Virtus Hayes Ltd

ENVIRONMENTAL PERMIT APPLICATION

Virtus London 2 Data Centre

70092911/LON2/EPR001
JUNE 2022

PUBLIC

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1 INTRODUCTION

WSP UK Ltd has been instructed by Virtus Hayes Ltd to prepare an application for an Environmental Permit (EP) for the installation referred to as Virtus Hayes, or LON2, Data Centre situated within the Western International Park, Hayes Road, Southall. The post code for the site is UB2 5XX.

The Data Centre is connected to the local electricity transmission network via multiple grid connections; however, given the nature of the data centre and the requirement to have an available energy supply at all times, LON2 (currently 12MW IT load) has 8 (eight) diesel-fired standby generators for Low Voltage generation installed, with a thermal input of 45.7MW(th), and is proposing to instal a 9th engine. This will increase the total thermal input to across all generators to greater than 50MW. LON2 is operated independently but operates under a common management system and management structure as other Virtus Data Centres across North London.

The generators provide power to the site in the event of an emergency situation such as a failure of the local electricity transmission network, or an internal component failure requiring disconnection from the grid. During such events there is a potential for a delay between fault detection and initial operation of these back-up generators; hence the initial uninterruptible power supply is provided by on-site battery arrays in order to cover this 'time gap' and the consequent loss or reduction in the power supply to the data servers.

The rated generation capacity of the installed generators is 2.0MWe each. Thermal input ratings to the existing engines is 5.714MWth each (based on Environment Agency calculation method). Thermal input ratings of the new engine type is 5.19 MWth each. The total rated thermal input (under standby power operating conditions) of all nine generators across the LON2 site will be 51.00MWth.

In accordance with the Environmental Permitting (England and Wales) Regulations 2016, as amended (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".

The site is therefore considered to be an 'installation' as defined in Paragraph 1, Part 1, Schedule 1 of the EPR as: "a stationary technical unit where one or more activities are carried on".

The "activities" that are proposed at the installation are defined in Chapter 1, Schedule 1 of the EPR under Section 1.1, Combustion Activities.

This document is therefore submitted on behalf of the Operator to support the application for a new bespoke Environmental Permit for the site, as per the requirements of Section2(1), Part 1, Schedule 5 of the EPR. It describes the operating techniques that will be implemented at the facility with respect to the diesel generators to ensure that environmental aspects are managed in compliance with the conditions of the Environmental Permit and in line with Best Available Techniques (BAT) requirements.

For the purposes of this application, relevant technical standards in the following documents have been referenced:

- GOV.UK Develop a management system: environmental permits guidance, 14 January 2019;
- GOV.UK Risk assessments for your environmental permit guidance, 25 March 2021;
- Environment Agency's Data Centre FAQ Headline Approach, provided directly on request by the Environment Agency, v11 dated 11/05/2020;
- Best Available Techniques (BAT) Reference Document for Large Combustion Plants, 2017 and the associated BAT Conclusions (Establishing Best Available Techniques (BAT) Conclusions, under Directive 2010/75/EU of the European Parliament and of the Council, for Large Combustion Plants, 31 July 2017); and,
- How to Comply with Your Environmental Permit Additional Guidance for Combustion Activities.

2 FORM A SUPPORTING INFORMATION

2.1 COMPANY DETAILS

Virtus Hayes Ltd

Registered office 4th Floor, 20 Balderton Street, London England W1K 6TL.

Company Number **07670476.**

Table 2-1 – Virtus Hayes Ltd Directors

Name	Address	Date of Birth	Occupation
Neil David Cresswell	4th Floor, 20 Balderton Street, London, W1K 6TL	[redacted]	CEO
Jonathan Allen King	4th Floor, 20 Balderton Street, London, W1K 6TL	[redacted]	COO
Nelson Lim Yueh Hua	Centennial Tower, 3 Temasek Avenue 28-01, Singapore 039190, Singapore	[redacted]	CFO
Bruno Lopez	Centennial Tower, 3 Temasek Avenue 28-01, Singapore 039190, Singapore	[redacted]	CEO
Daryl Robert Leslie Seaton	4th Floor, 20 Balderton Street, London, W1K 6TL	[redacted]	CFO
Nicholas Toh Lik Hau	Centennial Tower, 3 Temasek Avenue 28-01, Singapore 039190, Singapore	[redacted]	Vice President

The company structure of Virtus HoldCo Ltd is appended as Appendix A with the Virtus Hayes Ltd management team shown in Figure 3-2.

3 FORM B2 SUPPORTING INFORMATION

3.1 PRE-APPLICATION DISCUSSIONS

General discussions have been held concerning the Virtus data centre portfolio between the Operator and Howard Tee and Guy Elliot of the Environment Agency (EA) on 11th July 2018 to outline the EA's Approach to permitting datacentres and to understand Virtus' operations and obligations in relation to the EPR, followed up by e-mail on 12th July. More frequent discussions have been held regarding compliance of engines and 'future-proofing' compliance with specific Agency stated BAT standards, across the complete portfolio of Virtus Data Centres. Virtus are now applying for the Hayes unit, due to the increase of the proposed thermal input to the engines. Hayes is distant from the other Virtus Data Centres and hence isn't included in any campus agglomerations.

An enhanced pre-application submission was made on-line using the Environment Agency web service, reference number EPR/EP3247JV/A001. A response was received on 7 June 2022 which contained a Habitats screening report with maps, and an Installations pre-app basic advice summary.

The approach to be adopted for the Permit application follows the earlier Virtus applications and is:

- The Environmental Permit application will focus on the standby generators and associated routine activities (primarily testing) and not the operation of other data centre-related activities;
- The Permit is required for the routine generator testing regime and associated emissions, however the Air Emissions Risk Assessment to be submitted alongside (but subsequent to) this application will also include a generic emergency operational period required by the Environment Agency of 72 hours and comparison to US AEGL air quality guidelines;
- There may be a need for an air quality emergency action plan in conjunction with the Local Authority due to the location of the facility and the number of generators;
- Noise impacts could also require a similar emergency action plan with the Local Authority depending on the outcome of the noise screening risk assessment and any subsequent noise impact assessment if so required (which will also be separately to this application);
- Best available technique (BAT) for the generator engine planned maintenance and testing protocol is to minimise emissions at the worst times (i.e. during peak traffic hours). The maximum hours per generator should be logged and reported to be less than 50 hours per year to stay below the Medium Combustion Plant Directive specified generator requirements;
- Environment Agency BAT for the engines is to achieve certification at US EPA Tier 2 D1 level for emergency generators or TA Luft 2G equivalent, noting the lack of an available written standard for the latter;
- Fuel delivery and storage will be considered in the BAT assessment, containment systems will need to meet CIRIA C736 guidance;
- Details of reliability of the grid and connection philosophy etc. is required in the permit application as justification of the need for the standby role and associated peak impacts;
- A biodiversity pre-application screening assessment was included in the pre-app response; and,
- The charge for the application was also included the pre-application response.

The application comprises the following elements:

- Application forms (Parts A, B2, B3 and F1)
- Non-technical summary
- Operating Techniques
- Environmental Risk Assessment
- Air Emissions Impact Assessment (separate report submission)
- Noise screening or Impact Assessment (separate report submission)
- Drainage details and CIRIA C736
- BAT discussions
    - Grid reliability
    - Engine emissions and standards
    - Exhaust dispersion characteristics
- Site Condition Report

3.2 ABOUT THE SITE

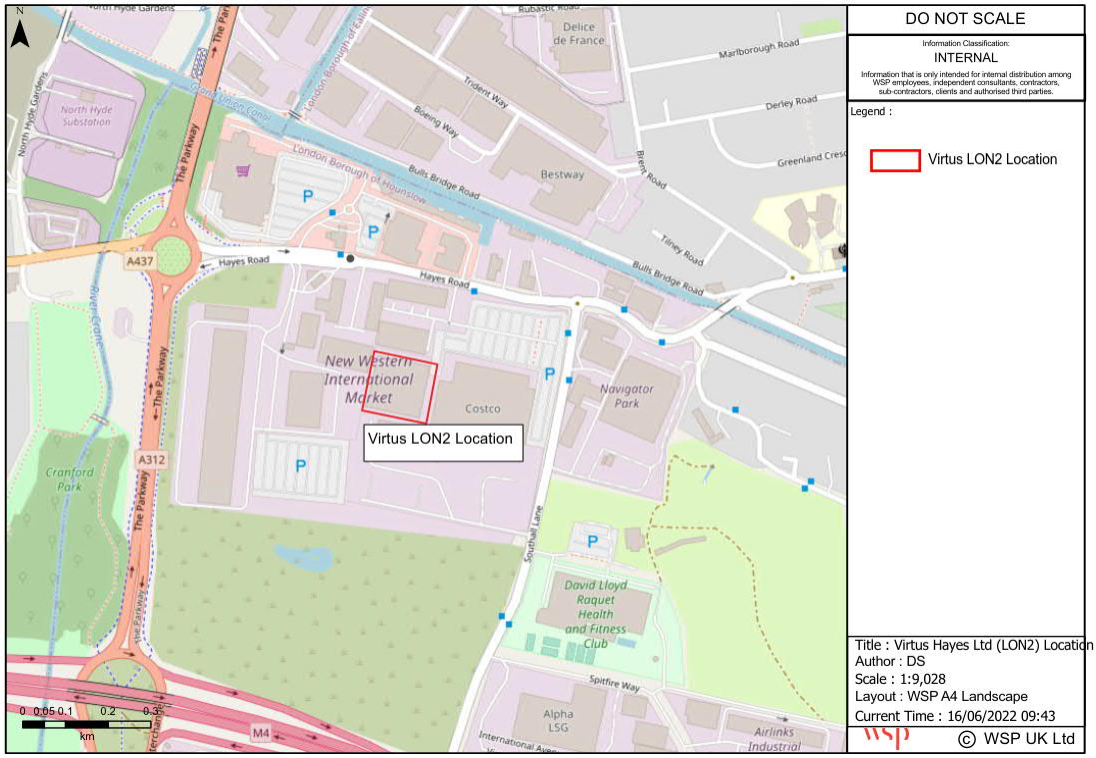
The address for the installation is:

Virtus Hayes Ltd (LON2)
Western International Park,
Hayes Road,
Southall,
UB2 5XX

OS National Grid Reference: TQ 10860 78698

The location of the site in relation to the local area is shown below and in full in Figure 1 in Appendix B.

Figure 3-1 - Location of Installation



TYPE OF REGULATED ACTIVITY / FACILITY

The site consists of a single installation comprising a stationary technical unit (STU) made up of the generator engines and fuel oil storage tanks for emergency use only. The individual engine thermal inputs are each less than 15MWth. The plant does **not** form a Chapter III Combustion Plant under the Industrial Emissions Directive. The total thermal input applied for is 51.00MWth.

More detailed discussion of the site itself (for the purposes of the Environmental Permitting Regulations) is provided in Section 5.

The site is not a multi-operator installation.

3.3 ABILITY AS AN OPERATOR

This section provides additional information in relation to Form B2 3d Management Systems.

3.3.1. Virtus subscribes to internationally recognised data centre design standards such as the Uptime Institute's Tier III design certification. The basic requirements of this standard include:

- 99.982% uptime of power;
- No more than 1.6 hours of power downtime per year; and,
- N+1 fault tolerant providing at least 72-hour power outage protection.

The generator sets are rated against the ISO8528 definition, and transient load acceptance tests completed to ISO8528 G3. The generators will be ANSI/TIA-942 compliant for Rated-1 through Rated-4 data centres.

3.3.2. Virtus has been designing, building and operating data centres since incorporation in 2008. Data centres are mission critical facilities that are designed to supply uninterrupted power to tenant equipment 100% of the time. Virtus customers have global presence and hence provide global services which they must maintain. Virtus are required to deliver the highest levels of resilience and ensure that new technologies are used which do not compromise reliability. Virtus data storage services are managed in accordance with, and certified to, the standards detailed in this application via an Integrated Management System (IMS) to ensure delivery of quality data centre services, energy and environmental performance, health and safety, and information security. The scope of certification is 'the design, build and ongoing operation of mission critical data centre facilities.' See also Section 5.3 for a comprehensive review of Virtus management systems.

Appendix A provides the ownership structure chart for the HoldCo level company, the Management structure for Virtus Datacentres including LON2 is shown below.

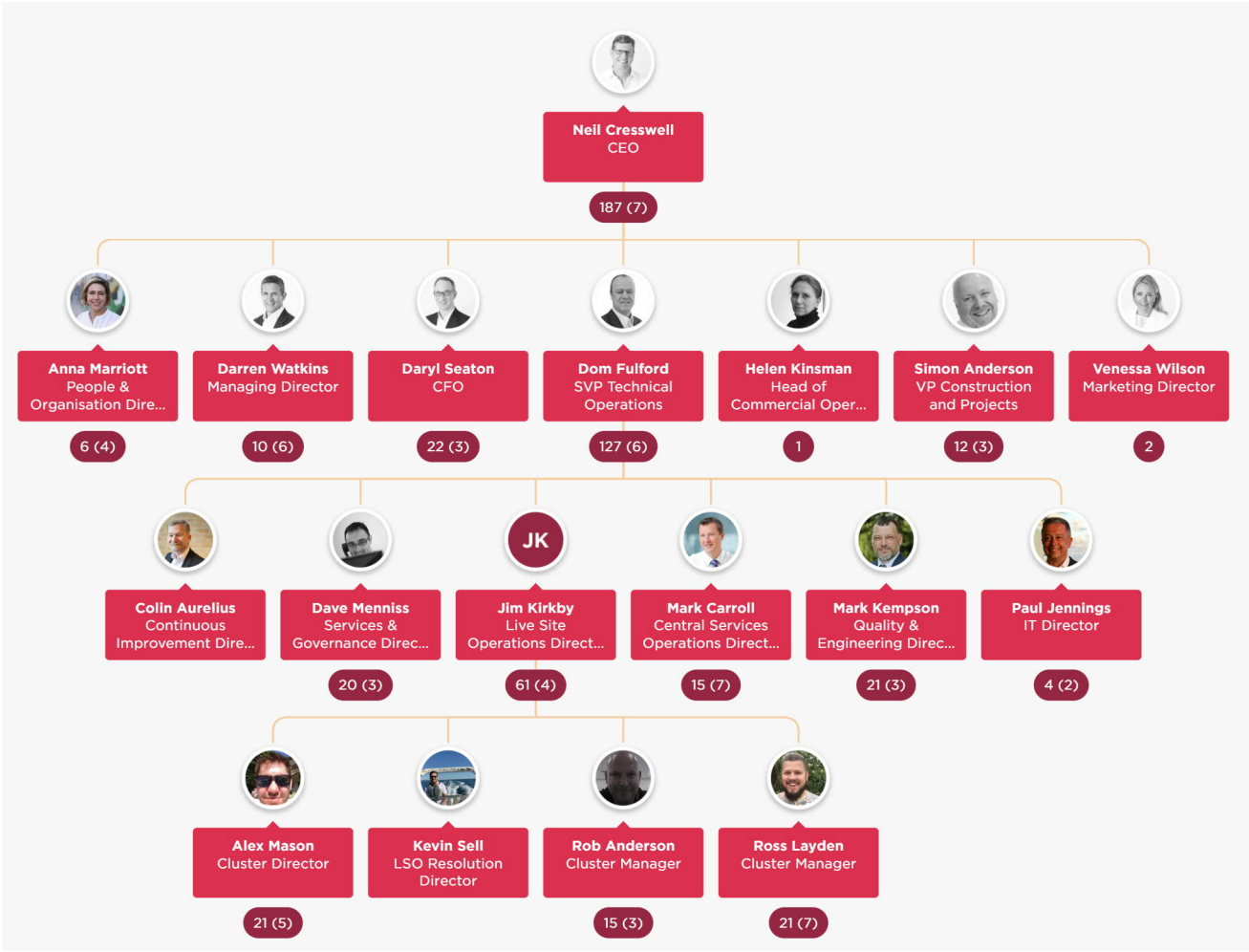


Figure 3-2 - Virtus Hayes Ltd Management Team

3.3.3. Management Systems

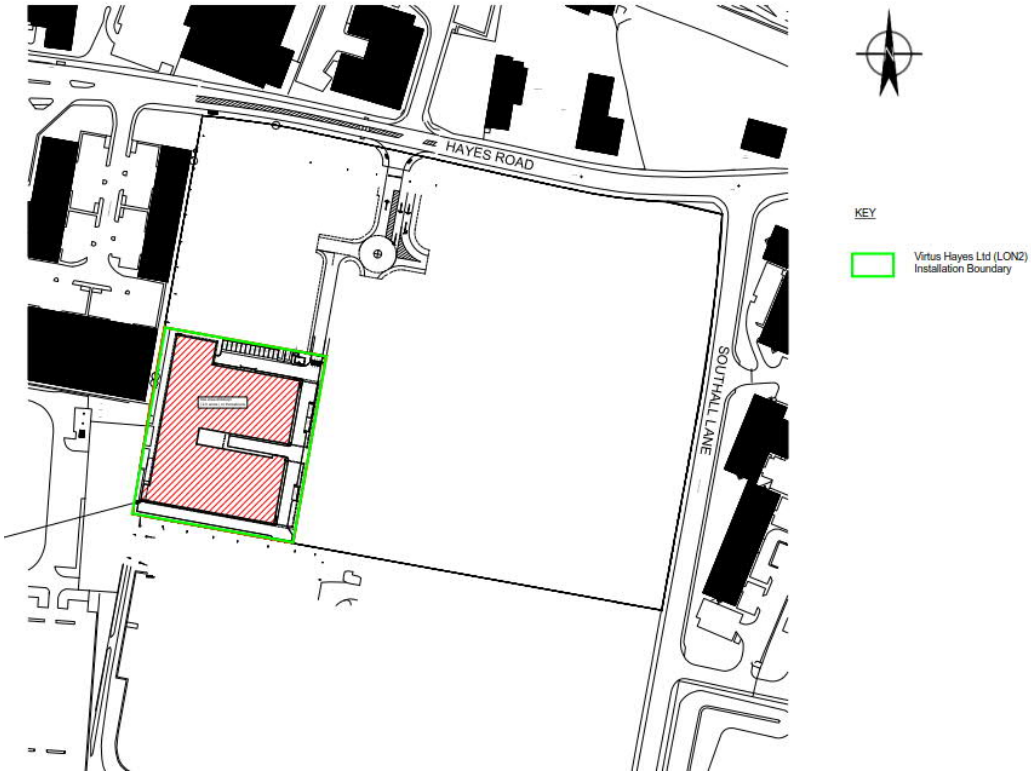
The data storage services at the site are managed in accordance with, and certified to, the standards and management systems described extensively in Section 5.3 via an integrated management system for the delivery of quality data centre services, energy and environmental performance, health and safety and information security. The scope of certification is the “design, build and ongoing operation of mission critical data centre facilities”.

The integrated management system is certified to ISO 14001 for the environmental management component (EMS) and is detailed in the Operations Manual (Chapter 6 Occupational Health & Safety and Environmental (OHSE) Management System). This includes an integrated policy (Compliance Policy), management principles, organisational structure, responsibilities, standards/procedures, process controls and resources which are in place to manage environmental protection across all aspects of the business.

3.4 PLANS

The location of the installation is shown in Figure 3-1 above and the installation boundary is shown below in Figure 3-3 and both as Figure 1 and Figure 2 respectively in Appendix B in A3 format.

Figure 3-3 - Installation Boundary



The following drawings accompany this Environmental Permit application in Appendix B:

1. Site Location
2. Installation Boundary
3. Emission Points
4. Drainage Plan

3.5 SITE CONDITION REPORT

A site condition report (SCR) has been developed and forms part of this application, reference 70092911/LON2/SCR/001.

The Site Condition Report (SCR) provides information on the current and previous condition of the land and groundwater at the site. This will be a 'live' document and will be updated during the lifetime of the installation and used to inform the surrender SCR at the time of installation closure.

The SCR report draws on a key report:

- Geotechnical and Geoenvironmental Report 251347-01(00) August 2011, RSK Group PLC.

The SCR describes historical activities on the site as well as any remediation works undertaken and references extensive geo-environmental assessments undertaken where available. It also contains the chemical analytical results of soil, leachate and groundwater sampling which provides the site baseline data, where this has been made available at the point of application.

3.6 ENVIRONMENTAL RISK ASSESSMENT

An environmental risk assessment (ERA) has been undertaken as part of this application, reference 70092911/LON2//ERA.

This has been undertaken in accordance with GOV.UK guidance Risk assessments for your environmental permit and covers the following steps:

- Step One – Identification of Risks
- Step Two – Identification of Receptors
- Step Three – Identification of Pathways between Sources and Receptors
- Step Four – Assessment of Risks
- Step Five – Controls for Risks
- Step Six – Presentation of the Results

Odour, noise, fugitive emissions, visible emissions, discharges and accidental releases from the installation are all considered in the ERA. There are not considered to be any significant risks to the environment. There is no risk of nuisance to nearby noise sensitive receptors from noise emissions, and a very low risk of land / water pollution in the event of any leaks or spills of diesel required for the generators; Air Quality risks are insignificant for normal operations (routine testing of engines) and insignificant for a long term full site emergency outage, which in itself is of low likelihood. The Air Quality Assessment which follows this application will discuss the emissions to air in more detail. Appropriate mitigation and emergency response procedures will be in place and are detailed below (Section 5) and in the ERA.

4 FORM B3 SUPPORTING INFORMATION

4.1 LISTED ACTIVITIES

This section supports Form B3.1.

4.1.1. The installation at Hayes Road comprises a single data centre unit referred to as London 2 (LON2), built to Uptime Tier III standard which means that there is no interruption to the operation of the computer hardware located in the centre, for example during routine maintenance of power and cooling systems. The emergency generators provide an important part of achieving the standard. LON2 has eight generators divided across 2 generator rooms, each room has six engine spaces, currently there are four engines in the northern room (Generator Room 1), and four in the southern room (Generator Room 2). This application will add a fifth engine in to Room 1.

The installation activities and directly associated activities are presented in Table 4-1.

Table 4-1 – Installation Activities

Installation Name	Schedule 1 Reference	Description Activity	Activity Capacity
Virtus LON2	Section 1.1 Part A(1)(a) Combustion	Burning any fuel in an appliance with a rated thermal input of 50 or more megawatts	Total 51.00 MWth (9 engines)
Directly Associated Activities			
Name of DAA	**Description of the DAA**		**Activity Capacity**
Storage of raw materials (fuel)	Storage of diesel in belly and day tanks for each engine serving the Schedule 1 combustion activity.		9 x 21,666 litres = 194,994 l belly tanks Plus day tanks 9 x 1200l = 10,800 l Total 205,794 l capacity

This application (including the associated modelling studies and risk assessments) will be prepared on the basis of the full complement installation numbers of standby generators shown in the Table below.

Table 4-2 – Virtus LON2 Standby Generator Numbers

Data Centre	No. of Installed Generator Sets	Design	Net Power Output kWe each	Current Thermal Input MW	Permit Design Thermal Input MW
LON2	8	Up to 9	2,000/1,888	45.71	51.0

Engine compliance to BAT is discussed in Section 5.6.

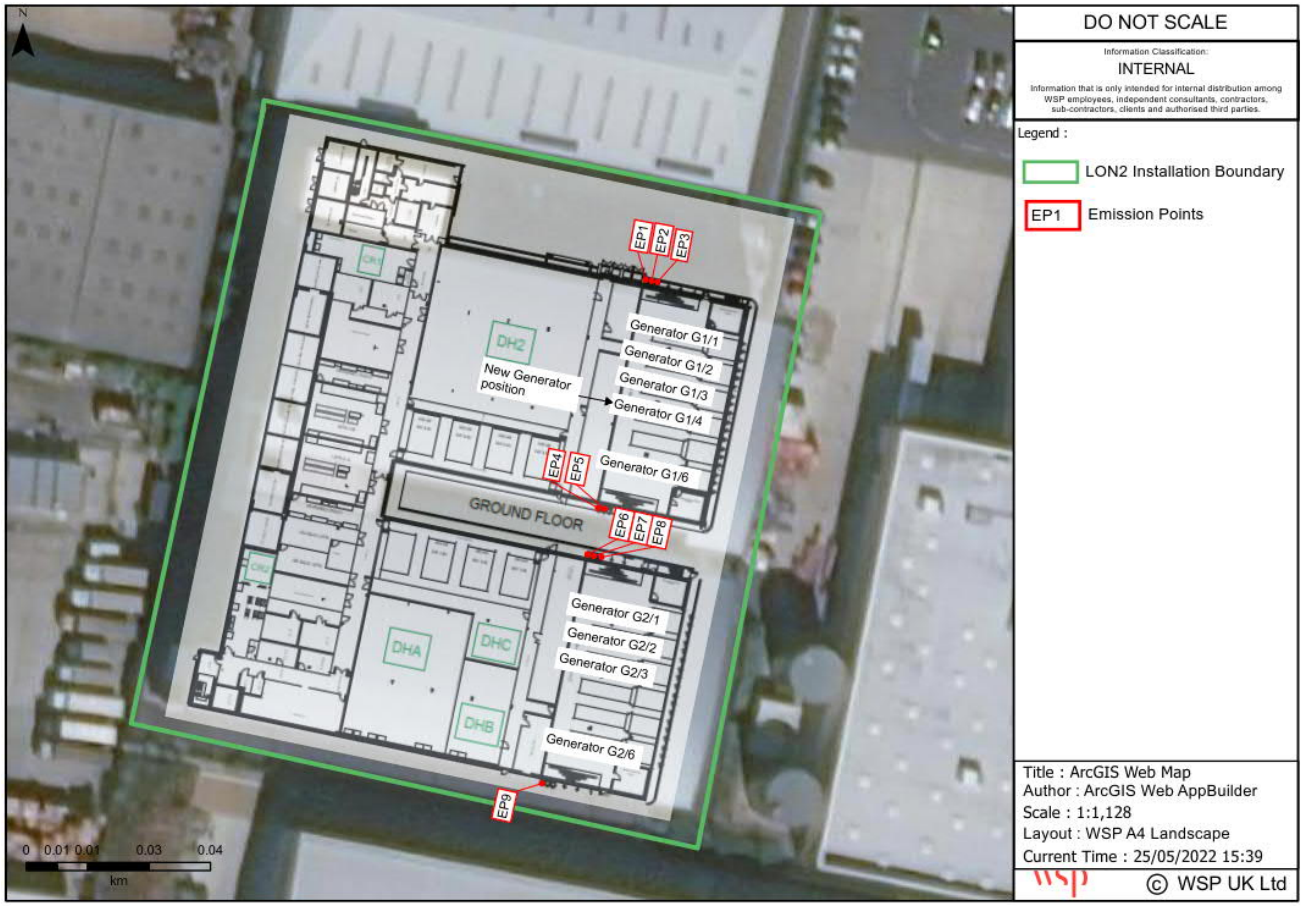
4.2 EMISSIONS TO AIR, WATER, LAND

This section supports Form B3.2 and provides the description of the principal release points from the site.

POINT SOURCE EMISSIONS TO AIR

There will be nine combustion point sources to air (numbered EP1-9), all of which are emergency generator sets exhausts. The emission point parameters are shown in the image copied below and in the full plan in Appendix B.

Figure 4-1 - Emission Points to Air



Emissions to air from the site will vary depending upon the operational scenario of the engines (specifically the testing regime required by the manufacturers and in some cases also by the data centre clients). The engines will only be operational during testing, or rarely, during periods of emergency back-up situations (i.e. in the event of a power outage from the national grid, or an internal system failure requiring a power stream to come off grid). There will be no point source emissions to air outside of these periods.

Emissions to air are discussed extensively in Operating Techniques 5.7 Emissions to Air and in the Air Dispersion Modelling Report being prepared in support of this application.

POINT SOURCE EMISSIONS TO WATER

There are no direct discharges to surface waters, the LON2 generator rooms are internal to the building in a suitably engineered concrete floor with floor gully drains serving the two engine rooms which discharge to public foul sewer. The fuel delivery pipe connections are external to the building in an enclosed locked box over a bunded and covered area with surface water drainage discharging via a Class 1 forecourt separator with 10,000 l capacity and high level alarm. This system then discharges via a stormwater attenuation tank with flow control ultimately to the public surface water sewer system.

Drainage drawings attached in Appendix B are listed below in Table 4-3:

Table 4-3 – Drainage Drawing references

Unit	Drawing
LON2	WML Consulting, 4722 E01, Final Construction issue Nov 2014

Daily asset integrity storage inspections and accompanied observed delivery following strict Virtus procedures will adequately control the risk of any spill or loss that might overwhelm the interceptor.

EMISSIONS TO LAND

There are no proposed point source emissions to land from the installation activities.

5 OPERATING TECHNIQUES

5.1 GENERAL

The installation at Hayes Road consists of a single data centre in one building, referred to as London 2. Virtus Data Centres are built to Uptime Tier III standard which means that there is no interruption to the operation of the computer hardware located in the centre, for example during routine maintenance of power and cooling systems. Virtus currently has a 100% uptime record.

The Data Centre has a total advertised net technical data centre space of 6,000m^2, delivering 12.2MW IT load. The buildings will operate with N+1 LV Datacentre Continuous rated generators with sufficient onsite fuel supply for 48 hours run time at emergency (near full) load. The site is built and partially equipped and commercially operational.

The generator output specifications are driven by the data centre design; the eight existing engines are 2,000kWe output Mitsubishi S16R2-PTAW mission critical standby packaged gensets, four in each Generator Room, and the generator proposed to be installed is based on a MTU 16V4000G24F DS2500 TA-Luft optimized engine.

These are described in this Chapter and in the datasheets attached in Appendix C.

The generators are only utilised as back-up emergency provision and hence the routine operation is for testing and maintenance only. The regime is outlined in Table 5-1 below.

Table 5-1 – Routine Operational Scenario

Scenario	Load	No. of Generator tests	Minutes per year per Generator	Total mins test all gens
Routine off-load testing per month (11 months)	15 mins @ 0%	99 spread across the year	165	1,485
On-load test once per year ("12th month")	20 minutes @ 100%, 120 mins @ 75%	9 spread across the year	140	1,260
Total	**-**	**108**	**305**	**2,745**

The designed total test period per generator per annum is hence 305 minutes or 5 hours 5 minutes.

The Air Quality Impact Assessment is also considering an emergency outage which for which the emissions are described further below.

5.2 STANDARDS

5.2.1. Form B.3a Technical Standards - Historical References

The following standards apply in general terms:

- Management Systems – ISO/IEC 27001:2013; ISO 9001:2015; ISO 14001:2015; ISO 50001:2011 (Certificates attached as Appendix D)

- Agency FAQ Data Centre BAT
- Engines to comply with US EPA Tier 2; TA Luft 2G or environmental equivalence
- CIRIA 736
- Diesel tanks built to BS799:Part 5 Type J (2010)
- Operations to Uptime Institute Tier III
- Adler & Allan ULSG specification
- Datasheets DS2500-3B- NOx and T0402-0001E (Appendix C)
- Chapter 6 – OHS&EM manual v2.5 (Appendix E)
- OLE Bund Alarm information (Appendix G)
- METHOD_STATEMENT_0478_VIRTUS DC_GENERATOR_DIESEL_TESTING_24.09.18 (Appendix H)
- Petrol Interceptor cleaning RAMS

The Uptime Institute requirements are described in the box below.

Note on the Uptime Institute Tiers, I, II and III

Tier I

A Tier I data centre is the basic capacity level with infrastructure to support information technology for an office setting and beyond. The requirements for a Tier I facility include:

- An uninterruptible power supply (UPS) for power sags, outages, and spikes.
- An area for IT systems.
- Dedicated cooling equipment that runs outside office hours.
- An engine generator for power outages.

Tier I protects against disruptions from human error, but not unexpected failure or outage. Redundant equipment includes chillers, pumps, UPS modules, and engine generators. The facility will have to shut down completely for preventive maintenance and repairs, and failure to do so increases the risk of unplanned disruptions and severe consequences from system failure.

Tier II

Tier II facilities cover redundant capacity components for power and cooling that provide better maintenance opportunities and safety against disruptions. These components include:

- Engine generators.
- Energy storage.
- Chillers.
- Cooling units.
- UPS modules.
- Pumps.
- Heat rejection equipment.
- Fuel tanks.
- Fuel cells.

The distribution path of Tier II serves a critical environment, and the components can be removed without shutting it down. Like a Tier I facility, unexpected shutdown of a Tier II data centre will affect the system.

Tier III

A Tier III data centre is concurrently maintainable with redundant components as a key differentiator, with redundant distribution paths to serve the critical environment. Unlike Tier I and Tier II, these facilities require no shutdowns when equipment needs maintenance or replacement.

The components of Tier III are added to Tier II components so that any part can be shut down without impacting IT operation.

5.3 MANAGEMENT SYSTEMS

Virtus' entire process is managed in line with its Operations Manual which incorporates the requirements of the organisations integrated management system. This section describes the management systems and processes which are in place / will be in place at the installation alongside assessment of how the management system will meet BAT requirements. The management system scope of certification is the 'design, build and ongoing operation of mission critical data centre facilities. The standards which Virtus complies with are:

Management System Standards:

- ISO/IEC 27001:2013 which specifies the requirements for establishing, implementing, maintaining and continually improving an information security management system. (Alcumus ISOQAR certificate 16390-ISN-001 expiry date 7th May 2025;
- ISO 14001:2015 which specifies the requirements for an environmental management system to enable an organization to develop and implement a policy and objectives which take into account legal requirements and other requirements to which the organization subscribes, and information about significant environmental aspects (Alcumus ISOQAR certificate 16390-MES-001 expiry date 7th May 2025);
- ISO 9001:2015 which specifies the requirements for establishing, implementing, monitoring, managing and improving quality throughout the organisation (Alcumus ISOQAR certificate 16390-QMS-001 expiry date 7th May 2025);
- ISO 50001:2011 which specifies requirements for establishing, implementing, maintaining and improving an energy management system, whose purpose is to enable an organization to follow a systematic approach in achieving continual improvement of energy performance, including energy efficiency, energy use and consumption (Alcumus ISOQAR certificate 16390-NRG-001 expiry date 7th May 2025);
- BS ISO31000:2009 Risk Management

The main certificates are attached as Appendix D for reference.

Environmental Policy

The ISO 14001 certified EMS is underpinned by an environmental policy wording included as part of an overall Compliance Policy. The Compliance Policy defines Virtus' commitment to continual improvement and to developing objectives and targets aimed at preventing pollution and improving environmental performance. The Policy is reviewed annually by the Senior Management Team of Virtus Hayes Ltd. Arrangements are in place to ensure that all employees are aware of the Policy and its contents and that the Policy is made available to company stakeholders, including contractors who undertake much of the onsite work around the generators (maintenance, deliveries, etc).

The Policy emphasises commitment to:

- Minimising (and where possible) preventing pollution;
- Improving environmental and energy performance;
- Ensuring robust maintenance regimes are in place;
- Auditing and evaluation of operational policies, processes, staff and controls, communicating findings to senior management; and

- Communicating and promoting policies, processes and controls to all relevant parties.

Environmental Aspects and Risk Management

Virtus ensures that internal and external issues relevant to the provision of services, energy & environmental aspects, information security, strategic direction, and in maintaining compliance are captured, evaluated and mitigated through a Risk Management System compliant with the requirements of BS ISO31000:2009 Risk Management.

A Risk Evaluation Register controlled under the Risk Management Process (Chapter 4 of the Operations Manual) is implemented This register details environmental aspects and risks associated with the organisation's activities, including a significance rating for each aspect. Environmental risks are evaluated in order to identify opportunities for continual improvement. This is undertaken alongside a regular energy performance review, a key aspect to identify opportunities to improve environmental performance. The energy review is used in particular to drive Power Usage Effectiveness figures which is the ratio of total amount of energy used by a computer data centre facility to the energy delivered to computing equipment.

'Significant' aspects are managed by establishing operational controls, process, procedures, training and the monitoring of activities via an audit programme. All staff are responsible for working in accordance with procedures relating to environmental compliance.

Integrating environmental aspects in the Risk Management Process ensures that identifying environmental risks together with the environmental aspect evaluation, allows routine management system procedures to manage risks under normal circumstances, and emergency plans to mitigate impacts under abnormal circumstances. Such assessments cover the implications of material storage, oil transfer, surface water drainage and site security.

All significant risks will be referenced in the Business Risk Register.

The process of managing and responding to environmental incidents is incorporated into an overall Incident Management Process (Chapter 2 of the Virtus Operations Manual) controlled via the Virtus Service Management Centre. All incidents are reported to the Compliance Manager, who is responsible for assessment of actions completed and updating of procedures and escalating to a business continuity plan if necessary.

The Operator has identified and documented a list of likely environmental incidents and developed controls around these.

A spill response procedure is in place with spill kits deployed strategically on site. Major diesel spill would initiate a High P2 incident with implementation of the Virtus Incident Management Process and Pollution Incident Response Plans.

Virtus also has an Emergency Preparedness Response Process. The process identifies risks under the headings of operational (environmental), third party (environmental), standards/statutory risk, and risks arising from natural disasters. This will be reviewed and updated as necessary.

Training

Environmental training relates to both general awareness and job-specific training. The site is managed by a sufficient number of staff, who are competent to operate the site. In accordance with the IMS:

- All staff have clearly defined roles and responsibilities;
- Records are maintained of the knowledge and skills required for each post;
- Records are maintained of the training and relevant qualifications undertaken by staff to meet the competence requirement of each post; and
- Operations are governed by standard operating instructions.
- Each individual's knowledge and skills are 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 are identified, prioritised and planned.

Training records are maintained and training needs regularly reviewed.

All contractors and sub-contractors are given appropriate training prior to the commencement of any works or services.

Review and Audit

The Operator recognises that continuous improvement requires the ongoing reappraisal of EMS and 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 examines the EMS 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 are internally audited at least annually. Internal audits are carried out by site staff with suitable audit experience and / or training.

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.

CRITICAL ASSET MANAGEMENT

Virtus identify and manage critical assets comprising of physical, non-computing systems such as power, cooling and life safety systems under a critical asset management process.

It identifies areas of criticality and ensures appropriate levels of planned preventative maintenance, Standard Operating Procedures, and Emergency Operating Procedures as well as an Operation and Maintenance Manual.

Contractor Management

Virtus' approach to contractor management is detailed in their Operations Manual (Chapter 13). Large areas of operation and maintenance are contracted to a Facilities Management (FM) Team, Optimum Group Services; who are specialists in Data Centre maintenance. Other assets are maintained and tested by the vendors – including the engines and generator sets.

All PPM scheduling is undertaken within the enterprise asset management system IBM Maximo. SFG20 is used as the standard to govern best practice in maintenance and parts replacement schedules.

Using the information controlled and retained in Maximo, the FM Team deploy a scheduling system that provides regulation of Vendors for maintenance and repair works. The system utilised is the proprietary Optimis solution. This solution details the planned maintenance and the Vendor details. Upon completion of the activity, records (such as engineer site reports, maintenance reports, statutory assessment reports) are uploaded to Optimis against the activity for full reconciliation of the activity.

The FM Team schedule maintenance activities as governed by SFG20 and the PPM schedule (Maximo) once vendors are appointed. Vendors have to upload RAMS, competencies and qualifications of operatives and other relevant documentation to the Optimis system prior to arrival on site. The FM Team are responsible for approving RAMS alongside Virtus site staff.

All maintenance works are to be completed through Maintenance Operating Procedures or MOPs that intend to:

- Create a safe system of work for the Vendor operatives.
- Ensure maintenance works are carried out in accordance with OEM specifications.
- Associated or linked systems are not impacted in the course of maintenance activities.

Operating Procedures must be followed in order to maintain the quality control and quality assurance processes and ensure continued service provision. The Operating Procedures are reviewed regularly by the FM Team senior contract staff. Current copies of the MOPs are readily available at each site situated near or on equipment.

The FM team also maintain Emergency Operating Manuals and the Emergency Operating Procedure (EOP) which explain emergency functionality, safety routines and procedures needed to establish a status of safe working in equipment and infrastructure for emergency operation.

MANAGEMENT SYSTEM BAT ASSESSMENT

Table 5-2 below identifies relevant BAT requirements for the installation and describes the current / proposed arrangements to meet these. The BAT requirements have been identified from relevant GOV.UK guidance and other BAT reference documents.

Table 5-2 – Indicative BAT Requirements for Management Systems from GOV.UK Guidance

GOV.UK Requirements	Current / Proposed Arrangements	BAT?
As part of the Environmental Management System guidance available on the GOV.UK website the following should be incorporated: You must include a Site Infrastructure Plan which highlights where the activities covered by an Environmental Permit are undertaken. Your plan must also include:	As part of its EMS, Virtus maintains all necessary documents for operational planning and control on a site-specific basis. This includes relevant site infrastructure plans containing the information detailed in the relevant guidance.	Y

▪ Buildings and other main constructions such as treatment plants, incinerators, storage silos and security fencing; ▪ Storage facilities for hazardous materials like oil and fuel tanks, chemical stores, waste materials; ▪ Locations of items for use in accidents and emergencies; ▪ Entrances and exits to be used by emergency services; ▪ Pollution control points, such as inspection and monitoring points; ▪ Trade effluent or sewage effluent treatment plants; ▪ Effluent discharge points; and ▪ Contaminated land, or land you believe is contaminated.	As a result of this permit application being made, site plans including point source emission points, drainage system and discharge points will be incorporated into the EMS.	Y
The plan must also demonstrate areas which are vulnerable to pollution from the site. Such as rivers and streams; groundwater sources; residential, commercial or industrial premises; protected wildlife. Your plan must show foul and combined drainage facilities marked in red and surface water drainage facilities in blue. It must also show: ▪ The direction of flow of water in the drain; ▪ The location of discharge points to sewer, watercourse or soakaway; ▪ The location of manhole covers and drains; and ▪ The location of stop and diverter valves and interceptors.	The Environmental Risk Assessment (ERA) included in this application covers this aspect of the requirements and will be incorporated into the Virtus EMS documentation.	Y
Your plan must show the location of mains water, gas and electricity supplies on your site including: ▪ The mains water stop tap; ▪ Gas and electric isolating valves and switches; and ▪ The routes for gas, electricity and water supplies around the site.	The installation being permitted is for the combustion of diesel to generate electricity and hence this section is deemed not relevant	
If your permit covers a standalone water discharge activity or point source standalone groundwater activity, your site plan must show: ETC – N/A	N/A as the permit is not for a standalone water discharge activity or point source standalone groundwater activity.	
Site Operations List the operations that will be carried out on your site during start up, normal operation and shut down.	All significant environmental impacts stemming from site operations are incorporated into the existing EMS. These will be reviewed and updated as necessary during the application process.	Y
For waste, mining waste, and installations, list the wastes that will be produced by each activity or process.	All details relating to waste generation and waste minimisation and management are held on Virtus internal environmental	Y

List the steps you will take to prevent or minimise risks to the environment from each activity or process and type of waste. [If you are a waste operator you must include a waste storage plan that states: (N/A)] Fire Prevention Plans (FPP) (N/A)	systems. This will be reviewed and updated as necessary as part of the permit variation application.	
You will need to produce a Site and Equipment Maintenance Plan detailing how you will maintain the site infrastructure and any machinery.	Virtus and its FM provider utilise IBM Maximo. All plant and equipment installed will be included in the maintenance regimes which are implemented in accordance with manufacturer's recommendations. These documents are described and form part of the Critical Asset Management chapter of the Virtus Operations Manual.	Y
You will need Contingency Plans to demonstrate how you minimise the impact on the environment of any: ▪ Breakdowns; ▪ Enforced shutdowns; and ▪ Any other changes in normal operations. A changing climate and how this could affect your operations should also be considered as part of contingency planning.	The Virtus Emergency Preparedness Response Process covers this. The process identifies risks under the headings of operational (environmental), third party (environmental), standards/statutory risk, and risks arising from natural disasters. Note the application is to test generator equipment to ensure it can be safely started in the event of a grid failure. A breakdown of an engine / generator set will result in the shutdown of the generator with minimum environmental impact. Loss or leakage of fuel will be managed through the site emergency procedures.	Y
You will need an Accident Prevention and Management Plan which details how you would deal with any incidents or events that could result in pollution. This plan must: ▪ Identify any potential accidents or other unexpected incidents which could cause an unexpected change to normal operations. For each potential incident the following must be stated: ▪ Likelihood of the accident happening; ▪ Consequences of the accident happening; ▪ Measures taken to avoid the accident from happening; and ▪ Measures to minimise any impacts if the accident happens. The plan must say how you will record, investigate and respond to accidents or breaches of your permit. It must also include:	The OHSE MS and Emergency Preparedness Response Process details incidents which could occur including spillage, leaks, F-gas release, hazardous waste contamination, etc. All incidents are managed through the Incident Management Process (Chapter 2 of the Ops Manual). Additional Pollution Incident Response Plans are initiated depending on the Incident Category. Response procedures are tested annually.	Y

▪ Date last reviewed; ▪ Date of next review; ▪ A list of emergency contacts and how to reach them; ▪ A list of substances stored on site and storage facilities; and Forms to record accidents on.		
Contact Information for the Public A noticeboard is to be displayed at the site entrance including the following information: ▪ Permit holder's name; ▪ Emergency contact name and telephone number; ▪ Statement to show the site is permitted by the Environment Agency; ▪ The permit number; and EA contact number and incident hotline number.	This will be established if required as a permit condition for the installation.	Y
You need a Complaints Procedure to record: ▪ Any complaints received in relation to the activities covered in your permit; ▪ How complaints are investigated; and ▪ Any actions taken as a result of complaints.	A complaints procedure will be developed to ensure compliance with the environmental permit condition.	Y
Include details in the management system on Staff and Resources including: ▪ An explanation of who is responsible for what procedures; ▪ Technical competency records; ▪ A list of roles carried out in relation to activities covered in the permit and by whom; and ▪ Competency check procedure and training records.	Details on posts, roles & responsibilities are displayed in the Virtus OHSE MS. Competency is addressed in the Awareness chapter in the OHSE MS. Sub-contractors on site are subject to site induction which provides the above awareness.	Y
Record Keeping Any records required by your permit must be kept. You must keep records to show how your management system is being implemented. Records to be kept include: ▪ Permits issued to the site; ▪ Legal requirements; ▪ Risk assessment; ▪ Management system plans; ▪ Any other plans required by your permit (such as noise); ▪ All operating procedures; ▪ Staff competence and training; ▪ Emissions and any other monitoring undertaken;	Virtus keeps records of all activities; permit requirements will be included.	Y

▪ Compliance checks, investigation findings and actions taken; ▪ Management reviews and changes made to the management system; and ▪ Certification audit reports and any actions taken. [Waste Operators must also record the following for each waste delivery to the site:… N/a] If you hold a permit for waste, mining waste or installations, a Site Condition Report is required. This must detail the condition of land or groundwater on the site and be kept updated regularly. The following information is to be included: Details of historic spills or contamination and responses to these incidents; and Evidence of the effectiveness of any measures taken to protect land and groundwater.	A Site Condition Report has been prepared and is submitted with this application.	Y
A procedure needs to be in place for checking you are complying with permit conditions and management system requirements. ▪ The management system is to be reviewed and updated when: ▪ Changes are made to the site, operations, or equipment that affect activities covered by your permit; ▪ If you apply to change / vary your permit; ▪ After an accident, complaint or breach of your permit; and ▪ If a new environmental issue is encountered and new control measures are implemented. ▪ Changes made to the management system will be recorded.	The EMS will be reviewed and updated as necessary. (Currently undertaken on at least an annual basis). The review will consider the permit conditions being applied for and environmental risks from the associated plant and equipment. Any changes will be recorded in the relevant Operations manual documentation.	Y

5.4 RAW MATERIALS (FUEL) CONSUMPTION

The most significant raw material input is fuel for the engines. The fuel consumption has been calculated for the engine testing scenarios only, on the assumption of off-load tests at 10% load for 15 minutes per test 11 times per year per engine; on-load tests at 20 minutes at 100% and 120 minutes at 75% load, once per year per engine. (Note data not available for the Mitsubishi engine hence equivalent fuel consumption of a 2MWe engine used).

The density of the fuel is taken as 820g/l as provided by the Adler & Allan fuel specification datasheet.

Table 5-3 – Estimated Annual Fuel Consumption

Engines	No.	Data Sheet consumption (l/hr) 10, 75, 100% load	Total fuel l/y	1000 l/y
LON2 Mitsu (proxy data for 2MWe engine used)	8	80.7 370.5 501.5	1775.4 5928.0 1337.1	9.04
LON2 G24F	1	76.26 378.2 516.1	209.7 756.4 172.0	1.14

Calculated fuel consumption is therefore 10,179 litres or **8.35** tonnes per annum. Fuel consumed for routine operations will also reported under the EU ETS scheme.

5.5 GRID RELIABILITY

Aside from the necessary monthly maintenance testing (described elsewhere but typically 5-15 minutes per month (11 times per year) with one longer test annually to a total of just over 5 hours of operation per generating set per year (equivalent to 0.06% of the year), the generating sets installed shall not be used for any purpose other than providing emergency back-up power generation. No installed generators shall support Short-Term Operating Reserve (STOR) and/or triad management activities during the lifetime of the development.

This represents a situation where there are no anticipated periods where the generating sets would be planned to be operated for any significant period of time.

As the operation of the generating sets is considered undesirable, Virtus has designed an incoming power system to the site (see Appendix I) to ensure that only the most major power interruption events would trigger the need for the generators to be used to support the buildings outside of maintenance activities.

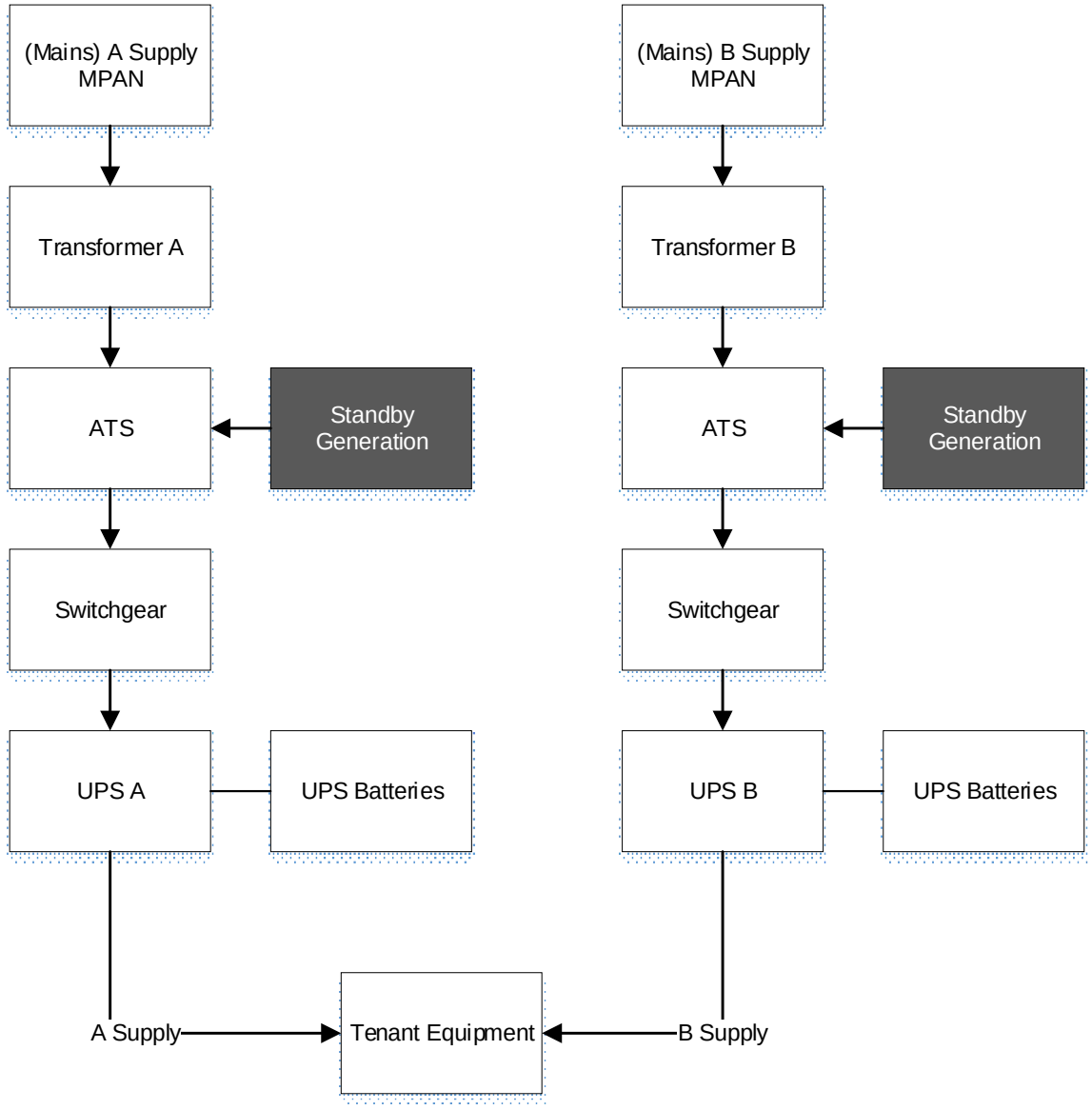
The incoming power system to the site will consist of three separate cables originating at Iver sub-station in Buckinghamshire, to the site, via Virtus Stockley Park campus, and electrical feeder breakers at Iver. Each component in series would make up a power feed to the site, and the system has been designed such that in the event of either of the main power feeds being accidently or maliciously damaged, undergoing a fault or being shut down for maintenance, the on-site power system could be re-aligned without needing to engage the back-up generating sets.

The power for the installation originates from the Iver grid connection point, owned and run by National Grid. The only circumstance envisaged by the project engineers where the generators would be used for a period of time would be a power outage directly from Iver or further upstream from this substation. This outage would be a major impact for the entire area, as it would affect a large number of people and businesses over a wide area from Denham to Hayes to Slough. Given the scale of such an impact, it could be reasonably expected that such an outage would be

addressed as a matter of top priority by National Grid, and therefore the back-up generating sets would run for as little time as possible.

The simplified schematic below highlights how standby generation for the data centres works. The main components in the power distribution are:

- Utility power – main power source for the facility
- Standby generators – supply power when utility power is not available
- ATS (Automatic Transfer Switch) – routes utility or standby power to switch gear
- Switchgear – routes utility or emergency generator power throughout
- UPS (uninterruptable power supply) – consists of battery bank, charger and inverter.



5.6 GENERATOR ENGINES BAT

ENGINE AND SET UP CHOICE

The diesel-powered stand-by electrical generating sets installed for the Data Centre installation are typical fit-for-purpose vendor-supplied units, having the following (or similar/equivalent) characteristics:

- Prime mover: V-16 or V-20, four-stroke water-cooled diesel, low fuel consumption OR low emissions set up;
- Set arrangement: Containerised with close coupled radiator; and,
- Standby rating: 1.85, 2.0, 2.2 or 2.4 MWe at 1,500 revolutions per minute, either 11kV or 400 volts, 50 Hertz.

Redundancy operates on a swing engine basis, usually within a power stream group of engines (up to 7 engines). In an emergency related to the power stream the swing engine therefore acts as back up should one of the engines fail to start.

In general emergency generator engines have been specified to be low brake specific fuel consumption combustion strategy. However, the choice of engines is also driven by design linked to the data centre design – hence resulting options are limited by availability in the marketplace, with low emissions versions of more engine types only recently being released to market.

Low levels of NOx are achieved by lowering the air temp in the cylinder which requires greater cooling airflow, in turn requiring a larger radiator and increased airflow, increasing the overall physical design dimensions of the acoustic enclosures (though not an issue at Hayes), increasing fuel consumption and hence overall capital and operating costs. This will impact on competitive viability for the client (whose primary business is the operation of a Data Centre, not the running of back-up generators). In addition this will also lead to a reduced load step acceptance figure and response time which is critical to Data Centre designs (Mission Critical standby function of the engines) and the fuel consumption rate will increase, so whilst meeting a level of NOx, other pollutant emissions such as PM, CO and unburned hydrocarbons will increase.

However, the Agency Data Centre FAQ requires engines that are low emission combustion strategy. Emission standards and real world emissions are discussed further in TA Luft 2g NOx and US EPA Tier 2.

The installed engines consist of 8 legacy Mitusbishi engines (ordered pre 2018) and 1 proposed new MTU TA-Luft compliant engines (meeting ‘2G’).

SIZE, NUMBER AND CONFIGURATION

The choice and configuration of back up energy plant is driven by the data centre design; each unit is based on strict requirements of a set of servers, cooling plant, the UPS battery system, determining the power supply required, and setting the back up requirement for that array, which is designed to be independently manage-able; and hence the number and choice of engines in the market place is therefore defined by the power required per power stream. Underlying that is the non-negotiable target for the business, which is the Uptime Institute Tier III compliance (see Note in

Section 5.2.1). Smaller numbers of larger capacity machines do not work when the purpose is to match standby to Data Centre power stream design requirements, and within site space constraints, economic, and technical viability. Stepping up to a 3MWe unit would mean a huge cost increase on capital equipment of generator and enclosures, fuel tanks, switchgear and associated equipment on site to such a point where this becomes an unviable proposition. The physical size of the larger engines and associated equipment will restrict the ability to fit the required engine numbers into the space available.

Maintenance is simplified by having standard package power trains in use rather than bespoke built larger units. These points are explored further in the box below.

In the construction of a data centre the stand-by generator selection is based on:

1. Size to support the critical IT loads and their associated supporting infrastructure, such as cooling equipment
    - The optimal/appropriately sized-to-power-stream generator (modular) approach allows for single generators to activate in the event of a single power stream failure instead of a larger generator activating to accommodate a similar failure. If the correctly sized generator is rated to support the power stream's demand load by design, then this configuration will minimise emissions. Larger generators supporting more than one power stream will have an increased chance of activating.
2. Flexibility to support isolated power streams in support of N+2 redundancy designs
    - Parallel configurations of smaller engines have the advantage of supporting load sharing and management especially for variable load applications such as a data centre IT loads.
3. Flexibility to support continuous N+1 operation
    - Inclusion of a swing generator set to support N+1 resilience during maintenance. Maintaining a smaller generator supporting a single power stream is more cost effective and more resilient than maintaining a larger generator supporting multiple streams.
4. Market availability and lead up times
    - Small to medium sized generators are more readily available and quicker to procure than larger generators.
5. Initial delivery and installation costs
    - Lower initial install costs for diesel generators
    - Lower weight / kW for diesel generators
6. In-operation costs

- On line in less than 10 seconds (NFPA[1] requirement under Tier III Uptime) and excellent transient capability. Gas engines have less load pickup (transient) capability and a larger frequency deviation (stability) than diesel generators.

7. Fuel type availability, upkeep costs (such as fuel polishing), storage and supply costs
    - To store quantities of diesel onsite is both more cost effective and safer (COMAH) than storing compressed fuel types. The availability of diesel is such that Virtus have retained emergency diesel suppliers with a 4-hour delivery SLA.
    - Diesel oil can be safely stored on site in quantities allowing for prolonged, emergency use (48-72 hours). Natural gas may be stored on site, but not in the quantities to achieve 48-72 hours without consequence. Customer SLAs typically demand a minimum of 48 hours of site-based emergency power generation. A gas pipeline would be a primary source of supply with a smaller stored amount of compressed gas available for emergency generation. The gas would then be considered a single point of failure if supply was affected. Natural gas is extremely explosive. A leak would possibly result in the entire site and its supporting emergency infrastructure being shut down for safety purposes until repairs are made, especially concerning the proximity to HV/LV transformers and switch rooms.
8. Replacement costs and/or availability of spare parts
    - Defective, larger engines have longer lead times and are more costly to replace.
9. Effective emissions
    - Marginal NOx reductions against increased cost per MW output and increased physical footprint in for larger generators.
    - Despite engine size, if the cumulative MWth input is greater than 20MW, then the data centre must enter the UK ETS (previously the EU ETS) emissions trading scheme. All diesel-consumption is recorded, and carbon emissions reported to the Environment Agency legalised under emissions licences. Emissions are then relinquished against emission credits.

Table 5-4 below outlines how the type of generators using a diesel fired engine installed at the site meet relevant BAT requirements.

Table 5-4 – BAT Summary for Data Centre Standby Generators

Engine Type or Fuel	Current / Proposed Arrangements	BAT?
Diesel Fired Generators	▪ High response (low start-up duration, 15 seconds)	Yes

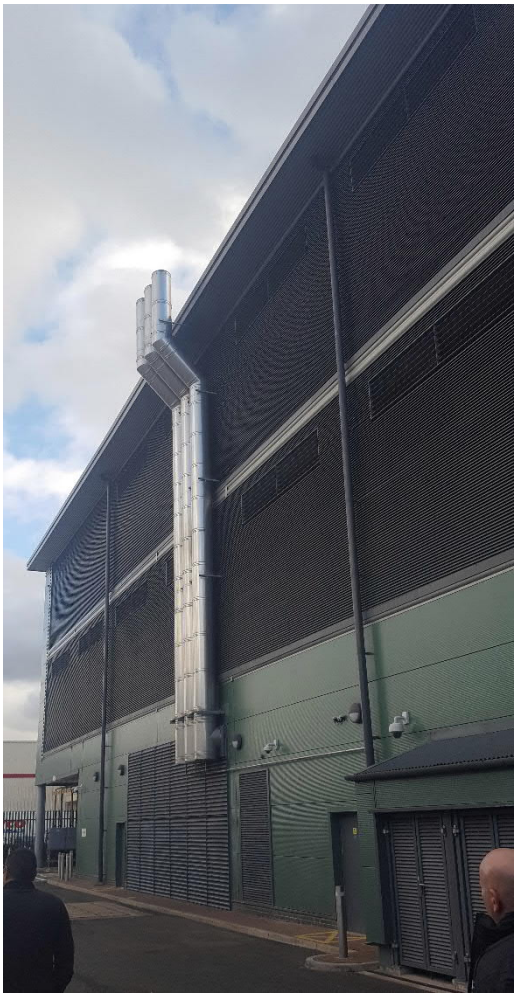
[1] National Fire Protection Association, NFPA, publisher of one of many sets of codes to which the operator must comply to obtain the Uptime Institute Tier III classification.

Reciprocating compression ignition engines fired on diesel fuel oil	▪ Good independent performance reliability due to the on-site storage of diesel fuel in sufficient quantities, ▪ Fuel managed and controlled by the facility, ▪ Fuel oil can be sourced from more than one supplier for delivery to the site. ▪ Handles variable loads readily. ▪ Large number of moving parts subject to failure requiring regular ongoing maintenance to ensure reliability, however these are readily obtained and replaced, 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. High polluting emissions to air, most notably NOx and particulate matter, which can impact local air quality if operated for prolonged periods of time.	
Gas-Fired Generators Reciprocating engine spark-ignition	▪ Are commercially available for the provision of emergency electricity generation, however do not have as fast a start-up as diesel engines (typically up to 5 minutes to provide 100% load), would compromise DC operations. ▪ Fewer moving parts than diesel engines which can be subject to failure, more reliable. ▪ The storage of gas on-site as a fuel source will not be possible due to space constraints, significant health and safety risks. Hence reliance on an off-site supply (pipeline) of gas, operated and maintained by others. Any interruption means no emergency back-up generation for the site, which does not meet the resilience requirements of the facility. ▪ Less capable in variable load environment (such as the DC). ▪ When compared to diesel generators gas-fired engines produce fewer polluting emissions to air.	No. For the purpose of this assessment, gas-fired generators are discounted.
Fuel Oil-Fired Gas Turbines	▪ Relatively good independent performance reliability due to the ability for on-site storage of kerosene fuel, under control of the facility. ▪ Multiple fuel suppliers improves flexibility and resilience. ▪ For reliability the fuel oil must be stored on-site in sufficient quantities to ensure sufficient supply on interruption to the grid electricity supply. As with gas-fired generators, start-up is not considered to be fast, typically more than 30 seconds. ▪ fewer moving parts than diesel engines which can be subject to failure, and are therefore considered to be more reliable, and operate with less vibration when compared to diesel generators.	No
Hydrogen Fuel Cell Generators	▪ Relatively new technology. ▪ In the absence of a piped supply of hydrogen in the immediate area which could supply the facility, there would be a need for the on-site storage of hydrogen and the provision of emergency back-up supplies.	For the purpose of this BAT assessment, fuel cell

	▪ The storage of hydrogen on-site as a fuel source is not considered possible due to restraints on available space, additionally there are significant health and safety risks associated with such storage.	generators have been discounted.

THE EXHAUST SYSTEM

The diesel engine exhausts are individually flued to vertical stainless steel flues running up the side of the building and exhausting at high level (see google Streetview screenshot and photograph below), just above the roof eaves.



Photograph of existing stack arrangement (3 engine exhausts)

Virtus do not design the engines or exhaust discharge systems and are hence at the vagary of suppliers who are however required to ensure adequate dispersion (and as can be seen ensure discharge points are close to (where diluted in cooling air flow) or above, the roof level.

BAT ASSESSMENT STACK SET UP

The stack set up and height was driven and is/will be confirmed by the following:

- The need to operate generators as individual units, i.e. not rely on joint exhaust air flows from other units to assist velocity or buoyancy;
- Occasional Planning requirements (though no restrictions in this case on visibility);
- Heights increased above those normally associated with emergency generators for short duration operation (typically venting through top of container to a max of 5m above ground);
- Industry standard data centre solutions packages availability from suppliers;
- Demonstration by ADMS modelling of dispersion of test regime and emergency emissions to be submitted in July 2022.

Other options for stack arrangements are limited and would include:

- Ducting flues together – larger structures, longer flues, into common windshields or gantries; Would need additional fan power, supporting foundations, would lead to increased visibility, complex ductwork and maintenance;
- Ducting flues into a common chimney – complexity of structure and increased fanpower to overcome stack air backpressure, at testing this would lead to loss of flow and velocity if single unit being tested with subsequent loss of dispersion.

Similar studies have shown (e.g. Centrica Roosecote[2]) that combining stacks does not necessarily lead to improved dispersion *("the potential aggregation of stacks would have minimal effect on both the predicted short term and long term air quality impacts associated with the development"*).

A similar conclusion was drawn at Colt Welwyn[3] and accepted by the Environment Agency: "*The operator has justified its use of a large number of smaller generators rather than installation of fewer larger generators because of the modular nature of the site and potential restriction of its expansion plans as new clients would be less able to modify data hall designs to suit their individual needs. Smaller generators can be more readily added to the site giving greater flexibility as the site expands. The operator has justified not limiting the number of stacks or not grouping stacks into common windshields because that would compromise the "2n" redundancy arrangement as, if one stack was unable to be used, then multiple generators may not be able to operate. In addition, routing stacks to common windshields is problematic due to the geographical location of the generators on site, the amount of pipework and support structures necessary and the overall space constraints on the site due to the fact it was not originally designed as a data centre*."

[2] http://www.epa.ie/licences/lic_eDMS/090151b280658335.pdf

[3] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/772593/Decision_document.pdf

Following the above arguments it is considered that for emergency standby generator arrangements with a low likelihood of operating in emergency scenarios both stack arrangement systems and heights are entirely appropriate and meet BAT.

ENGINE EMISSIONS STANDARDS

TA LUFT 2G NOX AND US EPA TIER 2

The standards quoted by the Environment Agency as representing BAT are quoted below from the Data Centre FAQ.

> The EA would expect that combustion plant for new Data Centres generators would be to the latest emission standards for standby plant unless otherwise justified under BAT. The minimum appropriate is the 'TA-Luft 2g' or Tier II USEPA with guaranteed emissions: this has requirements for 2000mg/m^3 NOx; 650 mg/m^3 for CO; particulates and dust 130 mg/m^3 and 150 mg/m^3 for hydrocarbons (all at reference conditions and 5% O2).

TA Luft 2g

TA Luft 2g as written above however, is not clear in whether the 2g level required is at a specific load (e.g. 100%), or at all times, or averaged across a load cycle unlike the very clear and publicly available US EPA Tier 2 standard.

2g compliant engines are available from specific suppliers for specific models yet will be inherently narrow in their application range and hence not simply transferable to any data centre design. The argument that it is the Data Centre design that leads to appropriately specified and sized back up engines therefore remains true here, irrespective of whether a 2g engine is available.

From an operational perspective, the simple statement that BAT for emergency back-up generators is TA Luft 2g is misleading as it prioritises one aspect of an engine's operation, and which is still being discussed at industry sector level. For example fuel efficiency, parasitic load, scrubber emissions and additional energy and raw materials consumption, are all ignored.

NOx emission is related to engine temperatures and load, and NOx levels vary significantly as load decreases. Although NOx concentrations may increase across the mid range loads, mass emissions decrease substantially due to reducing the exhaust gas volume flows (for example for the MTU engine variant, the exhaust mass flow drops from 12114kg/hr at 100% load to 4092kg/hr at 10% load, and NOx mass emissions drop from 4.7g/s to 1.1g/s for the same example).

Data Centre Test Regimes are undertaken for most of the year at off-load for short periods so the result is that the normal operation NOx may be higher than the 2g levels *as a concentration*, yet very low *as a mass emission*. The emissions modelling for Virtus LON2 will use the 10% load from the datasheet (if available – currently only a 100% load related emission value has been provided for the legacy engines) to determine the rate for the off load test given the absence of data for a 0% load (information requested from suppliers).

In addition product-compliance testing (which is effectively what 2g is) is measured in controlled environment conditions with the engine at temperature so therefore this level will not be met by any machines in a no-load start up test situation. A machine that is 2g compliant may have worse levels

of emissions at low load than those that aren't compliant due to engine tuning to a specific load. NOx emission levels are not linear based on load or power but a combination of engine design, coolant temperatures and in-cylinder Brake Mean Effective Pressure all of which also affect the overall performance of the generator in terms of load acceptance and critical performance that the client will be looking at when designing (e.g. to meet Uptime Institute Tier III requirements).

US EPA Tier 2

The US EPA requires stationary combustion ignition engines >560 bkW to be certified to Tier 2 equivalent standards for emergency applications and Tier 4 for non-emergency. The regulated limits apply to PM, CO, HC & NOx emissions – for emergency engines >560 bkW the NOx limit is combined with an NMHC limit & expressed as a total of 6.4 g/bkWh.

The regulated limits are applied as a weighted average of readings taken at the load points defined in the ISO 8178 D1 and D2 cycles. (The D1 cycle at 50, 75 & 100% load points is the more closely aligned with Data Centre applications). This point needs to be stressed as it may cause confusion when EPA Tier-certified engines are used in countries that are unfamiliar with the US EPA requirements. In these situations, there is often an expectation that an engine measured in the field will always produce <6.4 g/bkWh NOx whereas, because of the averaging/weighting calculation, the actual emissions may be over or under the regulatory limit. There is also a "Not-To Exceed" factor, which allows for variations in ambient temperature & altitude etc., so an actual in-field measurement can be substantially more than the 6.4 g/kWh limit, but the engine would still be in compliance with the certification standard. Similar to TA Luft 2G, Tier 2 is a 'range' certification process based on controlled environment tests on a sample of engines and will not be directly replicable under real world conditions.

In addition, the emissions data quoted in the datasheets cannot be used to accurately determine an engine's compliance with EPA certification levels as the measurement load points defined in the ISO D1/2 cycle are at percentages of engine gross power, whereas the load points quoted in manufacturer's datasheets are percentages of the genset's electrical output. A rough calculation can be performed to give an indication but, for a definitive answer, actual certificates are required from the manufacturer.

Selective Catalytic Reduction

To achieve lower emissions the only guaranteed method across the complete range of engines and loads is Selective Catalytic Reduction (SCR); however this would still not be applicable to a start-up test regime (though may become applicable to a longer on-load test). SCR will only operate when the machine exhaust system is above circa 350 – 400^{o}C, where the level of urea injection is set at expected running loads during commissioning; neither condition is expected to be achieved in a 5 to 15 minute start up test at no load. Over-injection of urea at low loads will also result in ammonia slip, which needs to be considered as an additional environmental impact.

Availability

However, over the last 2-3 years more mission critical (emergency) engines have become available that are capable of meeting the 2g standard and/or the US EPA Tier 2 standard.

Hence compliance, and the proposed improvement route to compliance, is described below.

VIRTUS LON2 EMISSIONS COMPLIANCE

There are several (eight) legacy engines at LON2 - the term legacy here is based on the term loosely used by the Environment Agency, noting that no specific cut-off date has been published in writing in any guidance. Engines were installed between 2015 and 2018.

Engine Legacy and Compliance

The dates that the orders were placed for the various engines are provided in Table 5-5. The order date is used to determine whether legacy standards apply against the requirement to meet BAT as 2g/Tier 2 or equivalent. In this case there is a clear delineation between legacy (existing eight engines) and new (one new engine).

Table 5-5 – Virtus Generators Legacy Status

Site	Engine Type	Customer Order Date	Commissioning Date	Legacy	TA Luft 2G / US EPA Tier 2
LON2	Mitsubishi Sets G1/1, 1/2, 1/3, 1/6 G2/1, 2/2, 2/3, 2/6	Approximately 2013/2014	Pre-2018	Y	No
LON2	MTU Set G1/4	2022	Tbc, anticipated early 2013	No	Yes

It can be seen from the table above that all the existing installed engines of the same variant were ordered and installed and commissioned prior to BAT guidance – these will be considered legacy and it is understood that the Agency may place improvement conditions in the permit to identify opportunities to reduce NOx emissions from these engines in the future.

5.7 EMISSIONS TO AIR

Emissions to air from the site will vary depending upon the operational scenario of the engines (specifically the testing regime required by the manufacturers and in some cases also by the data centre clients). The engines will only be operational during periods of emergency back-up situations (i.e. in the event of a power outage from the national grid, or an internal system failure requiring a power stream to come off grid), or during testing. There will be no point source emissions to air outside of these periods.

For the purposes of the Air Emissions Risk Assessment, the EA guidance 'Unclassified, Emissions from generators (Version 1) Guidance on dispersion modelling for oxides of nitrogen assessment from generators' states that where a generator is run on gas oil (diesel) only, NOx is the primary pollutant of concern. Additionally CO, particulates and NMVOC will be emitted although due to the short periods of engine operation and also the internal combustion nature, and high level discharge proposed, these are of less significance.

The engine data sheet emissions summary table in Appendix C shows various loads; note however that around 88% is the normal stabilised continuous emergency load. Off load tests are conducted at nil load, on load tests are conducted at 100% then 75% load. A nil-load emission level isn't provided by the manufacturer for routine monthly tests. Note the table presents the engine exhaust

emissions concentrations and will differ from the modelled emission flow rates which includes a substantial volume of engine enclosure cooling air. The data sheet values will also need to be interpolated to steady state long term emergency operation of the engines which will be determined by the power stream load (the maximum design load for IT, building requirements, cooling system load etc) which varies between data centres and can be designed to be around 85-90% of the engine maximum load capability (100%). Maximum output is generally only used for a short period of 20-30 minutes to recharge the UPS battery array.

A review of EA permit determination documents also informs the required air quality modelling scenarios as:

- The air quality model should be based on the worst extent of the planned testing scenarios of the generators;
- Virtus test 1: each individual generator is powered up once per month for 11 months and run with no load for 5 minutes but allowing up to 15 minutes in the model;
- Virtus test 2: Full service on-load test once annually, connected to a mobile load bank initial maximum load at 100% for 20 minutes followed by normal load of 75% for 120 minutes (one engine generator set at a time).

There are no planning restrictions placed on Virtus which means that operation of the generator sets for testing and maintenance purposes can be undertaken anytime. However Virtus commit to BAT which is to avoid peak-traffic periods e.g. between 16:00 to 19:00. Further there will be no simultaneous testing of 2 or more gen-sets.

Additionally, an average annual emergency operation scenario (assuming an emergency occurs once in every 5 or 6 years for 24 hours based on ofgem grid operator outage data and on site outage worst case estimates) was developed based around initial 20 minute start-up load and 220 minute subsequent stable operation to include:

- Virtus emergency 1: worst case grid outage for 4 hours per annum (not modelled); and
- Virtus emergency 2: Environment Agency specification to look at the impact of a 72 hour grid outage.

The emissions of NOx associated with the generator tests are presented in Table 5-6. These are based on the following two datasheets, contained in the Appendices, with proxy data used for poor data.

- Mitsubishi T0402-0001E Rev1 (2013) Exhaust Gas emission data, engine variant S16R2 PTAW; and
- MTU 16V4000G24F data set XZ5955410110 TA – Luft EDS 4000 1228 (2018)

The table provides the cumulative totals for the test regime (annual basis) for 9 engines. Emission rates have had to be calculated based on diesel combustion theory for the MTU engine. The 10% load related emission levels are used for nil-load given the absence of a nil-load figure in the datasheets. The Mitsubishi datasheet only provides an emission at 100% load, hence equivalent engine data has been sourced for this initial assessment (LON10 MTU EDS ZNG00013256 used as proxy data).

Table 5-6 – Operational Scenario Emissions

Scenario	Mins / Load	No. of gens	NOx g/s	Cumulative Annual Emission g/yr
Routine off-load testing per month	15 mins @ 0% (10% load used)	8 1	'Mitsu' 0.52 MTU 0.56	41,298 g/yr 5,533 g/yr
Mains Failure test once per year	20 mins @ 100% load, then 120 mins @ 75% load	8 1	Load: 100% 75% Mitsu': 5.79; 5.82 MTU: 2.77; 1.85	390,816 g/yr 16,560 g/yr
Total Test Emissions				**<0.5 tonnes NOx**
Emergency 72 hours per year	Modelled at scheduled load average for 72 hours*	8 1	100% load (1 hour) 75% load '(71 hours)	0.176 t 12.373 t
Total 72 hour Emissions				**12.55 tonnes**

**Initial Calculation for this submission undertaken on one hour at 100% load and 71 hours at 75% load though this will be refined in the Air Quality Assessment*

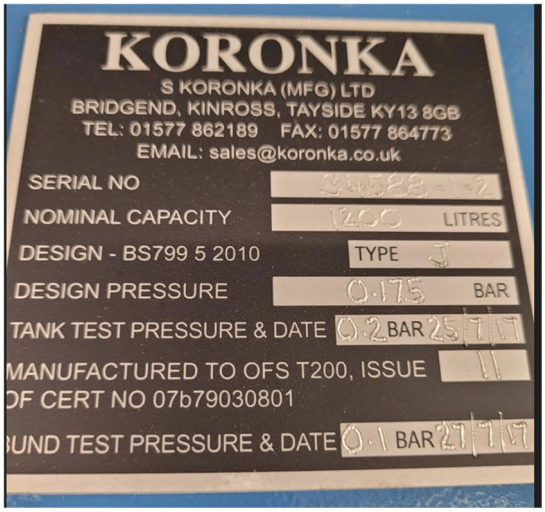
For the emergency scenarios, and in the absence of NOx concentration measurement data at specific load points, likely operational emissions concentrations for the emergency scenario emissions will be based on emissions data from the engine data sheets, interpolated between data points.

5.8 FUEL STORAGE, DELIVERIES AND BAT

STORAGE TANKS

The diesel (ultra low sulphur gas oil, 10ppm ULSG EN2869:2010 Class A2 see Adler and Allan specification below in Figure 5-1) is stored in steel 'belly' or 'slab' tanks, each one situated under and dedicated to an engine/generator set container, with a separate day tank for each generator. The set up is illustrated in the following photographs.

Photograph of Belly Tank set up (Generator G1/3):



Photograph of Day tank set up (Generator G1/1)

Design:

The above-ground storage tanks are built to BS799: Part 5 Type J (2010), or OFS T200, which is referenced in Environment Agency guidance Storing Oil at a Home or Business. These are double

skinned tanks with an alarm fitted between the skins. The 'bund' volume in this case is the void space or annulus between the inner and outer skin, which will prevent loss on leakage of the internal skin. Design drawings of the belly (or slab) and the day tanks are provided in Appendix C.

A typical example design key specification for the tanks is given below (outlined in red) as extracted from the Technical Submittal for another Virtus Data Centre.

Bulk Fuel Tanks
2750kVA:
28,000ltr usable Double skin, Rectangular, above ground structural slab style bulk storage tanks, each to provide sufficient fuel capacity to run 1 x 2750KVA generator for 48hrs when running at full load. (572.3ltr/hr x 48 = 27,470ltrs)

Tanks are specially manufactured to allow the full weight of the acoustic enclosure and generator to be skated down their length for reasons of ingress and egress.

Tank to BS 799 part 5 type J 2010. Max working head 0.5m above top of tank.
Tank plates fully welded internally & externally. Tank internally braced as 5.6.4 fig 1.
Material 6mm sheet Tank & Bund Ref: 43A/EN10025S275

2750kVA:
Skin Size: 13.75m long x 3.0m wide x 780mm high
Tank Size: 13.5m long x 2.9m wide x 762mm high
Tank internally braced with 6 no 2.9m wide 762 x 267 x 147 I Beams
Bund Skid Mounted 5 no : 152 x152 I beam bearers making total height 932mm
Unit Dry Weight 20 Tonne
Unit Wet Weight 47.0 Tonne

Connections:

- 600mm Sq. Manway.
- 50mm BSP Socket for fill point pipe to cabinet
- 50mm Vent pipe to bund
- 50mm bund vent to atmosphere
- 25mm BSP Socket for Contents gauge
- 25mm BSP socket for return line x 2
- 25mm suction Line c/w NRV & flanged to manway lid
- 50mm Drain line c/w suction pipe {Capped}
- 25mm BSP Socket for level probe {Plugged}
- 50mm BSP Socket - spare {Plugged} x 2
- 40mm BSP Nipple for bund Leak x 1
- 40mm BSP Nipple for tank alarm x 1
- no Lift Lugs
- Earth Lug to main body of vessel
- Access hatch to bund void area
- 2" overfill valve, heavy duty, for steel tanks, brass Prevents above ground storage tanks being overfilled.
- C2020-A A Tank Gauge Suits tanks from 300 mm to 3.0 meters (fuel oils)
- High/Low Alarm and 4-20 mA output.
- 12/24 vdc or 100/240 vac. Comes with 6 meters of probe cable and 1" Tank connection Gland
- C2020-B8 OLE Bund Probe
- Tank Mounted Cabinet for Fuel Polishing System.
- Gauge settings will be agreed and detailed on associated Tech Sub / FDS.

Standard Paint finish
Electric wire brush (Where necessary) & De Grease 1 coat primer 2 coats air drying enamel
Colour - TBA
Minimum Paint Thickness (Dft) – 70 Microns.
Tank base & bearers 2 coats Bitumen
Nominal Thickness 50 Microns

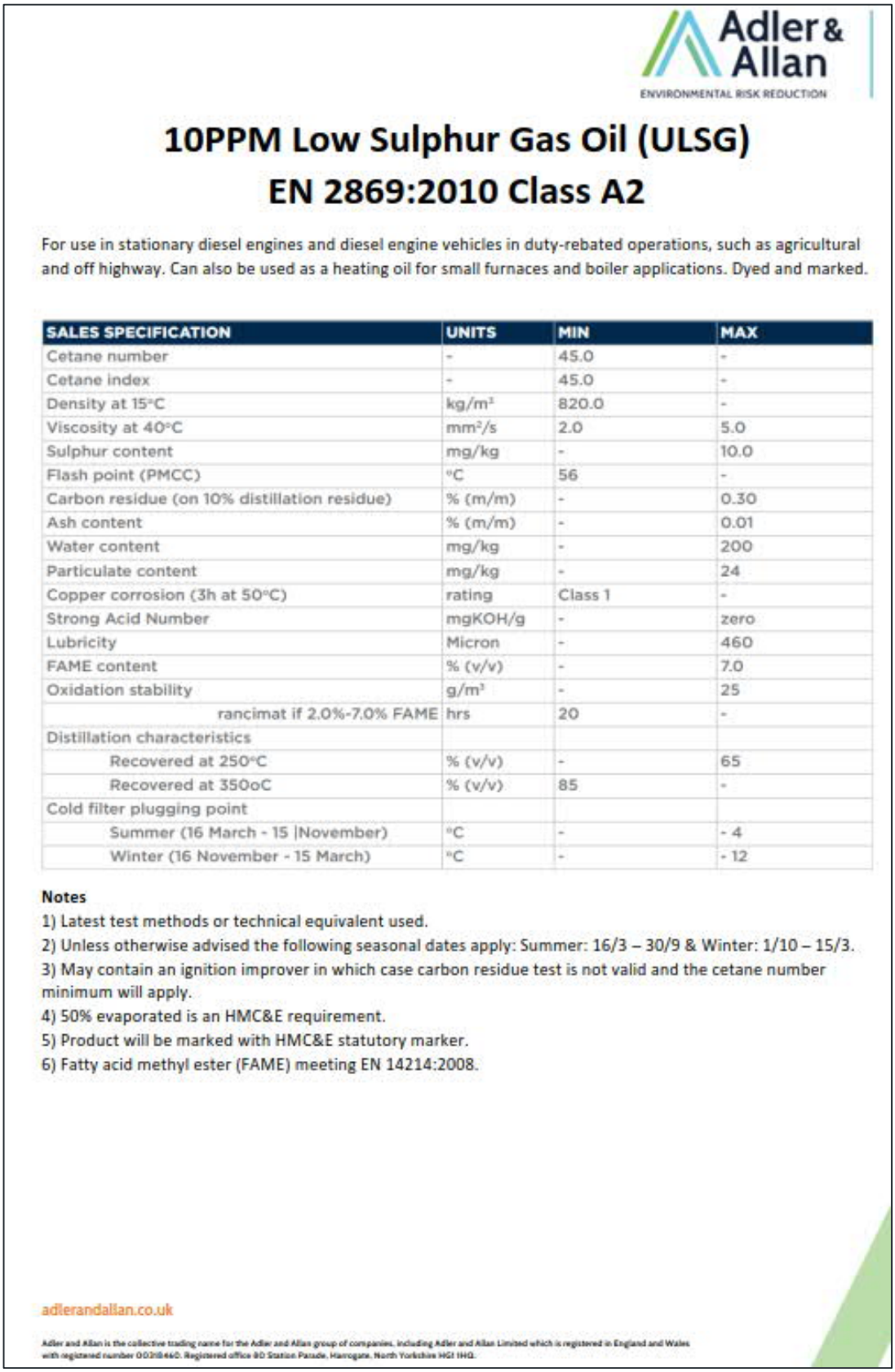
Fuel Polishing Unit * refer note 1 below.

- Fixed to the tank or wall mounted internally to the acoustic enclosure and piped to tank is 1 x fuel polishing unit from the tank manufacturers comprising of the following:
- Filter Separator element for FBO14 For refuelling applications the filter separator element is used to remove particulate contaminant and water from jet fuel, aviation, diesel fuels, and hydrocarbon fuels 10 Micron.
- Hydrocarbon filter vessel
- Racor FBO-14 DPL manufactured from die cast aluminium head with a steel body, both components are powder coated.
- Access to the single element is via four "locking ring collars", which require no tools to open. This has 1 1/2" NPT connections and is rated at 150 psi @ 240 deg F maximum operating parameters, supplied complete with differential pressure gauge to indicate element life. Also includes a water sight glass, used to indicate level of coalesced water in the sump of the vessel.
- Depending upon your recirculation time frame the FBO14 will flow 50lpm. This is based upon coalescer / separator elements. The clean differential will be less than 2.0psi, and the maximum for the elements is 15 psi.
- 240v 1ph 50Hz motor
- 100mm Vertical Pressure Gauge x 3/8" BSP 0-2 Bar.
- Installation of Pump into tank and bund unit as per requirements / drawing. Fit a lockshield valve and a pressure gauge just before filter to set the pressure/flowrate. Return line with lockshield (normally closed) fitted AFTER pressure gauge {before filter} & piped to top of tank
- Fit pipe work from filter to rear of tank & piped 50% into tank to prevent free fall of product, fit defuser to pipe end.

Leak Detection

- The generator enclosure includes 2 x float switch leak detection pockets c/w MOR float switches, one in each opposite corner. When the float rises the alarm will be raised at the Generator Set Controller.
- A similar leak detecting float switch is located within the slab fuel tank bund section also raising the alarm at the GCP.

The Adler and Allan Fuel Specification for ultra low sulphur gas-oil is provided below.



Adler & Allan
ENVIRONMENTAL RISK REDUCTION

10PPM Low Sulphur Gas Oil (ULSG)
EN 2869:2010 Class A2

For use in stationary diesel engines and diesel engine vehicles in duty-rebated operations, such as agricultural and off highway. Can also be used as a heating oil for small furnaces and boiler applications. Dyed and marked.

SALES SPECIFICATION	UNITS	MIN	MAX
Cetane number	-	45.0	-
Cetane index	-	45.0	-
Density at 15°C	kg/m³	820.0	-
Viscosity at 40°C	mm²/s	2.0	5.0
Sulphur content	mg/kg	-	10.0
Flash point (PMCC)	°C	56	-
Carbon residue (on 10% distillation residue)	% (m/m)	-	0.30
Ash content	% (m/m)	-	0.01
Water content	mg/kg	-	200
Particulate content	mg/kg	-	24
Copper corrosion (3h at 50°C)	rating	Class 1	-
Strong Acid Number	mgKOH/g	-	zero
Lubricity	Micron	-	460
FAME content	% (v/v)	-	7.0
Oxidation stability	g/m³	-	25
rancimat if 2.0%-7.0% FAME	hrs	20	-
Distillation characteristics			
Recovered at 250°C	% (v/v)	-	65
Recovered at 350oC	% (v/v)	85	-
Cold filter plugging point			
Summer (16 March - 15 |November)	°C	-	- 4
Winter (16 November - 15 March)	°C	-	- 12

Notes

1) Latest test methods or technical equivalent used.
2) Unless otherwise advised the following seasonal dates apply: Summer: 16/3 – 30/9 & Winter: 1/10 – 15/3.
3) May contain an ignition improver in which case carbon residue test is not valid and the cetane number minimum will apply.
4) 50% evaporated is an HMC&E requirement.
5) Product will be marked with HMC&E statutory marker.
6) Fatty acid methyl ester (FAME) meeting EN 14214:2008.

adlerandallan.co.uk

Adler and Allan is the collective trading name for the Adler and Allan group of companies, including Adler and Allan Limited which is registered in England and Wales with registered number 00218440. Registered office 80 Station Parade, Harrogate, North Yorkshire HG1 1HQ.

Figure 5-1 - ULSG Class A2 spec

Positioning:

The tanks internal to the building with no vehicle access so zero risk of a vehicle impact. The only vehicle movements will be diesel delivery by road tanker which will be supervised under a safe system of work procedure, as will the fuel delivery to the tank. Delivery procedures are described and are contained in s.6.7.9. of Chapter 6 of the Virtus OHS&E Manual, including covering of local at-risk drains. A spill response exercise is undertaken routinely to test the procedure.

Secondary Containment:

The Agency guidance states that secondary containment is "a drip tray" or "a bund – outer case which holds the container", secondary containment does not include 'double-skinned' tanks etc "where the tank is surrounded by a second skin for extra strength".

The attached Koronka design (Appendices) uses the term bunded rather than double skinned. The design is in fact to BS799: Part 5 which covers the internal Primary tank, fitted within an external tank which provides the bund function, within which the inventory will be prevented from releasing to the environment. This is therefore an integrally bunded design. Should there be any perforation in the Primary tank, the leak will result in the level of liquid levelling out across the primary tank and bund space; and trigger the alarm sensor. The alarm function is provided by a C2020-B8 BLE probe set to alarm if tank inventory is released to the annulus. A data sheet (C2020 I & O Manual) is attached at Appendix G.

All transfer pipes including the delivery point are within cabinets or within the fabric of the building, and balancing pipework between tanks are in the building (which provide the facility to pump diesel between adjacent tanks if necessary), these are routinely kept closed to prevent un-managed flow between tanks.

The internal building provides tertiary containment for the fuel storage tanks, whereas the delivery point is connect via bunded area and forecourt interceptor and stormwater storage system. These are therefore tertiary containment measures.

Deliveries

Procedures for diesel deliveries are included in Virtus management system and defined in the Operations Manual and described in the box below:

A fuel refill request is made by staff which initiates a controlled and safe system of work; a trained member of the FM Team takes a gauge reading and cross references this with a Monthly Log. If necessary cross reference is made to the secondary fuel gauges. Personnel are made aware of the maximum capacity of the generator fuel tanks at each location.

The tanks must 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 FM Team Contract Manager or Supervisor and Virtus. The FM Team shall inform both Virtus and site security that fuel delivery is to take place. Where necessary the local area will be appropriately cordoned off using barriers and cones. The tanker and its crew must be supervised at all times, a permit to work process applies. Any 'at risk' drains must be covered to prevent potential loss to the drains and spill kits must be positioned nearby. Any concerns over the quality of the spill kits or drain covers must be reported to FM Team Contract Manager and Virtus. Delivery of fuel will not be carried out until any remedial actions are conducted.

The FM Team must ensure that all combustible materials, flammables and naked lights and mobile phones are removed or switched off within the fuel delivery area and immediate vicinity.

All FM Team employees must ensure that they wear the correct level of PPE.

The FM Team are to obtain delivery receipts/reports indicating the exact amount of fuel delivered to individual fuel storage tanks.

A further procedure exists in the event of a spillage or leakage of fuel; triggering the Pollution Incident Response Plan if required. Virtus operate a Nine Point Fuel / Chemical Spill Procedure which assesses the severity of the spill and associated risks, and initiates the appropriate response in terms of alarms, actions, notifications and records.

Collected spilled oil and absorbent material is disposed of as hazardous waste.

Tank Inspections (Asset Integrity Programme):

Given the protection from impact (described above), and the structural design of the tank system (to BS 799: Part 5), the only remaining method of failure of the tank will be internal corrosion. This is a recent issue due to the increased use of biodiesel in diesel/gas-oil (see specification provided previously), Fatty Acid Methyl Esters attract water and dissipate it throughout the fuel which can cause acidic pitting of the tank surface internal, as well as the build-up of sludges.

Corrosion is managed/mitigated by:

- correct specification of the fuel (note the maximum zero Strong Acid Number specification of the Adler and Allan ULSG Fuel specification provided),
- on-site continuous circulation of the diesel through the fuel polishing system to remove water and particulates;
- quarterly fuel sampling as described in 6.7.9 of Chapter 6 of the OHS&E Manual;
- 5 yearly empty tank inspections;
- Visual inspections of the external structures on a daily basis for signs of corrosion (although these tanks are internal) with checks also being carried out as the generator is serviced (minor and major service) by the OEM or OEM approved provider (Ch6, 6.7.9) 6-monthly and annually.

Chapter 6 OHS&E Manual is attached as Appendix D.

All plant and asset management is controlled in Maximo and referencing SFG20 and other industry standard databases. The level and frequency of inspections and fuel sampling is greater than industry standard. Full detail of the 5-year tests will be provided when available.

5.9 SITE DRAINAGE

The surface water drainage strategy for the Data Centre is that the two engine compound area drainage systems are internal foul systems and separated from the drainage system serving the remaining building, roof and car parking surface water, and pass to the existing foul sewer. The fuel delivery area is bunded and separated by a Class 1 forecourt separator with 10,000 litre capacity and a high level alarm, before passing via a Tubosider attenuation tank providing 171 m^3 storage, then to the external surface water drainage system and existing SW sewer.

The full drainage plans are attached and the detail areas around the Generator Room 1 and the fuel fill cabinet are shown below.

The drainage strategy is contingent on catastrophic failure having been designed out of the diesel storage system. The procedures address potential local spills or overfill, notwithstanding that alarm systems and supervised delivery safe systems of work procedures are in place, as well as protection of 'at risk' drains during deliveries.

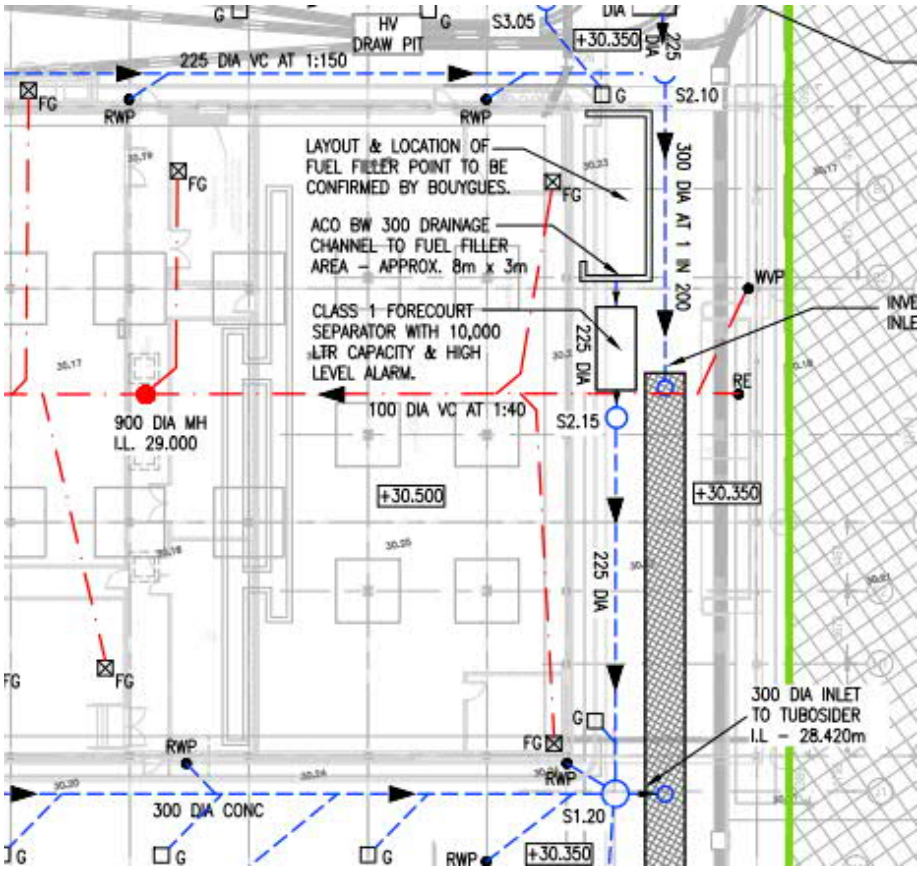


Figure 5-2 – LON2 example drainage detail (North generator room/fuel fill point)

Spill procedures are attached (Ch6 – Appendix E).

Currently there are limited procedures or checks that provide inspection at the discharge to surface water sewer with the exception of the interceptor cleaning, for which Virtus have contractors identified and undertake regular cleaning and inspections (RAMS can be provided which provide evidence that the interceptors are cleaned, however Virtus undertake to ensure these are comprehensively developed and built in to site management systems (currently being completed as part of Improvement Condition to Stockley Park data centre permit).

A frequent inspection of the surfaces around the engines and pathways to the drains are made on a daily basis. Any developing leaks or spills would be detected, and spill clean up instigated immediately, preventing any emission that might overwhelm the interceptor.

5.10 WASTE MANAGEMENT

Waste management procedures and controls are outlined in Operations Manual Chapter 6. Audits of service providers are audited regularly, including directly and indirectly contracted (via FM Teams).

Wastes which will be produced at the data centre will be recorded on a Waste Stream Duty of Care Matrix (QHS-37-06) which includes the following required information:

- Waste type and EWC code;
- Whether it is hazardous or non-hazardous;
- Activity waste has arisen from;
- Broker number (if applicable);
- Waste carrier and licence number;
- Name and addresses of waste transfer station (waste destination);
- Waste management licence number of destination facility; and
- Disposal route (i.e. recycled, recovered, etc.)

The matrix for the Data Centre will be maintained and updated by sub-contractor Optimum. Waste data will be recorded.

Virtus operate a Duty of Care system described previously which identifies the appropriate contractors for waste removal, ensures correct licensing and permitting of carriers and disposal locations, and undertakes audits to ensure legal compliance. All contractors/subcontractors who have a responsibility to collect or remove waste have their waste credentials registered in the Duty of Care spreadsheet, ensuring that all waste (both hazardous and non-hazardous) is handled in accordance with regulations. Waste oil-filters are currently sent to Slicker Recycling, Kent.

5.11 WASTE DIESEL MANAGEMENT

Waste diesel in quantity will only be produced if fuel polishing measures have failed to sufficiently maintain the quality of the diesel. Virtus processes therefore exist to avoid fuel degradation, and these are an important part of management of the system. It has been confirmed that there has been no waste diesel collected or disposed of, and therefore the 'expected quantities' of waste diesel are nil. However, the process for the collection of waste diesel is as follows:

Upon evidence from quarterly diesel sampling results that diesel is no longer suitable for combustion, the data centre site teams would contact the contracted diesel supplier to remove the unsuitable diesel and replenish the bulk tanks. The removal of waste diesel requires the mandatory on-the-spot completion of a Hazardous Waste Consignment Note with a Part E update to follow. All waste consignment notes are required to be issued to VIRTUS site management and compliance departments for verification against permits/registered activities.

Diesel Sampling contracted methodology:

Gain access to the top of the diesel tanks and take two samples of diesel, one from the middle of each diesel tank and one from the bottom of the diesel tank

The diesel tank samples will be sent to a Laboratory and the results will determine the condition of the diesel which will include the following:

1) Density of Diesel@ 15^{o}C

2) Flash Point of Diesel

3) Water Content - ppm

4) % of Fam/Bio Diesel

5) Specific Gravity – g/ml

6) Bacteria TC - cfu

7) Fungus / Mould - cfu

8) Sulphur-ppm

9) Practical Count

10) Supply a diesel sample test report for each generator diesel tank

The complete method statement is attached as Appendix H.

Waste diesel contained will be contained in filters or expended spill kits and is collected and removed from site by the specialist contractor completing the work (filters) and by contracted waste service providers (spill kits) for disposal. All removals/collections of such wastes are supported by the completion of Hazardous Waste Consignment Notes.

Appendix A

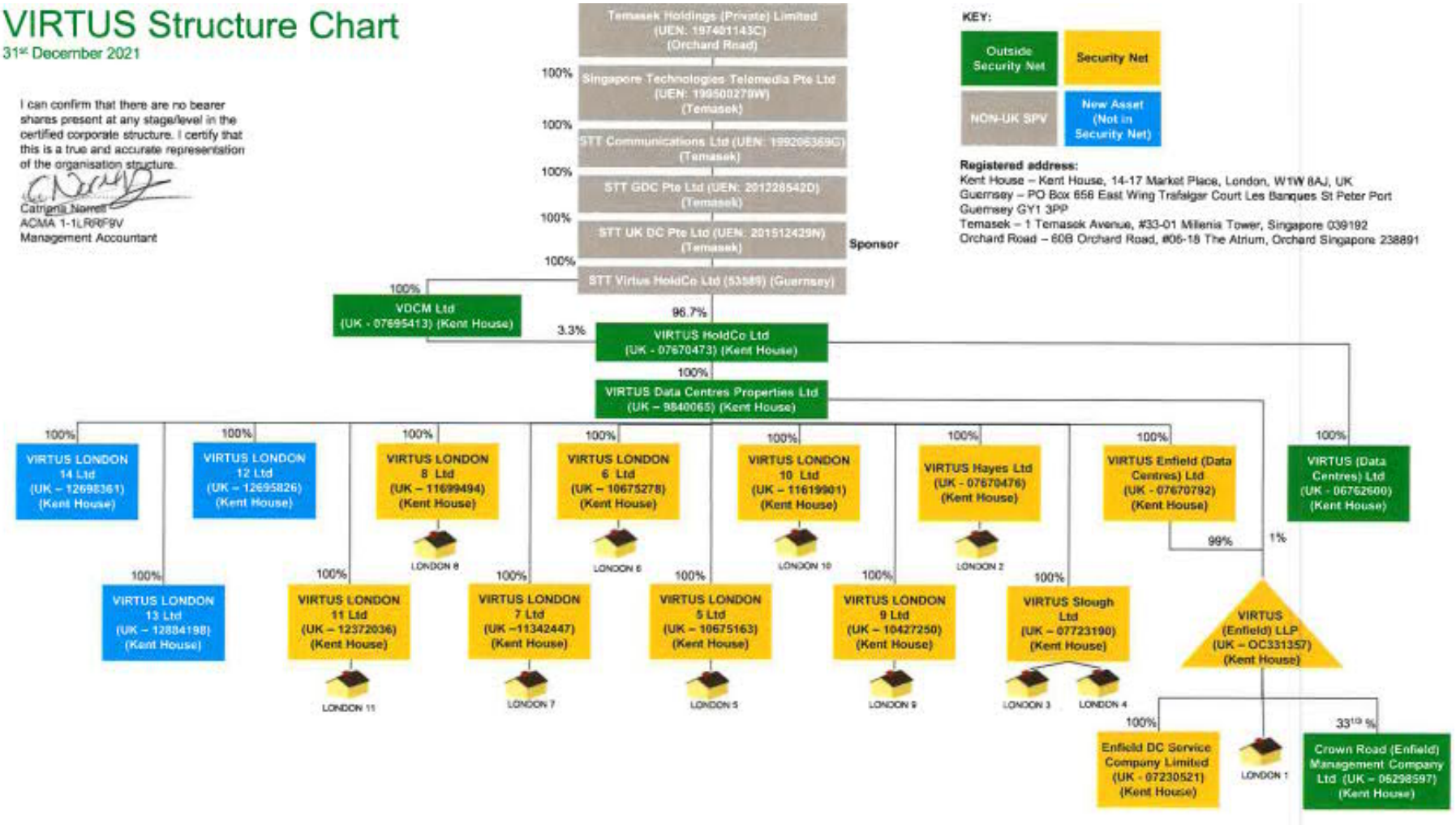
VIRTUS HAYES LTD STRUCTURE

VIRTUS Structure Chart

31st December 2021

I can confirm that there are no bearer shares present at any stage/level in the certified corporate structure. I certify that this is a true and accurate representation of the organisation structure.

Catriona Norrell
ACMA 1-1LRRF9V
Management Accountant



Appendix B

SITE & DRAINAGE PLANS

PLEASE REFER TO FOLDER LON2 APP B

Appendix C

DATASHEETS AND 2G COMPLIANCE INFORMATION

PLEASE REFER TO FOLDER LON2 APP C

MTU 16V4000G24F TA Luft optimised engine Data from EDS 4000 1228 or calculated as shown								
MTU % load	VFR @STP Dry m^3/s (calc)	VFR m^3/s (calc)	NOx mg/Nm^3 'Dry' actual O_2	O_2 %	T exhaust °C	H2O % (calc)	Emission Rate (calc) NOx g/s	Datasheet NOx STP and 5% O_2 mg/Nm^3
100	2.41	7.44	1151	9.5	504	4.92	2.77	1603
75	1.92	5.52	966	10.8	455	4.55	1.85	1513
50	1.43	3.84	895	11.8	411	4.05	1.28	1557
25	0.99	2.32	815	13.8	332	3.26	0.81	1815
10	0.86	1.63	649	16.6	226	2.10	0.56	2337

Appendix D

ISO CERTIFICATES

Certificate of Registration

This is to certify that the Management System of:

VIRTUS Holdco Limited t/a VIRTUS Data Centres
2nd Floor Kent House, 14-17 Market Place, London, W1W 8AJ

And as detailed on the annex of this certificate

has been approved by Alcumus ISOQAR and is compliant with the requirements of:

ISO 9001: 2015

Certificate Number:	**16390-QMS-001**
Initial Registration Date:	07/05/2015
Previous Expiry Date:	07/05/2021
Recertification Date:	25/03/2021
Re-issue Date:	07/05/2021
Current Expiry Date:	07/05/2024

Scope of Registration:

The design, build and ongoing operation of mission critical Tier III data centre facilities.

Signed:
Alyn Franklin, Chief Executive Officer
(on behalf of Alcumus ISOQAR)

This certificate will remain current subject to the company maintaining its system to the required standard. This will be monitored regularly by Alcumus ISOQAR. Further clarification regarding the scope of this certificate and the applicability of the relevant standards' requirement may be obtained by consulting Alcumus ISOQAR

Alcumus ISOQAR Limited, Cobra Court, 1 Blackmore Road, Stretford, Manchester M32 0QY.
T: 0161 865 3699 E: isoqarenquiries@alcumus.com W: alcumus.com/isoqar

Certificate of Registration

This is to certify that the Management System of:

VIRTUS Holdco Limited t/a VIRTUS Data Centres
2nd Floor Kent House, 14-17 Market Place, London, W1W 8AJ

And as detailed on the annex of this certificate

has been approved by Alcumus ISOQAR and is compliant with the requirements of:

ISO 14001: 2015

Certificate Number:	**16390-EMS-001**
Initial Registration Date:	07/05/2015
Previous Expiry Date:	07/05/2021
Recertification Date:	25/03/2021
Re-issue Date:	07/05/2021
Current Expiry Date:	07/05/2024

Scope of Registration:

The design, build and ongoing operation of mission critical Tier III data centre facilities.

Signed:
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Alcumus ISOQAR Limited, Cobra Court, 1 Blackmore Road, Stretford, Manchester M32 0QY.
T: 0161 865 3699 E: isoqarenquiries@alcumus.com W: alcumus.com/isoqar

Certificate of Registration

This is to certify that the Management System of:

VIRTUS Holdco Limited t/a VIRTUS Data Centres
2nd Floor Kent House, 14-17 Market Place, London, W1W 8AJ

And as detailed on the Annex to this certificate

has been approved by Alcumus ISOQAR and is compliant with the requirements of:

ISO 20000:2018

Certificate Number:	**16390-ITT-001**
Initial Registration Date:	04/12/2018
Previous Expiry Date:	29/09/2021
Recertification Date:	25/03/2021
Re-issue Date:	07/05/2021
Current Expiry Date:	07/05/2024

Scope of Activities:

The Service management system of VIRTUS Holdco Limited (trading as VIRTUS Data Centres) supporting the provision of the build and ongoing operation of data centre facilities consisting of retail and wholesale colocation, supporting cloud and high-density computing models to customers from LONDON1 – Enfield, LONDON2 – Hayes, LONDON3/4 – Slough, LONDON5 – Stockley Park, LONDON6– Stockley Park, London7- Stockley Park, London 9 - Slough and LONDON10 - Slough in accordance with Service Catalogue.

Signed:
Alyn Franklin, Chief Executive Officer
(on behalf of Alcumus ISOQAR)

This certificate will remain current subject to the company maintaining its system to the required standard. This will be monitored regularly by Alcumus ISOQAR. Further clarification regarding the scope of this certificate and the applicability of the relevant standards' requirement may be obtained by consulting Alcumus ISOQAR

Alcumus ISOQAR Limited, Cobra Court, 1 Blackmore Road, Stretford, Manchester M32 0QY.
T: 0161 865 3699 E: isoqarenquiries@alcumus.com W: alcumus.com/isoqar

Certificate of Registration

This is to certify that the Management System of:

VIRTUS Holdco Limited t/a VIRTUS Data Centres
2nd Floor Kent House, 14-17 Market Place, London, W1W 8AJ

And as detailed on the Annex to this certificate.

has been approved by Alcumus ISOQAR and is compliant with the requirements of:

ISO 27001:2013

Certificate Number:	**16390-ISMS-001**
Initial Registration Date:	12/02/2013
Previous Expiry Date:	07/05/2021
Recertification Date:	25/03/2021
Re-issue Date:	07/05/2021
Current Expiry Date:	07/05/2024

Scope of Registration:

Information security management for the design, build and ongoing operation of mission critical Tier III data centre facilities.
In accordance with the statement of applicability issue 3.

Signed:
Alyn Franklin, Chief Executive Officer
(on behalf of Alcumus ISOQAR)

This certificate will remain current subject to the company maintaining its system to the required standard. This will be monitored regularly by Alcumus ISOQAR. Further clarification regarding the scope of this certificate and the applicability of the relevant standards' requirement may be obtained by consulting Alcumus ISOQAR

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Certificate of Registration

This is to certify that the Management System of:

VIRTUS Holdco Limited t/a VIRTUS Data Centres

2nd Floor Kent House, 14-17 Market Place, London, W1W 8AJ

And as detailed on the Annex to this certificate

has been approved by Alcumus ISOQAR and is compliant with the requirements of:

ISO 50001: 2018 Energy Management

Certificate Number:	**16390-EnMS-001**
Initial Registration Date:	07/05/2015
Previous Expiry Date:	07/05/2021
Recertification Audit Date:	25/03/2021
Re-issue Date:	18/11/2021
Current Expiry Date:	07/05/2024

Scope of Registration:

The Management of energy relating to the design, build and ongoing operation of mission critical Tier III London Data Centres as follows; LONDON 1, LONDON 2, LONDON 3/4, LONDON 5, LONDON 6, LONDON 7, LONDON 9, LONDON 10 and Head Office at Kent House.

Signed:
Alyn Franklin, Chief Executive Officer
(on behalf of Alcumus ISOQAR)

This certificate will remain current subject to the company maintaining its system to the required standard. This will be monitored regularly by Alcumus ISOQAR. Further clarification regarding the scope of this certificate and the applicability of the relevant standards' requirement may be obtained by consulting Alcumus ISOQAR

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Appendix E

VIRTUS OHS&E CHAP 6

PLEASE REFER TO FOLDER LON2 APP E

Appendix F

TANK DRAWINGS

Refer to Folder LON2 APP F

Appendix G

OLE C2020 MANUAL

C2020 I & O MANUAL Revision 07

Firmware v4 **2018**

OLE (UK) LTD TEL 01243 267 930

1. Standard Kit = Sensor, Display & Tank connector.

AC Mains power supplies are available for 100 vac to 250 vac.
Power supply to the standard unit is 12 to 28 vdc.

Options include:

"TANK-KIT" which includes an IP67 junction box assembly, multiple entry, a 1" BSPT tank connection, and a 30 mm expanding tank connection. (See 4 below)
"C2020-M1" mounting kit, (See section 3)
"C2020-B8" bund alarm probe.

Tank connection may be one of two methods.

1/ Top entry by way of an existing free connection. The minimum size we need is 1" BSPT or NPT.

Bund Alarm float switch use the ame tank fittings

2/ Where no free access is available, the OLE 30 mm expanding seal is ideal.
Cold Bore tank top with a hole cutter 30 mm clearance hole. (zone 2 / safe area only) Insert the expanding fitting and tighten, ensuring the O-ring makes a suitable seal on the tank surface. (This fitting is suitable for Tank Testing up to 10psi / 0.7bar)

2. Probe installation. Top of Tank.

** Make sure the probe you have is right for the tank.

Measure the depth of the tank, Caution, If it is more than 3 meters, the standard C22 probe will not be suitable.
Install the probe onto the bottom of the tank in water based products, or suspended 50 mm above the bottom in Fuel oils and lubricants, to avoid the possible water interface areas. (This may avoid possible water / sludge affects on the probe sensor).
Tighten the Cable gland to suspend the sensor. Either run the remaining cable direct to the Gauge unit or **If using a junction box assembly**, (TANK-KIT) ensure this is mounted to avoid water ingress.

If cutting the sensor cable, strip back 200 mm of outer sheath to ensure free and easy termination without pulling on the cables.

Cut the vent tube to around 30 mm long, and cut the conductors to 200 mm long. If the cable is to be extended. This should be twisted screened pairs, back to the display. (Max cable length with Voltage sensor is 100 meters)
The junction boxes need a small vent hole drilled (0.5mm). This allows atmospheric pressure equalisation if you are not joining with OLE Vented cable (Available per meter) Silica gel packs to be fitted to absorb any moisture.
C code Sensor wiring = BROWN = Volt Sensor 5vdc GREEN = Volt sensor SIG **WHITE** = Volt sensor 0v
A code Sensor wiring = BROWN = mA Sensor +V GREEN = mA Sensor SIG (**WHITE** = NOT USED)

Sensors should exceed tank height and product. Specific gravity must be considered here.

STD Sensors & Cable L

Voltage sensor
C22 =0-2.55 Meter (Cable is 6 M long)
C23 = 0-3 Meter 7M
C25 = 0-5 Meter 10M
C27 =0-10 Meter 15M

Optional Milliamp Sensors
Model.Range.Cable L
A12 =0-3.0 Meter 10M
A14 =0-5.0 Meter 10M
A16 =0-10 Meter 10M
A18 =0-20 Meter 20M
A20 =0-30 Meter 30M

C2020 is for Zone 2 and Safe area applications only

CAUTION: Do not damage the outer sheath of the sensor. This may cause liquid to enter the cable and damage the transmitter circuit.

To test the Voltage Sensor Output. Measure with a multi-meter set to 20 volt DC range, across the GREEN and WHITE sensor connections. The sensor should read between 0.45V and 0.55V when out of the tank, and between 0.45 and 4.6V when in the tank with product present.
If the gauge can not see the sensor, the display will say so.

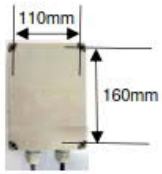
To test the Milliamp sensor, Open the Green wire from the board and measure milliamps in series with this green wire. Never test across the two terminals

3. Display mounting.

The displays may be mounted on walls or panels by utilising the displays own mount holes. These will retain the IP66 integrity. Allen Cap or Cross Head M4 is ideal for this. (Hole positions are shown on back moulding)

The universal mount bracket available from OLE allows for wall mounting as well as 2" pipe mounting, and 3" pipe mounting. The design allows for either Single display mount, or power box and single display mount. or Single display and T3100 remote monitor, or a Dual display. (Code C2020-M1)

4 mount holes external to case seals. M4 Bolt set included



4. Features The C2020 comes in 2 forms.

C2020-O is a standard Gauge with no Alarms
C2020-A = Gauge with **High and Low Alarm**
The Alarm is set between 0 and 100% (one contact)

Additional Options

C2020-B8 = **Bund** Alarm Probe option
The Bund Alarm is a mechanical Switch Float. This is fail safe, opening to Alarm. The Bund alarm comes with 6 meters cable and a 1" BSPT Tank connector. The standard gauge is supplied with a Link wire where the Bund Alarm would be connected. Remove this link and connect the 2 wire sensor. (Red / Green) (This is not polarity sensitive)

C2020-4-20OUT - Milliamp Output
This is proportional to 0 litres = 4 mA and 100% litres = 20 mA

TANK-KIT, Junction Box and Extra fittings.

5. Operation

The C2020 is very simple to operate. There is a Scroll button, which shows Tank Capacity and Ullage space.
This will show for 5 seconds before reverting to the standard display.
There is an Alarm / Test-Mute button. Press to test the alarm (If fitted). This self resets in 5 seconds.

If an alarm has been 'Muted' the Alarm symbol shows a crossed out image. If a Bund Alarm is incorporated, this shows as a 'B' on screen

If the TEST feature is X Cycle Gauge Power = Reset

H = High Alarm, L = Low Alarm
B = Bund Alarm

Calibration: See the separate sheet for calibration set-up.
A Jumper needs to be installed in the "CAL" position and then the various settings screens can be adjusted.

Note: The sensor settings screens are factory set and should not need changing, but can be adjusted to improve accuracy

Appendix H

DIESEL TESTING METHOD STATEMENT

Power Generation Services Ltd

ITT SERVICES

METHOD STATEMENT 0478 GENERATOR DIESEL TANK FUEL TESTING

1.1 **CLIENT: Optimum**

1.2 **SITE ADDRESS: VIRTUS DC London 5 Horton Road Stockley Park**

1.3 **LOCATION: Generator Containers**

2.1 NATURE of WORK: Diesel Tank Fuel Sample Testing

2.2 The work will involve accessing nine generator container diesel tanks to take two Samples of diesel for testing

2.3 Prior to commencement of work on site all ITT Services personnel will report to the security office to obtain site security passes and attend site induction which will address as a minimum the following points:-

a) **Location of site safety documentation**
b) **Fire and evacuation procedures**
c) **PPE/RPE requirements (When Required)**
d) **First Aid provisions and welfare arrangements**
e) **Site Rules**

2.4 On completion of site induction all operatives will sign confirming their understanding of the method statement and procedures

2.5 Clients authorised person to issue a Permit to Work

2.6 All switching within the generator to be carried out by the Optimum and ITT Services authorised engineer

2.7 **The generator will remain in AUTO Mode during the accessing of the diesel tank**

3.1 **Method Statement**

3.2 Obtain a permit to work

3.3 ITT Services engineer to gain access to the generator bulk tank

3.4 ITT Services engineer to remove diesel tank pipe work at the top of the tank or remove a bung union at the top of the diesel tank to gain access to the diesel tank

3.5 Using a diesel sample pump and sample container take two diesel samples from the middle and bottom of the diesel tank

3.6 Refit pipework or bung union and clean up any diesel spillages

Power Generation Services Ltd

ITT SERVICES

3.7 On completion of work sign off permit to work and supply the customer with service reports

4.1 **Access and Working Platforms**
All access platforms and scaffolding not required

5.1 **Waste**
All waste will be removed and disposed of in the correct manner

6.1 **Transport and Handling of Materials**
Where possible materials will be transported as close as possible to the place of work by mechanical means, i.e. van, trolley etc. manual handling of materials will be kept to a minimum.
Manual handling loads must not exceed the safe comfortable lifting capacity of the individual. If necessary boxed and bagged loads should be subdivided

7.1 **Plant and Equipment**
All plant and equipment necessary to carry out the generator fuel transfer pump removal will comply with all statutory requirements

8.1 **PPE and Noise Protection**
The correct PPE must be worn at all times

9.1 **Safe Working Procedures**
The risk assessment and Power Generation Services Ltd T/A ITT Services health and safety policy apply to this project

10.0 **Personal Protective Equipment**
Standard site requirements for PPE include, but are not restricted to safety hard hats, safety boots, hi –vist vests, overalls, dust masks, eye protection and ear protection may also be required (site specific)

11.1 **No Smoking on Site**

12.1 **Supervision and Personnel**

Kevin Bligh……..

Malcolm Copeland ……

12.2 **Date** 27th September 2018

Appendix I

HV DESIGN SCHEMATIC

Please refer to folder LON2 APP I

110 Queen Street
Glasgow
G1 3BX

wsp.com