ARUP

Amazon Data Services UK Ltd

Hemel Hempstead Data Centre - Emergency Back-up Generation Facility

Summary Technical Report - Environmental Permit Application

Reference: 284474-EP-STR

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1. Introduction

1.1 Overview

Ove Arup & Partners Ltd (Arup) has been commissioned by Amazon Data Services UK Ltd (the Operator) to prepare a Summary Technical Report (STR) to accompany a bespoke application for an Environmental Permit (EP) for a data centre.

The EP is for Hemel Hempstead Data Centre - Emergency Back-up Generation Facility only, not for the whole of the data centre.

The application is made by Amazon Data Services UK Limited which is the legal entity that will be responsible for operating the generating installation.

1.2 The Operator

The Operator currently runs own built data centres at three locations in-line with The Environmental Permitting (England and Wales) Regulations 2016.

The Operator also has additional operational data centres in England and Wales however, these are co-located sites and are operated by third-parties who hold the Environmental Permits.

1.3 The Site

The data centre is located at 3A Blossom Way, Hemel Hempstead. in the Borough of Dacorum, Hertfordshire.

The site is situated in the Prologis Industrial Park, located in a light industrial and commercial area in Hemel Hempstead, shown in the Site Location Plan[1], which can be found in the application provided as Drawing 284474-EP-DR001.

The northern boundary of the site consists of a Costa Coffee 'drive thru' and a fitness centre with its adjoining multi-deck car park. There are warehouses to the east; to the west there is a self-storage facility; and to the southwest there is a Travelodge Hotel, a car park and open space. Residential properties are located further to the west and south, approximately 100m from the site boundary. Several major roads are located in proximity to the site, including the A414 (Breakspear Way) to the south, the A4147 (Maylands Avenue) to the west. The M1 motorway is located 1.2km to the east.

The data centre will be manned on a 24-hour basis and will have around 50 operational staff. The majority of staff will be present during normal office hours. A team of key engineering staff and security will also be onsite 24 hours a day, involving approximately 7 personnel on a shift basis.

Once operational, up to 50 staff will be on site at the data storage facility at any given time (a maximum of 50 day time staff). It is estimated that up to 35 no. full time data storage facility staff will be on site on a daily basis during standard operation, including security staff with a further 7 no. night shift staff and 15 no. external staff/maintenance contractors/visitors.

[1] Site Location Plan (Document reference 284474-EP-DR001).

2. Legislative Framework

The following regulations and guidance are relevant to the assessment and has been taken into consideration in developing the approach to the assessment:

1. The Environmental Permitting (England and Wales) Regulations 2016, SI2016/1154.
2. EU, 2010 Directive 2010/75/EU of the European Parliament and the Council on industrial emissions.
3. EU, 2015. Directive (EU) 2015/2193 on the limitation of emissions of certain pollutants into the air from medium combustion plant.
4. The Control of Pollution (Oil Storage) (England) Regulations 2001
5. Best available techniques: environmental permits[2]
6. Risk assessments for specific activities: environmental permits[3].
7. Environment Agency Data Centre FAQ Headline Approach[4].
8. Reference Document - Best Available Techniques on Emissions from Storage 2016 [5].
9. CIRIA, 2014. Containment systems for the prevention of pollution (C736F)[6].

2.1 On-site activities

The site comprises 33 containerised generators for emergency purposes. 30 of the main back-up generators are double stacked, with two being included as secondary back-ups (redundancy). There is also a smaller ('house') generator to cover non-critical loads (e.g., office lights, office fire system) during an emergency.

Each generator has an individual flue terminating at 25m above ground, the locations of which are provided in the Site Layout and Emissions Point Plan[7] and can be found in the application provided as Drawing 284474-EP-DR002. The 30 double stacked generator flues are located close to each other but are separate flues.

Fuel will be stored in a top up diesel tank with a volume of 40,000 litres. This will be used to fill the 'belly tanks' of the generators, each 16,000 litres in volume. All tanks will be above ground and double skinned. The main top-up tank will be contained within a bund with a capacity of 110% of the storage capacity of the tank.

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[2] https://www.gov.uk/guidance/best-available-techniques-environmental-permits

[3] https://www.gov.uk/guidance/risk-assessments-for-your-environmental-permit

[4] EA, 2018. Data Centre FAQ Headline Approach – Release to Industry version 10.0 01/06/18. Available <https://consult.environment-agency.gov.uk/psc/cr0-4td-digital-realty-uk-limited/supporting_documents/Data%20Centre%20FAQ.pdf> Accessed March 2022

[5] EC, 2016. Reference Document - Best Available Techniques on Emissions from Storage. Available at <https://eippcb.jrc.ec.europa.eu/sites/default/files/2022-03/efs_bref_0706_0.pdf> Accessed March 2022

[6] CIRIA, 2014. Containment systems for the prevention of pollution. Secondary, tertiary and other measures for industrial and commercial premises. Available at < https://www.ciria.org/ItemDetail?iProductCode=C736F&Category=FREEPUBS> Accessed March 2022.

[7] Site Layout and Emissions Point Plan (Document reference 284474-EP-DR002).

Each belly tank is containerised and self-bunded to contain 110% of the storage capacity of the tank. All tanks will comply with the Oil Storage Regulations (*SI 2001/2954, The Control of Pollution (Oil Storage) (England) Regulations 2001*).

Combustion activities are regulated under The Environmental Permitting (England and Wales) Regulations 2016 (EPR). The regulations enact both the Industrial Emission Directive (IED) and the Medium Combustion Plant Directive (MCPD) in England and operators undertaking any of the activities identified under these regulations require an environmental permit to carry out these activities.

The data centre will be operated on power from the national grid however, in the event of grid failure back up power will be provided by backup diesel generators, with a total installed thermal capacity onsite of around 222 MWth[8]. The generators will be operated to provide power at a site during an emergency only, as well as routine testing in-line with manufacturers maintenance requirements.

They will not be used to provide a balancing service or for demand side response operations such as triad avoidance or fast frequency response. No electricity generated from the site will be exported off-site or fed back into the National Grid.

Combustion plant that have an aggregated capacity of greater than 50 MWth are listed in Annex I of the IED and must therefore be permitted to operate in line with Chapter II of the IED. However, the capacity of individual units are all below 15 MWth so the plant does not fall under the scope of Chapter III of the Directive and therefore are not required to meet the requirements of the EU BAT Conclusions document for Large Combustion Plant (LCP), including the Emission Limit Values (ELVs) set in the Best Available Technique (BAT) conclusions. To cover this gap in the EU guidance the MCPD will inform site specific BAT for certain IED Chapter II activities, including gas engines generating electricity with a capacity of more than 50 MWth, operated as the primary activity on the site.

On this basis, the EA will include MCPD requirements in the permit, as the minimum standards. These are influenced by the type and frequency of the generator's operation. As the planned operation of the generators is for the purpose of maintenance and testing only and for less than 50 hours the operation of the generators is unlikely will not to be subject to any Emission Limit Values (ELVs) or testing restrictions, provided it can be demonstrated that no adverse environmental impacts are predicted, for example to local air quality.

As the aggregated combustion capacity is greater than 20 MWth, the site will be required to obtain a Greenhouse gas emission permit as part of the Emissions Trading System. Conditions will be set out within the Permit detailing the requirements to monitor and report on emissions from the site, including specifying the frequency of monitoring and methods used. Annual monitoring reports will also be required to be submitted.

2.2 Permitting regime – IED or MPCD

As identified above, the backup generators will be permitted under the Environmental Permitting (England and Wales) Regulations 2016. The total aggregated capacity of the generators is above 50 MWth and will therefore be permitted under the IED. However, because the individual combustion is below 15 MWth the installation will be permitted as an IED Chapter II installation but not a Chapter III (LCP) installation. This means the installation will not be required to meet the BAT Conclusions for the LCP. The permit will therefore follow the guidelines set out under the MCPD.

Under the EPR a permit is required to operate the plant, including the commissioning. The permit application process has therefore been programmed to achieve a permit prior to the commissioning phase in the project programme.

[8] Based on assumed 35% efficiency

2.3 Scheduled Activities

The "activities" that are proposed are defined in 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. In accordance with the EPR:
"…where two or more appliances with an aggregate 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."

2.4 Directly Associated Activities

Schedule 1, Part 1 Regulation 2(1) of the EP Regulations provides that a Directly Associated Activity (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 the purpose of the on-site fuel storage is to serve the generators and the Scheduled Activity above, this storage of fuel therefore constitutes a directly associated activity to be covered in this Permit Application.

3. Data Centre Description

3.1 Installed Engines

In response to Part B3 question 7a.

The site comprises 33 containerised diesel generators for emergency purposes, as set out in ***Table 1***.

There are 32 main diesel back-up generators, each with an electrical output rating of 2.4MWe. 30 of these generators are double stacked, with two of which are secondary back-ups (redundancy).

There is also one is a smaller ('house') generator with an electrical output rating of 0.9MWe to cover non-critical loads (e.g., office lights, office fire system) during an emergency. Each generator has an individual flue terminating at 25m above ground, the locations of which are provided in the Site Layout and Emissions Point Plan[7].

Generator specification sheets can be found in Appendix 03-01.

Table 1 Generator details

ID	Type	Model	Rated Electrical Output (MWe)	Thermal Input (MWth)*
A1	House generator	QSK23-G3	0.9	2.57
A2	Main generator (redundancy 1)	QSK78-G16	2.4	6.86
A3	Main generator (redundancy 2)	QSK78-G16	2.4	6.86

ID	Type	Model	Rated Electrical Output (MWe)	Thermal Input (MWth)*
A4	Main generator 1	QSK78-G16	2.4	6.86
A5	Main generator 2	QSK78-G16	2.4	6.86
A6	Main generator 3	QSK78-G16	2.4	6.86
A7	Main generator 4	QSK78-G16	2.4	6.86
A8	Main generator 5	QSK78-G16	2.4	6.86
A9	Main generator 6	QSK78-G16	2.4	6.86
A10	Main generator 7	QSK78-G16	2.4	6.86
A11	Main generator 8	QSK78-G16	2.4	6.86
A12	Main generator 9	QSK78-G16	2.4	6.86
A13	Main generator 10	QSK78-G16	2.4	6.86
A14	Main generator 11	QSK78-G16	2.4	6.86
A15	Main generator 12	QSK78-G16	2.4	6.86
A16	Main generator 13	QSK78-G16	2.4	6.86
A17	Main generator 14	QSK78-G16	2.4	6.86
A18	Main generator 15	QSK78-G16	2.4	6.86
A19	Main generator 16	QSK78-G16	2.4	6.86
A20	Main generator 17	QSK78-G16	2.4	6.86
A21	Main generator 18	QSK78-G16	2.4	6.86
A22	Main generator 19	QSK78-G16	2.4	6.86
A23	Main generator 20	QSK78-G16	2.4	6.86
A24	Main generator 21	QSK78-G16	2.4	6.86
A25	Main generator 22	QSK78-G16	2.4	6.86
A26	Main generator 23	QSK78-G16	2.4	6.86
A27	Main generator 24	QSK78-G16	2.4	6.86
A28	Main generator 25	QSK78-G16	2.4	6.86
A29	Main generator 26	QSK78-G16	2.4	6.86
A30	Main generator 27	QSK78-G16	2.4	6.86
A31	Main generator 28	QSK78-G16	2.4	6.86
A32	Main generator 29	QSK78-G16	2.4	6.86
A33	Main generator 30	QSK78-G16	2.4	6.86
Total installed capacity			77.7	222
*Thermal input calculated based on an estimated efficiency of 35%				

3.2 Size of units needed

The number and configuration of the generators has been selected in order to ensure that the service requirements of the data centre and associated servers / critical infrastructure in the event of any temporary grid interruptions / failures can always be met, whilst providing the necessary redundancy / resilience to cover any generator failure / maintenance.

Based on the critical power requirements, diesel generators in the range between 1.5 and 8 MWth were considered to provide the best solution because:

- Units are readily available for this back up purpose (i.e. Hospitals, London Stock Exchange, banks, etc);
- They can be modularised (containerised);
- Components are "off the shelf" and easily changeable; and
- Each unit / module is self-sufficient.

Furthermore, a single smaller 'house' generator is also to be installed to supply cover non-critical loads (e.g., office lights, office fire system) during an emergency.

The decision for a larger number of smaller generators to be installed on-site, rather than a smaller number of larger generators, was made early in the process based on the flexibility it allows in the event of an emergency situation, whilst appropriately managing risk of unit failure and still guaranteeing supply (two catcher/ redundant generators operating at partial load in the event of emergency).

This proposed solution ensures that the back-up generators are operated at their optimal design capacity (typically high loads) should they be required, which maximises the fuel efficiency/combustion and therefore emissions to air. Operating a smaller number of diesel generator with greater rated electrical outputs at sub-optimal low loads can have an adverse impact on engine operations and ultimately their longevity, if repeatedly used over long periods.

The Electrical Supply Arrangement can be found in Appendix 03-02.

3.3 Operating regime

In response to Part B3 question 7a.

The planned maintenance and testing regime of the generators is set out in *Table 2*. This shows that each generator is planned to operate for significantly less than 50 hours which are used purely for a stand-by emergency role as stated in the EA Data Centre FAQ (v. 10 2018).

Table 2 Generator use regime

Scenarios	Operating profile	Description
Scenario 1: Biweekly	0.5 hour runs fortnightly = 13 hours per year	Each of the 33 generators to be tested, one at a time (daytime only). Generators will be tested at 25% Load.
Scenario 2: Biannual	1.5 hour runs, twice per year = 3 hours per year	Each of the 33 generators to be tested, one at a time (daytime only). Generators will be tested at 100% load.
Scenario 3: Maintenance	3 hours of cumulative running over the course of the year	Each of the 33 generators to be tested, one at a time (daytime only). Generators will be tested at 100% load.

Scenarios	Operating profile	Description
Annual planned operational hours per generator	**19 hours**	
Total planned operational hours at site	**627 hours**	

3.4 Network reliability and in-built redundancy

In the event of a loss of power supply, i.e. temporary grid blackout, the diesel powered emergency (back-up) generators will be utilised to maintain power supply. These generators are designed to automatically activate and provide power to the plant pending restoration of mains power. Every effort will be made to ensure that the emergency generators would not be required in practice, as described below.

Power for the data centre will be supplied from/by the National Grid which operates its transmission system in accordance with the Security and Quality of Supply Standard which is a requirement of its Transmission Licence. In accordance with this standard, a level of redundancy is also built into the transmission system[9].

National Grid's National Electricity Transmission System Performance Report 2020-21[10] states that the overall reliability of supply during 2020–21 was: 99.999966%. During 2020–21, the report states that there were 455 events where transmission circuits were disconnected either automatically or by urgent manual switching. The vast majority of these events had no impact on electricity users, with 10 resulting in loss of supplies to customers.

The total estimated unsupplied energy for these 10 incidents during 2020–21 was 74.36 MWh. The longest loss of supply incident lasted 454 mins (7.5 hours) in Tinsley Park, Sheffield, with a total of 55.39 MWh not supplied. None of the supply incidents reported in 20-21 were in the vicinity of the data centre site.

The power distribution system, on-site, starting from the High Voltage (HV) (132kV) intake substation down to the Low Voltage distribution, is designed to be safe, reliable, robust, and efficient and have in-built redundancy. The Operator designs and builds systems with in-built redundancy, based on High Voltage power supply connections from an electricity grid, being the primary power source to the site. The dual redundant circuit provides security of supply in the event of a fault or loss of supply from one source, the other circuit is capable of supplying full load to the site. To achieve this redundancy, the operator is proposing for the full supply to be split 50%/50% (dual-feeds) from alternative supply sources, each capable of supplying the 100%, if required.

Essentially, the data centre will be supplied from the Grid by an adjacent 132/33kV substation with two separate circuits from two separate feeders from the Elstree National Grid (NG) 400/132kV upstream substation; therefore, in the event of a loss of supply from a single source, 50% of the development is still on the alternative source, while the remaining 50% is on back-up emergency generators temporarily until the site's own distribution system can be rearranged to resume supply from the available source. For additional context, the Elstree substation is an important National Grid substation with capacity of more than 2750MVA.

This arrangement stays in place until the failed source has restored supply, at which point power returns to the two supply sources. This arrangement is subject to connection agreement and compliance with transmission and distribution regulations (and providers).

[9] Available at < https://www.nationalgrid.com/electricity-transmission/document/145976/download> Accessed Feb 2023

[10] Available at < https://www.nationalgrideso.com/document/211021/download> Accessed March 2022

The on-site infrastructure is designed as a minimum on N+1[11] reliability and concurrently maintainable design. This means that there is redundancy built into the system, so that any one component, or any one distribution path can be out of service without affecting operations. Similarly, for the grid connection to the data centre to fail, it would require a number of failures to the upstream distribution network to occur simultaneously. The requirement to run back-up generators is therefore minimised.

The Operator also undertakes a regular and robust infrastructure inspection, preventive maintenance and testing programme and has an integrated Building Management System (BMS) and an Electrical Power Monitoring System (EPMS): these are additional control tools which are used to monitor physical assets and equipment status and performance.

The measures above will minimise the potential for emergency operation of the diesel generators, reducing the overall environmental impact from the installation, in the rare event that they are triggered.

3.4.1 Phasing

The data centre is a phased facility which means that commissioning of the phases will likely to be carried out over time. The operator will not fully deploy all the IT and data storage equipment (or support infrastructure such as the emergency generators) across the entire facility; instead the data servers will be deployed on a phased-basis, determined by customer demand. The time-gaps between the phased deployment can be months. As subsequent data rooms are bought online, the approved backup generator sets in relation to that phase are delivered and installed. As such, when the data centre first becomes operational, the emergency backup generators associated with the latter phases (of which there are fifteen in total) will not be in use in initial operations.

The power distribution system, on-site, shall for Phase 1 on an interim basis be delivered at Medium Voltage (MV) (11kV). This is cut across to the HV supply described above once the HV substation is established onsite. The MV connection to site is provided via a looped feed rated at 11kV and delivering a capacity of 5MVA, supporting building Phase 1 only. The incomers shall terminate into a Utility ring main unit (RMU) within a glass reinforced plastic (GPR) enclosure located within the direct current (DC) building perimeter. Downstream, the power distribution and paths remain unchanged whilst on this intermediate power supply.

[11] N+1 redundancy is a form of resilience that ensures system availability in the event of component failure. Components (N) have at least one independent backup component (+1). The level of resilience is referred to as active/passive or standby as backup components do not actively participate within the system during normal operation

4. Potential Emissions

A summary of the potential emissions from the site are detailed in the Environmental Risk Assessment[12] provided as part of the EP Application (see Document Reference 284474-EP-ERA).

4.1 Emissions to air

Detailed atmospheric dispersion modelling has been undertaken to assess the potential impact of the use of the back-up diesel generators during routine testing and maintenance regime as set out in Table 1.

Furthermore, an additional scenario was also considered to assess the potential impact in the unlikely event of an emergency power outage. This scenario considered a single event where 30 generators plus the house generator will operate at 100% load and the two redundancy generators idling at 5% load, for up to 68 hours.

The Air Quality Assessment[13] accompanying the EP Application (see Document Reference 284474-EP-AQ) concludes that:

- Significant impacts from the planned maintenance and testing activities are unlikely, following the operating regime set out in Section 4.1.3 at sensitive human or ecological receptors; and
- Significant impacts during an emergency event of 68 hours are also considered unlikely at sensitive human or ecological receptors.

4.2 Emissions to water

There are no point source emissions to and from the generators or associated fuel storage.

4.3 Emissions to land

There are no point source emissions to and from the generators or associated fuel storage.

Discharges of surface water will be restricted to run-off from the roof hardstanding and paved areas.

4.4 Fugitive Emissions

The potential fugitive emissions from the site have been considered in the ERA which also details the measures to manage any potential significant releases. The assessment is included with the application as Document Reference 284474-EP-ERA.

4.5 Noise and Vibration

A Noise and Vibration Assessment[14] has been completed and can be found in Appendix 03-06. The generators are located within noise attenuating container units with the individual associated exhaust flues reaching a height of 25m above ground level.

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[12] Environmental Risk Assessment – Environmental Permit Application (2022) (Document ref 28447-EP-ERA) Hemel Hempstead Data Centre - Emergency Back-up Generation Facility

[13] Air Quality Assessment for Environmental Permit Application (2022) (Document ref 284474-EP-AQ) Hemel Hempstead Data Centre - Emergency Back-up Generation Facility

[14] Arup, 2022 Acoustic Assessment for Generators – Permitting (Document ref ARP-009) Hemel Hempstead Data Centre - Emergency Back-up Generation Facility

In summary, for ‘normal’ and ‘generator testing’ operational scenarios, the results show that predicted plant noise would not exceed the noise emission limits during the day and night-time periods at the nearest sensitive receptors. Routine testing and maintenance would also only occur during day-time hours.

During a full emergency scenario, the predicted plant noise levels marginally exceed the noise emission limits at two receptor locations. However, given the small magnitude of the exceedance, the rarity of this event and assumed short term duration of such an emergency event, this is not expected to cause an adverse effect at the nearest sensitive receptors. Further details are provided in the ERA[12] which is included with the application.

5. BAT Assessment

In response to Application Form Part B3 question 3a.

This section provides a review and assessment of the site against BAT, in-line with the relevant applicable guidance.

5.1 Generator type

The EA's Data Centre FAQ guidance[4] note states that *"We accept that oil fired diesel generators are presently the default technology for standby generators in data centres."*

Details into the BAT discussion justifying the choice of engine, the particular configuration and plant sizing meeting the standby arrangement are set out in Section 3.1 and 3.2.

Regarding the determination of engine type, diesel engines are considered to be BAT on the basis that:

- Diesel fuelled engine has been chosen due to the ability to store the required volumes of diesel on site and therefore maximise energy security in the system.
- Instantaneous supply of electricity is required in the event of power loss to the site, which diesel engines provide.
- The technology is well established, replacement parts are readily available and the maintenance costs are low.
- The size of the engines has been selected in order to ensure fast start up and shut down can be achieved as this is a fundamental requirement of the emergency back-up nature of the generators

Alternative options considered such as gas turbines and engines are well established in wider industry with clear advantages in terms of emissions to air (reduced levels of NOx and negligible levels of particulates and sulphur). However, as this would require reliance on a third-party for the gas supply, should there be a failure of this supply for whatever reason, it presented an unacceptable a risk for potential business continuity in the event of an electricity grid failure. Given the size constraints with site, the storage of gas on-site to minimise this potential reliance risk is not considered to be feasible.

Due to the required 77.7 MWe power demands at the data centre site, renewable energy sources were also not considered to be feasible for the back-up supply given the inability to rely on a consistent supply in the event of an electricity grid failure. There also isn't the available land on-site to potentially install a network of high capacity batteries which could store the harnessed renewable energy throughout the year.

5.2 Emissions to air

The following sections are set out in-line with those topics contained within the Pre-application Guidance for the Combustion Sector[15] and the Data Centre FAQ Headline Approach[16], provided by the EA, which require responses to demonstrate that the engines are specified to be BAT. This is for emergency standby diesel generators with a net rated thermal input above 1 MW, which are exempted from MCPD emission limits because they operate for less than 500 hours per year.

[15] Environment Agency. Supplementary combustion sector (Part A installations) basic pre-application advice (Version 1.0) (2021)

[16] Environment Agency. Data Centre FAQ Headline Approach (Version 11.0) (2022)

5.2.1 Generator emissions

The guidance specifies the BAT emissions specification for new diesel-fired reciprocating engines as 2g TA-Luft or US EPA Tier II (or equivalent standard) with NOx emission levels in the range of 2000 mg/m^3 at 5% oxygen and reference conditions.

The back-up generators to be installed and included in the assessment (as set out in ***Table 1***) state NOx emission concentrations of 2091 mg/m^3 at 5% oxygen and reference conditions (100% load standby mode).

Generator specification sheets can be found in Appendix 03-01 alongside this report submission[17, 18].

5.2.2 Stack height

Air Quality modelling has been undertaken to assess the potential impact of the use of the back-up diesel generators during routine testing and maintenance (19 hours per year per generator), as well as in the unlikely event of an emergency power outage for 68 hours.

Significant impacts are considered unlikely from any of the modelled events at sensitive human or ecological receptors.

This summary follows an extensive flue stack height determination study which was undertaken during the design process for the data centre, seeking to minimise the potential impact to local air quality, to ensure that no significant impacts were likely. This study (as set out in the AQA[13]), reviewed the potential impact of a range of stack height from 16m above ground level up to 30m and decided on a stack height of 25m for all stacks as being the optimum design.

All of the generators will have individual vertical release flue stacks which are clear of caps and any cowl impediments.

5.2.3 Maintenance periods

The planned testing and maintenance regime is set out in *Table 2* which shows a total of 19 hours per year per generator run time. This is significantly less than the 50 hours per year expectation set out in the Data Centre FAQ 2018 to minimise the potential for adverse air quality impacts and minimised diesel usage.

5.2.4 Flue gas monitoring

The guidance specifies the BAT is also the provision of flue gases sampling ports to allow for monitoring of NOx and Carbon Monoxide in line with web guidance ‘Monitoring stack emissions: low risk MCPs and specified generators’.

Sampling ports will be installed within each of the flues which comply with the EA’s MCERTS (monitoring certification scheme). Monitoring is expected to be required within four months of permit granting and when three times the number of maximum average annual operating hours have elapsed.

Further details on the monitoring strategy are set out in Section 7.1.

5.3 Emissions to water/land

No process waters will be generated by operation of the installation, hence there will be no associated process water discharge to ground or groundwater.

Discharges of surface water will be restricted to run-off from the roof hardstanding and paved areas.

[17] Cummins, QSK32-G3 (Non-Regulated) Specification sheet

[18] Cummins, C3000 D5e Generator set data sheet

Surface water and foul water drainage plans are illustrated in the Site Layout and Emissions Point Plan[7] and also the Drainage and FRA Report[19], which can be found in Appendix 03-03.

5.4 Fugitive emissions / leaks

5.4.1 Fuel storage and distribution

Management systems will be in place at the facility 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 emergency shutdown in the event of major faults in equipment. Scheduled maintenance of diesel tanks will be incorporated into the Environmental Management System (EMS), to minimise the risk of fugitive emissions of fumes to air.

The standby generation diesel fuel storage, fuel delivery and engine lubrication oil systems have been designed to consider the potential impact of leaks / spillages on the site.

The principal guidance for the design of the oil storage and associated infrastructure is the Control of Pollution (Oil Storage) (England) Regulations 2001. Additionally, the requirement for the safe environmental storage of fuel on-site (including transport of fuel) is covered within the EPR.

Best Available Technique (BAT) Reference (BREF) document 'Emissions from storage' for sites regulated under the IED has also been considered as part of the design.

A road tanker will fill up the diesel top-up tank at the fill point in a lockable cabinet. The tanker will be parked on an area of slab that slopes towards a central drain which is connected to an oil separator, and in turn is connected to the surface water drain network.

The top-up tank is located above ground within a bunded area capable of retaining 110% of the 40,000 litre tank volume in the event of spillage of diesel. This volume of diesel is required to meet the requirement to be able to provide uninterrupted power for three days without any external assistance. The tank has integral level alarms remotely monitored allowing instant accurate assessment of the filling level.

The top-up fuel tank bund has a sump-pump located within it to remove any surface water, which connects to an oil interceptor before discharging non-oily rainwater to the foul sewer network.

This top-up diesel tank is connected via a short underground twin walled pipe (pipe-in-pipe) which is connected to the main bunded generator enclosure area (110% capacity). The fuel is distributed to the individual generator 16,000 litre belly tanks via a single pipe network within the bunded area.

The short underground twin-layered pipe between the top-up tank and main generator bunded area is essential to remove the potential for risk of collision and rupture of an above ground fuel pipe during fuel delivery or other maintenance activities.

The underground pipe contains a leak detection system along the length, which uses a vacuum between the inner and outer pipe linked to an additional alarm panel. In the event of loss of vacuum, an alarm will activate and again be remotely monitored via the generator control system.

[19] Arup, 2022. Flood Risk Assessment and Drainage Strategy Report (2022) (Document ref ARP-005). Hemel Hempstead Data Centre - Emergency Back-up Generation Facility

The diesel will be automatically pumped from the receiver tanks directly to the belly tanks. See the Fuel Distribution schematics[20, 21, 22] provided for further details in Appendix 03-05.

All tanks, pipes and valves are designed to appropriate industry standards and flanged connections between pipes are kept to a minimum by the proximity of the tanker fill point.

When the twin-walled pipe appears aboveground next to the generator compound, the diesel fuel is briefly in a single-walled pipe before entering the main bunded generator area from distribution to the individual belly tanks. These fuel pipes are situated over hardstanding with surface water drainage which passes to an oil interceptor to minimise the impact of any leaks. Visual inspections will also take place daily to identify any leaks, with spill kits being on hand at multiple locations. In the event of any leaks at this location, the single-walled pipe would be isolated to minimise the quantity of fuel potentially released. The belly tanks can also be filled directly from within the bunded area, meaning operations can continue whilst any maintenance is undertaken with minimal disruption and environmental impact.

Fuel integrity is maintained with each generator housing a fuel polishing unit to constantly circulate and filter the fuel. Blockage alarms will also be installed as an additional risk reduction measure, which will be remotely monitored.

The belly tanks will also be provided with alarms in the event of pressure loss/significant leakage into the bund, as well as having alarms which alert at high and low fluid levels, both during filling and operation. These alarms will be remotely monitored via the generator control system. The operator will also carry out daily checks for signs of smaller leakage not notified by the alarm system.

Fuel tank filing will be carried out by trained fuel tanker drivers. This reduces any significant risk of spillages and leaks. Spill kits will also be available to deal with any leaks. Relevant spill response equipment will be situated at various locations around the site, designed for the particular hazard characteristics of the materials (fuel) present.

All spillages will be logged, investigated and corrective action will be taken.

It is anticipated that fugitive emissions of odour will not be significant for the facility. Diesel will be contained within vented tanks and therefore would only be a potential source of odour if a spill were to occur. Procedures will be incorporated within the EMS to ensure the potential for spills is minimised and they are dealt with swiftly should they occur.

No powders or other dry materials will be used or stored at the installation and therefore fugitive emissions of dust are unlikely to occur.

[20] Fuel Delivery Area (Document reference Appendix 03-05 Drawing ref LHR095-ARP-00-XX-DR-C-2006)

[21] Diesel Storage Schematic (Document reference Appendix 03-05 Drawing ref LHR095-AWS-01-XX-DR-M-1030)

[22] Diesel Distribution Schematic (Document reference Appendix 03-05 Drawing ref LHR095-AWS-01-XX-DR-M-1031)

6. Resource Use and Efficiency

6.1 Raw Materials

In response to Application Form Part B3 question 3c.

In response to Application Form Part B3 question 6d.

The raw materials to be used at the site are:

Diesel fuel oil: each generator will require (when providing 'standby' power):

- Main back-up generators QSK78-G16 (6.86 MWth): up to 627 litres per hour (at 100% load).
- House generator QSK23-G3 (2.57 MWth): up to 212 litres per hour (at 100% load).

Lubricating oil and anti-freeze: 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 and anti-freeze for the generators will be stored within the engines and manually topped up during servicing by an appointed service contractor.

Transformer oil: Occasional top up or replacement will be required.

No lubricating oil/anti-freeze or transformer oil will be stored on site by the operator; all oils will be brought to site and topped up/replaced during planned or forced maintenance periods only.

The BAT objective with regard to raw materials is achieved by the appropriate design, operation and maintenance of the generators 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 generator engines are designed for the combustion of diesel fuel oil, this being the fuel recommended/specified by the engine manufacturers. The diesel fuel will have a low sulphur content.

Diesel has been selected due to the ability to store sufficient volumes on site to ensure security of supply. Other fuels have been considered but do not currently provide the same level of security of supply. Natural gas could not be stored in sufficient volumes and would be reliant on the National Transmission System, a contract for uninterruptable supply would be excessively costly given the infrequency of use. Due to the limited hours of operation, any potential benefits from the lower impacts associated with emissions from natural gas are reduced.

The engines will utilise a closed-circuit cooling water (CCCW) system which will utilise a water / glycol mix. The cooling system, including coolers and CCCW circulating pumps will be fully within the container for each engine. There will be no need to routinely top up coolant and any spillages or leaks will be quickly identified and dealt with.

The lubricating and transformer oils may have other alternatives, however the type of fluids used are limited to those recommended/specified by the engine manufacturers and site engineers.

6.2 F-gases

In response to Application Form Part B3 question 6d.

F-gases will be used within the wider data centre however will not be used as part of the Scheduled Activities or Directly Associated Activities listed; namely the combustion of fuels with a rating >50MWth for the back-up diesel generators, together with the storage of the associated diesel fuel.

The data centre will use the refrigerants R-410A in the air conditioning systems and administration building air handling units.

R410A is a mixture of difluoromethane (CH_2F_2, R-32) and pentafluoroethane (CHF_2CF_3, called R-125). Whilst being zero ozone depleting, its global warming potential is greater than that of CO_2.

The refrigerant R-32 will also be used in the split units.

The Hybrid coolers do not have any refrigerant gas; they utilise ambient air to cool the water in the chilled water system (CHW) loop.

Regular maintenance will be undertaken by an approved specialist contractor to ensure the units are all operating correctly and to prevent any leaks. Records will also be maintained of any refrigerant top-ups needed.

6.3 Energy Efficiency

In response to Application Form Part B3 question 6a and 6b.

The Energy Efficiency Directive 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".*

As the total installed planned maintenance and testing schedule falls below the 1500 hour threshold (33 generators x 19 hours each = 627 hours), the data centre is therefore exempt from the EED requirements and an assessment of energy efficiency is not required.

The back-up generators 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.

The back-up generators are designed for use in the event of an emergency. The efficiencies of the main emergency generators and the smaller 'house' generators at the data centre are 35% each, with a total installed thermal input of 222 MW and a rated electrical output rating of 77.7 MWe.

The provision/implementation of combined heat and power (CHP) is not applicable as the back-up generators will each operate for substantially less than 500 hours per annum for the provision of emergency power generation.

Energy recovery is also not reasonably practicable for engines of this emergency nature with such small anticipated operational hours. However, as part of the operator's Environmental Management System (EMS), energy use will form one of the key environmental indicator and regular assessments of the site's energy usage will be undertaken with a view to identifying measures to improve energy efficiency, where possible.

Energy efficiency will form part of on-site staff training.

6.3.1 Climate Change Agreement

In response to Application Form Part B3 question 6c.

The operator is not a participant to a Climate Change Agreement (CCA) for the data centre sector, however the operator will assess the site at a corporate level against the European Commission lead Code of Conduct for Energy Efficiency for Data Centres, in-line with the most recently published Best Practice Guidelines[23].

Energy management techniques will be implemented to monitor, record and track power usage effectiveness (PUE) at the data centre.

[23] EC, 2022. Best Practice Guidelines for the EU, Code of Conduct on Data Centre Energy Efficiency. Available at < https://e3p.jrc.ec.europa.eu/publications/2022-best-practice-guidelines-eu-code-conduct-data-centre-energy-efficiency> Accessed March 2022

6.4 Water Minimisation

In response to Application Form Part B3 question 6d.

There will be no consumption of water associated with the back-up generators / combustion activities and use/ storage of diesel at the site.

As stated in section 6.1, 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 installation.

The area containing the coolers and CCCW circulating pumps will be within the engine containers so the risk of accidental discharge of process waters to controlled waters is minimised.

No fire-fighting water will be stored within the installation area, but will be included in the wider site (see Site Plan Appendix 03-04).

6.5 Waste Minimisation

In response to Application Form Part B3 question 6e.

The site will not produce significant amounts of waste due to the nature of its operations.

Any waste oil generated during testing/ maintenance will be removed from site by the appointed third-party contractor and managed by a suitably regulated waste management contractor. The same applies to any Waste Electric and Electronic Equipment generated on-site (not related to the Scheduled Activity or DAA, but wider site operations).

7. Monitoring

In response to Application Form Part B3 question 4.

7.1 Emissions to Air

Each of the back-up generators will each operate for less than 500 hours per annum and will not be subject to emissions limit values (ELV) as described in Section 2.2.

As the generators will also not be used for the elective generation of electricity they will not be considered specified generators in accordance with EPR 2018 and hence will not be subject to the ELV.

In-line with BAT guidance received during engagement with the EA, it is expected that the operator will need to demonstrate that the engines are BAT by including the provision of flue gas sampling ports to allow for NOx and CO monitoring, designed to meet BS EN 15259[24].

Any testing will be undertaken by an organisation with the EA's MCERTS accreditation for these measurements, so that the data meets the requirements of the MCERTS certification for emissions monitoring systems.

In-line with the MCPD requirements captured by the EPR 2018, it is expected that periodic measurements shall be required at least when three times the number of maximum average annual operating hours have elapsed for medium combustion plants with a rated thermal input >1MWth and less than <20 MWth. This is for plant which operate <500 hours and have no ELVs associated with their operation.

The first measurements shall be carried out within four months of the grant of a permit to, or registration of, the plant, or of the date of the start of the operation, whichever is the latest.

In addition, the operator will also 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.

As detailed in Section 4.1.1, one of the reasons for the decision to choose diesel back-up generators on-site is in relation to their 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 generators in use.

7.2 Emissions to water

7.2.1 Surface water

There are no point source emissions to and from the generators or associated fuel storage.

Uncontaminated surface water runoff from generator compounds will be discharged via the on-site surface water drainage system. This run-off will pass via a full retention oil interceptor to an on-site attention pond before leaving the site boundary and discharging to the Thames Water network.

[24] BSI, 2007. Air Quality. Measurement of stationary source emissions. Requirements for measurement sections and sites for the measurement objective, plan and report. BS EN 15259:2007

Monitoring of the surface water discharge from the data centre is not considered necessary.

For the purpose of the environmental permit, in relation to surface water runoff from the permitted Installation, there will be four point source emissions to water, referred to as W1-W4, the location of which is indicated on the Site Layout and Emissions Point Plan[7] the point at which it leaves the Installation boundary.

7.2.2 Foul water

There are no point source emissions to and from the generators or associated fuel storage.

The wider data centre, not the permitted installation, will be connected to the municipal combined sewer system for discharges of domestic grey water / sanitary effluent (sinks, toilets, cleaning water, etc.)

Drainage from the top-up diesel tank bunded area is connected via a sump pump to a separate full retention oil separator to the foul water network, before discharge to the sewer network (see Drainage and FRA Report[19] and Foul Water drawings[25]).

Based on the above information, monitoring of the foul water discharge from the data centre is not considered necessary.

For the purpose of the environmental permit, in relation to foul water discharge from the permitted Installation, there will be two point source emissions to water, referred to as W5 and W6, the location of which is indicated on the Site Layout and Emissions Point Plan[7] as the point at which it leaves the site boundary.

[25] Foul Water Drainage (drawing refs LHR095-ARP-00-XX-DR-C-1200 to LHR095-ARP-00-XX-DR-C-1204).

8. Environmental Management Systems

In response to Application Form B2 question 3d.

8.1 Overview

The operator will develop an EMS in line with the requirements of the international standard ISO14001:2015, or a suitable equivalent standard.

The operator has a corporate ISO 14001:2015 Environmental Management Systems (EMS) certification (Document reference Appendix 03-07) specifically for its wider co-located data centres. The operator's long term ambition is to have ISO 140001 certification across different types of sites.

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.

8.2 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.

8.3 Organisation

The operator will establish and maintain documented procedures for identifying and recording environmental aspects for all its activities, products 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.

8.4 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.

8.5 Environmental Risk Assessment

Environmental risk assessments, together with the environmental aspect evaluation, will allow routine management system procedures to manage risks under normal circumstances, and emergency plans to mitigate impacts under abnormal circumstances. Such assessments will cover the implications of material storage, oil 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.

8.6 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.

8.7 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 Environmental Permit.

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 Emergency Response Plan (ERP), 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.

8.8 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.

8.9 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.