Best Available Techniques Assessment

Longcross Data Centre: SP3004SB

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APPENDICES

1.0 INTRODUCTION

This Best Available Technique (BAT) assessment has been prepared by HDR on behalf of the legal operator, Ark Data Centres Ltd. (Ark) in support of the application for a new bespoke Environmental Permit, (ref SP3004SB) for following installation:

Longcross Data Centre
Longcross Film Studios,
Chobham Lane,
Longcross,
Chertsey,
KT16 0EE

Ark, as the legal operator, is required to apply to the Environment Agency (EA) for a permit because the total thermal capacity of the site's combustion plant exceeds the 50MW threshold stipulated in the legislation[1].

The Longcross Data Centre is currently being constructed with completion and handover expected in early 2025. The data centre will house various IT equipment that will require a constant stable electrical supply to operate effectively.

For a detailed description of the Data Centre (DC) and surrounding area, please refer to the Non-technical Summary (NTS) and Environmental Risk Assessment (ERA) submitted as part of the application for a permit.

1.1 Purpose of this report

It is a requirement that the operator demonstrates how they comply with the indicative BAT requirements, with assessment to be completed as part of the application for an environmental permit. 'Techniques' include both the technology used and the way the installation is designed, built, maintained, operated, and decommissioned.

At the time of writing there are no relevant published BAT reference documents (BREF notes) for Data Centres. The previous guidance document: 'Combustion Activities (EPR 1.01)' was withdrawn in August 2018. To replace this, the EA have produced a working draft BAT guidance document specifically for Data Centres: 'Data Centre FAQ Headline Approach v21' (November 2022). This BAT assessment is structured using this guidance document and seeks to provide evidence of BAT or justification where the requirements have not been met.

Some of the design choices that have been made are in response to local planning requirements and are specific to the constraints and circumstances for the site location. This report is therefore specific for this site only and should not be taken to represent the BAT position for other Data Centre developments.

Note: Each individual Emergency Standby Generator (ESG) is significantly below the threshold of 15MWth for large combustion plant. Therefore, the BAT requirements for large combustion plant are not relevant for this installation.

[1] The Environmental Permitting (England and Wales) Regulations 2016

2.0 SITE SUMMARY

We have presented a high-level summary below. Please refer to the Non-technical Summary (NTS) submitted with the application for more details.

Longcross Data Centre is currently under construction and will use Emergency Standby Generators or 'ESGs' to provide emergency power in the event of grid electrical failure. At final fit out the Data centre will see x28 no. Rolls Royce MTU DS4000 ESGs installed. Each ESG has a rating of 3.2 MWe or 8.01MWth. The total rated thermal input of these ESGs is approximately 224 MWth (See Appendix A).

The x28 ESGs will be installed over two floors and several phases, with x14 being installed in Phase 1 and the remaining x14 in Phase 2. The location of the ESGs can be seen in Figure 1 and Figure 2 below. The Installation Boundary, which is limited to the ESG plant area is outlined in green on Figure 1.

All the ESGs due to be commissioned are over 1MWth and are therefore classed as new 'Medium Combustion Plant' (MCP) and Specified Generators. These ESGs are 'limited hour MCPs' as they are purely standby plant that will operate less than 500 hours per year and there is no capacity agreement in place. The operation of the ESGs is likely to be limited to monthly/annual maintenance and testing of approximately 8 hours/year/ESG. The ESGs are capable of operating on diesel or biodiesel such as 'HVO' or Hydrotreated Vegetable Oil.

The Directly Associated Activities (DAA) include fuel storage tanks, Urea storage tanks, associated pipework, and the drainage network.

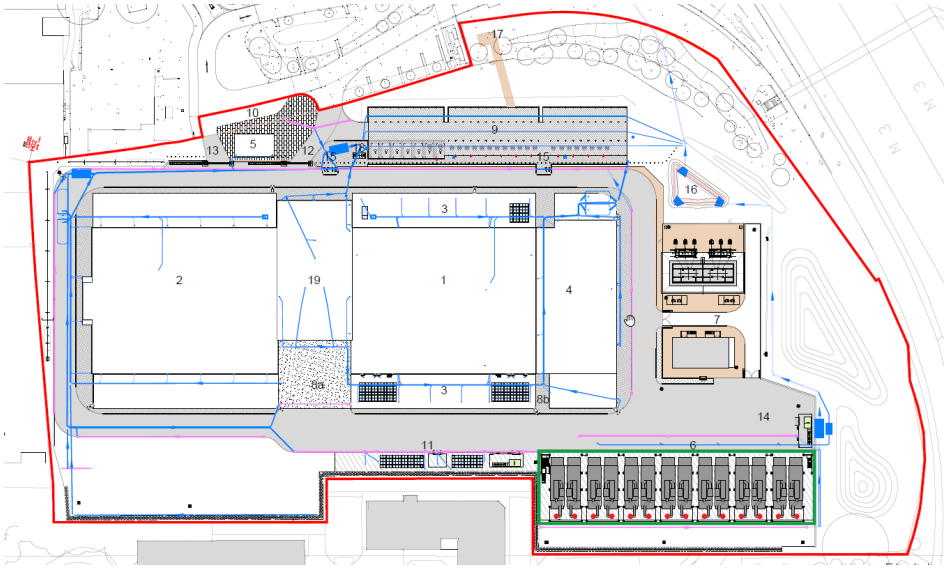

Figure 1 – Installation boundary and emissions points

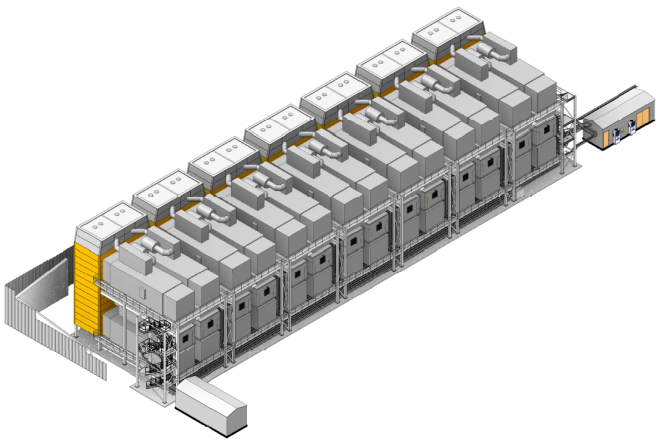

Figure 2 – Indicative Generator layout

3.0 DATA CENTRE DESIGN

3.1 Uninterruptable power provision

The Data Centre functions by renting out data halls to customers to fill with various servers and associated IT equipment. This equipment requires a stable and constant supply of electricity to operate.

'Uptime' or power availability is a term used to explain how reliable a power source is. Data centres require a high level of uptime or uninterruptable power provision and being supplied by the national grid brings a risk of mains failure events (black out) or fluctuations outside of acceptable limits (brown outs). Downtime i.e., power failures or voltage drops, even momentarily, may mean loss of service to customers e.g., banks. This could have significant negative implications to site services, both in terms of direct financial costs and indirectly through reputational damage. Therefore, an interruptible power supply is critical to a Data Centre's ability to operate.

Given this risk, the installation has emergency back-up generators to provide an electrical supply to the site. In the event of a loss of supply from the grid, the generators will start up, but they will not be able to take the electrical load immediately. Power is initially provided by the site's Uninterruptible Power Supply (UPS) (arrangement of batteries) until the generators start to take the site's electrical load. The generators start from 'cold' to take on the load from the UPS (typically within 30-60 seconds). The backup generators then provide ongoing power until a stable mains electrical supply is restored.

The Uptime Institute's Tier classification and performance standard[2] provides an objective basis for comparing one sites infrastructure vs another. The differing tiers are summarised below.

	Tier I	Tier II	Tier III	Tier IV
Active Capacity Components to Support IT Load	N	N+1	N+1	N after any failure
Distribution Paths	1	1	1 active and 1 alternate	2 simultaneously active
Concurrently Maintainable	No	No	Yes	Yes
Fault Tolerance (single event)	No	No	No	Yes
Compartmentalization	No	No	No	Yes
Continuous Cooling*	load density dependent	load density dependent	load density dependent	Yes (Class A)

Figure 3 – Uptime Institute's Tier classifications

Uptime is calculated based on the amount of downtime a site experiences as a % of the year i.e., 99% or 'two 9's' corresponds to about 7 hours and 12 minutes of downtime per month. As the "nines" uptime increases – to three (99.9%). Four (99.99%) and five (99.999%) the downtime decreases. In general, five nines are considered a reasonably high reliability. With six nines, or 99.9999%, an average customer would experience 2.6 seconds of downtime per month, or less than 32 seconds per year.

The National Grid produce an annual report of performance. Below is the performance statement from the National Grid report for 2022/23.[3]

> *"The Overall Reliability of Supply for the National Electricity Transmission System during 2021-22 was: 99.999612%."*

The Longcross facility has been designed and will be operated as a Tier III facility, which requires the provision of ESGs.

[2] https://uptimeinstitute.com/tiers

[3] https://www2.nationalgrideso.com/document/289196/download

3.2 Onsite electrical infrastructure

For resilience reasons, it is preferable to have numerous power supplies to the site; this provides an alternate route to switch to, should one supply be compromised during an outage. This can be provided in several ways, but the common option is to have separate supply routes within one substation, or to have multiple substations onsite. If one supply route fails, the Data Centre can switch to the alternate supply that is unaffected. This is a process known as “bus coupling.” This ability to switch to the unaffected supply route reduces the duration for which the generators operate in the event of an outage.

The Grid connection is fully redundant and dedicated. The likelihood of the loss of Grid supply is low considered the site is supplied via its own dedicated substation 132/11kV which is fed via the Grid 132kV supply.

The 11kV supply and distribution network at Longcross shall consist of 2No main 11kV distribution switchboards, namely EC MAIN HV-A-01 and MAIN HV-B-01, configured in a 2N arrangement each supported by a dedicated 11kV incoming UKPN utility supply feeder and 7No incoming generator connections

A description of the system operating under varying scenarios is as follows:

1. Normal operation: Site load fed by both available mains supplies and ESGs are in stand-by state not running,
2. Single mains failure: Site load fed by the one available mains supply and ESGs are in stand-by state not running,
3. Black-out Both Mains Failed: Mains not available, site load fed via ESGs, all 28nr Sets start and then drop off as required. Generators running and loaded on 85.7% if site load is 100% (highly unlikely).
4. Off-Load testing: Selected number tested (up to 2 ESGs at any one time) no load.
5. On Site-Load testing: All ESGs tested running on site load:
6. On Load Bank on Grid Load testing: 2nr ESGs tested running on load bank or on grid load.

3.3 Redundancy arrangement

The main source of power at the installation will be electricity. This will be supplied via its’ own dedicated substation, fed by the National Grid. To mitigate the risk of power failure on site, in line with the options outlined above, ESGs to provide electricity in event of grid failure are necessary. An uninterruptable power supply (UPS) in the form of a battery bank will also be utilised to bridge the short gap between supply failure and the generators starting up.

The installation has incorporated redundancy / resilience as a risk measure to help ensure that power provision is not interrupted in the event of a loss of mains electricity supply. The number and capacity of the proposed generators are based on the likely maximum electrical demand by prospective customers. The generators can provide the maximum amount of power that the DC could require at its current design.

The redundancy arrangement for the generators is N+2, where ‘N’ is the number of generators required to carry the maximum electrical load. At full capacity, each set would be running at a maximum of 85.7%. Thus in an outage only 24 of the 28 ESGs are required to carry the maximum site load i.e. 2 of each group of 14 are not required to operate.

In the event of a loss of supply from the grid, the generators will start up, but they will not be able to take the electrical load immediately. Power is initially provided by the site’s UPS until the generators start to take the site’s electrical load. The generators start from ‘cold’ to take on the load from the UPS (typically within 30-60 seconds). The backup generators then provide ongoing power until a stable mains electrical supply is restored. The redundancy arrangements are to safeguard power to the dedicated data halls as Diesel generators have up to a 15% probability of not starting and therefore +1 or +2 depending on total building load installed.

3.4 Technology selected to provide emergency power

ESGs capable of operating on diesel or HVO have been selected to provide emergency power to the installation in the event of grid failure. A BAT assessment, considering alternative technologies and why ESGs are considered BAT is presented below.

There are currently no BAT reference documents or BREF notes that have been made available by the European Commission for the specific provision of backup power in the Data Centre industry. We are therefore proposing an alternative which is based on the guidance in the EAs "*Data Centre FAQ v21 – Working Draft*".

The key criteria used in the selection of the BAT to fulfil the backup power requirements are split into two categories:

- Operational requirements
- Environmental risks

The criteria for both categories have been chosen based on the main risks posed and in accordance with the risk assessment guidance for bespoke permits.

3.4.1 Operational requirements

Table 1 – Operational requirements

Criteria	Considerations	Weighting
Cost benefit analysis	The initial capital cost of the technology being considered, and the potential cost of potential mitigation measures need to be considered to ensure they are not disproportionately high compared to the environmental benefits. Otherwise, the operator will cease to be competitive.	High – impacts competitiveness
Proven as a reliable technology	The resilience requirements of Data Centres are such that the key operational criterion is for the technology used to be a proven and reliable technology. An indication of reliability of a technology can be taken from the number of instances that the technology in question has been successfully utilised in the industry, i.e., whether this is a tried and tested technology or is it new and emerging. The technology also needs to suit the prevailing model of the industry.	High – if technology is not proven it presents a risk to the operator
Cold start capability	The technology will need to have the ability to start operating quickly in the event of a sudden loss of power. A warm start configuration would necessitate 24/7 operation of generators at the site: creating unnecessary fuel costs and environmental impacts. A slow start technology would necessitate additional energy storage UPS capacity (in the form of batteries or flywheels), taking up additional space and creating additional cost.	High – the ability to provide instant power is critical to business functions
Space requirements	Space requirements are relevant as an environmental consideration as a technology that requires excessive use of space (in the form of generator units, energy storage UPS capacity, and fuel storage) will reduce the amount of space available at the Data Centre for the IT equipment it is designed to host. This will necessitate a larger site area or construction of additional sites to provide the same level of service.	High / Medium – space limitations often dictate the technologies that can be considered
Fuel suitability	The fuel used needs to be capable of being stored / transported to and across the site without excessive risks to operations e.g., low risk of combusting.	Medium – low volatility and low risk is vital
Lifetime of stored fuel	The fuel will need to be stored onsite potentially over a long period of time as mains failure events are rare and as such the generators are not routinely operated, other than for maintenance and testing purposes. The fuel stored onsite may remain unused for a long period of time and should therefore be of a type that will remain useable under these conditions – rather than becoming a waste product in need of disposal.	Medium to low – whilst an added cost it is not top priority

3.4.2 Environmental risks

Table 2 – Operational requirements Environmental risks

Criteria	Considerations	Weighting
Air quality impact	Local air quality impacts from exhaust of combustion gases when operating the technology in combination with the fuel being combusted.	High – internal combustion engines perform poorly but they are run infrequently
Noise / odour	The technology should not incite regular Odour / Noise complaints from nearest sensitive receptors e.g., residences.	Low – complaints are unlikely due to infrequent operation
Global warming impact	The global warming impact of the fuel being combusted should compare favourably against the electrical output of the technology.	Medium – impact is high, but combustion of fuel is infrequent
Release to water (fuel spillage)	The risk of fuel escaping to the environment, e.g., local river course / ground should be low.	Low – fuel use is low due to infrequent operation
Fugitive emissions (leak of gaseous fuel)	The risk of fuel escaping to the air, e.g., gaseous escape should be low.	Low – fuel use is low due to infrequent operation
Security of fuel supply	Ability to store sufficient volumes to ensure security of supply. Supply also needs to be reliable i.e. guaranteed provision and cost effective.	High – security of fuel provision is critical to operation during an emergency

The following technologies were considered for the provision of emergency power to the data centre:

- Combustion engine Generators (includes operation on HVO / other liquid fuels)
- Diesel rotary uninterruptible power supply engines (DRUPS)
- Natural Gas (piped) Fuelled Generator – Spark Ignition Engine
- Natural Gas (piped) Fuelled Generator – Gas Turbine (CCGT or OCGT)
- Liquid Petroleum Gas (LPG) Fuelled Generator – Spark Ignition Engine
- Hydrogen Fuel Cell Technology: Polymer Electrolyte Membrane (PEM) Fuel Cells
- Hydrogen Fuel Cell Technology
- Standby Gas turbine Technology

The conclusion of the assessment is that emissions optimised ESGs (operating on Diesel / HVO) have been selected again as BAT for this installation for the following reasons which are in line with EA BAT guidance for Data Centres:

- Proven technology for providing reliable power supply
- Start-up time & cold start capability
- Space requirements
- Capital expenditure
- Environmental impact
- Fuel storage and security of fuel supply

3.5 Generator air emissions rates

The EA guidance for new generators is that they, as a minimum, achieve the following:

> *"TA-Luft 2g' or Tier II USEPA with guaranteed emissions: this has requirements for 2000mg/m3 NOx; 650 mg/m3 for CO; particulates and dust 130 mg/m3 and 150 mg/m3 for hydrocarbons (all at reference conditions and 5% O2)."*

The installation is not located within an Air Quality Management Area (AQMA) for NO_2.

The ESGs that have been selected to support the site development are emissions optimised and achieve the Tier II US EPA standard with NOx emissions of 2,172mg/Nm3 @ 5%O2 and at 75% load).

The generator engine and emissions datasheets are found in Appendix B. A summary of the mass emissions rates used in the Air Quality model has been provided in Table 3 below.

For the size and output, the engines selected are best in class for NO_x emissions. Smaller generators 2.5 – 3MVA in size could have been chosen for this site, but the cumulative air quality impact of 38no. 3MVA sets @ 2000mg/m^3N would be significantly greater than the proposed installation of 28nr 4 MVA generators with the above emissions.

Table 3 - ESG emissions rates

Parameter	Testing Scenario (25% load)	Outage Scenario (100% load)
Efflux Velocity	18.1 m/s	35.86 m/s
Volume Flux (Actual)	6.0Am3/s	11.9Am3/s
Actual O2 %	3.1	9.9
Exhaust gas temperature	386°C	520°C
NO_2 emission rate	1.687g/s	6.713g/s
PM_{10} and $PM_{2.5}$ emission rate	0.067g/s	0.048g/s

3.6 Generator noise attenuation

The project has gone through an extensive planning process which has led to significant requirements for acoustic mitigation on the ESGs. A summary is listed below:

- The generators are located in a less sensitive area away from Noise Sensitive receptors and towards the nearby noise sources.
- The generators will be installed within an acoustic canopy which includes attenuated inlet and outlet air paths and exhaust mufflers.
- The generators are to be used only in emergency purposes or during planned testing which can be scheduled in advance.

For more information on noise impacts, please refer to the noise impact assessment submitted with the application ('Noise Impact Assessment').

3.7 Generator flue and exhaust design

The flue arrangement for all x48 ESGs is as follows with Drawings overleaf:

- Each generator set has dedicated attenuated flue / 'stack' system
- Stacks will rise to 20m above ground, terminate vertically and be unimpeded by cowls or caps
- Thermally insulated twin wall stainless steel-clad flues rising within self-supporting multi-flue steep encased stacks
- Flue outlets presented into the common outlet air plenum, rising to the top of the plenum above the roof level

Flue gas from the new internal ESGs goes through a flue dilution system prior to dispersing vertically above roof height.

Dispersion of pollutants has been considered when designing the flues for the generators. As a result, all flues are unimpeded by flaps/cowls and have been orientated vertically, terminating at 1m above the height of the building. The design of the flues is therefore considered to be BAT for this application.

During the design process, consideration was given to implementing a common windshield to group stacks as this is understood to improve dispersion in certain situations. Common windshields require additional support structure and the space constraints for the new generators could not support this. Additionally, if the common windshield was compromised for any reason, the Data Centre's requirement for redundancy could be compromised also. During normal operation, generators are tested individually to minimise air quality and noise impacts. Thus. A combined flue arrangement would have little impact on emissions.

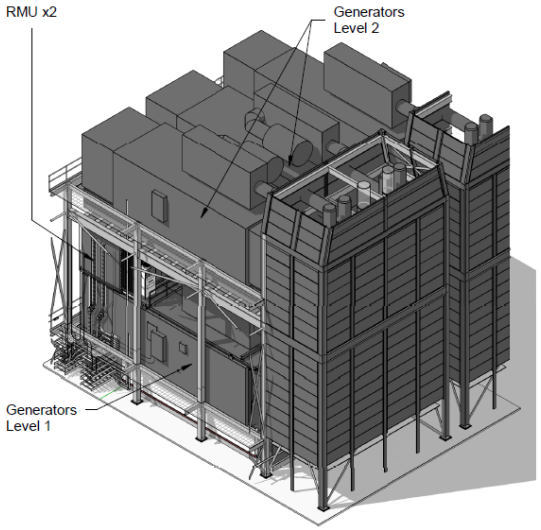

Figure 4 – Generator arrangement (side on view)

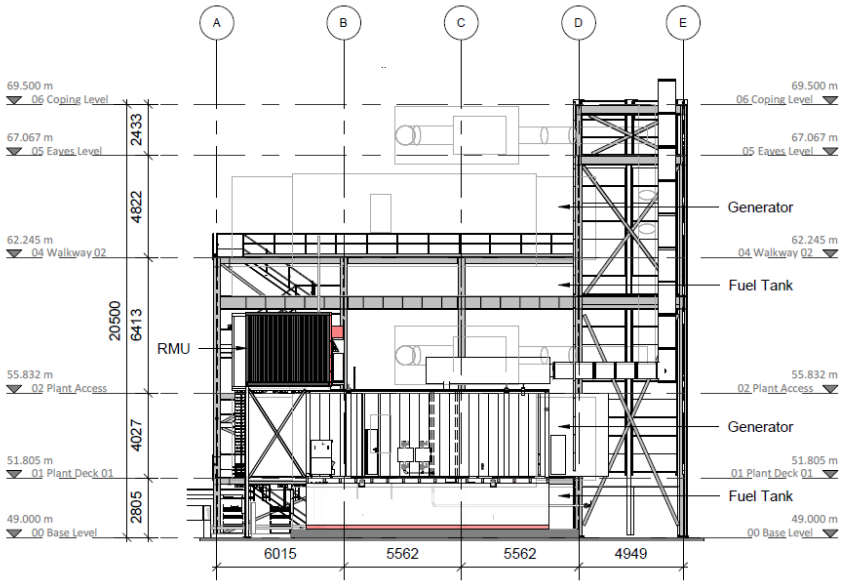

Figure 5 – Generator flue (side on view)

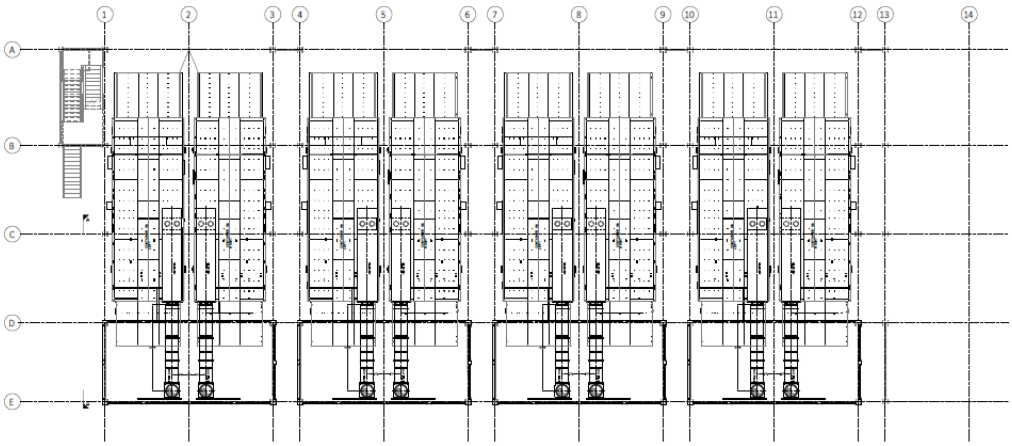

Figure 6 – Generator flues (top down view)

3.8 Fuel storage

The ESGs require a fuel source to generate electricity in an emergency. Each generator will have its own fuel supply, capable of providing 72 hours' of continuous operation at 100% rated load.

3.8.1 Fuel storage capacity

Each of the 28 generators will have its own 66,290 litre usable (73,717 litre brim-full) tank which sits below the generator itself (See Figure 7). Further Drawings are presented in Appendix C.

These "belly tanks" will be connected via pipes directly to the generator they serve. Each generating set shall be fed via the onboard fuel pump and an internal connection from the belly tank through to the canopy.

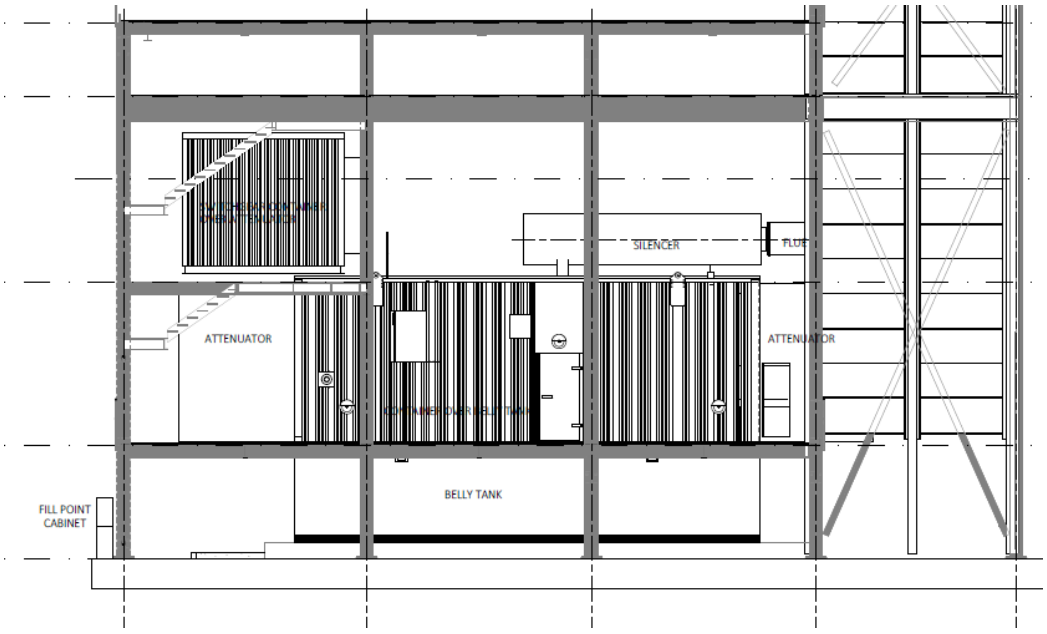

Figure 7 – Generator belly tanks and fill point cabinet

3.8.2 Fuel fill points

Each pair of generators are provided with a local double fill point cabinet which is installed at the front of the building. Each Fill point cabinet includes the following: - Complete with handle, lock, drip tray, instrument mounting panel, 3" filling valve and cap, 2" Overfill prevention valve with BSP Valve.

Within each fuel fill cabinet there will be an OLE 2020-A contents gauge which will display the current fuel level of the belly tank. A smart tank overfill unit will provide the overfill prevention alarms at the fill cabinet for the fill operator and a non-return valve is fitted to prevent back fill.

The fill point cabinet shall incorporate a leak detect float switch to alarm if a leak is detected.

3.8.3 Fuel Storage Controls

The tanks are bunded to 110% of the tank capacity, in line with oil storage regulations. Each tank will be made of mild steel in conformance with BS 799 part 5 type J 2010 requirements. In addition, each tank will have bund and overfill alarms fitted.

The tanks shall conform to BS 799 pat 5 type J 2010 with a max working head above tank of 0.5m. The tank plates shall be constructed from Material 5mm sheet, fully welded internally and externally and manufactured to the water environment standard for oil storage.

The belly tank comes complete with probes suitable for alarming fuel Low-Low, Low, High and High-High. The Tanks OLE C2020-A contents gauge shall provide detailed fuel level information within the fill point cabinet and the tank bund shall incorporate a leak detect float switch to alarm if a leak is detected.

Each belly tank will be supplied with an automatic fuel polishing system with an integrated pump and filter assembly, the fuel polisher is programmed to operate at pre-defined intervals. When operating, the polisher pump will draw fuel from the belly tank before passing it through a 10micron particulate and water separator before returning it to the opposite end of the belly tank.

A Hi/Hi float switch connected to the generator controller is situated in each individual belly tank.

If the generator controller detects that the levels have risen to a pre-set high level within the belly tank An audible alarm will be provided once the HI/HI pre-set level has been reached within the bulk tank. This will sound at the fill point cabinet via the tank alarm, alerting the person supplying the fuel to stop filling. If the fuel is still filling the tank above the pre-set level, an OPV has been installed to provide a failsafe and stop the tank from overfilling.

The Hi/Hi float switch is configured in a fail-safe configuration as normally on signal. In the event of loss of signal from the switch, the generator controller will raise the alarm.

Where there is a high risk of spillage, spill kits containing drain seals, absorbent materials, disposal containers and other appropriate equipment should be held.

3.8.4 Fuel pipework

The fill line supplying the belly tanks via the generator canopies shall be constructed of DN50 in DN80 double skinned welded pipe. As the pipework enters the canopies it shall step down to single skinned DN50 pipework which connects to the belly tank via the Overfill protection valve through a bunded area.

The generator supply and return lines shall consist of DN25 single skinned pipework connected through an internal connection between the belly tank and the generating set canopy.

3.8.5 Fuel management procedures and security

Fuel consumption is low in this installation due to the plant being used for emergency back-up power generation only. As such, fuel deliveries are on average less than once per year. When required, refuelling is conducted by trained fuel tanker drivers, and supervised by a trained member of the site engineering team.

A standard operating procedure (SOP) (or similar) is to be implemented to facilitate refuelling activities. This SOP is intended to help reduce the risk of a spillage during refuelling. These are supplemented by additional supplier procedures for fuel deliveries. In addition to this, additional controls are to be developed to help reduce the risk of an incident including an SOP for spill response and spill kits.

A periodic preventative maintenance (PPM) regime is to be implemented once operational that will include periodic visual checks for leaks / spills and checks for suitably stocked spill kits, and that these are located within close proximity of fuel storage tanks and fill points.

Spill kits and drain covers are to be located in the vicinity of the fill point to reduce the risk of spilt fuel entering the drainage network during refuelling or in an emergency.

The site will be operated 24-7 with a 24-7 managed security staff with CCTV and an alarm system in place. The site will have security office that allows operations to switch on all external luminaries on intruder detection by an operation switch.

The above controls and operating techniques are considered to meet the EA’s BAT requirements for this Data Centre.

3.8.6 Tertiary containment

3 no. full retention petrol interceptors will be installed on 3 no. surface water networks. Their locations can be seen on the site wide drainage plan in Appendix D with interceptor drawings in Appendix E.

The tanks will contain a sensor that will be linked to the BMS and trigger an alarm if the presence of fuel is detected. When contaminated water enters the unit, the internal design and configuration ensures lighter than water pollutants, i.e., oil, petrol and diesel rise to the surface of the water within the separator. Separated liquid is discharged through the core tube/coalescer assembly.

An oil probe should be positioned to detect the build up of oil in no or low flow conditions so that the alarm operates when the oil has accumulated to 90% of the maximum recommended oil storage volume.

4.0 OPERATING TECHNIQUES

4.1 Generator operation

The generators are likely to be used purely as standby plant to provide emergency standby power in the event of a loss of supply from the grid. There is no capacity agreement in place or elective operation of the plant for generating revenue (e.g., STOR, Triad avoidance, Demand Side Response, Peak Demand etc.). As such, operation of the generators is likely to be limited to monthly maintenance and testing only.

4.2 Maintenance and testing

The maintenance schedule for the generators is based on manufacturer guidelines. These guidelines help to prolong the life of the equipment, reduce the use of raw materials (e.g., replacement parts, oil changes) and ensure the engines perform efficiently to prevent increases in pollutant levels or black smoke.

Testing regimes for monthly and annual testing are detailed below. Where possible and practicable, the intention will be to avoid testing during peak traffic periods when background NOx has the potential to be elevated. There may be instances where operational requirements dictate the time tests are to be undertaken.

The current test regime is considered to meet the BAT requirements.

Table 4 - Annual operational hours per generator

Generator Test Frequency	Description	Load Profile	Individual Test Duration	Total hours / gen
Monthly test	Testing all generators in a unit simultaneously at 0% load for 0.25 hour every month per year. *The quarterly and annual tests would supersede the requirement for four monthly tests.*	0%	15 mins	**2**
Quarterly Test	Testing all generators in a unit simultaneously at 80% load (n+1) for 1 hour each quarter	80%	1 hour	**4**
Annual test	Testing each generator separately at 100% load against a load bank for 2 hours, once a year.	100%	2 hours	**2**
			Total hours of operation per generator	**8**

5.0 F-GAS

Fluorinated gases or ‘F-gas’ will not be used in the permitted activities e.g. generators and associated fuel storage.

There is potential that F-gases will be used in the chiller plant and or air conditioning units. This plant is to be maintained in accordance with manufacturer specifications and recommendations with relevant documentation retained. Once the site is operational, an F-gas register is to be maintained onsite, and will include details such as plant make, model and serial, the type and volume of refrigerant, and maintenance history. Any significant releases or leaks are to be recorded and notified to the EA as soon as possible.

6.0 ENERGY EFFICIENCY

6.1 Energy management

As energy prices rise and customers demand more of their Data Centre providers, there is increasing attention on energy efficiency and better energy management. The most prominent indicator of a Data Centre's energy efficiency is PUE (Power Usage Effectiveness), and this is often reported as a metric to customers. PUE is the ratio of the total energy delivered to the site compared with the energy used by just the IT equipment. A PUE of 2 means that 50% of the power delivered to the site is used to run the IT equipment. The closer the PUE is to 1, the more efficient the Data Centre is. Most efficient Data Centres are seeking to achieve a PUE of approx. 1-1.2. The annualised / seasonally adjusted PUE at 100% IT load for the Data Centre is likely to be approx. 1.2.

Once operational there are plans to implement an effective Environmental and / or Energy Management System (EMS / EnMS). A key focus of this will be maintaining a high level of energy efficiency particularly for high energy consuming activities such as cooling.

6.2 UK ETS

The site will need to apply for a Greenhouse Gas (GHG) Permit from the EA to participate in the UK Emissions Trading System (UK ETS). This is required for installations with combustion plant in excess of 20MWth[4].

Participating in UK ETS will require extensive monitoring of generator operational hours and fuel use to determine CO2e emissions per year. This data will likely need to be externally audited or 'verified' prior to submitting to the EA annually.

6.3 EED

The Energy Efficiency Directive (EED) provides an exemption for emergency back-up plant operating under 1500 hours per year. The current testing and maintenance plans do not exceed this limit and therefore EED requirements are not deemed to be applicable.

6.4 ESOS

The UKs Energy Savings Opportunities Scheme (ESOS) is a mandatory energy assessment scheme for organisations in the UK that meet the qualification criteria. At the time of writing these criteria are any company that either:

- employs 250 or more people
- has an annual turnover in excess of £44 million, and an annual balance sheet total in excess of £38 million

There is potential that this site could form part of an ESOS submission which would seek to identify opportunities to improve energy efficiency. Ark meets the ESOS requirements by operating an Energy Management System (EnMS) that is certified to ISO50001, This site will be included in the Ark EnMS

6.5 Measures to improve energy efficiency

The electricity efficiency of the generators ranges from 30-40%. Heat recovery on generators is not a viable option since the generators are backup plant that operate infrequently (approx. <8 hours per year). To ensure the generators operate as efficiently as possible, the site follows a periodic preventative maintenance (PPM) regime. This involves regular checks of the generators to help ensure each generator is operating efficiently.

[4] https://www.gov.uk/government/publications/participating-in-the-uk-ets/participating-in-the-uk-ets#free-allocation

7.0 EFFICIENT USE OF RAW MATERIALS

The main raw materials that will be used within the permitted installation are as follows.

7.1 Diesel / HVO

Current Plans are for the ESGs to operate on Diesel or HVO with enough onsite storage to provide 72 hours of electricity when running at 100% continuous rated load. Due to the highly reliable grid supply, it is unlikely that large volumes of fuel will be consumed by this installation. Fuel use will mostly be limited to maintenance running of the generators. The PPM regime in place will help seek efficient fuel use by the generators.

As per Section 4.2, each generator is tested for 8 hours per year. The generator datasheets provide fuel consumption at 50, 75 and 100% load. Using 100% load, the estimated fuel consumed per generator for testing would be 6,544 litres pa / ESG.

ESG details	50% l/hr	75% l/hr	100 l/hr	Hours per year	Litres / year
28No. 3.2 MW	429	598	818	8	**183,232**
				Approx fuel use per year (worst case)	**183,232**

This is a highly conservative estimate as it has been calculated using fuel consumption at 100% load when in reality, ESGs may be operated for less time on partial load or even offload, i.e., 0% load.

Diesel / HVO has been selected due to the ability to store sufficient volumes to ensure security of supply. Other fuels have been considered but do not currently provide the same level of security. Natural gas could not be stored in sufficient volumes and would be reliant on the National Transmission System. A contract for an uninterruptable supply would be excessively costly given the infrequency of use and would not necessarily guarantee gas supply in the event of a major grid outage, which would then result in a total loss of power supply to the data centre.

Further reasons for fuel selection are present within Section 3.4.2. Due to the limited hours of operation, any potential benefits from the lower impacts associated with emissions from natural gas are reduced.

7.2 Lubrication oils

The engines require lubrication oil to reduce wear and tear through friction. Periodic replacement of this oil is required. Waste oils are to be stored and disposed of responsibly and in accordance with applicable legislation.

8.0 AVOIDANCE, RECOVERY AND DISPOSAL OF WASTES

8.1 Waste

Waste streams arise as a result of operation and maintenance of the combustion plant. Maintenance extends the life of the plant and resolves issues in a timely manner, reducing waste associated oils, lubricants and replacement parts. The installation does not produce significant amounts of waste due to the standby nature of the generators.

A licenced third-party maintenance contractor is responsible for removing waste produced as a result of generator maintenance. Ark retains Duty of Care information including waste carriers' licences and transfer notes.

Waste streams arising from this installation can include:

- Lubrication oils used in maintenance and servicing (minimal)
- Air and fuel filters (minimal)
- Fuel that has reached end of life (infrequent)
- Used spill kits (emergency only, unlikely)
- Decommissioned plant (end of life only)

In line with the permitting requirements, the operator will aim to minimise waste generation through efficient use of raw materials including diesel, filters, and lubrication oils.

For example, the need to dispose of waste fuel is reduced / minimised by fuel polishing. Fuel polishing units are fitted to each of the generators. This unit filters the fuel in the tank, removing moisture and particulates from the fuel and ensuring the generators run cleanly. The aim is to help maintain the fuel to a usable standard, preventing early degradation and ultimately extending the life of the fuel.

9.0 GENERAL MANAGEMENT

9.1 Management Standards

The following management standards (or equivalent, including non-certified standards) are standard Ark practices and will be implemented on the site once it is operational:

- ISO 14001:2015 – specifies the requirements for an environmental management system that an organization can use to enhance its environmental performance.
- ISO 50001: 2018 is for organisations committed to addressing their impact, conserving resources, and improving the bottom line through efficient energy management. Designed to support organisations in all sectors, this ISO standard provides a practical way to improve energy use, through the development of an EnMS.
- ISO/IEC 27001:2013 – specifies the requirements for establishing, implementing, maintaining, and continually improving an information security management system within the context of the organisation. It also includes requirements for the assessment and treatment of information security risks tailored to the needs of the organisation. The requirements set out in ISO/IEC 27001:2013 are generic and are intended to be applicable to all organisations, regardless of type, size, or nature.
- ISO9001:2015 – specifies the requirements for establishing, implementing, monitoring, managing, and improving quality throughout the organisation.

9.2 Environmental Management System (EMS)

Once the site is operational there are plans to implement an effective EMS, based on the EMS already employed by Ark on other permitted sites. The management system developed will be in accordance ISO 14001:2015, or a suitable equivalent standard.

Once implemented, the EMS will include the policies, management principles, organisational structure, responsibilities, standards / procedures, process controls and resources in place to manage environmental protection across the permitted activities at the installation.

Integral to the EMS will be an overarching environmental policy. This will seek to underpin the EMS and help ensure uptake by all staff with sufficient training provided as required.

The operator will maintain records associated with the management system. These records will be stored on their central system and will be updated in line with the management system’s policies.

9.3 Energy Management System (EnMS)

Once the site is operational there are plans to implement an effective EnMS, based on the EnMS already employed by Ark on other permitted sites. The management system developed will be in accordance ISO 50001:2018, or a suitable equivalent standard.

Once implemented, the EnMS will include the policies, management principles, organisational structure, responsibilities, standards / procedures, process controls and resources in place to manage energy consumption across the permitted activities at the installation.

Integral to the EnMS will be an overarching policy for energy management. This will seek to underpin the EnMS and help ensure uptake by all staff with sufficient training provided as required.

The operator will maintain records associated with the management system. These records will be stored on their central system and will be updated in line with the management system’s policies.

10.0 EMISSIONS

There will be no point source emissions to water, air or land, except from the sources and emission points identified in the site plan shown in Figure 1. Emissions identified as significant have been further expanded in the following sections.

10.1 Noise Impact assessment

A noise impact assessment (NIA) was completed in support of the application for an environmental permit. This report identifies sensitive receptors and potential sources of noise from the installation. The primary noise sources are the site's generators. The impact assessment concluded the following:

"Two scenarios were assessed for the Stage 3 assessment which were as follows:

- *Scenario 1: Testing and maintenance – 28 generators tested monthly / annually*
- *Scenario 2: Emergency running – 24 generators operating continuously for 72 hours (2 generators in each group of 14 don't operate as they are for redundancy*

*For both scenarios, following the assessment procedure it was identified that the noise emissions with the proposed mitigation indicate a '**Low Impact' or 'No noise, or barely audible or detectable noise**' in terms of the EA guidance, subject to context. The contextual items that were considered were as follows:*

- *Character and Level of Sound – The level of sound is significantly masked by the high existing noise environment.*
- *Frequency of operation – The generators are not a continuous noise source and will only be used during testing or a power outage.*
- *Sensitivity of receptors – While residential receptors are classified as medium to high, the existing noise environment would likely mean that behavioural mechanisms to control noise would likely already been in place (closing windows during night periods etc.)"*

Given the above, the site's ESGs are unlikely to have a significant impact on surrounding receptors and therefore represent BAT.

10.2 Point source emissions to sewer / surface water

The site's drainage system is split into separate foul and surface water drainage systems.

The proposed below ground drainage systems serving the site collect surface water from the roof, podium and façade. Surface water flows are discharged into the sitewide surface water drainage system. Flow control valve and attenuation are provided in the surface water drainage system to control the discharge rate.

The surface water network has been designed to reduce the peak discharge rate, thus minimising the impact on the attenuation volume. All runoff from the roofs and paved areas are designed for 100% impermeability and the pipe roughness of 0.6mm.

The site ground slope is greater than 1% thus, the surface water network has been designed under pipe full to accept the design storm without surcharging for 1 years. The network is also designed to protect against no flooding for 1 in 30 year, 1 in 100 year return period with an additional 40% climate change and 1 in 500 year return period to comply with the client requirements.

The use of x3 no full retention petrol interceptors on all 3 networks will help ensure that contaminated runoff does not exit the site by isolating the system. The sites drainage system and interceptors will be subject to periodic visual inspections and integrity testing as part of the maintenance requirements.

10.3 Air Quality Assessment

Emissions to air will occur from the operation of the generators. Due to the Data Centre's high levels of resiliency, it is expected that operation will be limited to maintenance and testing only, with no capacity agreement / 'elective operation' as detailed in Section 4.1.

An Air Emissions Risk Assessment (AERA) was completed in support of the permit application to predict the impacts of operating the generators on short- and long-term air quality. A summary of the findings is as follows:

Scenario 1: Testing scenario

- Monthly – All generators will be tested monthly for 15 minutes
- Quarterly – All generators will be tested quarterly for 1 hour
- Annually – Each generator will be tested singly for 2 hours at maximum load capacity.
- As there are 28 generators, this amounts to a total of 63 hours of testing per year (out of the 63 hours there are only 7 hours of concurrent ESG running in any one year period and it will not be 7 hours of continuous running).

Scenario 2 – Emergency running scenario

24 of the generators would be used during emergency running. It has been assumed that the generators would be used for 72 hours of continuous, concurrent running at 100% load out of a year for power failure purposes. This is a conservative estimate as during an outage it is likely that the generators would run at less that 80% load at ant one time.

The conclusion of the assessment is as follows:

> *"The modelling assessment has shown that the long term impact of the Proposed Development on human health within the Site locale is insignificant for annual mean NO2, NO and PM10.*
>
> *In Scenario 1, exceedances of the short-term Air Quality Assessment Levels (AQALs) were predicted at one short-term location (R01), where it was predicted there is a chance of exceeding the hourly mean NO2 AQAL (AQSR). At all remaining receptors, the model predicted a <1% chance of exceedance. It should be noted, this was calculated on the basis that the generators will run concurrently for 63 hours, which is a conservative approach given the generators will only run concurrently for 7 out of the 63 hours. During the remaining 56 hours, the generators will run one at a time. When analysing the maximum hourly mean percentile data per generator, a <1% chance of exceedance at all modelled receptors.*
>
> *Scenario 2 operational impacts on annual mean NO2 concentrations were deemed not significant; however, short term impacts (the 82.74th hourly mean percentile) returned several potential exceedances of 200µg/m3 across the study area. The highest PEC was 702µg/m3 at R01, with concentrations also above 200µg/m3 predicted at R04 – R10. As such, there is a chance of exceedance of the hourly NO2 AQAL at these locations. All remaining receptors predicted a less than 1% chance of exceedance. It should be emphasised this scenario is highly conservative and unlikely to occur.*
>
> *On this basis, the overall effect on human health is considered 'not significant'."*

Given the above, the site's ESGs are unlikely to have a significant impact on surrounding receptors and therefore represent the BAT.

10.4 Air Quality Management Plan

To help reduce the potential impacts during a prolonged outage, BAT is therefore to develop an Air Quality Management Plan (AQMP) once the site is operational. This procedural document is to be implemented in the event of an outage.

The AQMP seeks to identify what receptors may be affected and if notification is required. The plan is to be developed in conjunction with the Local Authority and its Local Air Quality

Management Plan (LAQM) process. Once the AQMP is finalised, it shall be submitted to the EA for final approval.

Once the site is operational and following commissioning of the new ESGs, the AQMP will be updated to include more information on the following:

- Outage occurrence – e.g., date, time, season, meteorologic factors
- Receptors – e.g., AQ model receptors, general public
- Outage situation – e.g., likely duration, how receptors are affected.

11.0 MONITORING

11.1 Emissions limits and flue gas monitoring

The purpose of the ESGs is to provide power in the event of failure of national grid supplies. Thus operation is likely to be limited to monthly/annual maintenance and testing of approximately 8 hours/year/ESG. This is significantly below the 50 hours permitted under MCPD. As such, the generators are classed as 'limited hour MCPs' and are therefore exempt from meeting the BAT emissions limit values (ELVs) for new MCPs / specified generators.

To facilitate monitoring the flues are to be fitted with appropriate sampling ports to allow for NOx and CO monitoring.

Monitoring of flue gas monitoring is to be completed in accordance with web guide 'Monitoring stack emissions: low risk MCPs and specified generators' Published 16 February 2021 (formerly known as TGN M5)[5].

In line with existing permits for Data Centres, the expectation is that monitoring will be undertaken every 1500 hours of generator operation or once every five years (whichever comes first). The first round of monitoring is to be conducted on the new generators within the first year of operation.

This monitoring will seek to confirm that the generators are achieving the performance specification detailed in Section 3.5.

11.2 Generator operation

Generator operational hours and fuel consumption for maintenance, testing and during an outage are currently monitored for the 28 ESGs, and monitoring will be undertaken in a similar fashion. In addition to the annual report, outages should be notified to the EA within 24 hours of emergency operation commencing.

11.3 Discharges to sewer

As per Section 10.2, discharges to sewer are not anticipated. Any surface water run off which discharges to surface drainage will first pass via the drainage interceptor. This will be subject to periodic visual inspections. The EA is to be notified by the operator where significant pollution incidents occur that have the potential to cause harm.

[5] https://www.gov.uk/government/publications/monitoring-stack-emissions-low-risk-mcps-and-specified-generators/monitoring-stack-emissions-low-risk-mcps-and-specified-generators

12.0 CONCLUSION

We have set out the proposed design and operating techniques for this installation and these are considered to meet the EA's BAT requirements for this Data Centre.

APPENDIX A

THERMAL SCHEDULE

Thermal capacity - Longcross Data Centre

Ref	Emission Source Description	Supplier	Gen set model	Engine Manufacturer	Engine Model	output rating (kVA)	Output rating (kWe)	Max fuel (l/hr)	Assumed efficiency	Thermal capacity (MWth)	Cumulative thermal capacity
EP1	DCO1 - gen 1	AVK	DS4000	Rolls Royce MTU	20V4000 G94LF	4000	3,200	818	39%	**8.01**	**8.01**
EP2	DCO1 - gen 2	AVK	DS4000	Rolls Royce MTU	20V4000 G94LF	4000	3,200	818	39%	**8.01**	**16.02**
EP3	DCO1 - gen 3	AVK	DS4000	Rolls Royce MTU	20V4000 G94LF	4000	3,200	818	39%	**8.01**	**24.03**
EP4	DCO1 - gen 4	AVK	DS4000	Rolls Royce MTU	20V4000 G94LF	4000	3,200	818	39%	**8.01**	**32.04**
EP5	DCO1 - gen 5	AVK	DS4000	Rolls Royce MTU	20V4000 G94LF	4000	3,200	818	39%	**8.01**	**40.04**
EP6	DCO1 - gen 6	AVK	DS4000	Rolls Royce MTU	20V4000 G94LF	4000	3,200	818	39%	**8.01**	**48.05**
EP7	DCO1 - gen 7	AVK	DS4000	Rolls Royce MTU	20V4000 G94LF	4000	3,200	818	39%	**8.01**	**56.06**
EP8	DCO1 - gen 8	AVK	DS4000	Rolls Royce MTU	20V4000 G94LF	4000	3,200	818	39%	**8.01**	**64.07**
EP9	DCO1 - gen 9	AVK	DS4000	Rolls Royce MTU	20V4000 G94LF	4000	3,200	818	39%	**8.01**	**72.08**
EP10	DCO1 - gen 10	AVK	DS4000	Rolls Royce MTU	20V4000 G94LF	4000	3,200	818	39%	**8.01**	**80.09**
EP11	DCO1 - gen 11	AVK	DS4000	Rolls Royce MTU	20V4000 G94LF	4000	3,200	818	39%	**8.01**	**88.10**
EP12	DCO1 - gen 12	AVK	DS4000	Rolls Royce MTU	20V4000 G94LF	4000	3,200	818	39%	**8.01**	**96.11**
EP13	DCO1 - gen 13	AVK	DS4000	Rolls Royce MTU	20V4000 G94LF	4000	3,200	818	39%	**8.01**	**104.12**
EP14	DCO1 - gen 14	AVK	DS4000	Rolls Royce MTU	20V4000 G94LF	4000	3,200	818	39%	**8.01**	**112.12**
EP15	DCO2 - gen 1	AVK	DS4000	Rolls Royce MTU	20V4000 G94LF	4000	3,200	818	39%	**8.01**	**120.13**
EP16	DCO2 - gen 2	AVK	DS4000	Rolls Royce MTU	20V4000 G94LF	4000	3,200	818	39%	**8.01**	**128.14**
EP17	DCO2 - gen 3	AVK	DS4000	Rolls Royce MTU	20V4000 G94LF	4000	3,200	818	39%	**8.01**	**136.15**
EP18	DCO2 - gen 4	AVK	DS4000	Rolls Royce MTU	20V4000 G94LF	4000	3,200	818	39%	**8.01**	**144.16**
EP19	DCO2 - gen 5	AVK	DS4000	Rolls Royce MTU	20V4000 G94LF	4000	3,200	818	39%	**8.01**	**152.17**
EP20	DCO2 - gen 6	AVK	DS4000	Rolls Royce MTU	20V4000 G94LF	4000	3,200	818	39%	**8.01**	**160.18**
EP21	DCO2 - gen 7	AVK	DS4000	Rolls Royce MTU	20V4000 G94LF	4000	3,200	818	39%	**8.01**	**168.19**
EP22	DCO2 - gen 8	AVK	DS4000	Rolls Royce MTU	20V4000 G94LF	4000	3,200	818	39%	**8.01**	**176.20**
EP23	DCO2 - gen 9	AVK	DS4000	Rolls Royce MTU	20V4000 G94LF	4000	3,200	818	39%	**8.01**	**184.20**
EP24	DCO2 - gen 10	AVK	DS4000	Rolls Royce MTU	20V4000 G94LF	4000	3,200	818	39%	**8.01**	**192.21**
EP25	DCO2 - gen 11	AVK	DS4000	Rolls Royce MTU	20V4000 G94LF	4000	3,200	818	39%	**8.01**	**200.22**
EP26	DCO2 - gen 12	AVK	DS4000	Rolls Royce MTU	20V4000 G94LF	4000	3,200	818	39%	**8.01**	**208.23**
EP27	DCO2 - gen 13	AVK	DS4000	Rolls Royce MTU	20V4000 G94LF	4000	3,200	818	39%	**8.01**	**216.24**
EP28	DCO2 - gen 14	AVK	DS4000	Rolls Royce MTU	20V4000 G94LF	4000	3,200	818	39%	**8.01**	**224.25**
									Total NET input Thermal capacity (MWth) (MWth)	**224.25**	**224.25**

Appendix B

GENERATOR ENGINE & EMISSIONS DATASHEETS

Inhaltsverzeichnis
Contents

	Genset	Marine	O & G	Rail	C & I
Application	X				
Engine model	20V4000G94LF				
Rated power [kW]	3308				
Rated speed [rpm]	1500				
Application group	3D				
Emission Stage/Optimisation	NEA Singapore for ORDE				
Test cycle	D2				
Data Set No.	XZ54954100068				
Data Set Basis	NEA Singapore for ORDE				
Fuel sulphur content [ppm]	7				

Unterschriftenweg	EDS erstellt	TETC Teamleiter	TET Leiter Org.-Einheit	Baureihen - Teamleiter	Baureihen Leiter Org.-Einheit	Freigabe im EDM
Datum	04.04.2017	-	-	11.04.2017	13.04.2017	18.04.2017
Org.-Einheit	TET	-	-	TKF	TKF	TKM
Name	T. Lenhof	-	-	B. Mink	Dr. Baumgarten	M. Link

WORD	Datum/ Date	Name
Erstell. Drawn	20.09.2017 09:35:43	zwislerp
Bearb. Change	20.09.2017 13:37:26	zwislerp
Inhalt Content	10.04.2017	Locher
Gepr. Checked	20.09.2017	Kneifel

Motortyp / Engine Type: **20V4000G94LF**

Projekt-/Auftrags-Nr. Project/Order No.

Verwendbar f.Typ Applicable to Model

Format/Size: **A3**

Material-Nr./Material No.: **EDS 4000 1162**

Benennung/ Title: **Emissionsdatenblatt**

Emission Data Sheet

Zeichnungs-Nr./Drawing No.: **ZNG00005084**

Blatt/ Sheet **1** von/of **6**

Aenderungsbeschreibung/Description of Revision	Kommt vor/Frequency
Angabe Sauerstoffgehalt im Abgas bei Bezug auf 5% angepasst	

Buchst./Rev. Ltr.	Aenderungs-Nr./Revision Notice No.	Bearbeitungsstatus/Lifecycle
b.1		In Arbeit

Beschreibung/Description

Revision *Change index*					

Motordaten

engine data

	Genset	Marine	O & G	Rail	C & I
Application	x				
Engine model	20V4000G94LF				
Application group	3D				
Emission Stage/Optimisation	NEA Singapore for ORDE				
Test cycle	D2				
fuel sulphur content [ppm]	7				
mg/mN³ values base on residual oxygen value of [%]	measured				

Motor Rohemissionen*

*Engine raw emissions**

Cycle point	[-]	n1	n2	n3	n4	n5	n6	n7	n8
Power (P/PN)	[-]	1	0,75	0,50	0,25	0,10			
Power	[kW]	3307	2480	1653	827	331			
Speed (n/nN)	[-]	1	1	1	1	1			
Speed	[rpm]	1500	1499	1499	1500	1499			
Exhaust temperature after turbine	[°C]	482	427	434	403	268			
Exhaust massflow	[kg/h]	19196	15930	12083	7485	5323			
Exhaust back pressure (total)	[mbar]	52	32	14	5	0			
NOx	[g/kWh]	6,6	5,9	4,8	4,4	9,1			
	[mg/mN³]	1641	1326	930	676	776			
CO	[g/kWh]	0,3	0,4	1,0	1,4	2,8			
	[mg/mN³]	77	85	192	219	233			
HC	[g/kWh]	0,05	0,07	0,09	0,16	0,72			
	[mg/mN³]	13	14	16	25	60			
O2	[%]	9,9	11,2	11,9	13,1	15,8			
Particulate measured	[g/kWh]	0,02	0,03	0,10	0,18	0,05			
	[mg/mN³]	5	6	19	27	4			
Particulate calculated	[g/kWh]	-	-	-	-	-			
	[mg/mN³]	-	-	-	-	-			
Dust (only TA-Luft)	[mg/mN³]	-	-	-	-	-			
FSN	[-]	0,2	0,2	0,6	1,0	0,1			
NO/NO2**	[-]	-	-	-	-	-			
CO2	[g/kWh]	645,7	632,1	669,3	721,6	844,5			
	[mg/mN³]	155278	136196	126261	109200	70577			
SO2	[g/kWh]	0,003	0,003	0,003	0,003	0,004			
	[mg/mN³]	0,7	0,6	0,6	0,5	0,3			

* Emission data measurement procedures are consistent with the respective emission evaluation process. Noncertified engines are measured to sales data (TVU/TEN) standard conditions.
These boundary conditions might not be representative for detailed dimensioning of exhaust gas aftertreatment, in this case it is recommended to contact the responsible department for more information.
Measurements are subject to variation. The nominal emission data shown is subject to instrumentation, measurement, facility, and engine-to-engine variations.
All data applies to an engine in new condition. Over extended operating time deterioration may occur which might have an impact on emission.
Exhaust temperature depends on engine ambient conditions.

** No standard test. To be measured on demand.

Aenderungsbeschreibung/Description of Revision	Kommt vor/Frequency
Angabe Sauerstoffgehalt im Abgas bei Bezug auf 5% angepasst	

Buchst./Rev. Ltr.	Aenderungs-Nr./Revision Notice No.	Bearbeitungsstatus/Lifecycle
b.1		In Arbeit

MTU
Friedrichshafen GmbH

WORD	Datum/ Date	Name
Erstell. Drawn	20.09.2017 09:35:43	zwislerp
Bearb. Change	20.09.2017 13:37:26	zwislerp
Inhalt Content	10.04.2017	Locher
Gepr. Checked	20.09.2017	Kneifel

Motortyp / Engine Type
20V4000G94LF

Projekt-/Auftrags-Nr.
Project/Order No.

Verwendbar f.Typ
Applicable to Model

Format/Size
A3

Material-Nr./Material No.
EDS 4000 1162

Benennung/ Title
Emissionsdatenblatt
Emission Data Sheet

Zeichnungs-Nr./Drawing No. **ZNG00005084**

Beschreibung/Description

Blatt/ Sheet **2** von/of **6**

Revision *Change index*					

Motordaten

engine data

	Genset	Marine	O & G	Rail	C & I
Application	x				
Engine model	20V4000G94LF				
Application group	3D				
Emission Stage/Optimisation	NEA Singapore for ORDE				
Test cycle	D2				
fuel sulphur content [ppm]	7				
mg/mN³ values base on residual oxygen value of [%]	measured				

Not to exceed Werte*

*not to exceed values**

Cycle point	[-]	n1	n2	n3	n4	n5	n6	n7	n8
Power (P/PN)	[-]	1	0,75	0,50	0,25				
Power	[kW]	3307	2480	1653	827				
Speed (n/nN)	[-]	1	1	1	1				
Speed	[rpm]	1500	1499	1499	1500				
Exhaust back pressure (total)	[mbar]	52	32	14	5				
NOx	[g/kWh]	8,6	7,7	6,2	6,6				
	[mg/mN³]	2133	1724	1209	1014				
CO	[g/kWh]	0,5	0,7	1,9	2,9				
	[mg/mN³]	131	145	365	438				
HC	[g/kWh]	0,09	0,11	0,17	0,33				
	[mg/mN³]	22	24	30	50				
O2	[%]	9,9	11,2	11,9	13,1				
Particulate measured	[g/kWh]	0,03	0,05	0,15	0,27				
	[mg/mN³]	7	10	28	40				

* Calculated values are not proven by tests and therefore the accuracy cannot be guaranteed.

Emissions data measurement procedures are consistent with those described in the applicable rules and standards.

The NOx, CO, HC and PM emission data tabulated here were taken from a single new engine under the test conditions shown above and are valid for the following conditions:

- Ambient air pressure 1 bar
- Air intake temperature approx. 25°C
- Rel. Humidity 30%-60%
- New Engine
- New standard- air filter
- Exhaust gas back pressure according the given value in this EDS
- Fuel according to EN 590 or US EPA 40CFR89
- Coolant and Lubricants according MTU Fuels and Lubricants Specification

The nominal emissions data shown is subject to instrumentation, measurement, facility and engine to engine variations. Emissions data is based on single operating points and thus cannot be used to compare to EPA regulations which use values based on a weighted cycle. Emissions data may vary depending on the type of exhaust gas aftertreatment that may be installed on the engine, therefore it is suggested that the engine manufacturer be contacted directly for further information.

Field emission test data are not guaranteed to these levels. Actual field test results may vary due to test site conditions, installation, fuel specification, test procedures, and instrumentation. Over time deterioration may occur which may have an impact on emission levels. Engine operation with excessive air intake or exhaust restriction beyond published maximum limits, or with improper maintenance, may results in elevated emission levels.

Aenderungsbeschreibung/Description of Revision	Kommt vor/Frequency
Angabe Sauerstoffgehalt im Abgas bei Bezug auf 5% angepasst	

Buchst./Rev. Ltr.	Aenderungs-Nr./Revision Notice No.	Bearbeitungsstatus/Lifecycle
b.1		In Arbeit

MTU Friedrichshafen GmbH

WORD	Datum/ Date	Name
Erstell. Drawn	20.09.2017 09:35:43	zwislerp
Bearb. Change	20.09.2017 13:37:26	zwislerp
Inhalt Content	10.04.2017	Locher
Gepr. Checked	20.09.2017	Kneifel

Motortyp / Engine Type: **20V4000G94LF**

Projekt-/Auftrags-Nr. Project/Order No.

Verwendbar f.Typ Applicable to Model

Format/Size **A3**

Material-Nr./Material No.: **EDS 4000 1162**

Benennung/ Title: **Emissionsdatenblatt**

Emission Data Sheet

Zeichnungs-Nr./Drawing No.: **ZNG00005084**

Beschreibung/Description

Blatt/ Sheet **3** von/of **6**

Revision *Change index*					

Typzulassung für NEA Singapur

Type approval for NEA Singapore

	Genset	Marine	O & G	Rail	C & I
Application	x				
Engine model	20V4000G94LF				
Application group	3D				
Emission Stage/Optimisation	NEA Singapore for ORDE				
Test cycle	D2				
Data Set	XZ54954100068				
Serial-Number	V122				
Test-Report-Number	EDS40001162				
Test Location	P126				
Date of test	29.03.2017				
Tester	MTU Friedrichshafen GmbH				
Date of EDS	04.04.2017				

Emissions Zykluswerte*

*Engine cycle emissions**

Emission	Cycle Value [g/kWh]	U.S. T2-Limit [g/kWh]
NOX	5,47	-
HC	0,1	-
NOX+NMHC	5,57	6,4
CO	0,80	3,5
PM	0,074	0,20

* Cycle values based on not rounded values, differences between single values and added values, e.g. NOX/HC/NOX+HC.
NMHC = 0,98*HC (40 CFR Part 1065.650 (c)(5))

Aenderungsbeschreibung/Description of Revision	Kommt vor/Frequency
Angabe Sauerstoffgehalt im Abgas bei Bezug auf 5% angepasst	

Buchst./Rev. Ltr.	Aenderungs-Nr./Revision Notice No.	Bearbeitungsstatus/Lifecycle
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Motortyp / Engine Type
20V4000G94LF

Projekt-/Auftrags-Nr.
Project/Order No.

Verwendbar f.Typ
Applicable to Model

Format/Size
A3

Material-Nr./Material No.
EDS 4000 1162

Benennung/ Title
Emissionsdatenblatt
Emission Data Sheet

Zeichnungs-Nr./Drawing No. **ZNG00005084**

Beschreibung/Description

Blatt/ Sheet **4** von/of **6**

Revision *Change index*	a	b			

Motordaten

engine data

	Genset	Marine	O & G	Rail	C & I
Application	X				
Engine model	20V4000G94LF				
Application group	3D				
Emission Stage/Optimisation	NEA Singapore for ORDE				
Test cycle	D2				
fuel sulphur content [ppm]	7				
mg/mN³ values base on residual oxygen value of [%]	5				

Motor Rohemissionen*

*Engine raw emissions**

Cycle point	[-]	n1	n2	n3	n4	n5	n6	n7	n8
Power (P/PN)	[-]	1	0,75	0,50	0,25	0,10			
Power	[kW]	3307	2480	1653	827	331			
Speed (n/nN)	[-]	1	1	1	1	1			
Speed	[rpm]	1500	1499	1499	1500	1499			
Exhaust temperature after turbine	[°C]	482	427	434	403	268			
Exhaust massflow	[kg/h]	19196	15930	12083	7485	5323			
Exhaust back pressure (total)	[mbar]	52	32	14	5	0			
NOx	[g/kWh]	6,6	5,9	4,8	4,4	9,1			
	[mg/mN³]	2362	2172	1639	1375	2411			
CO	[g/kWh]	0,3	0,4	1,0	1,4	2,8			
	[mg/mN³]	111	139	339	445	723			
HC	[g/kWh]	0,05	0,07	0,09	0,16	0,72			
	[mg/mN³]	19	23	29	50	187			
O2	[%]	5,0	5,0	5,0	5,0	5,0			
Particulate measured	[g/kWh]	0,02	0,03	0,10	0,18	0,05			
	[mg/mN³]	7	10	33	55	13			
Particulate calculated	[g/kWh]	-	-	-	-	-			
	[mg/mN³]	-	-	-	-	-			
Dust (only TA-Luft)	[mg/mN³]	-	-	-	-	-			
FSN	[-]	0,2	0,2	0,6	1,0	0,1			
NO/NO2**	[-]	-	-	-	-	-			
CO2	[g/kWh]	645,7	632,1	669,3	721,6	844,5			
	[mg/mN³]	223605	223061	222522	222035	219215			
SO2	[g/kWh]	0,003	0,003	0,003	0,003	0,004			
	[mg/mN³]	1,0	1,0	1,0	1,0	1,0			

* Emission data measurement procedures are consistent with the respective emission evaluation process. Noncertified engines are measured to sales data (TVU/TEN) standard conditions.
These boundary conditions might not be representative for detailed dimensioning of exhaust gas aftertreatment, in this case it is recommended to contact the responsible department for more information.
Measurements are subject to variation. The nominal emission data shown is subject to instrumentation, measurement, facility, and engine-to-engine variations.
All data applies to an engine in new condition. Over extended operating time deterioration may occur which might have an impact on emission.
Exhaust temperature depends on engine ambient conditions.

** No standard test. To be measured on demand.

Aenderungsbeschreibung/Description of Revision	Kommt vor/Frequency
Angabe Sauerstoffgehalt im Abgas bei Bezug auf 5% angepasst	

Buchst./Rev. Ltr.	Aenderungs-Nr./Revision Notice No.	Bearbeitungsstatus/Lifecycle
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Friedrichshafen GmbH

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Motortyp / Engine Type
20V4000G94LF

Projekt-/Auftrags-Nr. Project/Order No.

Verwendbar f.Typ Applicable to Model

Format/Size **A3**

Material-Nr./Material No.
EDS 4000 1162

Benennung/ Title
Emissionsdatenblatt
Emission Data Sheet

Zeichnungs-Nr./Drawing No. **ZNG00005084**

Beschreibung/Description

Blatt/ Sheet **5** von/of **6**

Revision *Change index*	a	b			

Motordaten

engine data

	Genset	Marine	O & G	Rail	C & I
Application	X				
Engine model	20V4000G94LF				
Application group	3D				
Emission Stage/Optimisation	NEA Singapore for ORDE				
Test cycle	D2				
fuel sulphur content [ppm]	7				
mg/mN³ values base on residual oxygen value of [%]	5				

Not to exceed Werte*

*not to exceed values**

Cycle point	[-]	n1	n2	n3	n4	n5	n6	n7	n8
Power (P/PN)	[-]	1	0,75	0,50	0,25				
Power	[kW]	3307	2480	1653	827				
Speed (n/nN)	[-]	1	1	1	1				
Speed	[rpm]	1500	1499	1499	1500				
Exhaust back pressure (total)	[mbar]	52	32	14	5				
NOx	[g/kWh]	8,6	7,7	6,2	6,6				
	[mg/mN³]	3071	2824	2131	2063				
CO	[g/kWh]	0,5	0,7	1,9	2,9				
	[mg/mN³]	189	236	644	890				
HC	[g/kWh]	0,09	0,11	0,17	0,33				
	[mg/mN³]	32	39	55	100				
O2	[%]	5,0	5,0	5,0	5,0				
Particulate measured	[g/kWh]	0,03	0,05	0,15	0,27				
	[mg/mN³]	10	16	49	82				

* Calculated values are not proven by tests and therefore the accuracy cannot be guaranteed.

Emissions data measurement procedures are consistent with those described in the applicable rules and standards.

The NOx, CO, HC and PM emission data tabulated here were taken from a single new engine under the test conditions shown above and are valid for the following conditions:

- Ambient air pressure 1 bar
- Air intake temperature approx. 25°C
- Rel. Humidity 30%-60%
- New Engine
- New standard- air filter
- Exhaust gas back pressure according the given value in this EDS
- Fuel according to EN 590 or US EPA 40CFR89
- Coolant and Lubricants according MTU Fuels and Lubricants Specification

The nominal emissions data shown is subject to instrumentation, measurement, facility and engine to engine variations. Emissions data is based on single operating points and thus cannot be used to compare to EPA regulations which use values based on a weighted cycle. Emissions data may vary depending on the type of exhaust gas aftertreatment that may be installed on the engine, therefore it is suggested that the engine manufacturer be contacted directly for further information.

Field emission test data are not guaranteed to these levels. Actual field test results may vary due to test site conditions, installation, fuel specification, test procedures, and instrumentation. Over time deterioration may occur which may have an impact on emission levels. Engine operation with excessive air intake or exhaust restriction beyond published maximum limits, or with improper maintenance, may results in elevated emission levels.

MTU Friedrichshafen GmbH has made efforts to ensure that the information in this data sheet is accurate, but reserves the right to amend specifications and information without notice and without obligation or liability. No liability for any errors, facts or opinions is accepted. Customers must satisfy themselves as to the suitability of this product for their application. No responsibility for any loss as a result of any person placing reliance on any material contained in this data sheet will be accepted.

Aenderungsbeschreibung/Description of Revision	Kommt vor/Frequency
Angabe Sauerstoffgehalt im Abgas bei Bezug auf 5% angepasst	

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Motortyp / Engine Type

20V4000G94LF

Projekt-/Auftrags-Nr. Project/Order No.

Verwendbar f.Typ Applicable to Model

Format/Size **A3**

Material-Nr./Material No.

EDS 4000 1162

Benennung/ Title

Emissionsdatenblatt

Emission Data Sheet

Zeichnungs-Nr./Drawing No. **ZNG00005084**

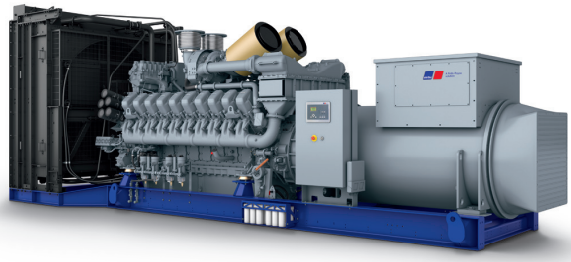
Beschreibung/Description

Blatt/ Sheet **6** von/of **6**

Diesel Generator Set

mtu 20V4000 DS4000

400 V - 11 kV/50 Hz/standby power/NEA (ORDE) + Tier 2 optimized 20V4000G94LF/water charge air cooling



Optional equipment and finishing shown. Standard may vary.

Product highlights

Benefits
- Low fuel consumption
- Optimized system integration ability
- High reliability
- High availability of power
- Long maintenance intervals

Support
- Global product support offered

Standards
- Engine-generator set is designed and manufactured in facilities certified to standards ISO 2008:9001 and ISO 2004:14001
- Generator set complies to ISO 8528
- Generator meets NEMA MG1, BS 5000, ISO, DIN EN and IEC standards
- NFPA 110

Power rating
- System ratings: 3950 kVA - 4000 kVA
- Accepts rated load in one step per NFPA 110*
- Generator set complies to G3 according to ISO 8528-5
- Generator set exceeds load steps according to ISO 8528-5*

Performance assurance certification (PAC)
- Engine-generator set tested to ISO 8528-5 for transient response
- 85% load factor
- Verified product design, quality and performance integrity
- All engine systems are prototype and factory tested

Complete range of accessories available
- Control panel
- Power panel
- Fuel system
- Fuel connections with shut-off valve mounted to base frame
- Starting/charging system
- Exhaust system
- Electrical driven radiators
- Medium and oversized voltage alternators
- Low voltage alternator

Emissions
- Tier 2 optimized engine
- NEA (ORDE) optimized

Certifications
- CE certification option
- Unit certificate acc. to VDE-AR-N 4110

* Changes to the standard parameter sets (alternator-regulator and genset-controller) are necessary

A Rolls-Royce solution

Application data [1)]

Engine

Manufacturer	***mtu***
Model	20V4000G94LF
Type	4-cycle
Arrangement	20V
Displacement: l	95.4
Bore: mm	170
Stroke: mm	210
Compression ratio	16.4
Rated speed: rpm	1500
Engine governor	ADEC (ECU 9)
Max power: kWm	3308
Air cleaner	dry

Fuel system

Maximum fuel lift: m	5
Total fuel flow: l/min	27

Fuel consumption [2)]

	l/hr	g/kwh
At 100% of power rating:	818	205
At 75% of power rating:	598	200
At 50% of power rating:	429	215

Liquid capacity (lubrication)

Total oil system capacity: l	390
Engine jacket water capacity: l	260
Intercooler coolant capacity: l	50

Combustion air requirements

Combustion air volume: m^3/s	4.7
Max. air intake restriction: mbar	30

Cooling/radiator system

Coolant flow rate (HT circuit): m^3/hr	80
Coolant flow rate (LT circuit): m^3/hr	44
Heat rejection to coolant: kW	1270
Heat radiated to charge air cooling: kW	930
Heat radiated to ambient: kW	105
Fan power for electr. radiator (40°C): kW	105

Exhaust system

Exhaust gas temp. (after engine, max.): °C	482
Exhaust gas temp. (before turbocharger): °C	693
Exhaust gas volume: m^3/s	11.9
Maximum allowable back pressure: mbar	50
Minimum allowable back pressure: mbar	–

Standard and optional features

System ratings (kW/kVA)

Generator model	Voltage	NEA (ORDE) + Tier 2 optimized		
		without radiator		
		kWel	kVA*	AMPS
Leroy Somer LSA54.2 ZL17 (LV Leroy Somer standard)	400 V	3200	4000	5774
Leroy Somer LSA54.2 ZL12 (Medium volt. Leroy Somer)	11 kV	3160	3950	207
Marathon 1040FDH7105 (Medium volt. Marathon)	11 kV	3200	4000	210
Leroy Somer LSA54.2 ZL14 (MV Leroy Somer oversized)	11 kV	3160	3950	207
Leroy Somer LSA54.2 ZL14 (Engine output optimized)	11 kV	3200	4000	210

* cos phi = 0.8

1 All data refers only to the engine and is based on ISO standard conditions (25°C and 100m above sea level).

2 Values referenced are in accordance with ISO 3046-1. Conversion calculated with fuel density of 0.83 g/ml. All fuel consumption values refer to rated engine power.

Standard and optional features

Engine

- ■ 4-cycle
- ■ Standard single stage air filter
- ■ Oil drain extension & shut-off valve
- ■ Closed crankcase ventilation
- ■ Governor-electronic isochronous
- ■ Common rail fuel injection
- ■ Tier 2 optimized engine
- ■ NEA (ORDE) optimized engine

Generator

- ■ 4 pole three-phase synchronous generator
- ■ Brushless, self-excited, self-regulating, self-ventilated
- ■ Digital voltage regulator
- ■ Anti condensation heater
- ■ Stator winding Y-connected, accessible neutral (brought out)
- ■ Protection IP23
- ■ Insulation class H, utilization acc. to H
- ■ Radio suppression EN 55011, group 1, cl. B
- ■ Short circuit capability 3xIn for 10sec
- ■ Winding and bearing RTDs (without monitoring)
- ■ Excitation by AREP + PMI
- ■ Mounting of CT´s: 3x 1 core CT´s
- ■ Winding pitch: 127° pitch
- ■ Voltage setpoint adjustment ± 5%
- ■ Meets NEMA MG-1, BS 5000, IEC 60034-1, VDE 0530, DIN EN 12601, AS 1359 and ISO 8528-3 requirements
- ■ Leroy Somer low voltage generator
- □ Leroy Somer medium voltage generator
- □ Marathon medium voltage generator
- □ Oversized generator

Cooling system

- ■ Jacket water pump
- ■ Thermostat(s)
- ■ Water charge air cooling
- □ Electrical driven front-end cooler
- □ Jacket water heater
- □ Pulley for fan drive

Control panel

- ■ Unit cabling with coded plugs for easy connection of customer-specific controls (V0)
- □ Pre-wired control cabinet for easy application of customized controller (V1+)
- □ Island operation (V2)
- □ Automatic mains failure operation with ATS (V3a)
- □ Automatic mains failure operation incl. control of generator and mains breaker (V3b)
- □ Island parallel operation of multiple gensets (V4)
- □ Automatic mains failure operation with short (< 10s) mains parallel overlap synchronization (V5)
- □ Mains parallel operation of a single genset (V6)
- □ Mains parallel operation of multiple gensets (V7)
- □ Basler controller
- □ Deif controller
- □ Complete system metering
- ■ Digital metering
- ■ Engine parameters
- ■ Generator protection functions
- ■ Engine protection
- ■ SAE J1939 engine ECU communications
- ■ Parametrization software
- ■ Multilingual capability
- ■ Multiple programmable contact inputs
- ■ Multiple contact outputs
- ■ Event recording
- □ IP 54 front panel rating with integrated gasket
- □ Remote annunciator
- □ Daytank control
- □ Generator winding- and bearing temperature monitoring
- □ Modbus TCP-IP

Connectivity

The engine system automatically collects and transfers engine data to the manufacturer from time to time. The data is used by the manufacturer for the purposes of product development and improvement as well as service optimization. Users can log in or register via https://mtu-go.com and also gain insight into the data.

■ Represents standard features
□ Represents optional features

Standard and optional features

Power panel

- ☐ Supply electrical driven radiator from 45kW – 75kW

Fuel system

- ■ Flexible fuel connectors mounted to base frame
- ☐ Fuel filter with water separator
- ☐ Fuel filter with water separator heavy-duty
- ☐ Switchable fuel filter with water separator
- ☐ Switchable fuel filter with water separator heavy-duty
- ☐ Seperate fuel cooler
- ☐ Fuel cooler integrated into cooling equipment

Starting/charging system

- ■ 24V starter
- ☐ Redundant starting system
- ☐ Starter batteries, cables, rack, disconnect switch (lockable)
- ☐ Battery charger
- ☐ Alternator

Mounting system

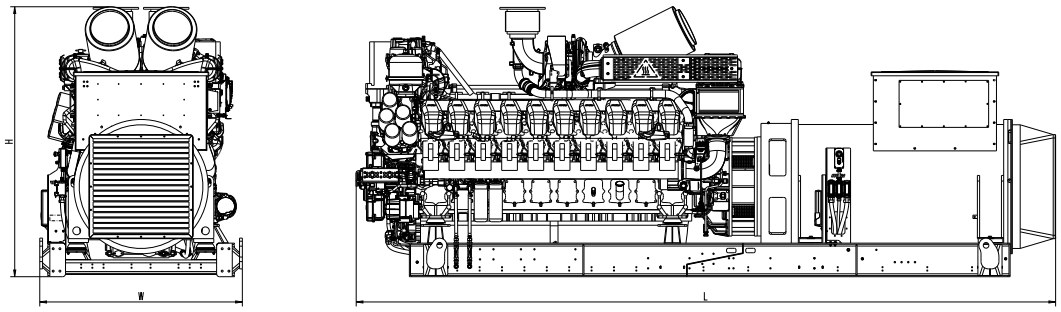
- ■ Welded base frame
- ■ Resilient engine and generator mounting
- ■ Modular base frame design
- ☐ Base frame mounting on foundation/base plate with using clamping brackets

Exhaust system

- ■ Exhaust bellows with connection flange
- ☐ Exhaust silencer with 10 dB(A) sound attenuation
- ☐ Exhaust silencer with 30 dB(A) sound attenuation
- ☐ Exhaust silencer with 40 dB(A) sound attenuation
- ☐ Y-connection-pipe

■ Represents standard features
☐ Represents optional features

Weights and dimensions



Drawing above for illustration purposes only, based on a standard open power 11 kV engine-generator set. Lengths may vary with other voltages. Do not use for installation design. See website for unit specific template drawings.

System	Dimensions (LxWxH)	Weight (dry/less tank)
Open power unit (OPU)	6343 x 1810 x 2421 mm	20810 kg

Weights and dimensions are based on open power units and are estimates only. Consult the factory for accurate weights and dimensions for your specific engine-generator set.

Sound data

— Consult your local ***mtu*** distributor for sound data.

Emissions data

— Consult your local ***mtu*** distributor for emissions data.

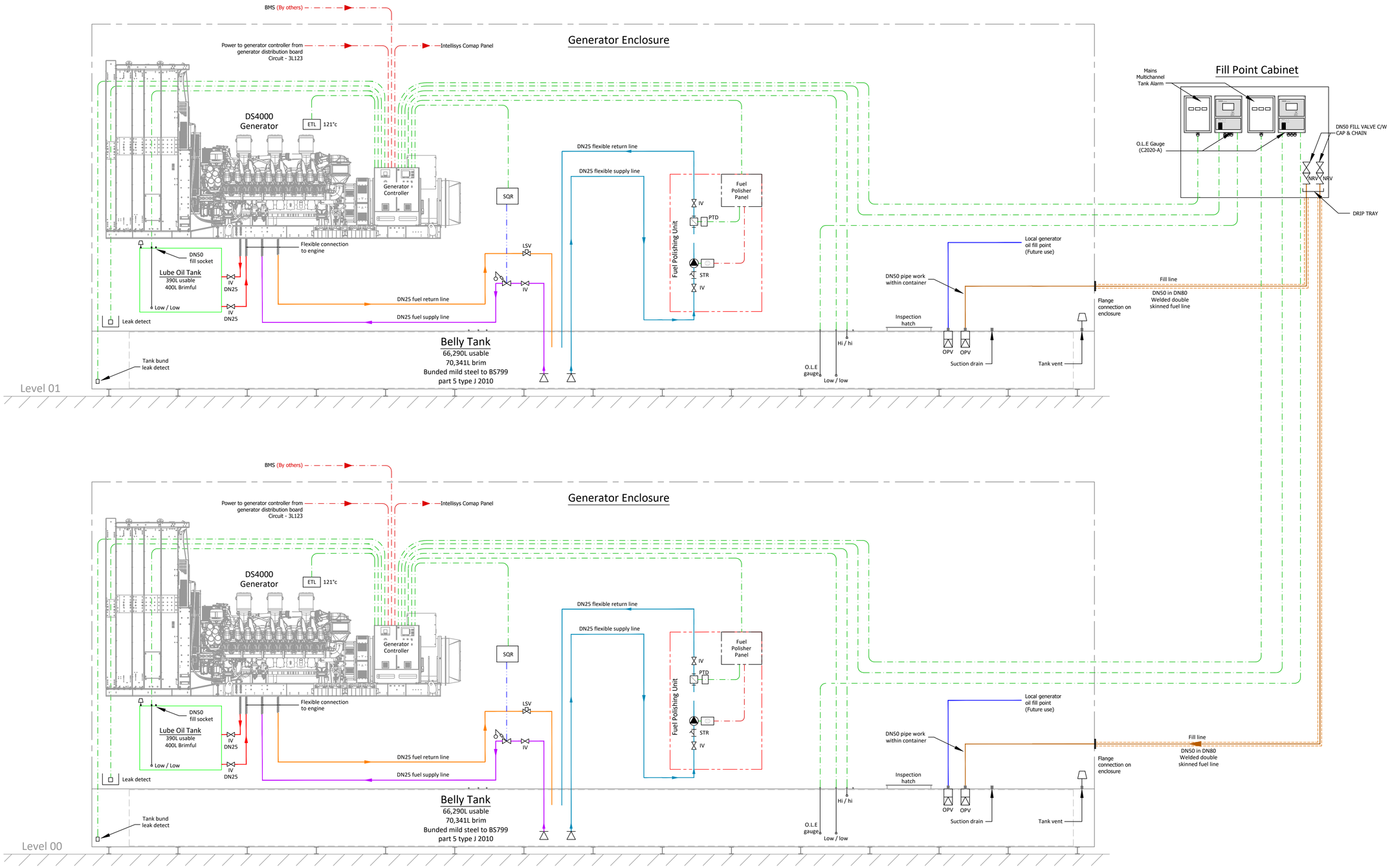
Rating definitions and conditions

— Standby ratings apply to installations served by a reliable utility source. The standby rating is applicable to varying loads for the duration of a power outage. No overload capability for this rating. Ratings are in accordance with ISO 8528-1, ISO-3046-1, BS 5514 and AS 2789. Average load factor: ≤ 85%.
Operating hours/year: max. 500.
— Consult your local ***mtu*** distributor for derating information.

Subject to change. | 32310771 | Edition 02/22 | BMC 2022-05.

APPENDIX C

FUEL TANK DRAWINGS AND SCHEMATICS



Legend

- Isolation valve (N/O)
- Isolation valve (N/C)
- Lock shield valve
- Strainer
- Non-return valve
- MO/SC 24v — Motorised valve Motor open/spring close
- MC/SO 24v — Motorised valve Motor close/spring open
- F.V — Fire drop valve N/O held open
- ETL — Electro thermal link
- SQR — Solenoid quick release
- FS — Flow switch
- PFM — Pulse Flow Meter
- PS — Pressure switch
- Fuel polisher
- PTD — Pressure transducer
- PG — Pressure gauge
- Pump
- Local isolator
- Mushroom vent
- OPV — Overfill prevention valve
- Flexible pipe
- Pipe in pipe
- Signals cabling
- Power supply
- Supply by others

Iss.	Date	Change	By
P01	22-03-23	FIRST ISSUE	M.K.

3rd Angle Projection — Do Not Scale. — All Dimensions in MM Unless Otherwise Stated.

AVK THE POWER PEOPLE

Power Systems House
1-3 Malvern Road,
Maidenhead, Berkshire,
SL6 7RE.

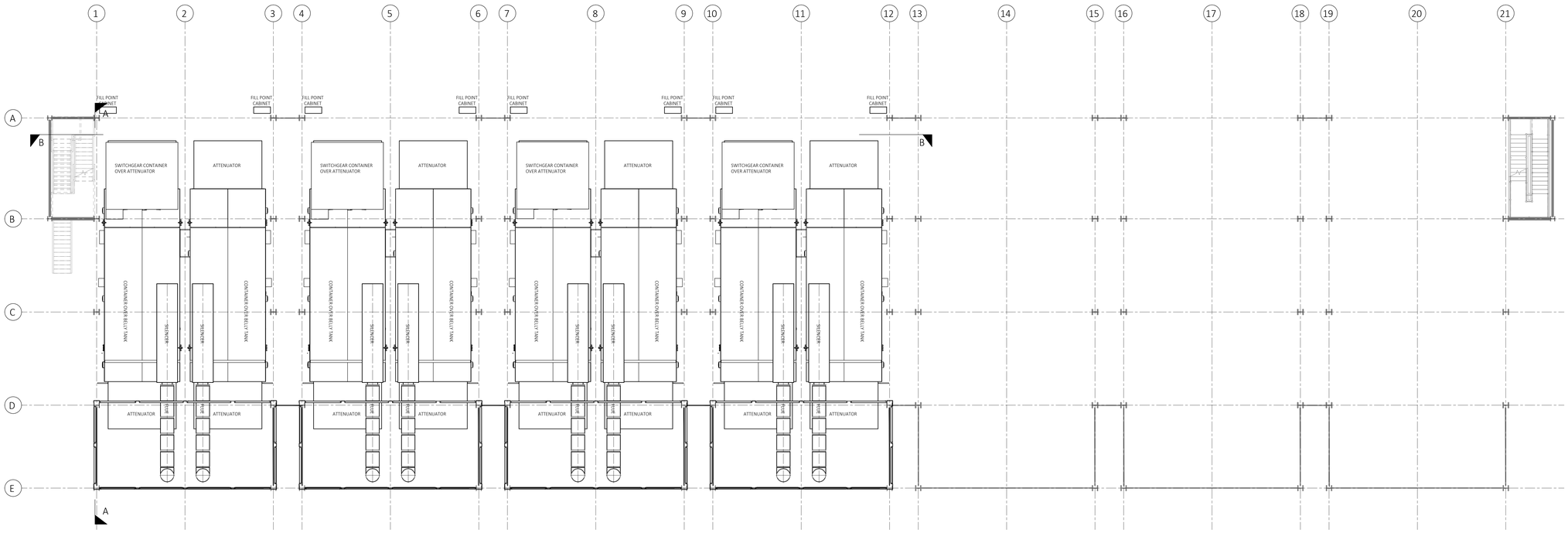
Tel:01628 503900
www.avk-seg.com
sales@avk-seg.com

Customer: J.C.A.

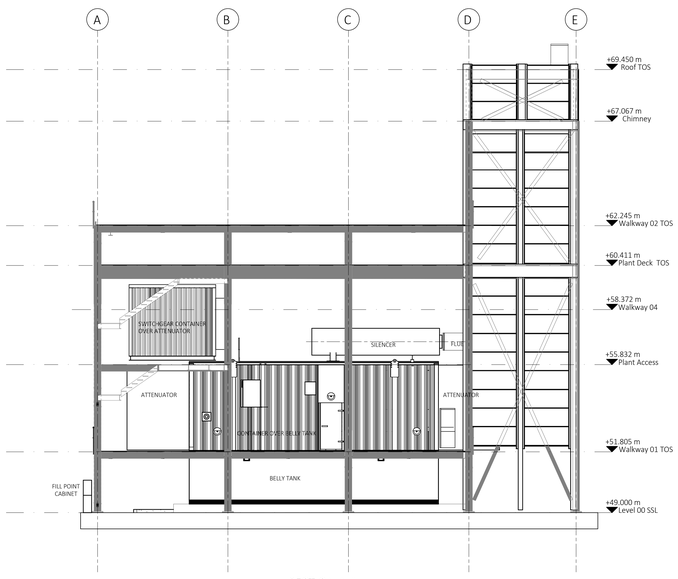
Site: ARK LONGCROSS

Title: Fuel & Lube Oil Schematic

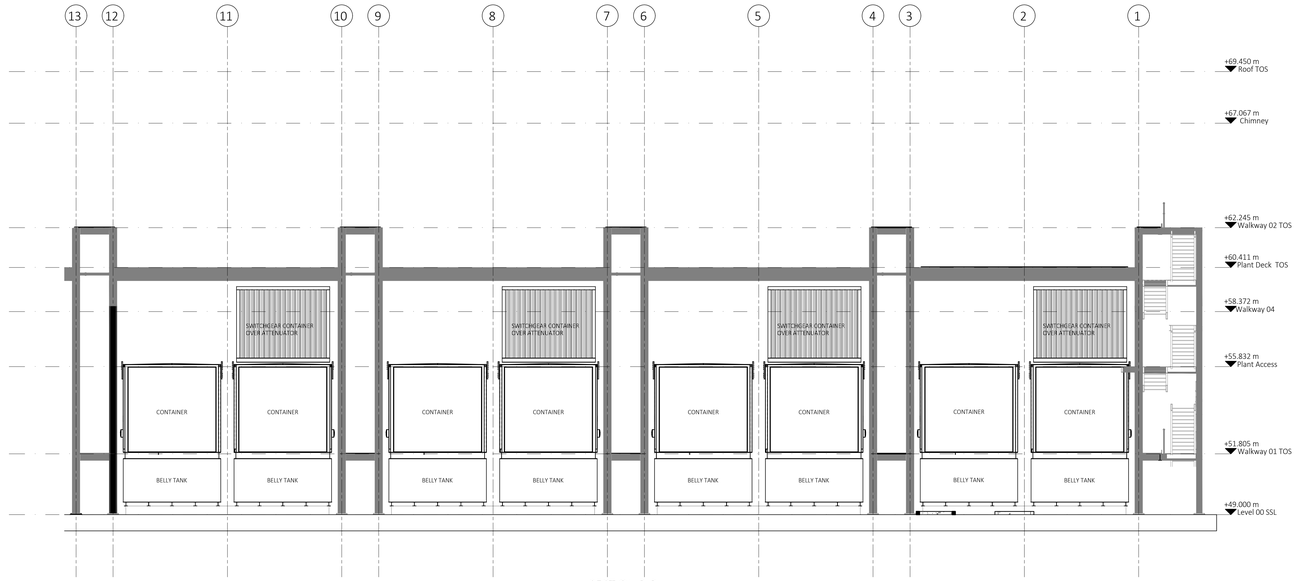
Drawn: M.K.	Date: 22-03-23	Scale: N.T.S.
Checked: M.Easton	Date: 22-03-23	Sheet Size: A1
AVK Ref.: Jn30354A-003		Rev:
Drawing No.: AVK-LC01-GEN-XX-DR-E-10003		P01



PLAN



SECTION A-A



SECTION B-B

Iss.	Date	Change	By
P01	11/04/23	FIRST ISSUE	M.K.

3rd Angle Projection — Do Not Scale. All Dimensions In MM Unless Otherwise Stated.

STATUS: S3

AVK THE POWER PEOPLE

Power Systems House
1-3 Malvern Road,
Maidenhead, Berkshire,
SL6 7RE.

Tel:01628 503900
www.avk-seg.com
sales@avk-seg.com

Customer: JCA

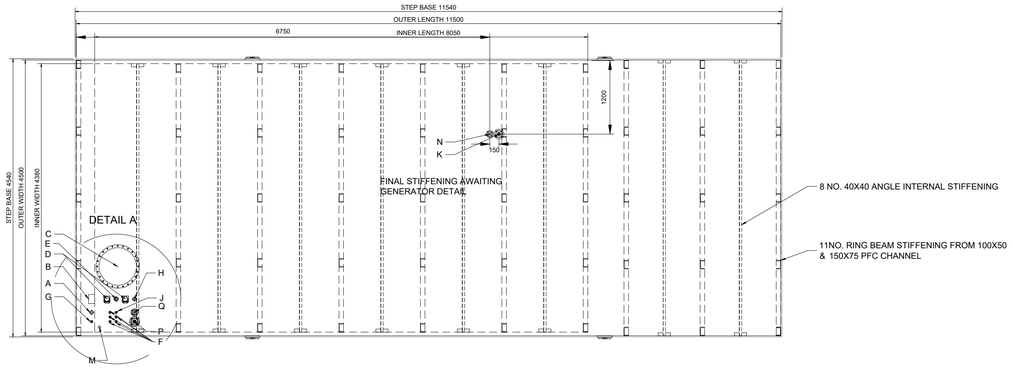
Site: ARK LONGCROSS

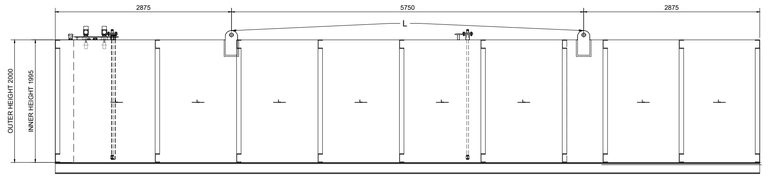
Title: GROUND FLOOR GENERATOR SITE LAYOUT

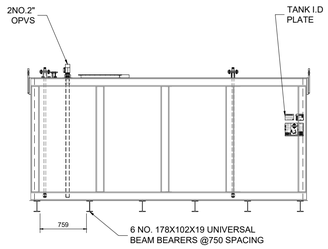
Drawn:	Date:	Scale:
M.K.	11/04/23	1:100
Checked: M.G.	Date: 11/04/23	Sheet Size: A0

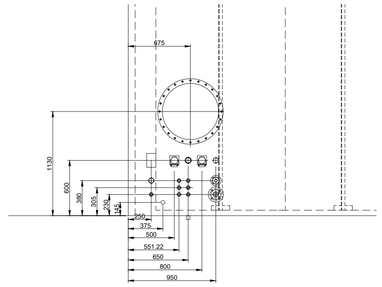
AVK No.: Jn30354A-004 — Rev: P01

Drawing No.: AVK-LC01-GEN-00-DR-E-20005



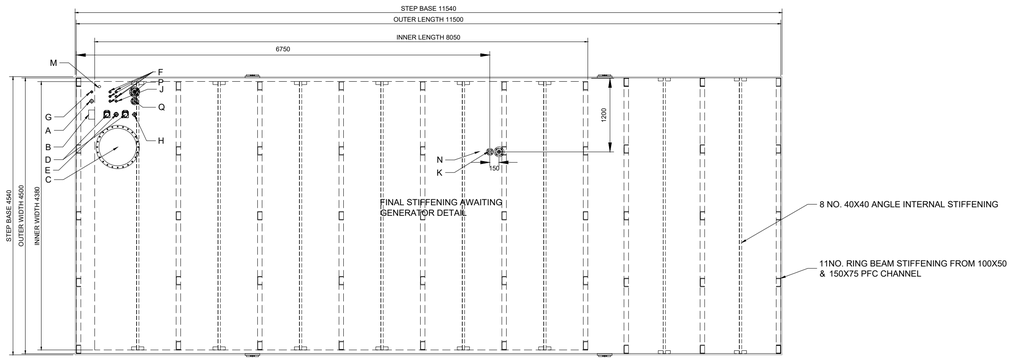


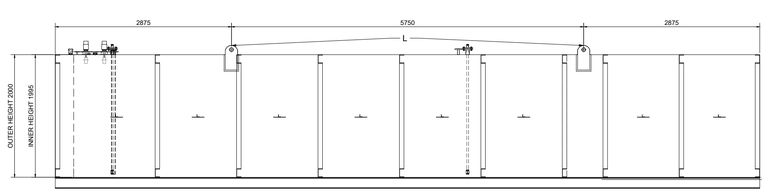


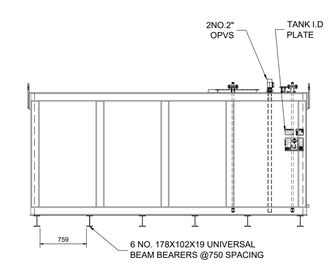


DETAIL A

RIGHT HAND TANK







LEFT HAND TANK

TANK DIMENSIONS

BRIMFUL CAPACITY: 7034 l/L	**USABLE CAPACITY:** 66290L
DRY WEIGHT: 18100KG	**WET WEIGHT:** 84000KG
DOUBLE SKINNED? YES	**BS 799 PART 5 TYPE:** J
INNER TANK DETAILS	- AIR TESTED TO: 0.200 BAR
LENGTH: 8050	**MATERIAL:** MILD STEEL
WIDTH: 4380	**THICKNESS:** 5MM
HEIGHT: 1995	
OUTER TANK DETAILS	
LENGTH: 11500	**MATERIAL:** MILD STEEL
WIDTH: 4500	**THICKNESS:** 5MM
HEIGHT: 2000	
PRIMER: STD	**COLOUR:** T.B.C

CONNECTION DETAILS

CODE	SIZE	TYPE	No.	COMMENTS
A	50	VENT	1	VENT TO ATMOSPHERE
B	STD	VENT	1	VENT TO BUND - 150X100X50 BOX
C	600	ACCESS	1	MANWAY
D	50	F/S	2	FILL CONNECTION W/OPV
E	50	F/S	1	SPARE, PLUGGED
F	25	F/S	5	LEVEL SWITCH/SPARE SOCKETS
G	25	F/S	1	BUND LEAK DETECTION SOCKET
H	50	DRAIN	1	SLUDGE SUCTION DRAIN
J	25	F/S	1	RETURN LINE SOCKET
K	25	DRAW	1	ENGINE SUCTION
L	N/A	LIFTING EYES	4	METCRAFT TYPE 'C'
M	M12	EARTH	1	M12 EARTH BOSS
N	25	RETURN	1	ENGINE RETURN
P	25	DRAW	1	POLISHER DRAW
Q	25	RETURN	1	POLISHER RETURN

NOTES

1. TANK FINISH DETAILS :-
   1.1. ELECTRIC WIRE BRUSH (WHERE NECESSARY), DEGREASE.
   1.2. 1ST COAT - CROMADEX 750 RAPID PRIMER, 30µm DFT.
   1.3. 2ND COAT - CROMADEX 800 TOPCOAT, 30µm DFT.
2. WELDING TO BE CARRIED OUT i.a.w. BS EN 1011-1:2009.
3. WITH REFERENCE TO BS EN 1011-2:2001.
4. WELDING SYMBOLS USED ARE i.a.w. BS EN ISO 2553:2013.
5. INSPECTION & TESTING TO BE CARRIED OUT i.a.w. BS EN 1011-1:2009.
6. ANY GAUGES AND ALARMS SHOWN WILL BE SUPPLIED LOOSE UNLESS OTHERWISE STATED.
7. STIFFENING INSIDE THE TANK IS NOT SHOWN ON THE DRAWING. ALL TANKS ARE STIFFENED IN ACCORDANCE WITH BS799-5:2010. PLEASE SEE THE BELOW INFORMATION REGARDING THE PITCH OF THIS STIFFENING.

HEIGHT OF TANK (M)	MAX STIFFENING PITCH (MM)
0.5	1343
1	950
1.25	849
1.5	775
2	671
2.5	600
3	548

Iss.	Date	Change	By
P01	19/04/23	FIRST ISSUE	M.K.

3rd Angle Projection — Do Not Scale. All Dimensions in MM Unless Otherwise Stated.

STATUS

S3

THE POWER PEOPLE

Power Systems House
1-3 Malvern Road,
Maidenhead, Berkshire,
SL6 7RE.

Tel:01628 503900
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sales@avk-seg.com

Customer:

JCA

Site:

ARK
LONGCROSS

Title:

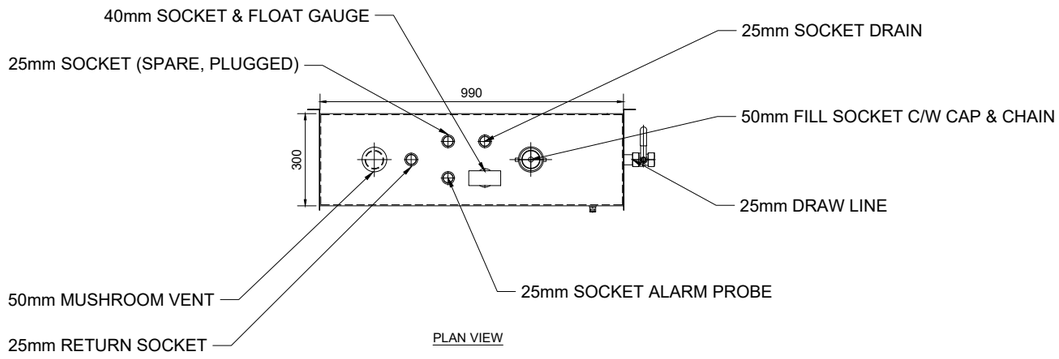
BELLY FUEL TANK
GENERAL ARRANGEMENT

Drawn:	Date:	Scale:
M.K.	19/04/23	1:50
Checked:	Date:	Sheet Size: A1

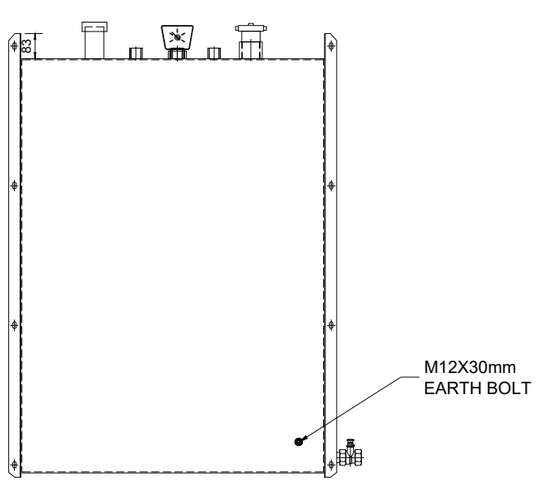
AVK No.: Jn30354A-014

Drawing No.: AVK-LC01-AZ-XX-DR-E-40001

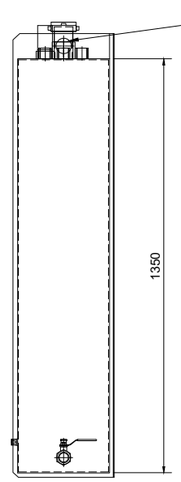
Rev: P01



PLAN VIEW



ELEVATION



END ELEVATION

TANK DIMENSIONS	
BRIMFUL CAPACITY: 400L	**USABLE CAPACITY:** 390L
DRY WEIGHT: 1120KG	**WET WEIGHT:** 1453KG
DOUBLE SKINNED? NO	**BS 799 PART 5 TYPE:** III
TANK DETAILS	- AIR TESTED TO: 0.200BAR
LENGTH: 300	**MATERIAL:** MILD STEEL
WIDTH: 990	**THICKNESS:** 5MM
HEIGHT: 1350	
PRIMER: STD	**COLOUR:** T.B.C

NOTES

1. TANK FINISH DETAILS :-
   - 1.1. ELECTRIC WIRE BRUSH (WHERE NECESSARY), DEGREASE.
   - 1.2. 1ST COAT - CROMADEX 750 RAPID PRIMER, 30µm DFT.
   - 1.3. 2ND COAT - CROMADEX 800 TOPCOAT, 30µm DFT.
2. WELDING TO BE CARRIED OUT i.a.w. BS EN 1011-1:2009.
3. WITH REFERENCE TO BS EN 1011-2:2001.
4. WELDING SYMBOLS USED ARE i.a.w. BS EN ISO 2553:2013.
5. INSPECTION & TESTING TO BE CARRIED OUT i.a.w. BS EN 1011-1:2009.
6. TANK TO BE STORED IN A SUITABLE BUNDED COMPARTMENT WHICH CAN CONTAIN 110% OF THE BRIMFUL CAPACITY OF THIS TANK.
7. ANY GAUGES AND ALARMS SHOWN WILL BE SUPPLIED LOOSE UNLESS OTHERWISE STATED.

COLOUR:	T.B.C	
TOLERANCE.	± 20MM	
DIMENSIONS.	MM	

Iss.	Date	Change	By
P01	20-04-23	FIRST ISSUE	M.K.

3rd Angle Projection — Do Not Scale. — All Dimensions in MM Unless Otherwise Stated.

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Tel:01628 503900
www.avk-seg.com
sales@avk-seg.com

Customer: JCA

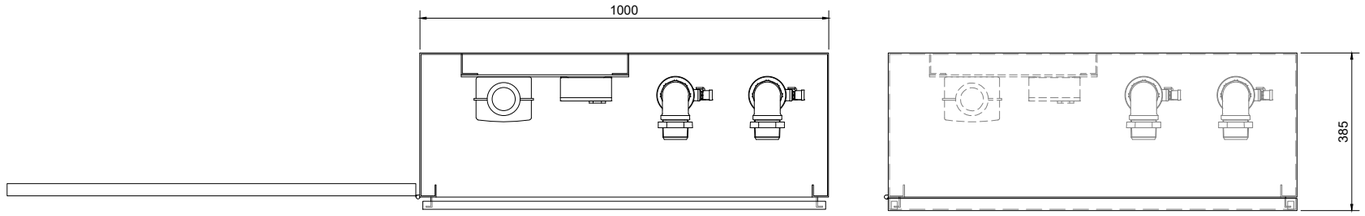
Site: ARK LONGCROSS

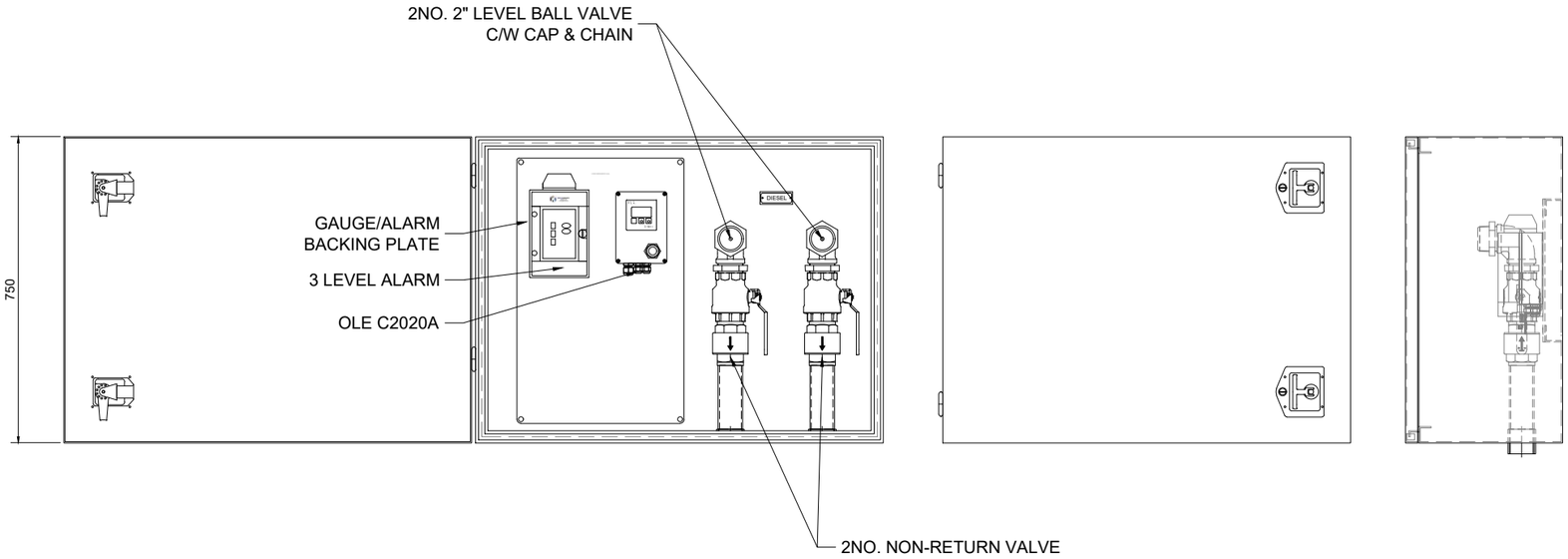
Title: LUBE OIL TANK

Drawn:	Date:	Scale:
M.K.	14-04-23	1:20
Checked:	Date:	Sheet Size: A3

Drawing No.: AVK-LC01-AZ-XX-DR-E-40003

Rev: P01





COLOUR:	T.B.C
TOLERANCE.	± 20MM
DIMENSIONS.	MM

Iss.	Date	Change	By
P01	20-04-23	FIRST ISSUE	M.K.

3rd Angle Projection

Do Not Scale.

All Dimensions in MM
Unless Otherwise Stated.

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THE POWER PEOPLE

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Customer:

JCA

Site:

ARK LONGCROSS

Title:

FUEL FILL POINT
CABINET
G.A.

Drawn:	Date:	Scale:
M.K.	14-04-23	1:20
Checked:	Date:	Sheet Size: A3

Drawing No.:	Rev:
AVK-LC01-AZ-XX-DR-E-40003	P01

Appendix D

DRAINAGE PLAN

LEGEND (BELOW GROUND DRAINAGE)

- PROPOSED FOUL WATER DRAINAGE
- PROPOSED SURFACE WATER DRAINAGE
- PROPOSED INTERNAL MH
- PROPOSED POROUS PAVING TANK
- PROPOSED ATTENUATION TANK
- PROPOSED DRAINAGE FOR THE RETAINING WALL PILE DRAINS
- PROPOSED GATIC CHANNEL WITH EXTERNAL ACCESS BOX
- PROPOSED VENTILATION PIPE
- SITE BOUNDARY OUTLINE
- PILLING WALL OUTLINE

PI 3
KLARGESTER NSFA 100
FUEL STORAGE CAPACITY =
1000 LITRES

PI 2
KLARGESTER NSFA 100
FUEL STORAGE CAPACITY =
1000 LITRES

PI 1
KLARGESTER NSFA 100
FUEL STORAGE CAPACITY =
1000 LITRES

PI 1A
KLARGESTER FORECOURT
FUEL STORAGE CAPACITY =
10000 LITRES

KEY PLAN

NOTES

1. For General Drainage Notes refer to drawing HYD-LC01-SW-XX-DR-C-52010
2. For Drainage Specification refer to HYD-LC01-SW-XX-SPE-C-52000

POROUS PAVING

-	CONTRIBUTING AREA	1,376m^2
-	POROUS PAVEMENT SUBBASE AREA	1,376m^2
-	SUBBASE STORAGE DEPTH	350mm
-	SUBBASE STORAGE VOLUME	144m^3
-	COVER LEVEL	49.30m AOD
-	BASE LEVEL	48.70m AOD
-	TANK COVER LEVEL	49.05m AOD

ATTENUATION TANK

-	SUPPLIER	WAVIN
-	SIZE	1450m^2 x 1.6m = 2320m^3
-	WATER VOLUME	2,200m^3 (95% VOIDS)
-	GROUND LEVEL	49.30m AOD
-	TOP TANK LEVEL	48.60m AOD
-	BASE TANK LEVEL	47.00m AOD
-	COVER	700mm
-	DUTY	AQUACELL CORE-R

OUTFALL RESTRICTED TO HYDROBRAKE TO 13.0l/s

2x 4no. 100Ø VENTING PIPES TO BE CONNECTED TO CATCHPIT CHAMBERS FITTED WITH VENTED COVERS

ATTENUATION POND

-	TOP LEVEL	49.30m AOD
-	MAX WATER LEVEL	48.45m AOD
-	BASE LEVEL	47.45m AOD
-	SIDE SLOPE	1:2
-	MIN STORAGE PROVIDED	76m^3
-	CATCHMENT AREA	6,700m^2

OUTFALL RESTRICTED BY 300Ø PIPE
PVC LINER TO POND BASE

REV	REVISION NOTES/COMMENTS					
	DRAWN BY	DATE	CHECKED BY	DATE	APPROVED BY	DATE

Hydrock
Merchants' House North
Wapping Road
Bristol
BS1 4RW
t: +44 (0)117 945 9225
e: bristolcentral@hydrock.com

CLIENT

ARK DATA CENTRES

sweet PROJECTS

PROJECT

LONGCROSS PARK

TITLE

PROPOSED SITE WIDE DRAINAGE STRATEGY

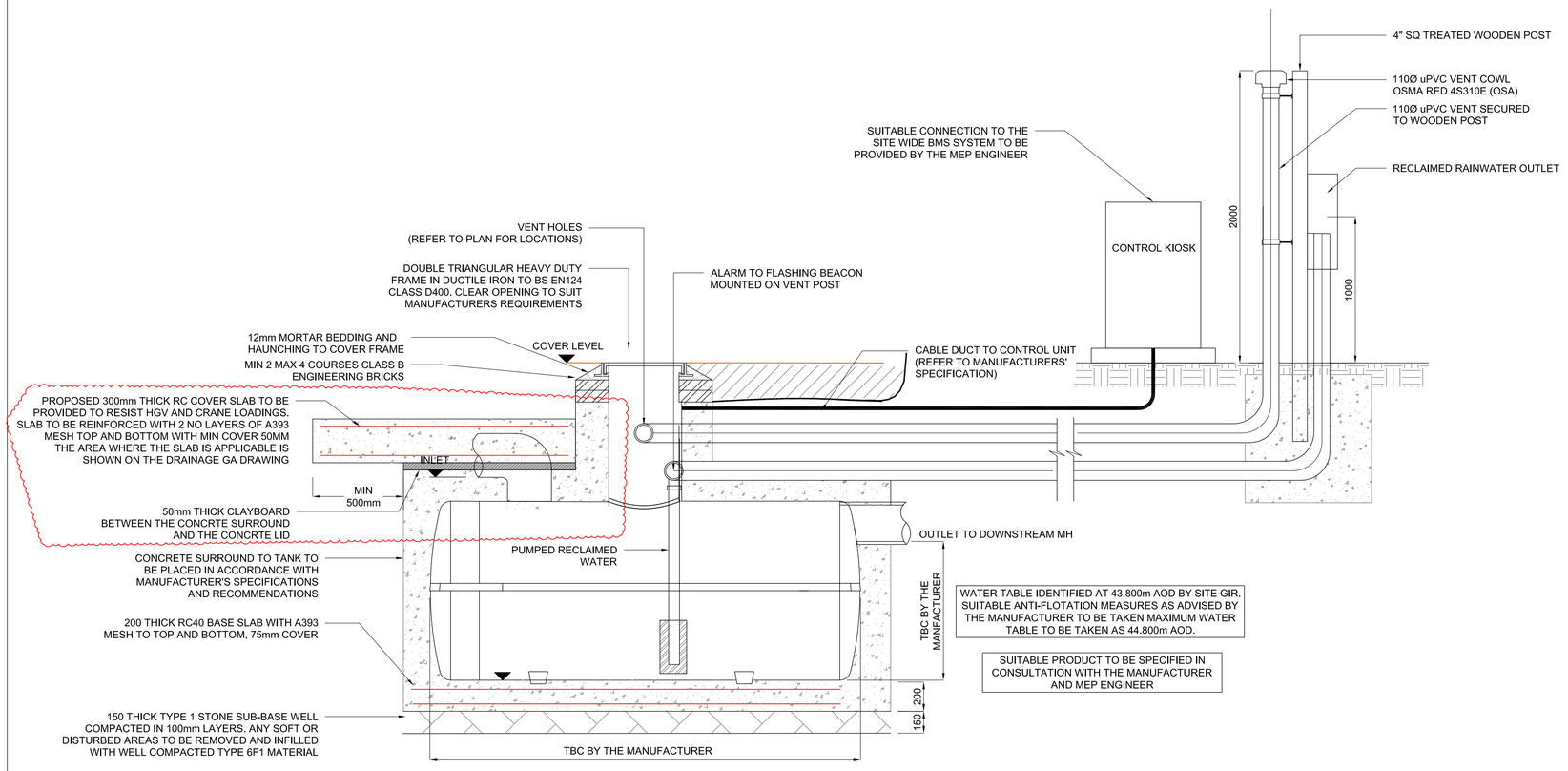
HYDROCK PROJECT NO.	SCALE @ A1
21162	1:500

STATUS DESCRIPTION	STATUS

DRAWING NO. (PROJECT CODE-ORGINATOR-ZONE-LEVEL-TYPE-ROLE-NUMBER)	REVISION

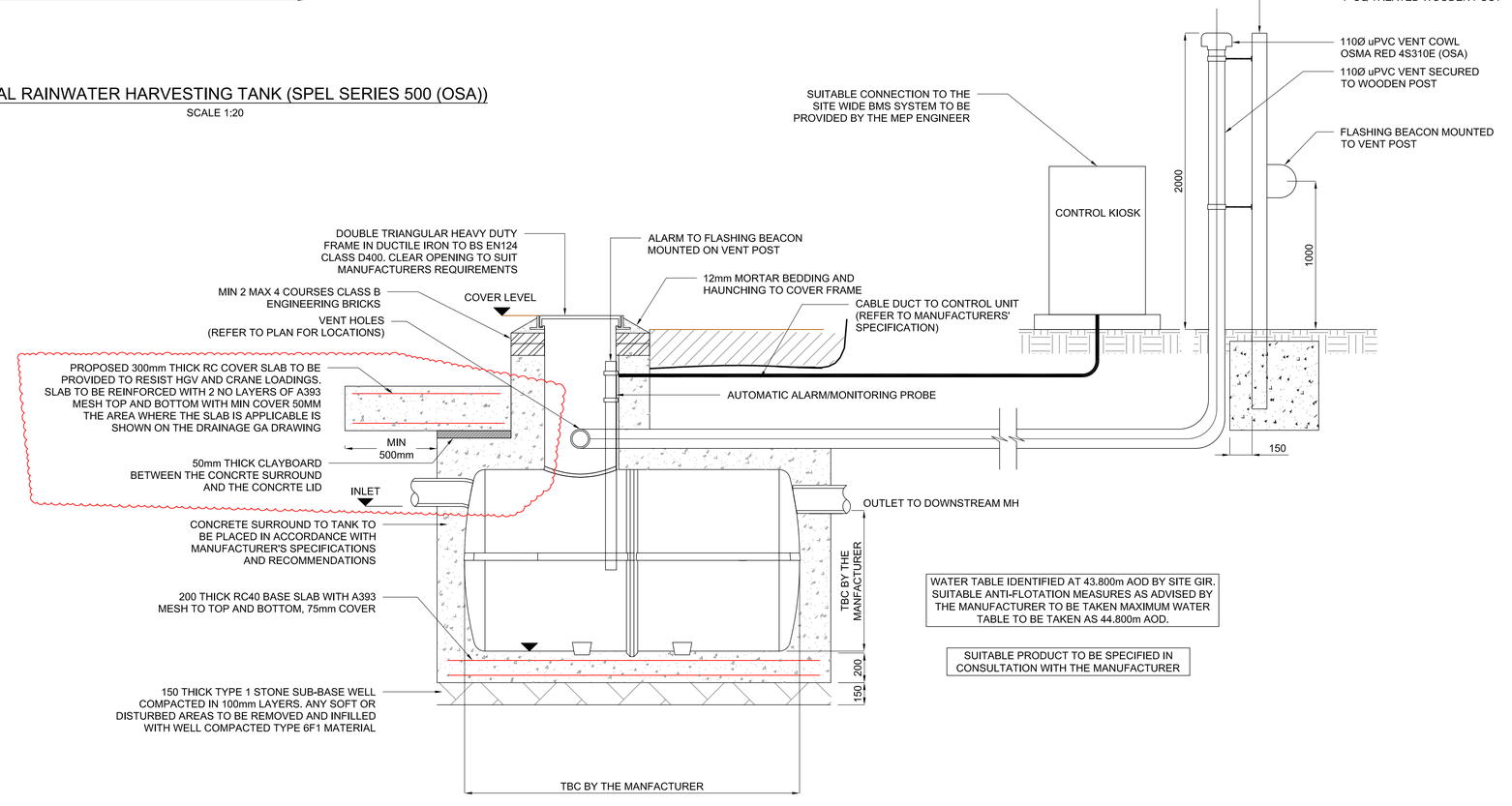
APPENDIX E

FUEL INTERCEPTOR DRAWING



TYPICAL RAINWATER HARVESTING TANK (SPEL SERIES 500 (OSA))

SCALE 1:20



TYPICAL FULL RETENTION PETROL INTERCEPTOR

SCALE NTS

KEY PLAN

NOTES

1. For General Drainage Notes refer to drawing HYD-LC01-SW-XX-DR-C-52020
2. For Drainage Specification refer to LC01-HYD-ST-XX-SPE-C-52000

REV						
C02	COVER SLAB DETAIL CHANGED					
	O. CHARD	07/11/23	V. KARATANOV	07/11/23	V. KARATANOV	07/11/23
C01	ISSUED FOR CONSTRUCTION					
	O. CHARD	14/07/23	V. KARATANOV	14/07/23	V. KARATANOV	14/07/23
P03	ISSUED FOR STAGE APPROVAL					
	O. CHARD	20/01/23	V. KARATANOV	20/01/23	V. KARATANOV	20/01/23
P02	ISSUED FOR STAGE APPROVAL					
	O. CHARD	21/10/22	V. KARATANOV	21/10/22	V. KARATANOV	21/10/22
P01	PRELIMINARY ISSUE					
	O. CHARD	11/03/22	V. KARATANOV	11/03/22	V. KARATANOV	11/03/22
REV	REVISION NOTES/COMMENTS					
	DRAWN BY	DATE	CHECKED BY	DATE	APPROVED BY	DATE

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CLIENT

ARK DATA CENTRES

sweet PROJECTS

PROJECT

LONGCROSS PARK

TITLE

PETROL INTERCEPTOR AND RAIN WATER HARVESTING TANK DETAILS

HYDROCK PROJECT NO.	SCALE @ A1
21162	1:20

STATUS DESCRIPTION	STATUS

DRAWING NO. (ORIGINATOR-PROJECT CODE-ZONE-LEVEL-TYPE-ROLE-NUMBER)	REVISION
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