Best Available Technique Assessment - JP3647JU

Kao Data Centre – KLON 06

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APPENDICES

1.0 INTRODUCTION

This Best Available Technique (BAT) assessment has been prepared by HDR on behalf of the operator KD 2 Limited (Kao) in support of the application for a new bespoke Environmental Permit (ref: JP3647JU) for the KLON-06 Data Centre located at 672 Galvin Road, Slough, SL1 4AN.

Kao as the legal operator is required to apply to the Environment Agency (EA) for an Environmental Permit because the total thermal capacity of the emergency back-up combustion plant exceeds the 50MW threshold stipulated in the regulations[1].

At the time of writing the installation is operating below 50MWth. Only once the new generators are commissioned will the combustion plant exceed 50MWth pending receipt of the Environmental Permit, or permission to operate from the EA.

For a detailed description of the Data Centre and surrounding area, please refer to the Non-technical Summary 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 The previous guidance document: 'Combustion Activities (EPR 1.01)' was withdrawn in August 2018.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.

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 (as amended)

2.0 SITE SUMMARY

We have presented a high-level summary below. Please refer to the Non-technical Summary (NTS) document submitted with the application for a non-technical introduction to the installation and the application for a permit.

KLON-06, has been operating as a Data Centre since 2009 and as with other Data Centres, it utilises ESGs to provide emergency power in the event of grid electrical failure. KLON-06 was designed with a future expansion provision. The current fit out and expansion works by Kao is utilising the expansion provision provided under the original design in 2009. Future expansion works will see 7no. new ESGs installed and commissioned which will result in the total thermal capacity exceeding 50MWth for the first time in the sites history.

All the ESGs due to be commissioned are over 1MWth and are classed as 'Medium Combustion Plant' (MCP). Details of the existing and new MCPs are in Table 1 below with more details in Figure 1 and in the thermal schedule in APPENDIX A.

Table 1 – Summary of MCP details

MCP type	No. of ESGs	Thermal capacity	Install date
Existing	6	~40MWth	Pre 2010
New	7	~60MWth	2023-2025
Total after expansion	**13**	**~100MWth**	-

The plans at present are for the x7 new ESG to be installed in Phases:

- Phase 1 – Q2 2023, 3 no. ESGs installed within the existing warehouse
- Phase 2 – Q1 2024, 2 no. ESGs installed in the yard, externally
- Phase 3 – Q1 2025, 2 no. ESGs installed in the yard, externally

The ESGs are "excluded MCPs" as they are purely standby plant 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 2hrs/month or 24 hrs/gen/year. The ESGs are capable of operating on diesel or biodiesel such as 'HVO' or Hydrotreated Vegetable Oil

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

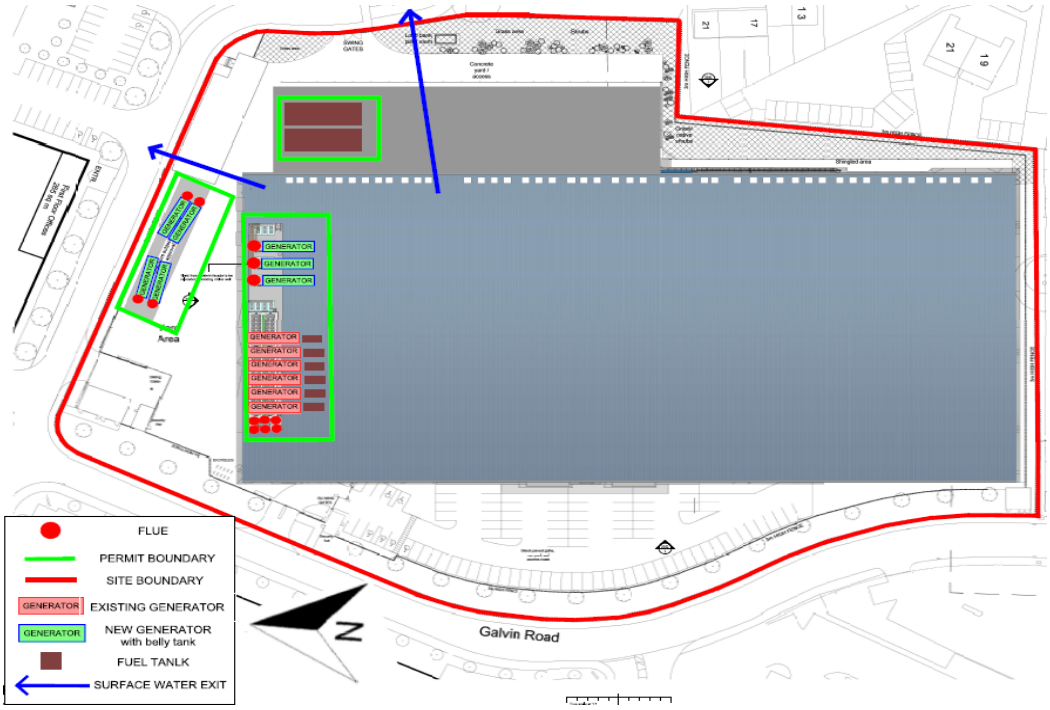

Figure 1 – Installation boundary and emission points

3.0 DATA CENTRE DESIGN

3.1 Uninterruptible 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 uninterruptible power provision and being supplied by the national grid brings a risk of a 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 uninterruptible power supply is critical to a Data Centre's ability to operate.

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 2 – 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 about 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 2021/22[3].

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

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 installation can be fed from two substations: Foxtrot and Golf. Each feed can support the full site load, meaning that if one feed was to fail, electrical provision to the installation would not be compromised. A site wide failure is considered extremely rare as it would require a catastrophic regional failure on the grid, or at the supplying power station, and would likely impact not only the site but the surrounding London area.

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

[3] https://www.nationalgrideso.com/document/267701/download

Given the risk of downtime via brown/black outs, the installation has installed ESGs to provide an electrical supply to the Data Centre.

The installation has incorporated redundancy / resilience as a risk measure to help ensure that power provision is not interrupted even in the event of a mains failure. The size and number of generators is based on the site electrical IT load plus supporting equipment load on a design day. Generators are only sized to provide the maximum amount of power.

The redundancy arrangement for the generators is stated below where 'N' is the number of generators required to carry the maximum electrical load.

- Existing ESGs: N+2
- New ESGs: N+1

In the event of grid failure, 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 redundancy arrangements are to safeguard power to their dedicated data hall as Diesel generators have up to a 15 % probability of not starting and therefore a +1 or +2 depending on total building load is installed.

3.3 Grid outage scenario

Major power outages are rare. In the last 8 years the KLON-06 site has had high levels of grid reliability, only experiencing brown outs (micro-outages or 'blips') that lasted less than 0.1 second.

In a major outage where the installation loses both A & B grid supplies, all generators will start. If generators start, Kao will look to sequence with the mains and come off generators once the supply to site is stable. Connection with the mains supply can be restored manually via a control panel or will automatically return to mains power as a primary source after 1 hour.

3.4 Technology selected to provide emergency power

ESGs 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 2 – 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 3 – 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

The following technologies were considered for the provision of emergency power to the Data Centre:

- Diesel Generators (includes operation on HVO / alternative 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 was that Gas and Diesel generators are the preferred method for back up electricity generation at this site. Kao have decided to install Diesel generators at this installation as they outperform Gas generators when comparing their cold start capability and their reliability in providing an uninterruptible power supply, due to the reliance of an off-site supply of natural gas.

Emissions optimised generators were chosen previously for the existing data halls and have been selected again as BAT for this installation. The following are reasons to support the selection of the generators and are in line with EA guidance on BAT for Data Centres:

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

3.5 Generator emissions performance

The generator engine and emissions datasheets for the existing and new ESGs can be found in APPENDIX B and are summarised in Table 4 below.

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/m^3 NOx; 650 mg/m^3 for CO; particulates and dust 130 mg/m^3 and 150 mg/m^3 for hydrocarbons (all at reference conditions and 5% O_2)."*

The 7no. new ESGs that have been selected to support the site expansion are emissions optimised and achieve the Tier II US EPA standard (See APPENDIX B).

The installation is located within an Air Quality Management Area (AQMA) for NO_2 and as such, the operator has made significant investment in NO_x abatement technology in the form of Selective Catalytic Reduction (SCR). The SCR system has been sized to reduce NO_x emissions concentrations to 507 mg. Nm^{-3} at 5% O_2 (190 mg. Nm^{-3} at 15% O_2). Factory Acceptance Tests (FAT) available on request.

The 6no. existing generators are legacy sets which were commissioned in 2009 and thus have not been fitted with SCR.

The generator emissions rates used in the Air Quality Assessment (AQA) (See Section 10.3), are presented in Table 4 below.

Table 4 – ESG emissions rates

Emissions point reference	Emissions point description	Generator make and model	Pollutant	Emissions at 75% load (mg/Nm^3) [a]	Emissions at 100% load (mg/Nm^3) [a]	Emission Rate at 100% load (g/s)
EP1-6	x6 no. Existing gens	MTU 20V4000 G63L	NO_x	3,378	3,893	8.094
			CO		233	0.403
			PM		20	0.027
			HC		50	0.094
EP7-13	x7 no. New gens	KOHLER KD103V20	NO_x (unabated)	1,567	2,991	8.109
			NO_x (abated)	507	507	1.375
			CO		46	0.128
			PM		1.3	0.004
			HC		87	0.237

3.6 Generator noise attenuation

Since operations commenced in 2009 there have been no noise complaints associated with the operation of the generators. The generators are located within an individual generator enclosure which provides added noise attenuation to achieve an acoustic pressure level of 65dB(A) (100% load) @ 1m around the perimeter of the container under standard test conditions.

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

3.7 Generator flue design

The flue arrangement for the existing and new ESGs has been summarised in the table below.

- Each generator set has dedicated flue / 'stack'
- Flue gas from the x3 no. 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 new generators. As a result, all new build generator flues are unimpeded by flaps/cowls and have been orientated vertically, exiting above the height of the building.

Table 5 – ESG flue arrangements

MCP type	No. of ESGs	Flue height (m)	Flue orientation	Cowls / caps?
Existing (internal)	6	17	Horizontal	None
New (internal)	3	17	Vertical	None
New (external)	4	7	Vertical	None

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 new generators. As a result, all new build generator flues are unimpeded by flaps/cowls and have been orientated vertically, exiting 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.

3.8 Fuel storage arrangements

The sites ESGs required adequate fuel storage to allow them to operate during a grid failure. The existing ESGs are fed from day tanks which are in turn fed from larger bulk tanks. The new ESGs receive fuel from their dedicated belly tank. The locations of the bulk and day tanks can be seen in Figure 1. Details of the tanks and associated activities are covered in the following sections.

The ESGs are capable of operating on diesel or biodiesel such as 'HVO' or Hydrogenated Vegetable Oil.

3.8.1 Fuel storage capacity

Details of the sites fuel storage tanks is summarised in the table below.

Table 6 – Bulk Fuel tanks

Tank reference	Description	Type	No.	Capacity (litres)	Serves	Location
T1&2	Bulk tanks 1 & 2	Bulk tank	2	80,000	Existing x6 no internal generator day tanks	Under the gantry external to the main data hall building
T3-T8	Day tanks 1-6	Day tank	6	4,000	Existing x6 no internal generators	Adjacent to the existing x6 no internal ESGs within the generator room
T9-11	Belly tanks 1-3	Belly tank	3	18,500	New x3 no internal generators	Beneath the new ESGs within the generator room
T12-14	Belly tanks 4-7	Belly tank	4	18,500	New x4 no external generators	Beneath the new ESGs inside each individual generator container

The site stores enough fuel to operate in the event of Grid failure. This is based on a worst-case scenario where the data halls are at capacity requiring the generators to run at 100% load, which is highly unlikely as Halls are rarely above 50-75% of their design capacity. The current fuel storage is as follows:

- Existing ESGs – 48 hours
- New ESGs – 24 hours

The fuel for the 6no. existing ESGs is held in 2no. bulk tanks which are located outside of the main building under the gantry. Fuel is pumped from these 2 no. bulk tanks to 6no. day tanks inside the plant room adjacent to each ESG. The new 7no. ESGs each have their own dedicated belly tank below the ESG they feed.

3.8.2 Fuel storage controls

All tanks (T1-14)
All tanks are located above ground, there are no underground fuel storage tanks.

Tanks are situated either internally or externally over good quality hardstanding. All tanks have high- and low-level alarms to help prevent overfilling. Alarms and tank levels are linked to the sites building management system (BMS) for remote monitoring.

Tanks are fitted with digital OLE electronic gauges indicating the volume of fuel in the tank. These can be physically read at the tank or remotely via the BMS.

Overfill Prevention Valves (OPV) are to be fitted to the tank fill line to help prevent overfilling.

Each day tank will be fitted with high- and low-level alarms. The tank bund shall incorporate a leak detect float switch to alarm if a leak is detected.

Tanks are filled either directly or remotely via tank fill points which are located inside locked cabinets. Drip trays are present inside the cabinets to capture minor spillages during refuelling. These cabinets will be locked when not in use.

All ESGs have pressure relief valves that are designed to prevent over pressurisation of diesel supplied from bulk / belly tanks.

To help reduce the risk of corrosion, all pipework is either painted or constructed of corrosion resistant material.

Spill kits are located adjacent to the generator enclosures / within generator rooms / fuel tanks and fill points.

Drain covers are colour coded to identify foul (red) and surface water (blue).

Bulk tanks 1 & 2 (T1 & T2)
These tanks are double skinned and conform to BS 799 Type J and have been manufactured with 6mm mild plate steel.

These tanks are refuelled via connections in independent fill point cabinets. The fill points are located within lockable cabinets and are accessed from the rear service yard. Within the fill cabinet there are pneumatic gauges to measure tank levels.

Day tanks 1-6 (T3-T8)
There are x6 no. double skinned day tanks located in the generator room adjacent to the existing x6 no. ESGs. These are fed from Bulk tanks 1&2 (T1&T2).

Belly tanks 1-7 (T9-14)
The x7 no. new belly tanks that will sit beneath the x no. new ESGs are to be integrally bunded to 110%. These will be refuelled directly to a fill point on the belly tank by a hose extended from the fuel tanker.

For more information on the bulk and belly tanks, see the tank diagrams submitted in support of this application.

Tertiary containment
Tertiary containment is provided in the form of a Hydrodynamic Vortex Separator is in place in the rear service yard. A drawing of the current design is presented in APPENDIX D.

Surface run off from the external yard / generator area will drain to a hydrodynamic vortex separator prior to discharging to the local sewer network. This will be fitted with an automatic shut off valve which will activate when fuel is detected. This valve can also be closed manually in the event of a fuel spillage or in order to contain fire water.

3.8.3 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) is in place 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 in place to help reduce the risk of an incident including an SOP for spill response and spill kits.

The sites periodic preventative maintenance (PPM) regime includes 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.

Drain covers have been purchased to help prevent spilt fuel from entering the drainage network, during refuelling or in an emergency.

The Data Centre is currently staffed 365 days a year with monitoring by security staff located within a security office, using an extensive CCTV and alarm system. Entry and exit to the site are tightly controlled via a security gate and turnstiles. The site is bounded by a palisade security fence that acts as an impenetrable perimeter to prevent unauthorised access to the site.

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

3.9 Urea storage arrangements

Urea is to be used in the Selective Catalytic Reduction (SCR) equipment to reduce the NO_x emissions from the ESGs. This SCR system uses Urea as a raw material to achieve the prescribed NOx reductions.

Each generator will have its own 2,500 litre bunded urea tank (see APPENDIX F). Tanks will be fitted with the following:

- 2'' fill point
- Inspection lid
- Clock gauge
- Lockable cabinet
- Interconnecting system pipework

4.0 OPERATING TECHNIQUES

4.1 Generator operation

The generators are to be used purely as standby plant to provide emergency standby power in the event of grid failure. 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 of approx. 24 hours/year/generator.

4.2 Maintenance & 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. The AQA in Section 10.3 has not identified significant impacts to short term Air Quality from the proposed test regime. The current test regime is considered to meet the BAT requirements.

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.

Table 7 –Annual operational hours per generator

Frequency	Duration	No. tested	Approach	Total hours per Gen
Monthly test	Up to 2 hours	x6 existing ESGs	Staggered, one generator operating at a time for a max of 2 hours using a load bank. The load bank will allow the load to be cycled up from 0 – 100% load.	**22 hrs**
Monthly test	Up to 1 hour	x7 new ESGs	Off-load test with all generators coming online, synchronising and then running for 1 hour allowing them to fully warm up. After the completion of the hour all machines would drop off and shut down.	**12 hrs**
Annual full load Test	Up to 2 hours	All ESGs	Annually a full load test shall be performed individually on each generator against a load bank for 2 hours. The load bank will allow the load to be cycled up from 0 – 100% load.	**2 hrs**
Annual Black Building test	30 mins	All ESGs	Black building test shall also be performed annually to check the response of the systems to utility failure during which all generators would synchronise and run for 30 minutes against the site load.	**30 mins**

5.0 F-GAS

Fluorinated gases or ‘F-gases’ 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. During the development of the sites Environmental Management System, an F-gas register is to be maintained onsite, and will include details such as plant make, model and serial number, 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.

Kao have an Energy Management System (EnMS) certified to ISO 50001 for other Kao sites. Plans are to include this installation in the future. A key focus of this management system is improving energy efficiency particularly for high energy consuming activities such as cooling.

6.2 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 (13 ESGs x 24 hours each = 312 hours total) do not exceed this limit and therefore EED requirements are not deemed to be applicable.

6.3 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. <30 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. Once the new 7no. ESGs are operational, they are to be included within the existing PPM regime.

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

The installation will store enough diesel / Hydrogenated Vegetable Oil (HVO) to provide 24 hours' worth 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 24 hours per year. The generator datasheets provide fuel consumption at 50, 75 and 100% load. Using 100% load, the total estimated fuel consumption for each generator can be seen below.

- 6x no existing ESGs 620 litres/hr /gen = 89,280 litres per year
- 7x no new ESGs 711 litres /hr/gen = 119,448 litres per year
- TOTAL at 100% for all ESGs is approx. 208,728 litres per year.

This is a highly conservative estimate as it has been calculated using fuel consumption at 100% load for the full 2 hours when in reality ESGs may be operated for less time on partial loads. In addition, only a few gens will be installed in 2023 as per Section 2.0.

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. 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.

7.3 Urea

Urea is to be used in the Selective Catalytic Reduction (SCR) equipment to reduce the NO_x emissions. It is expected that there will be urea deliveries every 1 to 2 years as limited amounts will be required during routine site operation.

The controls detailed in section 3.8.3 will also apply for Urea deliveries.

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 & 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. Kao 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)

Kao aims 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 2 bulk tanks. This unit filters the diesel in the tank, removing moisture and particulates from the fuel, 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 in place:

- 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 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

Kao has an Environmental Management System (EMS) accredited to the internationally recognised ISO 14001:2015 standard. The certificate can be found in APPENDIX E.

The EMS focusses on ensuring continual improvement and includes information on 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. It also includes Kao's commitment to protect the natural environment through set objectives that comply with relevant legislation.

Kao intends to implement an EMS for the KLON-06 Data Centre following commissioning of the new ESGs. The EMS is likely to place a specific focus on the following:

- Reducing risks to the environment to a level that is as low as reasonably practicable using best available techniques
- Integrating EMS responsibilities within line management
- A commitment to personnel environmental awareness and competence
- The ongoing monitoring and review of environmental performance
- A commitment to working to achieve continuous improvement in environmental performance.
- Integral to the EMS will be an overarching environmental policy. This will seek to underpin the EMS and help ensure uptake by each staff with sufficient training provided as required.

It is a requirement of the EMS that Kao maintains relevant records. These records are to be stored for the appropriate duration on a backed-up system and updated in line with the management system's policies. Records include:

- Organisational procedures
- EMS manual
- Aspect register
- Compliance register
- Monitoring documents
- Accident, prevention, and control procedures
- Training records
- Review and audit records
- Environmental risk assessments

10.0 EMISSIONS

There will be no point source emissions to water, air or land, except from the sources and emission points identified in Section 2.0, 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 sites generators.

The impact assessment concluded that:

> "*noise levels are predicted to achieve the noise limits at the nearest noise sensitive properties and therefore noise impacts are not considered to be significant."*

Further information can be seen in the 'Noise Impact Assessment' submitted as part of this application.

10.2 Point source emissions to sewer / surface water

The sites drainage system is split into separate foul and surface water networks as shown in APPENDIX C.

The area immediately surrounding the 2no. external bulk tanks and the 4no. new external ESGs is covered in good quality hard standing. As per Section 10.2, discharges to sewer are not anticipated. The EA are to be notified where incidents occur that have the potential to cause pollution / environmental harm. Site drainage exits into the drainage network for the entire industrial estate. Thames Water are the sewerage provider and ISS are responsible for the industrial estate network.

Indicative locations for where the sites surface water drainage system enters the local network is identified in Figure 1. Discharges are expected to be limited to surface water run-off, which is not anticipated to contain spilt fuel due to the mitigation measures in place (described below).

The surface water drainage system around the data hall is connected to a Hydrodynamic Vortex Separator prior to discharging to the local network. Current plans for this can be found in APPENDIX D. This will be fitted with an automatic sensor / shut off valve that will close upon detecting the presence of spilt fuel. This will help ensure that contaminated runoff does not exit the site by isolating the system.

The sites drainage system and interceptor will be subject to periodic visual inspections and integrity testing as part of the PPM regime. The tank will be emptied periodically or in the event of a spillage with contaminated liquids disposed of appropriately as hazardous waste.

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 Quality Assessment (AQA) 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 below, with further information in the 'Air Quality Permit Assessment'

Scenario 1: 'Testing and Maintenance'
In this scenario, all generators are expected to run concurrently for 2 hours per month at 100% load. Throughout scenario 1, the existing generators will operate under load bank, with one generator operating at a time. The generator shall be operated at 100%. The new generators shall be operated against site load with all generators coming online and then dropping off.

Scenario 2: Emergency operation
72-hour 'Grid Failure'/ power outage emergency inclusive of the testing and maintenance run times above.

The conclusion of the assessment is as follows, with further details, in the AQA:

> *"Long term impacts from the proposed SDGs were predicted to be insignificant during testing and maintenance (Scenario 1) and a prolonged grid failure (Scenario 2) at all relevant modelled receptor locations. Short term impacts were also found to be insignificant during testing and maintenance operations. Exceedances of the short-term UK Air Quality Objective for NO2 was only predicted during a prolonged 72-hour grid failure event for the following receptors: Gym Group gymnasium and Astoria Heights residences.*
>
> *Prolonged 72-hour grid failure events are considered to be extremely rare events and therefore do not reflect the likely impacts from the installation."*

The conclusion of the AQA indicates that there is a low likelihood of that short- and long-term impacts from operation of the sites ESGs is likely to be insignificant.

10.4 Air Quality Management Plan

The AQA identified that an exceedance of the Air Quality Objective (AQO) is more likely to occur during a prolonged outage over regular testing and maintenance of the ESGs. BAT is therefore to develop an Air Quality Management Plan (AQMP) to be implemented in the event of a prolonged outage.

As part of the application for a permit, a draft AQMP has been created as a basis for identifying which receptors may be affected and if notification is required. 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

The plan is to be developed in conjunction with the Local Authority and its Local Air Quality Management (LAQM) process. Once the AQMP is finalised, it shall be submitted to the EA for final approval.

11.0 MONITORING

11.1 Emissions limits & flue gas monitoring

The generators are classed as Medium Combustion Plant (MCP). Operational hours are unlikely to exceed 50 hours per year and thus the plant is classed as 'excluded' MCP which are exempt from meeting the new plant BAT emissions limit values (ELVs).

Monitoring will be conducted in-line with BAT guidance received during engagement with the EA; it is expected that the operator will need to demonstrate that the engines are BAT by including the provision of flue gas sampling ports to allow for NO_x and CO monitoring, when required by the permit. Any testing is to be undertaken by an MCERTS accredited supplier.

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

Total mass emissions for NO_x, SO_x, PM, and CO are to be reported to the EA annually.

11.2 Generator operation

Generator operational hours and fuel consumption for maintenance, testing and during an outage, are currently monitored for the 6no. existing ESGs. Once the 7no. new ESGs are commissioned, 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. Surface water run off which discharges to surface drainage will pass via Hydrodynamic Vortex Separator. This is 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.

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

Kao KLON-06 thermal schedule

Ref	Emission Source Description	Location	Approx install date	MCP type	Supplier	Gen set model	Engine Manufacturer	Engine Model	output rating (kVA)	Output rating (kWe)	Assumed efficiency	NET input Thermal Capacity (MW)	Cumulative thermal capacity
EP1	Existing gen 1	internal	2010	Existing	CTM	MT 3050A	MTU	MTU 20V4000 G63L	3,000	2,400	37%	**6.49**	**6.49**
EP2	Existing gen 2	internal	2010	Existing	CTM	MT 3050A	MTU	MTU 20V4000 G63L	3,000	2,400	37%	**6.49**	**12.97**
EP3	Existing gen 3	internal	2010	Existing	CTM	MT 3050A	MTU	MTU 20V4000 G63L	3,000	2,400	37%	**6.49**	**19.46**
EP4	Existing gen 4	internal	2010	Existing	CTM	MT 3050A	MTU	MTU 20V4000 G63L	3,000	2,400	37%	**6.49**	**25.95**
EP5	Existing gen 5	internal	2010	Existing	CTM	MT 3050A	MTU	MTU 20V4000 G63L	3,000	2,400	37%	**6.49**	**32.43**
EP6	Existing gen 6	internal	2010	Existing	CTM	MT 3050A	MTU	MTU 20V4000 G63L	3,000	2,400	37%	**6.49**	**38.92**
EP7	New gen 1	internal	2023	New	Kohler	KD4000-E	Kohler	KD103V20	3,970	3,176	37%	**8.58**	**47.50**
EP8	New gen 2	internal	2023	New	Kohler	KD4000-E	Kohler	KD103V20	3,970	3,176	37%	**8.58**	**56.09**
EP9	New gen 3	internal	2023	New	Kohler	KD4000-E	Kohler	KD103V20	3,970	3,176	37%	**8.58**	**64.67**
EP10	New gen 4	external	>2023	New	Kohler	KD4000-E	Kohler	KD103V20	3,970	3,176	37%	**8.58**	**73.25**
EP11	New gen 5	external	>2023	New	Kohler	KD4000-E	Kohler	KD103V20	3,970	3,176	37%	**8.58**	**81.84**
EP12	New gen 6	external	>2023	New	Kohler	KD4000-E	Kohler	KD103V20	3,970	3,176	37%	**8.58**	**90.42**
EP13	New gen 7	external	>2023	New	Kohler	KD4000-E	Kohler	KD103V20	3,970	3,176	37%	**8.58**	**99.01**
												99.01	**99.01**

APPENDIX B.

GENERATOR ENGINE & EMISSIONS DATASHEETS

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CONFIRMATION N. 6700 **19.02.2008**

Subject: Slough Data Centre

TECHNICAL DESCRIPTION

N.4 DIESEL GENERATING SETS MODEL MT.3050

The generating sets will be powered by MTU diesel engines which will be coupled to Stamford alternators.

GENERATOR DUTY

In accordance with the specification requirements the generators are rated to operate at 100% load 2400 kWe which is equal to 3000 KVA at 0.8 pf in accordance with L.T.P in ISO 8528 (BS7698).

The generator nominal frequency will be 50Hz with a nominal engine speed of 1500 rpm, the nominal voltage produced at the alternator will be 11,000 V. Each generator set is governed by a class A1 MTU ADEC electronic governor.

The reference conditions for achieving the stated duty are:

- 40 °C intake air temperature
- 100 m altitude above sea level

MTU DIESEL ENGINE MODEL 20V4000G63L

- 4 stroke
- Direct injection
- Turbocharged and inter-cooled
- 20 cylinders 'V' disposal – liquid cooled
- Bore 170 mm
- Stroke 210 mm
- Capacity 95.4 litres
- Compression ratio 16.5:1
- Rotation: anticlockwise viewed from flywheel side
- Piston speed at 1500 RPM: 10.5 m/sec
- LTP rating as per ISO 3046: 2850 KW at 1500 RPM, overload 10% for 1 hour each 12
- Fuel type: EN590: grade n.1d and n.2d according to ASTM D975-00 (with low calorific value of 9.700 Kcal/Kg)
- Fuel consumption at 100% load 221 gr/KWh
- Specific lube oil consumption: 0.82 gr/KWh
- ADEC electronic governor Class A1(injection pump)

ALTERNATOR – LEROY SOMER LSA 54 VL75

- Nominal rating for continuous operation 2800 KVA (PRP)
- Nominal rating for standby operation 3080 KVA (PRP)
- Nominal voltage 11kV ± 5%
- Rated power factor: 0.8
- Frequency: 50 Hz at 1500 RPM
- Rated ambient temperature 40^0 C
- Double bearings construction form, according to IM1001
- Brushless excitation
- 4 Poles
- 6 Wires
- Short circuit current – 3 x full load current for 10 seconds
- Insulation: class F
- Over temperature to Class H
- Self ventilated by internal fan
- IP 23 mechanical protection
- Winding pitch 5/6
- Cooling IC0A1
- AVR
- Current transformers for paralleling facility between alternators
- Current Transformers for restricted earth fault protection (supplied and installed by CTM)
- Anti-condensation heater
- PT100 for bearings (n.1 per each bearing)
- PT100 for windings (n.2 per each phase)
- CT's for paralleling
- PMG

FUEL SYSTEM

- Feed pump
- Fuel oil-water separator, static type complete with Racor type connecting parts
- Full flow filters with replaceable elements
- Electrically operated 24V shut down solenoid
- Overspeed devices

ENGINE COOLING SYSTEM

- Tropical horizontal radiator with separate electric driven fans for jacket and aftercooler circuits
- Cooling radiators will be skid mounted. Low noise electric driven fans will be installed above the radiator cores pulling air through the radiator
- Engine driven centrifugal pump and water precirculating electric pumps (one for jacket circuit and one for aftercooler circuit)
- Thermostatic valves
- Engine temperature transducers (one for jacket, one for aftercooler)
- High water temperature alarm switch, two steps (high alarm and high high shutdown)
- Water immersion heater (1*9000W) with thermostat
- All pipe work, connections, valves and supports are included
- Coolant includes for a corrosion inhibitor with a 40% mix of antifreeze and water
- Low water level alarm/shut-down switch (one for jacket and one for AC)
- Low water temperature switch (jacket)

LUBRICATING SYSTEM
- Oil/water pack type heat exchanger
- Centrifugal pump (engine driven)
- Oil pressure transducer
- Oil temperature transducer
- Pressure switch (two step) for low oil pressure alarm and low low oil pressure shut-down
- Manual pump for lube oil drain
- Lube oil top up tank with automatic refilling to allow engine to operate for 48 hours unattended (lube oil tank capacity : 70 lt)
- Min oil level switch
- High oil temperature switch

STARTING SYSTEM
- 24 V electric motor starting
- Single set of starting batteries
- Battery type - Lead acid type, - 24 Volt, 600 A/h (suitable for 3 starting attempts each and 10 seconds rest between attempts)

COMPRESSED AIR STARTING SYSTEM
- electric motor driven compressor
- diesel engine driven compressor
- air starting motor
- air receiver
- safety pressure valves
- connection pipes and accessories

ENGINE INTAKE AIR SYSTEM
- Dry type air filters with replaceable elements
- Visual clogging indicator
- Turbochargers

EXHAUST GAS SYSTEM (NOT supplied by CTM)
- Exhaust gas silencer to reduce noise by absorption and through resonance. The exhaust gas enters an expansion chamber covered with a sound absorbent material. This is protected by perforated metal sheet, and then a sound-proofing absorbent body. The outer casing is made of carbon steel.
- Air cooled exhaust manifold
- Stainless steel flexible bellows
- Exhaust gas temperature transducers
- System designed to achieve the noise criteria of 75 dBA @ 1m in free field

ENGINE/ALTERNATOR COUPLING
- The engine/alternator coupling is a highly flexible plug-in type coupling which creates a torsionally soft connection between an internal combustion engine and the alternator.
  The highly flexible torque transmitting element is designed as a rubber disc which torsional strain twists, absorbing high torsional vibrations and any misalignments.
  The inner diameter of the rubber disc element is vulcanized directly to a taper hub or to a metal sleeve. On its outside diameter the rubber disc is engaged into an internally toothed aluminium ring making a backlash free plug-in connection.
  The flange dimensions of the coupling are according to SAE J 620 and DIN 6281 respectively. A bell housing is provided between engine and alternator.

GENERATOR MOUNTING

- The engine and alternator are mounted on a structural steel sub-base sized to support the engine, alternator and the auxiliary systems to form a rigid frame. The sub-base is designed to support the equipment and maintain the correct alignment. The sub-base includes lifting eyes and drip pan fitted under the engine side with drain cock (outside flow).
- The engine/alternator are mounted on anti-vibration mounts fixed to the steel sub-base.

GENERATOR CONTROL SYSTEM (CONTROL PANELS & SYNC. PANELS)

NEUTRAL CONTACTOR & EARTHING RESISTOR

UPS FOR CONTROL SYSTEM

Contents

	Genset	Marine	O & G	Rail	C & I
Application	X				
Engine model	20V4000G63L				
Rated power [kW]	2590				
Rated speed [rpm]	1500				
Application Group	3B, 3E, 3F, 3G				
Legislative body	Fuel-consumption optimized				
Test cycle	D2 + 110%				
Data Set No.	XZ54954100444				
Data Set Basis	Fuel-consumption optimized				
Fuel sulphur content [ppm]	5				

Content **Page**

PDF	Name	Project no. -	Size A4
Configurator	Theiss, Sandro (TVMG)	Order no. -	
Approver1	Kneifel, Alexander (TSLE)	EDS-ID 2181-09.01.2023	
Approver2	Koliwer, Michael (TV)		
Approver3			
Approver4			
User	FN2\graeter		

Engine model **20V4000G63L**

Title **Emission data sheet**

Description of Revision	Frequency

Data generated by EDS Creator version 1.0 and uniplot.
Ref.-dataset: 420_G_020_bearbeitet.nc.nc2 for 1282 in EDS platfrom.

Emissionstage **Fuel-consumption optimized**

Configuration-ID	Documentation
1282	Request Neil Spence

Emissionstage basis **Fuel-consumption optimized**

General Disclaimers (valid for Measured and NTE values)

Please note that these data are physical and/or technical values only referring to and representing a normative defined operating condition. Any change in operating time and conditions will have impact on physical values and engine behavior, which must be considered and assessed within the complete propulsion system especially in regard to emission compliance and product safety.

Measurements listed in this EDS are representative of the listed engine rating at the time of testing. These measurements and results can change according to instrumentation, boundary condition, and engine to engine variability. In addition - changes to the engine family hard or software may occur which could result in changes to some of the listed values.

Emissions data measurement procedures are conducted according to applicable rules and standards as per “Emission Stage/Optimization”. Potential deviations from these procedures are documented internally.

The listed emission values relate to the corresponding certification data. Seller doesn´t take any responsibility or liability neither out or in connection with the contract nor on any other basis
- beyond these specified operating conditions of the engine
- and for any installation/modification of the entire propulsion system by the customer itself or any third party
and the customer will indemnify MTU on first demand for any third party claim out or in connection with this.

Seller 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.

Seller reserves all rights in the information contained in this data sheet. It shall not be reproduced, made available to a third party or otherwise used in any way whatsoever.

When applicable, emission values are measured after combined exhaust streams.

Measured Emissions data is based on single operating points and thus cannot be used to compare to regulations which use values based on a weighted cycle.

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.

The SO2 emission rates comprehend exclusively the SO2 content as found in the fuel source, oil consumption effects are not included. Variation of sulfur content in the fuel changes only the stated SO2 emissions, cross sensitivity to other emissions (e.g. particulates) is not possible.

All values based on metric units, inaccuracies for non metric values can occur, values are not binding.

Specific to gas engines: The listed emission values are based on gas composition at the time of certification measurement. Gas composition is as displayed in the EDS-document. Carbon dioxide and methane concentrations have direct influence on the corresponding displayed carbon dioxide and methane emissions.

EAT Specific Disclaimers (valid for EDS values)

NH3 emissions levels measured with AVL SESAM i60/ 4 FT Multi Component Exhaust Measurement System (FTIR) including EPA 40 CFR 1065 legislation compliant automated checks for linearity.
Generators or engines with exhaust after-treatment systems require a stabilization period of approximately 1 hour to ensure stable temperatures across SCR prior to performing an emissions test. Performing emissions measurements before a stable temperature has been achieved can result in inconsistent emission values. NOx Values only applicable if temperatures across SCR reached for DEF Dosing.

NTE Disclaimers (valid for NTE calculated values)

Calculated not to exceed values (NTE) are not proven by tests and therefore the accuracy is not guaranteed.

All emission data shown in chapters Emission Data Sheet, Not to Exceed Values, and Type Approval were gathered from a corresponding certification engine under test conditions shown above and complying to corresponding TEN data.

PDF	Name	Project no.	Size
		-	A4
Configurator	Theiss, Sandro (TVMG)	Order no.	
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Approver1	Kneifel, Alexander (TSLE)	EDS-ID	
Approver2	Koliwer, Michael (TV)	2181-09.01.2023	
Approver3			
Approver4			
User	FN2\graeter		

Engine model
20V4000G63L

Title
Emission data sheet

Description of Revision	Frequency

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Ref.-dataset: 420_G_020_bearbeitet.nc.nc2 for 1282 in EDS platfrom.

Emissionstage
Fuel-consumption optimized

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Configuration-ID	Documentation	Emissionstage basis
1282	Request Neil Spence	**Fuel-consumption optimized**

Engine data

	Genset	Marine	O & G	Rail	C & I
Application	X				
Engine model	20V4000G63L				
Application Group	3B, 3E, 3F, 3G				
Legislative body	Fuel-consumption optimized				
Test cycle	D2 + 110%				
Fuel sulphur content [ppm]	5				
mg/mN^3 values base on residual oxygen value of [%]	5				

Engine raw emissions*

Cycle point	[-]	n1	n2	n3	n4	n5	n6
Power	kW	2848	2590	1942	1295	647	259
Power relative	[-]	1.1	1	0.75	0.5	0.25	0.1
Engine speed	1/min	1499	1500	1500	1500	1500	1500
Engine speed relative	[-]	1	1	1	1	1	1
Filter smoke number	Bosch	0.18	0.23	0.2	0.3	0.69	0.19
Exhaust temperature after ETC	grdC	515.1	503.6	483.3	438.5	344.9	222.5
Exhaust back pressure after ETC (static)	mbar	31	30	17	8	3	2
Exhaust mass flow wet	kg/h	13698	12175	9590	7515	5647	4778
NOX-Emissions specific	g/kWh	9.19	11.25	11.53	8.58	6.39	10.2
SO2-Emissions specific	g/kWh	0.002	0.002	0.002	0.002	0.002	0.003
CO-Emissions specific	g/kWh	0.69	0.56	0.33	0.41	1.21	3.87
HC1-Emissions specific	g/kWh	0.1	0.13	0.14	0.17	0.36	1.1
CO2-Emissions specific	g/kWh	610.4	599.9	603.6	628.6	702.9	901.7
PM-Emissions specific (Meas.)	g/kWh	0.024	0.038	0.029	0.054	0.204	0.5
NOX-Emissions (based on 5% O2)	mg/m3N	3484	4237	4323	3105	2028	2499

PDF	Name	Project no.	Size
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Configurator	Theiss, Sandro (TVMG)	Order no.	
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Engine model
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Emissionstage
Fuel-consumption optimized

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Configuration-ID	Documentation
1282	Request Neil Spence

Emissionstage basis
Fuel-consumption optimized

CO2-Emissions (based on 5% O2)	mg/m3N	223577	222807	222816	222342	220545	216101
CO-Emissions (based on 5% O2)	mg/m3N	251.7	207.3	120.3	146.1	379.3	926.6
HC1-Emissions (based on 5% O2)	mg/m3N	37.7	46.6	50.3	60.1	113.1	264.4
SO2-Emissions (based on 5% O2)	mg/m3N	0.7	0.7	0.7	0.7	0.7	0.7
PM-Emissions (based on 5% O2)	mg/m3N	8.8	13.9	10.6	19.3	64	119.8
Oxygen (O2)	%	8.2	8.1	8.7	10.1	13	16.2

PDF	Name	Project no. -	Size **A4**
Configurator	Theiss, Sandro (TVMG)	Order no. -	
Approver1	Kneifel, Alexander (TSLE)	EDS-ID	
Approver2	Koliwer, Michael (TV)	**2181-09.01.2023**	
Approver3			
Approver4			
User	FN2\graeter		

Engine model
20V4000G63L

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Emission data sheet

Description of Revision	Frequency

Data generated by EDS Creator version 1.0 and uniplot.
Ref.-dataset: 420_G_020_bearbeitet.nc.nc2 for 1282 in EDS platfrom.

Emissionstage
Fuel-consumption optimized

Sheet
4
of
5

Configuration-ID	Documentation
1282	Request Neil Spence

Emissionstage basis
Fuel-consumption optimized

Engine data

	Genset	Marine	O & G	Rail	C & I
Application	X				
Engine model	20V4000G63L				
Application Group	3B, 3E, 3F, 3G				
Legislative body	Fuel-consumption optimized				
Test cycle	D2 + 110%				
Fuel sulphur content [ppm]	5				
mg/mN^3 values base on residual oxygen value of [%]	5				

Not to exceed emission values*

Cycle point	[-]	n1	n2	n3	n4	n5	n6
Power	kW	2848	2590	1942	1295	647	259
Power relative	[-]	1.1	1	0.75	0.5	0.25	0.1
Engine speed	1/min	1499	1500	1500	1500	1500	1500
Engine speed relative	[-]	1	1	1	1	1	1
NOX+HC1 mass flow	kg/h		38.42	29.55	14.85	6.67	5.85
NOX-Emissions specific	g/kWh		14.62	14.98	11.15	9.58	19.39
CO-Emissions specific	g/kWh		0.95	0.55	0.79	2.42	7.74
HC1-Emissions specific	g/kWh		0.21	0.23	0.32	0.72	3.2
NOX+HC1-Emissions specific	g/kWh		14.84	15.21	11.47	10.3	22.59
PM-Emissions specific (Meas.)	g/kWh		0.056	0.046	0.082	0.306	1.849
NOX-Emissions (based on 5% O2)	mg/m3N		5508	5620	4036	3042	4747
NOX+HC1-Emissions (based on 5% O2)	mg/m3N		5587	5706	4150	3268	5514
CO-Emissions (based on 5% O2)	mg/m3N		352.4	204.5	277.7	758.6	1853
HC1-Emissions (based on 5% O2)	mg/m3N		79.3	85.4	114.1	226.3	766.7
PM-Emissions (based on 5% O2)	mg/m3N		20.9	17	28.9	96	443.1

PDF	Name	Project no.	Size
		-	A4
Configurator	Theiss, Sandro (TVMG)	Order no.	
		-	
Approver1	Kneifel, Alexander (TSLE)	EDS-ID	
Approver2	Koliwer, Michael (TV)	2181-09.01.2023	
Approver3			
Approver4			
User	FN2\graeter		

Engine model
20V4000G63L

Title
Emission data sheet

Description of Revision	Frequency

Data generated by EDS Creator version 1.0 and uniplot.
Ref.-dataset: 420_G_020_bearbeitet.nc.nc2 for 1282 in EDS platfrom.

Emissionstage
Fuel-consumption optimized

Sheet
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of
5

Configuration-ID	Documentation
1282	Request Neil Spence

Emissionstage basis
Fuel-consumption optimized

KOHLER®

KD4000-E

50 Hz. Diesel Generator Set
EMMISSIONS OPTIMIZED DATA SHEET

ENGINE INFORMATION

Model:	KD103V20	Bore:	175 mm (6.89 in.)
Type:	4-Cycle, 20-V Cylinder	Stroke:	215 mm (8.46 in.)
Aspiration:	Turbocharged, Charge Air Cooled	Displacement:	103 L (6311 cu. in.)
Compression ratio:	16:0:1		
Emission Control Device:	Direct Diesel Injection, Engine Control Module, Turbocharger, Charge Air Cooler		

EXHAUST EMISSION DATA:	**EPA D2 Cycle 5-mode weighted**
HC	0.4 g/kWh
NO_x (Oxides of Nitrogen as NO_2)	6 g/kWh
CO (Carbon Monoxide)	0.7 g/kWh
PM (Particulate Matter)	0.1 g/kWh

EMISSION DATA

Cycle point	**100% ESP**		**100% PRP**		**75% ESP**		**75% PRP**		**50% PRP**	
Power [kW]	3608		3280		2706		2460		1640	
Speed [rpm]	1500		1500		1500		1500		1500	
NO_X [g/kWh]	11.3		8.9		5.32		5.1		5.23	
CO [g/kWh]	0.11		0.14		0.34		0.38		1.0	
HC [g/kWh]	0.25		0.26		0.30		0.33		0.5	
PM [g/kWh]	0.004		0.004		0.017		0.02		0.07	
	@ 5% O_2	@ 15% O_2	@ 5% O_2	@ 15% O_2	@ 5% O_2	@ 15% O_2	@ 5% O_2	@ 15% O_2	@ 5% O_2	@ 15% O_2
HC [mg/Nm^3]	87	32	87	33	93	35	101	38	151	56
NOx [mg/Nm^3]	3916	1469	2991	1122	1641	615	1567	588	1575	590
CO [mg/Nm^3]	39	15	46	17	105	39	117	44	302	113
PM [mg/Nm^3]	1.4	0.5	1.3	0.5	5.2	2.0	5.8	2.2	21.2	7.9

TEST METHODS AND CONDITIONS

Test Methods:
Steady-State emissions recorded per ISO8178-1 during operation at rated engine speed (+/-2%) and stated constant load (+/2%) with engine temperatures, pressures and emission rated stabilized.

Fuel Specification:
EN590 Diesel Fuel

Reference Conditions:
25°C (77 °F) Air Inlet Temperature, 40°C (104 °F) Fuel Inlet Temperature, 100 kPa (29.53 in Hg) Barometric Pressure; 10.7 g/kg (75 grains H2O/lb) of dry air Humidity. Intake Restriction set to maximum allowable limit for clean filter; Exhaust Back pressure set to maximum allowable limit.

Data was taken from a single engine test according to the test methods, fuel specification and reference conditions stated above and is subjected to instrumentation and engine-to-engine variability. Test conducted with alternate test methods, instrumentation, fuel or reference conditions can yield different results.

Data and specifications subject to change without notice.

Industrial Diesel Generator Set – KD4000-E
50 Hz - Emission Optimized – EPA Tier 2 Compliant
DATASHEET

01/2022

GROSS RATINGS RANGE		
Standby	kVA	3820 - 4360
	kWe	3056 - 3488
Data Center / Mission Critical	kVA	3820 - 4360
	kWe	3056 - 3488
Prime	kVA	3600 - 3970
	kWe	2880 - 3176

Benefits & features

KOHLER premium quality

- KOHLER provides **one source responsibility** for the generating set and accessories
- The generator set, its components and a wide range of options have been **fully developed, prototype tested, factory built**, and production-tested
- The generator sets are designed in accordance to ISO8528-5 performance **class G3** and accepts rated load in one step

KOHLER premium performances

Engines

- Low fuel consumption thanks to a high technology common rail injection engine
- A smaller footprint thanks to a high-power density
- Low temperature starting capability
- Long maintenance interval

Alternator

- Provide industry leading motor starting capability
- Excitation system to permit sustained overcurrent > 300% In, during 10 sec
- Built with a class H insulation and IP23

Cooling

- A flexible solution using an electrical driven radiator fan
- High temperature and altitude product capacity available

Control Panel

- The KOHLER wide controller range provide the reliability and performances you expect from your equipment. You can program, manage and diagnose it easily and in an efficient way

KOHLER worldwide support

- A standard three-year or 1000-hour limited warranty for standby applications.
- A standard two-year or 8700-hour limited warranty for prime power applications.
- A worldwide product support

GENERAL SPECIFICATIONS	
Engine type	KOHLER KD103V20
Alternator choices	KH08890T KH09720T
Voltage (V)	11000
Standard Control Panel	M80-D, APM802
Consumption @4050kVA ESP (L/h)	769
Consumption @3680kVA PRP (L/h)	711
Engine optimization	Emission optimization
Type of Cooling	Electrical driven fan
Performance class	G3
One step load acceptance (out of ISO criteria)	100%

DIMENSIONS COMPACT VERSION WITH ALTERNATOR KH08890T AND WITHOUT COOLING	
Length (mm)	6686
Width (mm)	2248
Height (mm)	2829
Tank capacity (L)	0
Dry weight (kg)	26000

GENERATOR SET RATINGS

Alternator reference	Voltage	Gross rating (without cooling) or Net rating (with cooling)	Standby Rating Depending on alternator T° rise									Data Center Mission Critical Rating Depending on alternator T° rise									Prime Rating Depending on alternator T° rise				
			Class H					Class F				Class H					Class F				Class H			Class F	
			163°C/27°C			150°C/40°C		143°C/27°C		130°C/40°C		163°C/27°C			150°C/40°C		143°C/27°C		130°C/40°C		125°C/40°C			105°C/40°C	
			kWe	kVA	Amps	kWe	kVA	kWe	kVA	kWe	kVA	kWe	kVA	Amps	kWe	kVA	kWe	kVA	kWe	kVA	kWe	kVA	Amps	kWe	kVA
KH08890T	11000/ 6350V	Gross	3240	4050	213	3168	3960	3112	3890	3056	3820	3240	4050	213	3168	3960	3112	3890	3056	3820	2944	3680	193	2880	3600
		Net with electrical cooling	*3120*	*3900*	*205*	*3048*	*3810*	*2992*	*3740*	*2936*	*3670*	*3120*	*3900*	*205*	*3048*	*3810*	*2992*	*3740*	*2936*	*3670*	*2840*	*3550*	*186*	*2760*	*3450*
		Net with mechanical cooling	*3240*	*4050*	*213*	*3168*	*3960*	*3112*	*3890*	*3056*	*3820*	*3240*	*4050*	*213*	*3168*	*3960*	*3112*	*3890*	*3056*	*3820*	*2944*	*3680*	*193*	*2880*	*3600*
KH09720T	11000/ 6350V	Gross	3488	4360	229	3488	4360	3456	4320	3392	4240	3488	4360	229	3488	4360	3456	4320	3392	4240	3176	3970	208	3168	3960
		Net with electrical cooling	*3368*	*4210*	*221*	*3368*	*4210*	*3336*	*4170*	*3272*	*4090*	*3368*	*4210*	*221*	*3368*	*4210*	*3336*	*4170*	*3272*	*4090*	*3056*	*3820*	*200*	*3056*	*3820*
		Net with mechanical cooling	*3400*	*4250*	*223*	*3400*	*4250*	*3400*	*4250*	*3392*	*4240*	*3400*	*4250*	*223*	*3400*	*4250*	*3400*	*4250*	*3392*	*4240*	*3088*	*3860*	*203*	*3088*	*3860*

Reference Conditions: 25°C Air Inlet Temperature, 40°C Fuel Inlet Temperature, 100 kPa Barometric Pressure; 10.7 g/kg of dry air Humidity. Intake Restriction set to maximum allowable limit for clean filter; Exhaust Back pressure set to maximum allowable limit.
Data was taken from a single engine test according to the test methods, fuel specification and reference conditions stated above and is subjected to instrumentation and engine-to-engine variability. Test conducted with alternate test methods, instrumentation, fuel or reference conditions can yield different results. Data and specifications subject to change without notice.

KOHLER

Industrial Diesel Generator Set – KD4000-E

50 Hz - Emission Optimized – EPA Tier 2 Compliant

DATASHEET

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Engine

General

Engine brand	KOHLER KD Series
Engine reference*	KD103V20-5BES
Air inlet system	Turbo
Fuel	Diesel Fuel
Engine optimization	Emission optimization
Cylinders configuration	V
Number of cylinders	20
Displacement (L)	103.43
Bore (mm) * Stroke (mm)	175 * 215
Compression ratio	16 : 1
Speed (RPM)	1500
Maximum stand-by power at rated RPM (kW)	3608
Piston type & material	Steel
Charge Air coolant	Air/Water
Frequency regulation, steady state (%)	+/- 0.25%
Injection Type	Direct
Governor type	Electronic
Air cleaner type, models	Dry

Fuel system

Maximum fuel pump flow (L/h)	1200
Fuel Inlet Minimum recommended size (mm)	TBC
Fuel Outlet Minimum recommended size (mm)	TBC
Max head on fuel return line (m)	3.50
Maximum allowed inlet fuel temperature (°C)	70

Engine specific fuel consumption	PRP engine	ESP engine
Consumption @ 100% load (g/kWh)	195	194
Consumption @ 75% load (g/kWh)	210	205
Consumption @ 50% load (g/kWh)	218	215
Consumption @ 25% load (g/kWh)	246	242

** : Engine reference may be partially modified depending on genset application, options selected by the customer and lead time required.*

Lubrication System

Oil system capacity including filters (L)	700
Min. oil pressure (bar)	3.7
Max. oil pressure (bar)	11
Oil sump capacity (L)	575
Oil consumption @100% ESP (L/h)	1.69

Air Intake system

Max. intake restriction (mm H2O)	510
Intake air flow (L/s)	4781

Exhaust system

	PRP engine	ESP engine
Heat rejection to exhaust (kW)	2340	2530
Exhaust gas temperature (°C)	455	460
Exhaust gas flow (L/s)	11352	12311
Max. exhaust back pressure (mm H2O)	850	

Optional cooling system (HT/LT)
Mechanical driven fan or electrical driven fan availables

Type of coolant	GENCOOL
Fan power, mechanical driven fan cooling syst. (kWm)	88
Fan power, electrical driven fan cooling system (kWe)	120
Total coolant circuit capacity, engine+cooling, HT/BT (L)	Aprox. 1250
Radiated heat to ambiant (kW)	160
Heat rejection to coolant HT (kW)	1200
Flow on the HT circuit at 0.7Bars pressure drop off engine (L/min)	1950
Outlet coolant temperature (°C)	95
Coolant capacity HT, engine only (L)	295
Max coolant temperature, Shutdown (°C)	103
Restriction pressure drop off engine – HT circuit (mbar)	700
Minimal pressure before HT pump (mbar)	400
Max. pressure at inlet of HT water pump (mbar)	2500
Thermostat begin of opening HT (°C)	71
Thermostat end of opening HT (°C)	81
HT Standard pressure cap setting (kPa)	100
Heat rejection to coolant LT (kW)	1000
Flow on the LT circuit at 0.7Bars pressure drop off engine (L/min)	650
Temperature of inlet to LT engine water circuit (°C)	55
Coolant capacity LT, engine only (L)	105
Restriction pressure drop off engine – LT circuit (mbar)	700
Minimal pressure before LT pump (mbar)	400
Max. pressure at inlet of LT water pump (mbar)	2500
LT Standard pressure cap setting (kPa)	100

Reference Conditions: 25°C Air Inlet Temperature, 40°C Fuel Inlet Temperature, 100 kPa Barometric Pressure; 10.7 g/kg of dry air Humidity. Intake Restriction set to maximum allowable limit for clean filter; Exhaust Back pressure set to maximum allowable limit.
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Industrial Diesel Generator Set – KD4000-E

50 Hz - Emission Optimized – EPA Tier 2 Compliant

DATASHEET

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Alternator Specifications	
Alternator choices	KH08890T KH09720T
Number of pole	4
Number of bearing	Double Bearing
Technology	Brushless
Indication of protection	IP23
Insulation class	H
Number of wires	06
Winding pitch	5/6
Capacity for maintaining short circuit at 3 In for 10 s	Yes
AVR Regulation	Yes
Coupling	Semi-elastic
Application data	
Overspeed (rpm)	2250
Power factor (Cos Phi)	0.80
Voltage regulation at established rating (+/- %)	0.50
Wave form : NEMA=TIF	<50
Wave form : CEI=FHT	<2
Total Harmonic Distortion in no-load DHT (%)	<3.5
Total Harmonic Distortion, on linear load DHT (%)	<3.5
Recovery time (Delta U = 20% transcient) (ms)	500
Unbalanced load acceptance ratio (%)	8

Alternator Standard Features

- All models are brushless, rotating-field alternators
- NEMA MG1, IEEE, and ANSI standards compliance for temperature rise and motor starting
- The AVR voltage regulator provides superior short circuit capability
- Self-ventilated and dip proof construction
- Sustained short-circuit current of up to 300% of the rated current for up to 10 seconds
- Superior voltage waveform

Note: See Alternator Data Sheets for alternator application data and ratings, efficiency curves, voltage dip with motor starting curves, and short circuit decrement curves.

Reference Conditions: 25°C Air Inlet Temperature, 40°C Fuel Inlet Temperature, 100 kPa Barometric Pressure; 10.7 g/kg of dry air Humidity. Intake Restriction set to maximum allowable limit for clean filter; Exhaust Back pressure set to maximum allowable limit.
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KOHLER

Industrial Diesel Generator Set – KD4000-E

50 Hz - Emission Optimized – EPA Tier 2 Compliant

DATASHEET

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Compact version dimensions without cooling

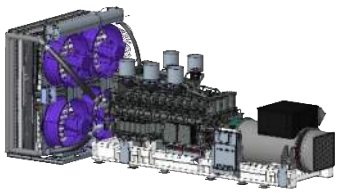
Alternator reference	Length (mm)	Width (mm)	Height (mm)	Dry Weight (kg)	Wet Weight (kg)	Tank capacity (L)
KH08890T	6686	2248	2829	26000	27000	0
KH09720T	6779			26100	27200	

Compact version dimensions with mechanical driven fan cooling

Alternator reference	Length (mm)	Width (mm)	Height (mm)	Dry Weight (kg)	Wet Weight (kg)	Tank capacity (L)
KH08890T	8329	3172	3578	30100	31800	0
KH09720T	8422			30200	32000	

Compact version dimensions with electrical driven fan cooling

Alternator reference	Length (mm)	Width (mm)	Height (mm)	Dry Weight (kg)	Wet Weight (kg)	Tank capacity (L)
KH08890T	8911	3538	3650	30300	32200	0
KH09720T	9004			30400	32400	



Walkin container version with mechanical or electrical driven fan cooling

Alternator reference	Length (mm)	Width (mm)	Height (mm)	Dry Weight (kg)	Wet Weight (kg)	Tank capacity (L)
KH08890T	17400	4000	Aprox. 8000	Aprox. 58000 w/o belly tank	Aprox. 60000 w/o belly tank	To be defined per project
KH09720T						

Reference Conditions: 25°C Air Inlet Temperature, 40°C Fuel Inlet Temperature, 100 kPa Barometric Pressure; 10.7 g/kg of dry air Humidity. Intake Restriction set to maximum allowable limit for clean filter; Exhaust Back pressure set to maximum allowable limit.
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KOHLER

Industrial Diesel Generator Set – KD4000-E
50 Hz - Emission Optimized – EPA Tier 2 Compliant
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M80-D

The M80-D can be used as a basic terminal block for connecting a control unit and as an instrument panel with a highly intuitive LCD screen giving an overview of your generating set's basic parameters:

- Oil gauge
- Coolant temperature
- Oil temperature
- Engine speed
- Battery voltage
- Charge air temperature
- Fuel consumption
- etc.

The engine main functions can be controlled and events are recorded to facilitate diagnostics:

- Starting
- Speed adjustment
- Stopping
- Droop
- etc.

APM802

ADVANCED POWER PLANT MANAGEMENT CONTROL
Dedicated to power plant management APM802 provides advanced control, system monitoring, and system diagnostics for optimum performance and compatibility

- Graphic display with touchscreen
- User language selectable
- Specially researched ergonomics
- High level of equipment availability
- USB and Ethernet ports
- Modbus protocol
- Making it easy to extend the installation
- Complies with the international standard IEC 61131-3

Reference Conditions: 25°C Air Inlet Temperature, 40°C Fuel Inlet Temperature, 100 kPa Barometric Pressure; 10.7 g/kg of dry air Humidity. Intake Restriction set to maximum allowable limit for clean filter; Exhaust Back pressure set to maximum allowable limit.
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KOHLER

Industrial Diesel Generator Set – KD4000-E
50 Hz - Emission Optimized – EPA Tier 2 Compliant
DATASHEET
01/2022

STANDARD SCOPE OF SUPPLY

All our KD Series gensets are fitted with:

- Industrial water cooled DIESEL engine
- Electric starter & charge alternator 24 V D.C
- Electronic governor
- Standard air filter
- alternator IP 23 insulation class H
- Welded steel base frame
- M80-D control panel
- Flexible fuel lines & lub oil drain pump
- Fuel water separator filter
- Exhaust outlet with flexible and flanges
- User's manual (1 copy)
- Packing under plastic film
- Delivered with oil

CODES AND STANDARDS

Engine-generators set is designed and manufactured in facilities certified to standards ISO9001:2015 & ISO14001:2015. The generator sets and its components are prototype-tested, factory built and production tested and are in compliance with the relevant standards:

- Machinery Directive 2006/42/EC of May 17th 2006
- EMC Directive2014/30/UE
- Safety objectives set out in the Low Voltage Directive 2014/35/UE
- EN ISO 8528-13, EN 60034-1, EN 61000-6-1, EN 61000-6-2, EN 61000-6-3, EN 55011, EN 1679-1 et EN 60204-1

TERMS OF USE

According to the standard, the nominal power assigned by the genset is given for 25°C Air Intlet Temperature, of a barometric pressure of 100 kPA (100 m A.S.L), and 30% relative humidity. For particular conditions in your installation, refer to the derating table.

WARRANTY INFORMATIONS

Standard Warranty Period:

- for Products in "back-up" service
    - 30 months from the date the Product leaves the plant, **extended to 42 months for KD series**
    - 24 months from the Product's commissioning date, **extended to 36 months for KD series**
    - 1,000 running hours

  The warranty expires when one of the above conditions is met.

- for Products in "continuous" service (continuous supply of electricity, either in the absence of any normal electricity grid or to complement the grid),
    - 18 months from the date the Product leaves the plant, **extended to 30 months for KD series**
    - 12 months from the Product's commissioning date, **extended to 24 months for KD series**
    - 2,500 running hours, **extended to 8700 running hours for KD series**

  The warranty expires when one of the above conditions is met.

For more details regarding conditions of application and scope of the warranty please refer to our General "terms & conditions of sales".

Reference Conditions: 25°C Air Inlet Temperature, 40°C Fuel Inlet Temperature, 100 kPa Barometric Pressure; 10.7 g/kg of dry air Humidity. Intake Restriction set to maximum allowable limit for clean filter; Exhaust Back pressure set to maximum allowable limit.
Data was taken from a single engine test according to the test methods, fuel specification and reference conditions stated above and is subjected to instrumentation and engine-to-engine variability. Test conducted with alternate test methods, instrumentation, fuel or reference conditions can yield different results. Data and specifications subject to change without notice.

APPENDIX C.

DRAINAGE PLAN

FOR DETAILS IN THIS AREA REFER TO
JOHN TOOKE & PARTNERS
DRAWING NUMBERS 3360/526 & 527

FOR DETAILS IN THIS AREA REFER TO
JOHN TOOKE & PARTNERS
DRAWING NUMBERS 3360/532 & 533

FOR DRAINAGE LAYOUT REFER TO
JOHN TOOKE & PARTNERS
DRAWING NUMBERS 3360/504

FOR DETAILS IN THIS AREA REFER TO
JOHN TOOKE & PARTNERS
DRAWING NUMBERS 3360/531

FOR DETAILS IN THIS AREA REFER TO
JOHN TOOKE & PARTNERS
DRAWING NUMBERS 3360/530

FOR DETAILS IN THIS AREA REFER TO
JOHN TOOKE & PARTNERS
DRAWING NUMBERS 3360/534 & 535

FOR DETAILS IN THIS AREA REFER TO
JOHN TOOKE & PARTNERS
DRAWING NUMBERS 3360/528 & 529

Galvin Road

IL 29.040
CL 30.660

SW 10
IL 29.600

SW 11

SW 12

SW 3
IL 29.200

SW MH
IL 29.680

IL 29.480
CL 30.300

SW 9
IL 29.900

SW 4
IL 29.440

SW 5
IL 29.600

SW 8
IL 29.600

SW 7
IL 29.440

SW 1

SW 2

SW 6

150Ø

375Ø

225Ø

600Ø

525Ø

150Ø 1 IN 55

150Ø 1 IN 51

PUMP DISCHARGE

Proposed 8m high green wall screen

AS BUILT DRAWING

KEY

- EXISTING SURFACE WATER NETWORK
- PROPOSED SURFACE WATER NETWORK
- EXISTING FOUL WATER NETWORK
- PROPOSED EXTERNAL FOUL WATER / PROCESS NETWORK
- PROPOSED INTERNAL FOUL WATER NETWORK
- PROPOSED INTERNAL PROCESS NETWORK
- FOUL DRAINAGE POINT
- PROCESS DRAINAGE POINT
- PROPOSED BT DUCTS
- EARTHING DUCTS

NOTES

1) THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS AND ENGINEERS DRAWINGS AND SPECIFICATIONS

REV	AMENDMENTS	DATE
E	AS BUILT ISSUE	29/09/08
D	DRAINAGE GULLEY ADDED	04/08/08
C	EARTH DUCT POSITIONS AMENDED (GRIDS A-10 & 11)	02/04/08
B	DRAWING LOCATIONS ADDED	26/03/08
A	CONSTRUCTION ISSUE	17/03/08

SEGRO

DATE FEBRUARY 2008

667 - 673 GALVIN ROAD
SLOUGH

SCALE 1:250 @ A0

DRAWN BY LLOYD

COORDINATED ON-SITE
SERVICES PLAN

DRG No
3360/525 E

MOSS
CONSTRUCTION

JOHN TOOKE & PARTNERS
CONSULTING ENGINEERS
1A, MONTFORD PLACE, LONDON SE11 5DE
TEL No 020-7582-0255 FAX No 020-7820-0297

APPENDIX D.

HYDRODYNAMIC VORTEX SEPARATOR

SDS
Water Infrastructure Systems

SDS Aqua-Swirl™

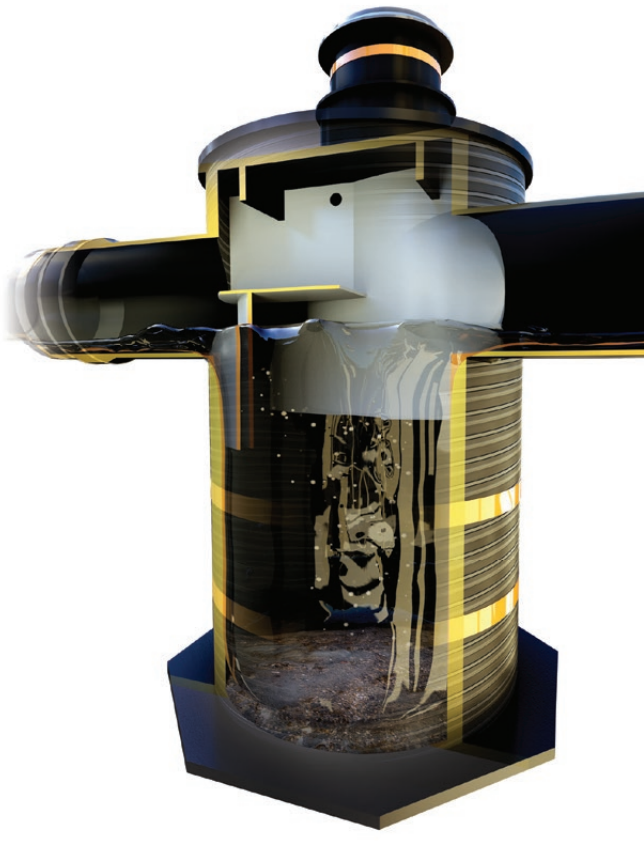
Hydrodynamic Vortex Separator

SDS Aqua-Swirl™ is a custom engineered, flow through water quality device that utilises hydrodynamic separation technology to maximise the removal of sediment, debris and free floating oil within surface water runoff.

SYMBiotIC™

When connected to a SDS SYMBiotIC™ system, SDS Aqua-Swirl™ provides real time data on a broad range of key operating factors such as pollutant loads and silt capture level.

- *BBA HAPAS approved*
- *HDPE plastic construction*
- *No moving parts*
- *Sealed baffle*
- *Large debris storage chamber*
- *Lifting supports*
- *Compact dimensions*
- *Available in 9 different sizes*
- *Bespoke sizing available*



SDS Aqua-Swirl™ is sized according to water quality treatment flow rates which are based on the initial movement of pollutants into the storm drainage system. This flow rate typically represents approximately 90% to 95% of the total pollutants in the runoff volume.

The treatment flow rate of the SDS Aqua-Swirl™ system is engineered to meet or exceed the local water quality treatment criteria and form an intrinsic part of the SuDS solution train.

SDS Ltd, Clearwater House, Castlemills, Biddisham, Somerset, BS26 2RE
T: +44 (0)1934 751303
E: info@sdslimited.com

Features	Benefits
Available with performance monitoring via SDS SYMBiotIC™.	Provides bespoke suite of operating data, such as silt levels and pollutants, viewable via a secure web portal dashboard with live notifications via email and text.
BBA HAPAS certified.	Approved for installation under roads and pavements; adoptable by the Highways Agency.
Manufactured from HDPE high strength plastic Weholite.	Offers a durable, light weight and low cost alternative to concrete. Easy and quick to install resulting in substantial cost savings.
Specialised sealed baffle.	Delivers the most effective performance of any vortex separator.
Internal bypass with pollution retention.	Able to treat localised rain and larger storm events while retaining captured pollutants.
NJDEP verified performance.	Verification accepted by UK Government environmental regulators (as cited in the CIRIA C753 SuDS Manual).
Single swirl chamber.	Simplifies inspection and maintenance facilities with no special equipment required.
Compact dimensions.	Reduces ground excavation and product installation costs.
Small footprint design.	Can be retro-fitted with minimal disruption to existing infrastructure utilities or surface features, extending the ability to meet new regulations.
Certified installation lifting supports.	Easy installation without the need for large, expensive cranes.
Suitable for use during site construction programme.	Can be put into operation prior to completion of the site build, with the inclusion of a planned maintenance schedule.
Available in 9 different standard sizes and also bespoke.	Provides greater design flexibility and assists the removal of sediments at a greater rate than comparable systems.

SPECIFICATIONS

SDS Aqua-Swirl™ Model No.	Maximum ID pipe connection (mm) BYP[1]	Chamber Internal Diameter (mm)	Water Quality Treatment Flow Rate NJDEP (l/s) Fine	Water Quality Treatment Flow Rate (l/s) OK110 Coarse	Oil/debris storage capacity litres	Sediment storage capacity m^3	Aqua-Swirl™ Weight kg
AS-2	375	750	16	30	136	0.3	300
AS-3	500	1050	31	53	416	0.6	700
AS-4	600	1200	40	77	644	0.8	1000
AS-5	750	1500	63	120	1382	1.3	1100
AS-6	900	1800	91	173	1439	1.8	1400
AS-7	1050	2100	123	235	1987	2.5	1700
AS-8	1200	2400	161	307	2612	3.3	2200
AS-9	1350	2800	220	418	3596	4.4	2600
AS-10	1500	3000	252	480	4164	5.1	3100

[1]BYP (Internal Bypass) provides full treatment of the first flush of water while the peak design storm is diverted and channelled through the main conveyance pipe.

Notes:
Details of pollution mitigation indices, head loss and CAD details, standard drawings and Installation Guides available upon request.
The sediment storage capacity has been calculated in accordance with the relevant test protocol and is not a physical maximum; any additional sediment capacity required is achieved with bespoke deeper units.
For assistance in design and specific sizing using historical rainfall data, please contact SDS.

A-S DS/0819

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APPENDIX E.

ISO 14001 CERTIFICATE

Certificate of Registration

This is to certify that the Management System of:

Kao Data

672 Galvin Road, Slough, SL1 4AN

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

ISO 14001: 2015

Certificate Number:	**16950-EMS-002**
Initial Registration Date:	19/04/2023
Expiry Date:	22/01/2025

The validity of this certificate depends on the validity of the main certificate and is one of several issued to registration number 16950-EMS-001

Scope of Registration:

The hosting of client hardware and data in purpose-built data centres.

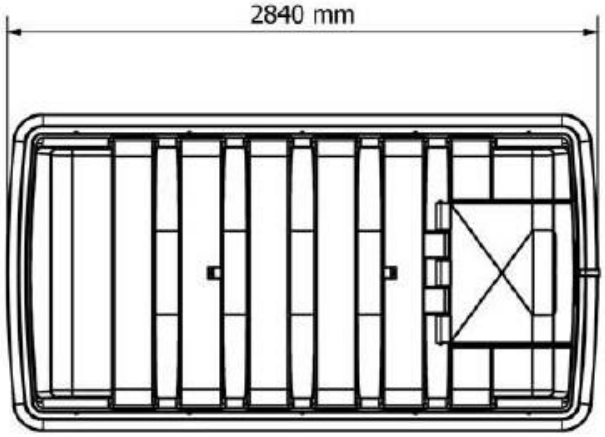
Signed:
Alyn Franklin, Chief Executive Officer
(on behalf of Alcumus ISOQAR)

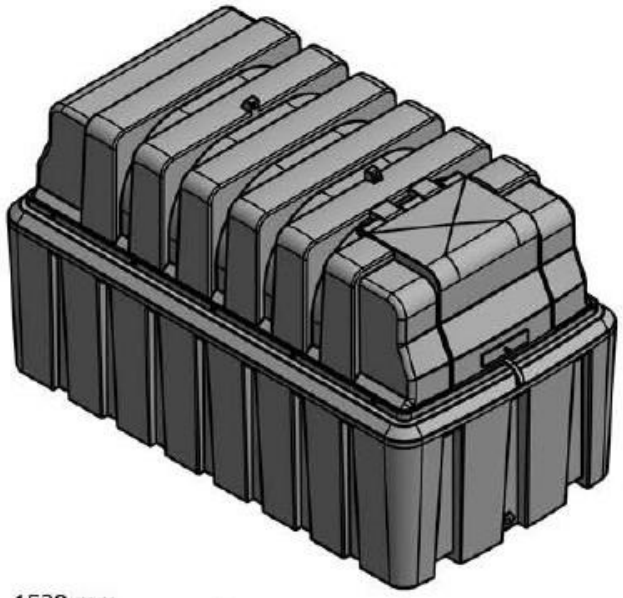
This certificate will remain current subject to the company maintaining its system to the required standard. This will be monitored regularly by Alcumus ISOQAR. Further clarification regarding the scope of this certificate and the applicability of the relevant standards' requirement may be obtained by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

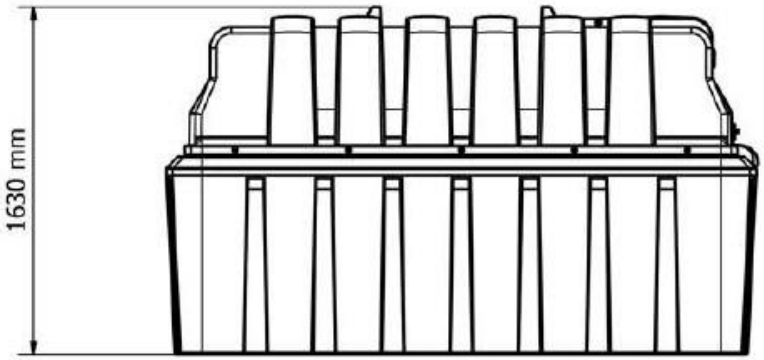
Alcumus ISOQAR Limited, Cobra Court, 1 Blackmore Road, Stretford, Manchester M32 0QY.
T: 0161 865 3699 E: isoqarenquiries@alcumus.com W: alcumus.com/isoqar

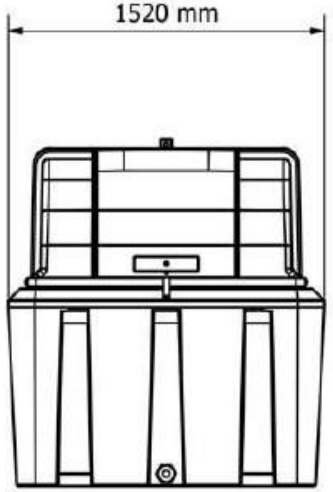
APPENDIX F.

UREA TANK DRAWINGS









DESIGNED BY	CHECKED BY	APPROVED BY	DATE		DATE	WEIGHT
Rob Smith	J Shenton	30/07/2018			15/07/2018	270 KGS

AGRIEMACH LTD

KLON06-KOH-00-L1-DR-M-0001

ISSUE	SHEET
	1 / 1

TECHNICAL SPECIFICATION

MODEL:	Tuffa 2500HB/AdBlue®
CAPACITY (L):	2500
LENGTH (mm):	2840
WIDTH (mm):	1520
HEIGHT (mm):	1630
WEIGHT (kg):	260
MATERIAL:	Lower Linear Density Polyethylene

SPECIFICATION

- Bunded construction
- 2" dry break coupling
- Screened vent
- Lockable hinged flip lid
- 1" Stainless steel top suction outlet with foot valve and ball valve
- Clock gauge

GUARANTEE 10 YEAR GUARANTEE

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