment, the implementation of such changes will be managed via the EMS change management process.

10.1.1 Climate Change Risk Assessment and Adaptation Plan

A Climate Change Risk Assessment (CCRA) and Climate Change Adaptation Plan (CCAP) will be developed in accordance with EA guidance[1]. This will be included within the proposed EMS.

1 Climate change: risk assessment and adaptation planning in your management system - GOV.UK (www.gov.uk)

11.0 Monitoring

The SBGs at the data centre will each operate for less than 500 hours per annum and will not be subject to emissions limit values (ELV) for the substances listed in Annex V of Directive 2010/75/EU on industrial emissions (Industrial Emissions Directive, IED).

As the SBGs will not be used for the elective generation of electricity they will not be considered 'specified SBGs' in accordance with EPR 2018 and hence will not be subject to the ELV for NO_x (190mg/kg (within 10 minutes of the specified SBG commencing operation)).

The operator will undertake periodic monitoring (every 1,500 hours of operation or once every 5 years, whichever comes soonest) of the SBG combustion emissions for of NO_x and carbon monoxide (CO) in accordance with the *Monitoring stack emissions: low risk MCPs and specified generators*[2].

In addition, the operator will record:

- the operating hours of each engine for planned maintenance;
- the operating hours of each engine for emergency operation; and
- the amount of fuel used on an annual basis.

For the purposes of determining operating hours, the SBGs are regarded as having minimal start-up or shut-down times. Operational hours will be counted from the first fuel ignition. This will include the shorter periods of plant 'overlap' when redundant plant is started as a precautionary measure before final load is reached with the optimum/minimum number of SBGs.

11.1 Point Source Emissions to Atmosphere

Point source emissions to air will be from the SBGs as a result of diesel combustion. Based on the findings of the air emissions risk assessment (410.064891.00001 AERA) the products of combustion which will be released to air as a result of planned maintenance and testing and during commissioning of the 5 proposed SBGs will not result in an adverse impact on the environment.

For operation of the SBGs under an emergency (brown- or black-out) scenario modelled at 72 hours, adverse impacts are considered unlikely at all but three of the locally designated sites. This assumes the emergency outage is >24 hours. As stated previously, it is recognised that such a prolonged emergency scenario is highly unlikely.

The SBGs on-site will each operate for less than 500 hours per annum and will not be subject to emissions limit values (ELV) for the substances listed in Annex V of Directive 2010/75/EU on industrial emissions (Industrial Emissions Directive, IED).

The operator will record operating hours and fuel use as stated above.

For the purposes of determining operating hours, the SBGs are regarded as having minimal start-up or shut-down times. Operational hours will be counted from the first fuel ignition.

11.2 Point Source Emissions to Sewer

The data centre will be connected to separate foul and surface water drainage systems. Discharges to sewer are limited to sanitary effluent (sinks, toilets, cleaning water, etc.) i.e. domestic type discharges. This is not considered to be a trade effluent discharge and

[2] Monitoring stack emissions: low risk MCPs and specified generators - GOV.UK (www.gov.uk)

monitoring of this discharge is not considered necessary. There are no discharges to foul sewer within the plant area where the SBGs are/will be located.

11.3 Point Source Emissions to Water

Uncontaminated surface water runoff from the service yard where the SBG container units and the fuel loading area is located will be via the on-site surface water drainage system. This runoff will pass via Class 1 full retention oil interceptors prior to discharge to one of three on-site soakaways – refer to section 7.2 for details. Monitoring of the surface water discharge from the data centre is not considered necessary.

For the purpose of the EP, in relation to surface water runoff from the permitted Installation, there will be 3 point source emissions to water, referred to as SW1, SW2 and SW3, the locations of which is indicated on drawing 002 submitted with this EP application.

12.0 Best Available Techniques

The assessment for the implementation for Best Available Techniques (BAT) at the data centres is based on the following:

- the latest version of the '*Data Centre FAQ, Draft Version 21.0 to TechUK for Discussion 15/11/22'* – Release To Industry', provided by the EA; and
- with respect to technology selection, Department of Energy & Climate Change, Developing Best Available Techniques for Combustion Plants Operating in the Balancing Market, Final Report, June 2016.

12.1 Data centre BAT - Operating Regime

12.1.1 Planned Maintenance and Testing

During operation for planned testing/maintenance at the data centre, the SBGs will each operate typically for 3 hours per year; this is notably below the 50 hour per annum data centre BAT requirement.

In the event that electricity is not available from the local transmission network (e.g. brown-or black-out) the SBGs will be operated to deliver the required data centre customer load.

Whilst emergency operation (if required) would increase the total operational hours of each SBG, it is extremely unlikely that operation of any single SBG would exceed 500 hours per annum (this being the definition of an 'emergency' unit).

The SBG provision includes for a level of redundancy to the SBG system such that, even in a worse case blackout scenario, whilst all SBGs would start up they would not operate at full capacity; the operational capacity of the SBGs at the time of a blackout would be dependent on extent of the facility's IT load at the time. Should an SBG fail the engine will be covered by the remaining engines, which will operate to share the required IT load at that time .

Emergency operations are taken to include unplanned hours required to come off grid to make emergency repair of electrical infrastructure within the data centre.

The Operator will notify the EA:

- In advance of planned outage/maintenance of the local transmission system that is expected to exceed 18 continuous hours; and
- Upon an incident of unplanned continuous outage that exceeds 18 hours.

12.1.2 Elective Electricity Generation

The SBGs at the data centre will not be operated for elective electricity generation.

12.1.3 Operating Regime Time Limit

The air emissions modelling (410.064891.00001 AERA) has predicted that operation of the SBGs for the planned maintenance and testing regime of 3 hours per SBG per year, as detailed in Table 6-2, will not result in adverse impacts on air quality. The operator will therefore not operate the SBGs for more than these hours per year for the purpose of planned maintenance and testing.

12.2 Data Centre BAT: Engine Selection

Diesel-fired SBGs have been chosen for the provision of emergency back-up energy in the event of a black- or brown out at the facility. A BAT assessment has been undertaken which compares diesel SBGs to other available technologies to support the chosen technology.

The following key requirements for the SBGs to provide emergency back-up electricity have been considered for the selected technologies:

- Start-up time;
- Reliability;
- Independence of off-system services; and
- Causing the least environmental impact.

A comparison of these technology types is presented in **Error! Reference source not found.**. Start up, efficiency and emissions data as stated has been obtained from a report prepared by DECC (Department of Energy & Climate Change, Developing Best Available Techniques for Combustion Plants Operating in the Balancing Market, Final Report, June 2016) unless otherwise stated. Figures are reported at oxygen reference values of 15%.

Table 12-1: Comparison of Technologies

	Combined Cycle Gas Turbines (CCGT)	Open Cycle Gas Turbines (OCGT)	Aero Derivative Gas Turbines[3]	Gas Engines	Diesel Engines
Process Description	CCGT technology uses a primary gas turbine coupled to a secondary steam turbine. Air is compressed through a rotating compressor, then mixed with fuel and combusted before being expanded through a gas turbine, converting the thermal energy into rotation of the turbine blades. Some of the mechanical energy powers the compressor, with the majority turning a SBG which converts the mechanical energy to electricity. The hot turbine exhaust gases then pass through a boiler to generate steam. The steam is fed to a steam turbine which powers a second SBG, producing further electricity.	OCGT consist of a compressor, combustion chamber and gas turbine. They differ from CCGTs in that they operate without the secondary component to recover heat. Air is fed into the compressor, pressurised and then passed to the combustion chamber where fuel is added and combusted. The hot exhaust gas turns the turbine blades and energy is converted to electricity. OCGTs can provide STOR and peaking services but not fast reserve services as during start-up thermal stresses need to be managed through a slow heating up process.	Aero Derivative Gas Turbines are similar to open cycle gas turbines but have been derived from turbines used for aeronautical applications. As a result of the different requirements for use of gas turbines in aircraft, they are more flexible than OCGT plant, and are able to operate under wider ranges of load and start up and shut down quicker than other turbines.	A gas engine consists of a bank of fixed cylinders inside which pistons move, injecting air and fuel, compressing the mixture, igniting the mixture and then expanding the hot gas produced converting the thermal energy into rotation of a crank shaft. The engine load is adjusted by controlling the amount of gas and air injected into the cylinder, which is controlled by an automated system. A SBG connected to the crank shaft of the engine converts the mechanical energy into electricity.	Diesel engines work in a similar fashion to gas engines with the key difference being that diesel fuel is injected into the cylinder after compression of the air has taken place, and automatically ignites as a result of the high temperature of the compressed air. Engines are generally rated for a continuous power output but can exceed this by stated amounts for shorter periods of time in modes named Standby (1hr maximum) and Prime (12hr maximum). These higher power outputs come at the cost of higher emissions and greater equipment stress.
Start-Up Time[4]	1 – >3.5 hours	15 -30 minutes	As low as 1 minute	1-10 minutes	<10 minutes

	Combined Cycle Gas Turbines (CCGT)	Open Cycle Gas Turbines (OCGT)	Aero Derivative Gas Turbines[3]	Gas Engines	Diesel Engines
Thermal Efficiency (LHV%)	58.8-60.7	38.3-39.9	35-39	35.0-45.0	35.0-37.0
Notes	The secondary steam turbine increases the start-up time of the facility, as it requires slow warming. The complexity and footprint of a combined cycle, combined with the efficiency of steam cycles only being high at relatively large capacities means that CCGT systems are only suitable for large facilities (c.100MW+)	The significant amount of heat lost in the exhaust gas makes open cycle gas turbines significantly less efficient than combined cycle systems.	As with the open-cycle gas turbine, heat loss in exhaust gases means these systems are not as efficient as other options. Certain enhancements can be added, e.g. steam injection, but these are relatively novel and difficult to apply in a non-continuous scenario.	Gas engines are proven, reliable technology and are known to perform well and emit relatively low amounts of NO_x, SO_x and particulates when compared to diesel fired engines.	Diesel engines, unabated, emit relatively high amounts of SO_2 and particulate matter as well as NO_x. The use of low sulphur fuel, catalysts and particle filters can reduce this but diesel engine emissions are considerably higher than other options.

[3] GE Power Systems, Aero Derivative Gas Turbines – Design and Operating Features

[4] Note that this is based on typical industrial facilities.

Technology Selection

Gas Turbines

As per Table 12.1, CCGTs are not considered BAT for the provision of emergency/standby power. This is due to their lengthy start up times and their size limitations; the efficiency of steam cycles being relatively low at small capacity and the overall system complexity being more appropriate to larger size installations.

OCGTs have relatively high capital investment, operating and maintenance costs and lower thermal efficiencies than can be achieved by CCGTs and gas engines.

Aero derivative gas turbines can achieve suitably short start-up times of as low as one minute, however they suffer from relatively low efficiencies compared to engines and the enhancements which have recently become available to improve these are relatively novel and unproven. This is especially applicable for non-continuous operation, where steam or water injection may become a problem as a result of potential condensation within turbine sections.

Reciprocating Engines

Reciprocating engines perform well in terms of their thermal efficiencies. At the upper end of their efficiency range, gas engines have higher thermal efficiencies than diesel engines and OCGTs.

Reciprocating engines also have shorter start up times and are thus more suitable for the provision of emergency/standby power. Under standby conditions, higher emissions are produced, including NO_x, SO_2 and Particulate Matter as soot.

Gas engines benefit from lower NO_x emissions than diesel engines and can utilise gas delivered by the national gas grid, avoiding the additional transport and fuel storage issues associated with diesel systems.

Reciprocating engines fired on diesel fuel oil have a high response (i.e. low start-up duration) and good independent performance reliability due to the on-site storage of diesel fuel in sufficient quantities, which will be managed and controlled by the facility, with the option for fuel oil to be sourced from more than one supplier for delivery to the site. Diesel-fired engines do have a large number of moving parts which can be subject to failure and require regular ongoing maintenance to ensure reliability, however these moving parts can be readily obtained and replaced and are typically included as part of the service agreement with the generator vendor. Due to the number of moving parts, diesel generators when operated can be noisy and generate vibration.

When compared to gas-fired generators diesel engines produce polluting emissions to air, most notably NO_x and particulate matter, which can impact local air quality if operated for prolonged periods of time.

Final Choice of Engine

From the above options, and considering all the aspects required of the plant to provide emergency/standby power for the data centre, diesel engines have been determined as BAT on the basis that:

- These engines provide a fast response speed to the required load; as stated previously, fast start-up of standby generators for data centre is fundamental as an almost instantaneous supply of electricity is required in the event of power loss to the site.

- Diesel engines have low maintenance costs and replacement parts are readily available.
- The need for a reliable supply of fuel (diesel) is essential to ensure reliance, the on-site storage of sufficient quantities of diesel fuel provides the required level of independent performance reliability.

In addition, the diesel engines will allow for the use of HVO as an alternative fuel without having any detrimental impact on the engine.

The storage of gas on-site as a fuel source will not be possible due to restraints on available space, additionally there are significant health and safety risks associated with such storage. As such, there will be reliance on an off-site supply of gas, which would have to be provided to the site via a pipeline which would be operated and maintained by others. Should this supply of gas be interrupted there will be no emergency back-up generation for the data centre, and as such would not meet the resilience requirements of the facility.

12.3 Data centre BAT: Emissions

The '*Data Centre FAQ Headline Approach*' specifies the BAT emissions specification for new diesel-fired reciprocating engines as 2g TA-Luft or US EPA Tier II (or equivalent standard).

All the existing SBGs are Caterpillar 3516b engines; the manufacturer specification states these engines are optimised for reduced emissions and fuel use. Based on standby power rating the NO_x emissions (nominal emissions) are 1,813mg/Nm_3 (@ 5% oxygen). As stated in the Data centre FAQ, there is no minimum appropriate for existing SBGs, however the Caterpillar generators accord with the 2g-TA LUFT emissions standard of 2,000mg/m^3 (@5% oxygen) (refer to the SBG manufacturer specification provided in Appendix B for details on emissions).

Retrofit abatement techniques for existing installations for engine emissions such as selective non-catalytic or catalytic reduction (SNCR or SCR) are not applicable to emergency/standby plant.

The new SBGs are Kohler KD3500-E engines; the manufacturer specification for each engine type states that the engine models are optimised to be US EPA Tier II compliant. As stated in the Data centre FAQ, Tier II USEPA is the minimum appropriate for new SBGs, the 6 proposed Kohler SBGs are therefore considered to be compliant. Additionally, the operator will be installing SCR abatement on each of the proposed SBGs to reduce NO_x emissions to meet the MCPD emission limit of 190 mg/Nm^3 (@ 5% oxygen).

The operator will report the following to the EA (annually):

- the operating hours of each SBG for planned maintenance and testing;
- the total operating hours of all SBGs for emergency use and the number of emergency occurrences; and
- the annual amount of fuel used.

Given the short start-up and shutdown times for diesel engines, the SBGs are regarded, for the purposes of determining operating hours, as commencing operation at the first fuel ignition. This is taken to include the shorter periods of plant 'overlap' when engines provided as redundancy are started as a precautionary measure before final load is reached with the optimum/minimum number of SBGs.

The emissions from the site will be estimated using emissions factors, as discussed in Section 7.0.

12.4 Data centre BAT: Stacks

Data Centre FAQ Headline Approach states that data centres usually have very low profile sites and as such can have short, below roof level emission stacks which can impact on the efficiency of dispersion of emissions. BAT is that release stacks are vertical to aid the dispersion of emissions from the SBGs.

By elevating stack heights it is possible to increase the dispersion of exhaust gases as a result of mixing with the surrounding air once the plume of exhaust gases leaves the stack. Whilst this will not reduce the concentration of pollutants leaving the stack, it will result in a lower concentration at ground level – i.e. a lesser impact on the receptor. Increasing the stack height also avoids the effects of building wake and entrainment of the emissions in the locality of the emission source. The use of taller stacks does have an impact on the operation of the engine(s) as it will marginally increase the back pressure on the engine.

By bringing together the exhaust streams for multiple engines, it is possible to improve the mixing of flue gases with the surrounding air. This aggregation does not decrease the absolute quantities of NO_x emitted but does lead to a lower concentration at ground level – i.e. a lesser impact on the receptor.

The reduction in ground level concentration is achieved through improved mixing with the surrounding air once the plume of exhaust gases leaves the stack. A higher mass flowrate of gases will result in a greater momentum that increases the final height of the plume after it has left the aggregated stack. This increased mixing leads to a lower concentration of pollutants at receptors.

Each SBG will have a dedicated stack to aid the dispersion of the engine flue gases (for further details, please see the Air Emissions Risk Assessment (410.064891.00001 AERA)):

- The stack release heights for the existing and proposed SBGs at the data centre will be 16.1m above ground level (agl).

The stacks will be vertical; each stack will be 16.1m in height to the top of the proposed risers.

The AERA has taken into account the profiles and heights of all the stacks and building downwash impacts at the data centre and has concluded that:

- For planned maintenance and testing significant impacts are not predicted on air quality;
- Commissioning of the 6 proposed SGBs will not result in adverse impacts on air quality; and
- For operation of the SBGs under an emergency (brown- or black-out) scenario modelled at 72 hours, adverse impacts are considered unlikely at all but three of the locally designated sites. This assumes the emergency outage is >24 hours. As stated previously, it is recognised that such a prolonged emergency scenario is highly unlikely.

Further air emissions controls are not considered necessary as, given the very low probability of emergency operation at the site, the overall environmental risk is not considered to be significant[5].

[5] Refer to Air Emissions Risk Assessment (SLR Ref: 410.064891.00001 AERA) and Environmental Risk Assessment (SLR Ref: 410.064891.00001 ERA)

12.5 Data centre BAT: Electrical System Reliability

Section 5.4 provides a description of the on-site electricity supply system for the data centre which has been implemented to service the ‘customer load’ that, in addition to the SBGs, incorporates physical connections to the local transmission network (to allow for the failure of any single connection).

The electrical system for the data centre will provide significant protection against the failure of (or fluctuation in) the electrical supply to the site before it would become necessary to start the SBGs.

The operator will ensure information security at the data centre is managed in accordance with ISO 27001:2013 standard.

Operation of the SBGs will in the main be limited to maintenance and testing. The operator will implement a programme of planned maintenance and testing of the SBGs, in accordance with manufacturer requirements, to limit unplanned maintenance/testing of the generators and thus avoiding the unnecessary use of diesel and the generation of emissions to air.

12.6 Data centre BAT: Air Quality Action Plan

The operator has developed a draft Air Quality Action Plan (AQAP). The AQAP is presented in Section 9 of the EP application.

The AQAP details the management actions to be taken in the event of an emergency outage of the national electricity transmission system that could result in the prolonged usage of the SBGs which could potentially result in adverse impacts on local air quality.

The operator will liaise with the Local Authority and the Environment Agency to agree actions to be taken in the event of a prolonged outage situation (>18 hours) and a finalised plan will be incorporated into the site’s EMS.

The operator will maintain open lines of communication with the Local Authority, particularly to manage any risks that may be identified in the future as becoming significant threats to the local air quality, for example identification of new emissions sources (cumulative impacts) or potential for future site expansion.

12.7 Data centre BAT: Fuel Storage

Fuel will be stored in day tanks within the container units for each of the 5 existing SBGs and in belly tanks located with the container units for the 6 proposed Kohler SBGs.

There is also bulk storage of fuel (currently diesel) at the data centre in three below ground bulk storage tanks (Bulk Tank 1, 2 and 3). Each bulk tank has a 45,000 litres capacity.

The service yard where the SBGs are/will be located, along with the fuel tanker offloading area is hard surfaced; this minimises the risk of percolation of any unplanned fuel releases to the underlying soil and groundwater.

The SBG gantry area will have fixed blade weather louvres and guards which will act to protect the generator container units from the risk of vehicular damage.

To minimise the risk of unauthorised access the data centre site has security fencing, compromising 2m high fencing at the front of the site and 3m high around the remaining three sides, along with perimeter gates. There is secured access to the site via entrance gates. There is CCTV covering internal and external areas of the site. There is a minimum of 1 employee on site at all times.

12.7.1 SBG Day Tanks and SBG Belly Tanks

The SBGs will be housed within proprietary steel container units.

For the existing SBGs, located in each container unit is a day tank which automatically supplies fuel to the SBG in that container. Each day tank has a capacity of 2,700 litres. The container unit provides containment of the day tank in the event of a leak from this tank.

Fuel delivery to the day tanks for the 5 existing SBGs is from the three below ground bulk tanks.

For the 6 proposed Kohler SBG container units, beneath each SBG will be a belly tank, this being integral to the SBG container unit; this will automatically supply fuel to the SBG. Each belly tank will have a capacity of 17,000 litres. Each tank will be bunded (110% capacity).

The delivery of fuel to the proposed SBGs belly tanks will be direct from a fuel tanker via a new fill cabinet located in the service yard.

The existing day tanks have the following protection measures:

- 110% containment (provided by the container unit in which each day tank is located).
- Tank level gauge.
- To minimise the risk or corrosion all pipework is constructed of corrosion resistant material.

The 6 proposed Kohler SBG fuel belly tanks will have the following protection measures:

- Bund designed to provide 110% containment.
- Automatic tank contents level gauge with bund sensor.
- Alarm for water presence in the fuel filter.
- Fuel filter clogging alarm.
- High and low level alarms connected to the BMS.
- A pressure delivery over-fill prevention valve.
- Leak detection alarms connected to the BMS.
- The SBGs will have mechanical relief valves to prevent over pressurisation of fuel supplied from the belly tanks.
- To minimise the risk or corrosion all pipework will be painted or constructed of corrosion resistant material.

In addition to the above protection measures, the 5 existing SBG container units have, and the 6 proposed SBG container units will have, a fire cut off cable that switches the SBG off in the event of fire. The new SBG container units will also have flame detection which will be connected to the data centre’s control room via the BMS.

12.7.2 Bulk Tanks

There is bulk storage of diesel at the data centre in three bulk tanks (Bulk Tank 1, 2 and 3). Each bulk tank has circa 45,000 litres capacity. The bulk tanks are located below ground level within a concrete lined chamber. These tanks are subject to NDT testing to ensure the tank integrity is maintained.

The existing SBGs utilise the bulk storage tanks. Diesel is automatically pumped from the bulk tanks directly to the existing SBG day tanks. Diesel is delivered by road tanker to the bulk tanks via a fill cabinet located at ground level in the service yard.

Each of the three bulk tanks have the following protection measures:

- A tank level gauge located at the tank fill point (the BMS also indicates the tank level).
- High high/high and low low/low level alarms connected to the BMS.
- A leak detection alarm (external tank skin alarm) connected to the BMS.
- To minimise the risk or corrosion all pipework is constructed of corrosion resistant material.

12.7.3 Fuel Delivery

12.7.3.1 Bulk Tanks

Diesel is delivered from a fuel tanker to the 3 below ground bulk tanks via a fill cabinet, as detailed in section 8.2.

The delivery pipework from the bulk tank to the exiting day tanks is below ground in a concrete lined pipe duct. The delivery pipework does not have leak detection but is subject to weekly inspection to check pipework integrity and for leaks.

A summary of how the bulk tanks are filled is provided below (refer to the Fuel Delivery and Storage procedure presented in Appendix G):

- Following a refill request a designated safe system of work will be invoked.
- A trained staff member will take a gauge reading and cross-reference this with the BMS. Where accuracy is in doubt a dipstick reading will be taken.
- Sump pumps will be switched off by manual controls located as a precaution.
- Where necessary the local area will be appropriately cordoned off using barriers and cones. The tanker will be supervised at all times.
- Any ‘at risk’ drains will be covered to prevent any illegal discharges and spill protection will be positioned for ease of access if required. Any concerns over the quality of the spill kits or drain covers will be reported to the Contract Manager and the customer. Delivery of fuel will not be carried out until any remedial actions are conducted.
- Fuel delivery tankers are required to park in a dedicated tanker refuelling area.
- The tanks will not be filled more than 95% of their capacity. The supplier must be given an accurate reading. Any concerns over the accuracy of the readings must be reported to the Contract Manager and then to the Client.

12.7.3.2 Proposed Kohler SBGs

Each new SBG will be located in a bespoke container unit. A fill cabinet will be mounted onto each SBG container to enable the SBG belly tanks to be filled directly by a fuel delivery tanker. Within each fill cabinet will be a motorised fill valve controlled by a fuel fill panel. The fill valve will have an overfill prevention valve. There will also be a manual fill point via the overfill prevention valve.

All deliveries of fuel will be fully supervised by a member of the SF LHR Limited site team and the fuel tanker driver.

Fuel deliveries will be managed in accordance with the fuel delivery procedures; these will form part of the EMS for the data centre.

12.7.4 Tertiary Containment

Tertiary containment will be provided by the service yard hard standing where the SBGs and the fuel road tanker off-loading area are/will be located. This tertiary containment (along with the capacity of the each of the three oil interceptors and surface water drainage serving this area) will provide containment.

Any unplanned release of diesel would be prevented from percolating into the ground by the hard standing; should such a release enter the local on-site surface water drainage system it would be captured by the alarmed interceptors. The interceptor alarm will activate on detection of diesel; this alarm is connected to the BMS and will notify key data centre staff. In such an event, spillage procedures would be implemented.

The risk of a leak/spill from more than one belly/day tank at a time is considered to be low; the tertiary containment will therefore provide more than adequate capacity to contain a leak/spill of diesel from a belly tank (maximum 17,000 litres).

Further details of the surface water drainage system and interceptors are provided in section 7.3 Emissions to Water.

12.7.5 Preventative and Predictive Maintenance (PPM)

The operator has a planned preventative maintenance (PPM) system in place. PPM is managed and completed by the facilities management personnel and appointed approved third-party specialists, as required. The PPM system is used to inform facility management personnel of plant status and any system issues.

The PPM system includes the requirement for regular inspection, maintenance and testing of containment on the fuel storage tanks, along with regular checks of the condition of tertiary containment at the site.

Visual six monthly inspections are carried out in accordance with the PPM to confirm the integrity of storage tanks/bunds, spill prevention and protection equipment, and to identify any unsafe conditions. Where there are any changes the Fuel Storage Inspection Log will be updated.

The facility is manned 24 hours a day by data centre personnel with a minimum of 1 employee on site at all times.

It is considered that diesel delivery and storage arrangements are BAT.

13.0 Conclusion

Based on the above discussions, it is considered that the SBGs and associated diesel storage arrangements at the data centre will be operated and maintained in accordance with all relevant BAT.

Appendix A EA Enhanced Pre-application Advice

Environmental Permit Application

Best Available Techniques and Operating Techniques LON1, Feltham

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Appendix B Engine Manufacturer Specifications (Caterpillar 3516b and Kohler KD3500-E engines)

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Appendix C Generator Technical Details

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Appendix D Proposed SCR Abatement System

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Appendix E Electricity Supply Arrangement

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Appendix F Drainage Plan

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Appendix G Fuel Delivery and Storage Procedure

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