Technical Proposal

SERVERFARM LON1

3No x GENERATING SETS 3,500 kVA DCP 400V 50Hz
Sound level 65dBA @ 3m

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Quote No. S228455
11/08/2023
REV3A

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100 years in Power, and a Global Leader in Power Solutions Technology

KOHLER are a Global leader in the design, manufacture, and delivery of the most comprehensive range of Diesel and Gas Power Solutions packages throughout the world. Today, KOHLER is the market leader, and industry benchmark, for the manufacture and delivery of the highest quality, and internationally recognized delivery, of not only standard emergency power products, but also, the supply and project delivery of the most comprehensive, and complex, mission critical emergency power backup systems to the worlds Data Centre industry.

Global coverage

- KOHLER has manufacturing plants in France, USA, China, India, South America, and other regions around the world.
- KOHLER operates a global sales and service network (over 250 subsidiaries and distributors).

Comprehensive energy solutions on the market

RENTAL POWER

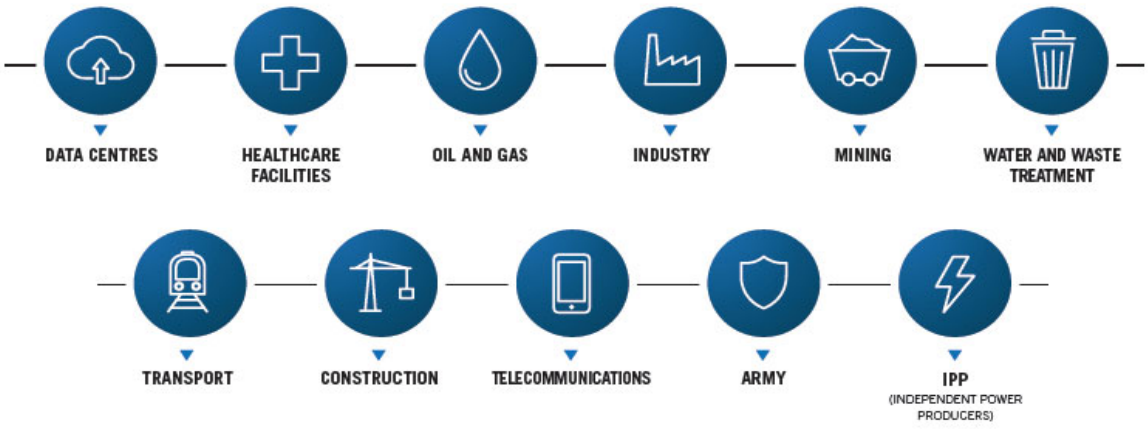
INDUSTRIAL POWER PRODUCTS

PROJECTS

Engineering based Design Bespoke solutions

SERVICES

After-sales, spare parts, training



Power Solutions Applications

Proactive engineering for specific applications

The combination of KOHLER's industrial power, and technical know-how is the key to the company's never-ending capacity for innovation.

Telecommunications, Data Centres, military installations, standby generating sets for hospitals, power plants...

From the simplest to the most challenging projects, KOHLER's engineering and applications department applies all its energy to addressing the comprehensive and demanding needs of the specific industry sector.

Whether the application is for a Water Treatment plant in Africa, a Nuclear Power plant on Europe, or a major Data Centre project in the USA, Europe, or the Far East, no matter where critical power is needed, our international experience in delivering power solutions projects worldwide is second to none.

The Power Solutions division of KOHLER has a work force of over 100 engineers, technicians and project managers who control every aspect of the project, from initial design, right through to client handover.

A professional and experienced to providing, a "bespoke" solution

1. Initial project phase

Understanding the project requirements, budget, and program needs: feasibility study, environmental impact assessment, and health & safety review, full engagement with all interested parties, Client, Consultant, Contractor, Validation body, Certification body, etc

2. Contract / Order

Approval of the specifications, selection of associates, definition of lead times, organization of the KOHLER team

3. Design

Providing substantial and innovative solutions: drawings, diagrams, calculations, technical documentation, 3D Modelling, etc

4.Development & Manufacture

Manufacture of the power solutions package, including all components needed, Containers, Fuel Tanks, Fire Suppression, etc, etc

5. Installation & Commissioning

Installation and Level 1 to 5 testing, full on-site IST, and client handover

6. Maintenance Program

Commitment to post-project technical follow-up and 24/7 back up support & maintenance

Power Solutions, two direct contacts

For the delivery of this project, we will appoint a **Factory Project Manager,** and a **Site Project Manager**.
These engineers will be the customers contacts within KOHLER, from the start of the contract, right through to final handover

Duties of the Factory Project Manager

As soon as the project is allocated,

Manages the order file and the various contractual items
Prepares the health & safety file.
Prepares the Quality file.
Reviews the contract and makes sure that the contractual clauses have been adhered to and that the customers' needs have been fully understood
Sets up a schedule for the delivery of the project, taking into account the customer needs, specification requirements, build program, FAT dates, and overall project program.
Appoints and manages the various internal and external participants in the execution of this project
Manages customer relations, and all interfacing with the factory
Is responsible for the factory support right **up to the final hand over of the equipment**

Duties of the Site Project Manager

As soon as the project is allocated,

Reviews the **installation** contract, making sure that the contractual clauses have been adhered to and that the customer needs have been fully understood.
Prepares a site health & safety file.
Establishes a schedule for the installation, taking into account the site conditions and restraints, delivery and commissioning program, overall project program.
Manages site operations, including, site coordination meetings, other trade interfaces, IST programming, all site documentation including RAMS, scripts, H&S file, Quality file, etc
Coordination with all site certification and acceptance bodies
Manages quality, environmental and safety issues, in compliance with management instructions and current applicable regulations
Management of all site compliance and documentation

I. Generator KD3500-E

1. GENERAL DATA

3No generating sets KD3500-E	
Genset power rating (DCP):	3500 kVA/2800 kWe *
Engine KOHLER:	KD83V16-5CES
Alternator LEROY SOMER:	LSA 54 M90

Site climatic conditions:	
Outside minimum temperature:	0ºC
Outside maximum temperature:	40ºC
Altitude:	>100 m

** The generating set(s) is (are) available according to DATA CENTER ISO 8528-1 power definition (DCP): available in continuous operation for an unlimited number of hours per year. Overload is not allowed.*

Net apparent power on site conditions:	3500 kVA
Service DUTY according ISO 8528-1:	DCP
Rated power factor:	0.8
Rated frequency:	50 Hz
Rated voltage:	400 V
Rated current:	5052 Amps
Enclosure:	Close fit acoustic enclosure
Sound level:	65 dBA at 3m
Cooling:	Remote, electric
Weight (wet):	TBC
Container dimensions:	L:16,600mm x W:2,800mm x H4,050mm
Discharge rising duct:	+H11,600mm
Belly tank:	17,817L per pack
Urea tank:	2,500L per pack

2. ENGINE

Specifications as per NF ISO 3046-1 standard

Compliant with US Standards EPA Tier 2.

General Data

Brand	KOHLER
Model	KD83V16-5CES
Number of cylinders	16
Cylinder arrangement	V
Cylinder capacity	82.74 L
Stroke	215 mm
Bore	175 mm
Rated RPM	1500 tr/min
Piston speed	10.75 m/s
BMEP	26.4 bar
Compression ratio	16 ; 1
Mechanical Standby power	3007 kWm
Charge Air coolant	AIR/WATER
Engine regulator	ELEC
Regulation	+/- 0.25 %
Injection Type	DI
ECU type	KODEC

Fuel system

Maximum fuel pump flow	1070 L/h
Max. restriction at fuel pump	3.5 m
Max head on fuel return line	3.5 m
Maximum allowed inlet fuel temperature	70 °C

Consumption with cooling system

Consumption 100% ESP	200 g/kWh 707.5 L/h
Consumption 75% ESP	211 g/kWh 559.8 L/h
Consumption 50% ESP	223 g/kWh 394.4 L/h

Lubrication system

Oil capacity	560 L
Oil sump capacity	460 L
Min. oil pressure	3.7 bar
Max. oil pressure	N bar
Oil capacity between dipstick marks	83 L
Oil cooler	EXPLAQ
Oil consumption 100% ESP	1.42 L/h

Air intake system

Max. intake restriction	510 mm H2O
Intake air flow	3720.58 L/s

Exhaust system

Heat rejection to exhaust	2090 kW
Exhaust gas temperature (ESP)	510 °C
Exhaust gas flow (ESP)	10266 L/S
Max. exhaust back pressure	867 mm H2O

Cooling system

Ambient temperature design	40°C
Radiated heat to ambient	140 kW
CAC Heat Rejection	N kW
Heat rejection to coolant HT	1100 kW
Heat rejection to coolant LT	820 kW
Coolant capacity HT, engine only	270 L
Coolant capacity LT, engine only	105 L
Flow on the HT circuit	1980 L/min
Flow on the LT circuit	620 L/min
Maximum Coolant temp without derating	100 °C
Outlet coolant temperature	85 °C
Type of coolant	GENCOOL
Compressor Discharge Temp at 25°C	N °C
Thermostat begin of opening HT	71 °C
Thermostat begin of opening LT	45 °C
Thermostat end of opening HT	81 °C
Thermostat end of opening LT	57 °C

3. ALTERNATOR

Specifications as per IEC 60034 standard

Main data:						M
Power:	**3,550**	kVA	**2,840**	kWe	**2,943**	kWm
Voltage:	**400**	V	Frequency:		**50**	Hz
Rated voltage range:	+5% / -5%		Speed:		1500	rpm
Power factor - Lagging:	0.8					
Nominal current:	5,124	A	Phases		3	
Insulation / Temperature rise:	H / H		Connexion		Star serial	
Cooling:	**IC01**		Winding type:		p2/3	
			Winding:		- 6 Wires	
Ambient temperature:	40	°C				
Altitude:	1000	m	Overspeed (rpm)		1800	
Duty: Base Rating			Total Harmonic Distortion (THD) < 3.5%			

Efficiency (Base 2840 kWe)					IEC
	25%	50%	75%	**100%**	110%
Power factor - Lagging: 0.8	94.07	96.14	96.52	**96.48**	96.42
Power factor - Lagging: 1	94.47	96.72	97.28	**97.41**	97.41

Reactances (%) - (Base 3550 kVA)

Unitary impedance (1 per unit) = 0.04507 ohms

		Direct axis *Unsaturated*	Direct axis *Saturated*		Quadrature axis *Unsaturated*	Quadrature axis *Saturated*
Synchronous reactance	Xd	270	238	Xq	138	121
Transient reactance	X'd	25.6	21.8	X'q	138	121
Subtransient reactance	X"d	12.3	10.5	X"q	11.8	10.0
Negative sequence reactance	X2	12.1	10.2			

X0	2.4	Zero sequence reactance
Xl	6.2	Stator leakage reactance
Xr	21.0	Rotor leakage reactance
Kc	**0.42**	Short-circuit ratio

Time constants (s)

	Direct axis		Quadrature axis	
Open circuit transient time constant	T'do	3.40	T'qo	NA
Short-circuit transient time constant	T'd	0.322	T'q	NA
Open circuit subtransient time constant	T"do	0.050	T"qo	0.252
Subtransient time constant	T"d	0.024	T"q	0.022

Ta	0.033	Armature time constant

Resistances (%)

Ra	1.2	Armature resistance	R0	0.8	Zero sequence resistance
X/R	9.0	X/R ratio (without unit)	R2	2.4	Negative sequence resistance

Voltage accuracy: 0.25%
Maximum inrush current for a voltage dip of 15%: 2719 kVA
when starting an AC motor having a starting power factor between 0 and 0.4

Additional accessories:

- PT100 stator
- PT100 rear bearing
- Alternator heater
- PMG excitation

4. STARTING CIRCUIT

- Motor coupling bell housing with 2 cavities for the 2 starters
- Electric starter
- Battery charging alternator
- 24 Volt emergency electric starter
- 24 Volt lead starter batteries
- 2nd 24 Volt lead starter battery
- Battery isolator switch for battery circuit 1
- Battery isolator switch for battery circuit 2

5. INCLUDED ADDITIONAL ENGINE OPTIONS

- Intake air filter: this system should be necessary to supply clean air to the engine.
- Engine coolant pre-heated by a self-regulated resistor incorporated to the engine block
- Primary fuel filter installed upstream of the standard filtration for the separation of water in the engine fuel supply
- Fuel return cooler equipped with a fan driven by an electric motor. The fuel return cooler is installed and connected between the engine fuel system outlet and the daily service tank via diesel return pipes. This system cools the fuel if necessary.
- Electric pre-lubrification pump
- Manual pump mounted on the engine allowing for easy drainage of the oil sump
- Electronic engine speed regulator including a logic controller, injection pump with actuator and speed measurement sensor mounted to the engine bell
- Emergency engine oil temperature sensor for the transmission of temperature information to the control unit for immediate stop

II. Generator control cabinet

1. DESCRIPTION OF THE APM802

The APM802 enables user-friendly, ergonomic and autonomous operation of generating sets and power plants.

- 12-inch color touch screen
- Navigation system
- 100% usable without the need for an external computer
- Languages: French, English, Spanish, Portuguese, German, Dutch, Russian
- The APM802 manages:
  - Control of the genset and/or the power plant in both manual and automatic mode, as well as tests off load or on load.
  - Mechanical and electrical measurement displays
  - Status and time-stamped event displays (up to 1000 events)
  - Adjustment of parameters accessible to the customer (timers, etc.)
- The APM802 comes with built-in:
  - Software, accessible from an external computer, a tablet or smartphone, used for modifying some parameters and displaying the APM802 data.
  - Configuration of site specific functions
- The APM802 is designed for operation under the following conditions:
  - Operating temperature - 20°C to + 60°C
  - Humidity: 93% at 40°C
- The APM802 is protected:
  - Protection index on front: IP65
  - Electronics protected against dust and humidity with tropicalized varnish

Embedded cabinet APM802 on genset.

1.1. Ergonomics, user-friendliness and convenience of the APM802

The ergonomics have been completely redesigned for improved user-friendliness and convenience.
The user is guided through how to operate the product according to their access level, making it easy to get started and reducing the risk of errors.

1.1.1. 3 profiles defines: User, Operator or Specialist



PROFILE	USER	OPERATOR*	SPECIALIST*
ACCESS	System monitoring	Trained in power plant operation	Trained by KOHLER and approved partner
		End customer or maintenance company	
		Maintenance of wearing parts	Start-up, assistance, programming

**Profiles can be accessed using a password*

1.1.2. Mobile supervision (Please refer to optional communication)

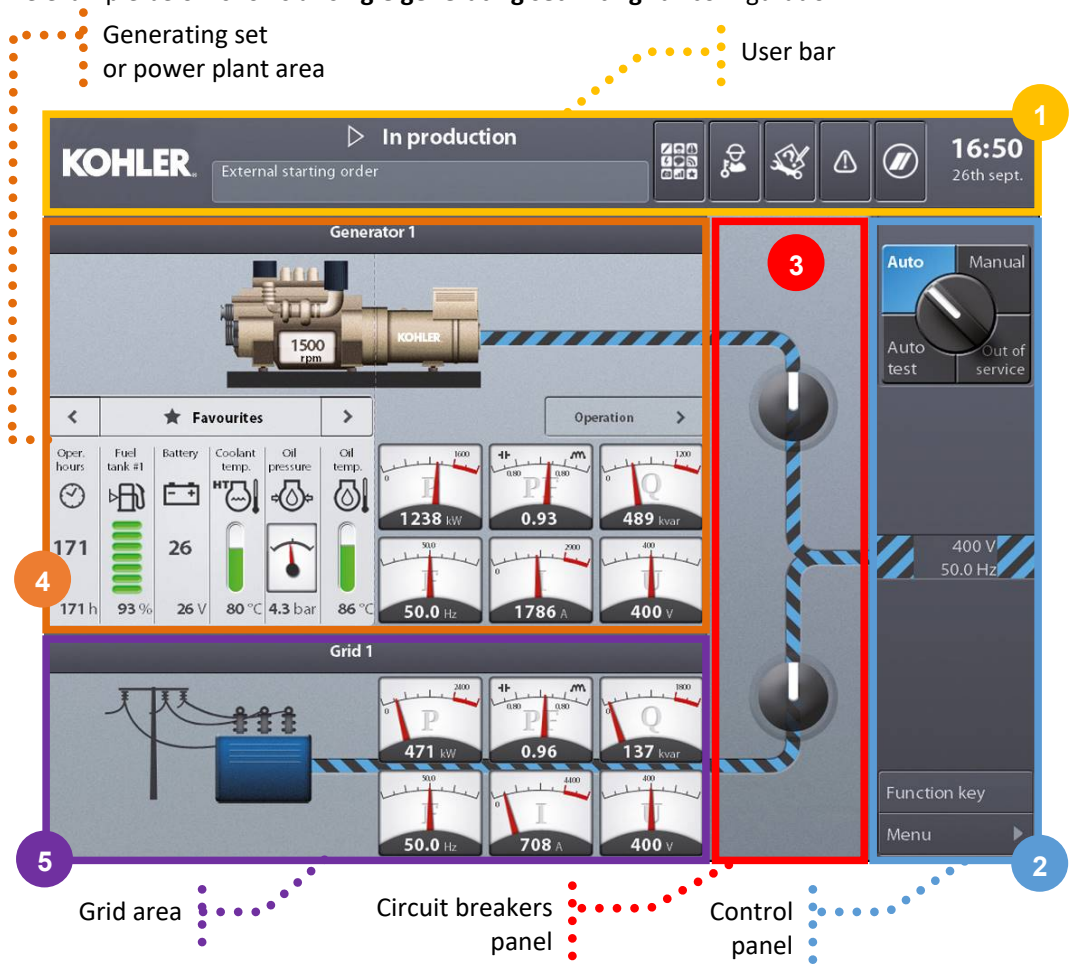
Remote access is easy in terms of the display and getting started with the installation (service, user).

1.2. Operating the APM802

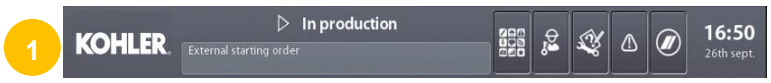
Representation area Whatever the HMI **configuration**, the "**operation**" screen is always divided into 5 very distinct parts.
The example below shows a "**single generating set with grid**" configuration.

1.3. Operating the APM802

Representation area Whatever the HMI **configuration**, the "**operation**" screen is always divided into 5 very distinct parts.
The example below shows a "**single generating set with grid**" configuration.



1.3.1. User bar



The user bar is divided into 3 parts or screen areas:

- Generating set, power plant and grid status messages
  - Generating set status
  - Time delay countdowns
  - Event displays, e.g.: External starting order, etc.

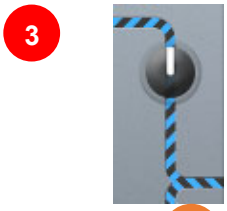
- Area with 5 keys:
  - Direct access to "User applications"
  - Identification for a password protected "Operator" access level
  - Access to maintenance functions
  - Access to all events, alarms and faults time-stamped for consultation, analysis and processing:
    - Oil pressure
    - Engine coolant temperature
    - Overspeed
    - Fail to start
    - Alternator protection triggered
    - Emergency stop triggered
  - Back to "Operation" screen
- Date and time display

1.3.2. Control panel

The control panel is divided into 5 parts or screen areas:

- Control and operation mode area: Auto, Manual, Auto test & Out of service
- Voltage and frequency indication during use
- Function key:
  - Access specific commands, if programmed
- Menu key:
  - Access the settings required for any aspect of generating set or power plant operation.
  - Complete display of all mechanical and electrical measurements (generating sets, power plant and grids)
  - Display of the history of all the electrical and mechanical values
    - Energy meters:
      - One active energy meter
      - One reactive energy meter
    - Counters:
      - A generating set operating hours meter
      - A generating set starting sequence meter
  - Run diagnostics on the status of any logic input and input, analog input or system input.
  - Complete system configuration (application, regulation, protection)
  - Description of complete system architecture

1.3.3. Circuit breakers panel



- Representation area of part of the electrical installation located downstream of the generating set, power plant and grid transformer.

1.3.4. Generating set or power plant area

- Generating set number or power plant name indicated in the title bar
- Generating set Start/Stop button present in Manual mode
- Alternator connection display – live and on load protection.

- Mechanical values display
- Electrical values display

1.3.4.1. Genset mechanical values

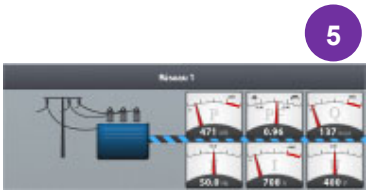
- Engine mechanical values

- Engine speed
- Oil pressure
- Coolant temperature
- Starting battery voltage
- Etc.

1.3.4.2. Generating set or power plant electrical values

- Electrical measurements of:
  - 3 line-to-neutral voltages
  - 3 line-to-line voltages
  - 3 phase currents
  - Alternator frequency
  - Active power per phase and overall active power
  - Reactive power per phase and overall reactive power
  - Power factor (Cos phi) per phase and average power factor
  - Voltage, frequency and phase differences for synchronization

1.3.5. Grid area



- Grid number indicated in title bar
- Grid connection display – live and on load protection.
- Electrical values display

1.3.5.1. Grid electrical values

- Electrical measurements of:
  - 3 line-to-neutral voltages
  - 3 line-to-line voltages
  - 3 phase currents
  - Alternator frequency
  - Active power per phase and overall active power
  - Reactive power per phase and overall reactive power
  - Power factor (Cos phi) per phase and average power factor

1.4. Front of embedded cabinet

1.4.1. Equipment

- HMI (Human Machine Interface)
  - Selecting the various modes:
    - Manual
    - Auto
    - Auto test
      - Test off load
      - Test on load
      - End test
    - Out of service
  - Controlling the power supply devices (if motorized):

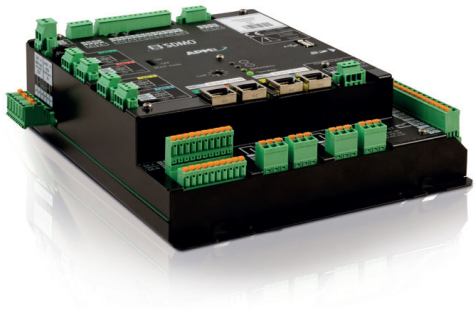
        - Closing the generating set power supply device
        - Opening the generating set power supply device
        - Closing the grid power supply device
        - Opening the grid power supply device
    - Stopping sound alarm
    - Acknowledging faults
    - Programming via touch screen, for:
        - Adjusting the parameters
        - Programming additional functions
        - Settings accessible via touch screen
- A "genset emergency stop" push-button with a protective cover that locks when pressed.

Measures additional equipment:

- Additional 1 battery ammeter(s) installed on the front of the cabinet
- supply and installation of an oil temperature indicator (diameter 52) on the front of the control panel
- fuel level indicator for APM

1.4.2. Inside

1.4.2.1. A base module which manages the entire generating set



BASE Module

- **Main functions of base module:**
    - Executes the automatic function via integrated and application software
    - Manages the system communications
    - Manages the external communications (Modbus, Web)
    - Manages and saves the operating configuration
    - Saves up to 1000 time-stamped events (statuses, alarms, faults)
    - Provides and checks stabilised power supply to the HMI
- **Base module: Inputs and outputs**
    - 1 pick-up analog input (speed detection)
    - 2 battery current analog inputs
    - One 24 VDC power supply input
    - 4 resistive inputs
    - 3 analog inputs, 1 of which isolated
    - 18 digital inputs
    - One 24 VDC HMI power supply output
    - 2 analog outputs, 1 of which isolated
    - 18 relay outputs
- **Base module: Communication ports**
    - 4 CAN buses, of which 1 bus isolated
    - 2 system Ethernet ports (intercommunication connection)
    - 1 Ethernet port for user (e.g.: Connection for supervision)
    - 1 HMI Ethernet port

- 1 isolated RS 485 serial link (e.g.: Connection for supervision)

1.4.2.2. A « Regulation card » Module

Regulation Module

- **Main functions of regulation module:**
  - Manages electrical measurements
  - Manages speed and voltage regulation
  - Manages synchronization, parallel operation and distribution
  - Manages power setpoints
  - Manages generating set, power plant and grid protection
  - Connection with the base module via CAN bus port
- **Synchronization and parallel operation:**
  - Frequency regulation (with centering in isolated operation)
  - Voltage regulation (with centering in isolated operation)
  - Power factor regulation
  - Active power regulation
  - Reactive power regulation
  - Analog distribution of P and Q
  - Digital distribution of P and Q
  - Droop (Hz/V)
- **Grid detection:**
  - Three-phase power cut detection
  - Rotating magnetic field checking
- **Protection:**
  - (ANSI 49) thermal image
  - (ANSI 50) alternator overload
  - (ANSI 32PQ) Maximum reactive power
  - (ANSI 32PH) Maximum active power
  - (ANSI 32PL) Minimum active power
  - (ANSI 32RP) Active power reverse
  - (ANSI 32RQ) Reactive power reverse or excitation loss
  - (ANSI 78) Vector jump
  - (ANSI 81R) DF / DT
  - (ANSI 27) Minimum voltage
  - (ANSI 59) Maximum voltage
  - (ANSI 81L) Minimum frequency
  - (ANSI 81H) Maximum frequency
  - (ANSI 68L/H) Power supply voltage min/max checking

1.4.2.3. The module(s) with 8 logic inputs and 4 logic outputs required for the application

1.4.3. Additional equipment

Mains pack:

- A 3-phase control relay for **mains failure detection** (undervoltage and overvoltage, phase sequence, phase fault detection, asymmetry), adjustable trip thresholds +2 to + 20% in the range of 220 to 440 V AC, adjustable time delay 0.1 ... 10 s, +/- 10%

- Regulated charger of battery 24 V allowing to maintain the battery in good load conditions
- Driving preheating by resistance on the cooling circuit

Starter / Charger / battery:

- management for 2 emergency starters with automatic changeover
- 24 V 20 A second charger

Electrical protections:

- alternator temp safety device PT 100 (nb 3, 1 per phase) including:
  - 1 3 PT100 temperature input boards
- alternator bearing temp safety device PT100 including:
  - 1 3 PT100 temperature input boards
- temperature cad 3 inlets

Mechanical protections:

- Fuel filter clogging alarm
- alarm for water presence in the fuel filter
- oil low level alarm
- alarm for fuel presence in retention bund of the tank frame
- loss of preheating alarm
- main tank low level alarm with 1 digital fault input(s) on APM802
- main tank very low level alarm with 1 digital fault input(s) on APM802
- tank leak alarm with 1 digital fault input(s) on APM802

Auxiliary output:

- output protected by a circuit breaker for tank leak power supply
- single-phase alternator preheating
- container convector output 1 with 230Vac power supply protection(s)
- 7.5 kW - 400 V motor output including: One 3-phase circuit breaker-contactor unit
- 2 x aero engine starts
- container lighting unit output including 1 protection(s) per circuit breaker 16A
- start for container's security lighting
- 24Vdc power supply protection for motorized damper
- 230Vac protection for motorized damper power supply
- a digital output on APM802 for motorized damper control
- 3-phase circuit breaker(s) for fuel pump protection < 4 kW
- fuel pump contactor(s) < 4 kW
- solenoid valve start
- 24 V start
- control panel preheating start
- SCHUKO domestic sockets

- Management and protection of motorised damper. This option includes fuse protection, a relay and connection terminals (24V or 230V power supply possible).

Miscellaneous and accessories:

- functional analysis
- buzzer
- operating switch

- 24 Vdc neon lighting inside the cabinet
- logical diagram
- parts list for electrical equipment in the cabinet
- cabinet terminal block drawing
- main wiring diagrams
- provision of an information exchange frame in line with the MODBUS communication protocol

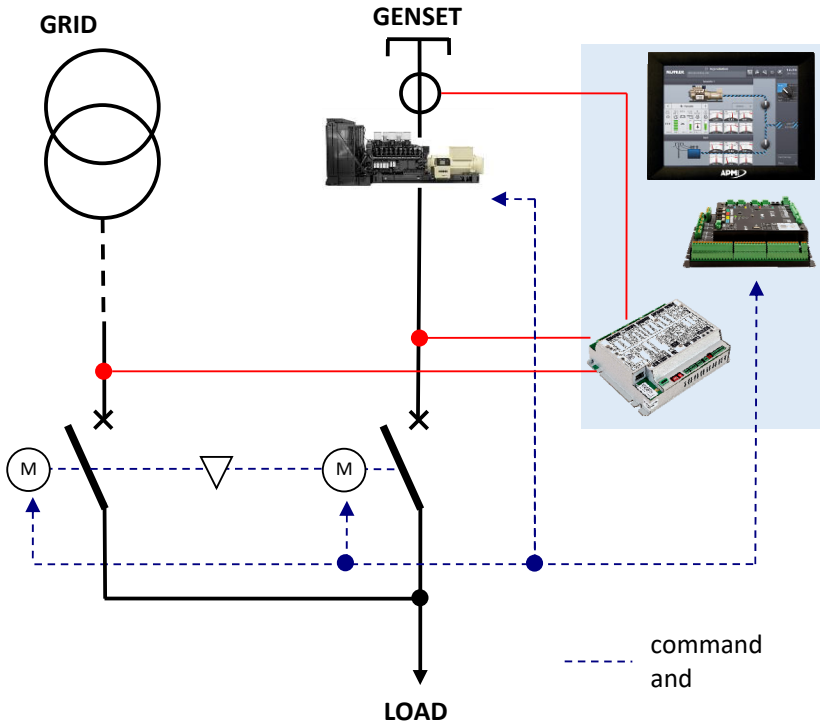
1.4.4. Reports

This information is transmitted via dry potential-free contacts (specifications: 8A, 240 VAC, AC1)

- generator unavailable in automatic
- fault report
- alarm report
- generating set run
- Other information to be confirmed during studies
- analogical remote(s) 4-20 mA including:
  - 1 logic output(s) APM802 wired on terminals
- additional safety device comprising:
  - 1 digital fault input(s) on APM802
- additional ETOR

2. A622 LOW VOLTAGE CONFIGURATION WITH CABINET EQUIPPED WITH AN APM802

Designed to operate with a generating set in case of grid power cut.
The APM802 is designed for the possibility of managing a non auto-controlled automatic transfer switch.



2.1. Functional description

This offer covers the supply of a generating set power plant cabinet designed to provide:

- Emergency electrical supply to an installation following grid loss. The grid will be restored via Normal / Emergency switchover with cut-off.
- Emergency or production operation by selecting FORCED RUN mode.
  - This operation may be used to protect against any grid power cut (e.g.: Stormy weather).

2.2. Automatic operation

- **Loss of grid voltage**
  - grid loss adjustable acquisition time delay
  - generating set start demand
  - genset speed increases
  - grid power supply device opened
  - genset power supply device closed after the voltage and frequency have stabilized

  Grid voltage restoration
  - grid restoration adjustable acquisition time delay
  - genset power supply device opened
  - grid power supply device closed
  - cooling time delay
  - genset shut down and set to standby

2.3. FORCED RUN operation (remote operation)

- This operation mode is authorised in automatic mode. The operator has the option of starting up and shutting down the generating set via remote operation. The generating set safeties are active in this operation mode.
- **Start of FORCED RUN operation**
  - generating set start demand
  - genset speed increases
  - grid power supply device opened
  - genset power supply device closed after the voltage and frequency have stabilized

  The installation is supplied by the generating set.
- **End of FORCED RUN operation**
  - genset power supply device opened
  - grid power supply device closed
  - cooling time delay
  - genset shut down and set to standby

  The installation is supplied by the grid.

2.4. MANUAL operation

This operation mode is selected by pressing the MANUAL button. The operator has the option of starting up and shutting down the generating set via the HMI. The generating set vital safeties are active in this operation mode.

The operator is responsible for this operation mode.

2.5. TEST operation for testing

This operation mode may be regularly used for operating checks.
The system is set to **Automatic** mode
The genset is started up and shut down using the **test off load/test on load/end test** keys, after setting the system to **Automatic Test** mode

- **Test off load**

This operation mode is selected on the APM802.
The duration of this test depends on when the end test button is pressed, or by default after a 10 minute time delay.
This operation makes it possible to run a genset starting test without a genset power supply device closing command.
Upon grid loss, the automatic function operates in the same way as automatic selection.

- **Test on load**

This operation mode is selected on the APM802.
The duration of this test depends on when the end test button is pressed.
This mode is used to test the complete execution of the genset automatic function as a FORCED RUN operation.
Upon grid loss, the automatic function operates in the same way as automatic selection.

III. Enclosures

1. ENCLOSURE TYPE

Walk-round; Drop-over & supplied with a bunded underbase.

2. OVERALL DIMENSIONS, WEIGHT & SOUND LEVEL

Canopy & Base:	10500mmL x 2800mmW x 4050mmH
Inlet Attenuator:	+2300mmL x 2800mmW x 3100mmH
Discharge Attenuator:	+1500mmL x 2700mmW x 2800mmH
Discharge Lined Spacer:	+1100mmL x 2700mmW x 2800mmH
Discharge Lined Turning Duct:	+1200mmL x 2700mmW x 2800mmH
Discharge Plain Steel Riser Duct:	+11600mmH
Weight:	to be confirmed
Sound Level:	65dBA at 3m around the perimeter of the unit under test conditions (1.2m from floor), free field

3. CANOPY CONSTRUCTION

100mm Thick preformed construction, comprising of a “Zintec”, Zinc coated steel outer skin and a perforated steel inner skin. The intervening space packed with High-density mineral wool and additional heavy-mass layers as required. Underbase: bunded (to the capacity of the engine & radiator) underbase.
We assume the floor level is flat without any change in distance.

4. LIFTING

4-point Package Top lift facility. For Canopy & Base) / Inlet / Lined turn and Riser sections.

5. ACCESS

1-off single & 1-off hinged double lockable doors on one side only provides access to both sides of the engine and alternator. Slamlock Handles c/w internal panic release mechanisms; and weld-on hinges. Security “Pin Torx” screws & Door retainers are supplied as standard. A further hinged access panel is allowed in the Lined discharge riser to access the Damper and ensure drainage ways are clear.

6. VENTILATION

Inlet System:
End facing, externally mounted air Inlet Splitter Attenuator, complete with fixed blade weather louvres, & vermin guards.

Discharge System:
A discharge Ventilation fan support plenum is fixed into the end wall of the canopy.
4-off short cases axial ventilations fans, sized on the above data.
An end facing, externally mounted air Discharge Splitter Attenuator, complete with fixed blade weather louvres, & vermin guards, designed to achieve 75dB(A)@1m.

A lined turn (to vertical) duct is supplied to turn the airflow to vertical, maintaining the overall 65dB(A)@3m.
Most of the riser duct is supplied acoustically lined to ensure acoustic performance from the Exhaust gas systems, which discharge into his riser.
The final vertical discharge duct is “plain” steel not acoustically lined.

7. EXHAUST SYSTEM

Supplied SCR system would terminate into the acoustically treated riser.
Lagging of bellows.
Supply of a “4 into 1” Exhaust manifold pre-fitted to the generator set.
Manifold & Bellows lagging kits included. Designed to achieve 65dB(A)@3m from top of riser.

8. OTHER CANOPY PENETRATIONS

Exhaust: Engine exhaust outlet, suitably weatherproofed.

Fuel: Fuel entries in Floor or Sidewall to suit connection of fuel lines (By others) from bulk fuel tanks below.

9. ELECTRICS

AC lighting system, comprising 7-off 1500mm LED) fittings, 1-off unit fitted with a 3-hour non-maintained Emergency backup, 2-way switched. 2-off twin RCD protected UK SPEC. 230V/13A sockets, including a 3 phase Distribution board as previously.
External PE1 Bulkhead fittings with Emergency back-up fitted above the door sets.
All wired in Galvanised conduit/trunking. The system is tested in line with UK Standards: IEE Regulations to BS.7671.

10. EARTHING

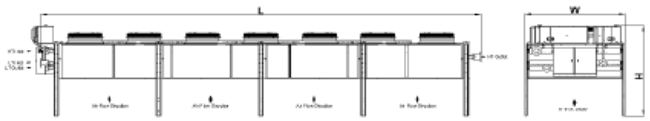
Not included.

11. INTERIOR AND EXTERIOR FINISH

Externally finish painted in a single standard colour 2-pack acrylic paint system, suitable for an inland environment. Paint colour to be of your choice from the BS4800 / RAL / BS381C colour charts.
(EXCLUDING RAL 9006 & 9007 metallic Colours, which are not suited to wet paint systems).
Internally: Semi-Gloss White finish.
The underbase is painted black & fully undersealed.

IV. Remote dry cooler

PRODUCT DESCRIPTION:	60dba@3m - EC FAN+FLOWGRID - S228455 KD83V16 40C AIR ON HORIZONTAL LT-HT RADIATOR



General Specifications:		
Lenght(L):		9480 mm
Width(W):		2400 mm
Height(H):		1770 mm (approx.)
Weight(Dry):		2400 kg (approx.)
Weight(Filled):		2846 kg (approx.)
LT Inlet:	(Single Inlet)	89,9 (3")
LT Outlet:	(Single Outlet)	89,9 (3")
HT Inlet:	(Single Inlet)	139,7 (5")
HT Outlet:	(Single Outlet)	139,7 (5")
LT Connection:	Same Side	
HT Connection:	Counter Side	

Heat Exchange Specifications:	LT Circuit	HT Circuit	
Capacity	820,86	1103,13	kW
Exchange Surface	826,65	867,90	m^2
Exchange Coefficent	44,07	42,67	W/m^2K

Air Side Specifications:	LT Circuit	HT Circuit	
Altitute	1000		m
Max. Air on temperature	40	55,2	C^o
Air outlet Temperature	55,2	75,6	C^o
Inlet Humidity	70	32,4	%
Outlet Humidity	32,4	13,1	%
Volumetric Flow(Inlet/Outlet)	202000	224968	m^3/h
Mass Flow	192580		kg/h
Velocity(Outlet)	3,13	3,32	m/s
Air Pressure Drop	30,2	34,2	Pa

Coolant Side Specifications:	LT Circuit		HT Circuit	
Coolant	Water	+ 40%	Eth. Glycol	(-23°C)
Inlet Temperature	80,8		100,0	C^o
Outlet Temperature	59,8		91,2	C^o
Flow Rate	37,20		118,80	m^3/h
Velocity in the tubes	1,03		1,57	m/s
Velocity in Collectors	1,94		2,48	m/s
Inner Volume	200,55		246,67	lt.
Pressure Drop	37,16		37,39	kPa

Coil Specifications::	LT Circuit	HT Circuit	
Tube Material	Copper		
Fin Material	Aluminium		
Fin Material	Flat		
Collector Material	Steel Pipe		
Tube thickness	0,35		mm
Fin thickness	0,2	0,12	mm
Fin Pitch	4,6	2,7	mm

Fan Specifications:	EC FAN + FLOWGRID
Number of Fans	14 pcs
Diameter of fan	800 mm
Fan RPM	769 rpm
Adjustable Angle	no

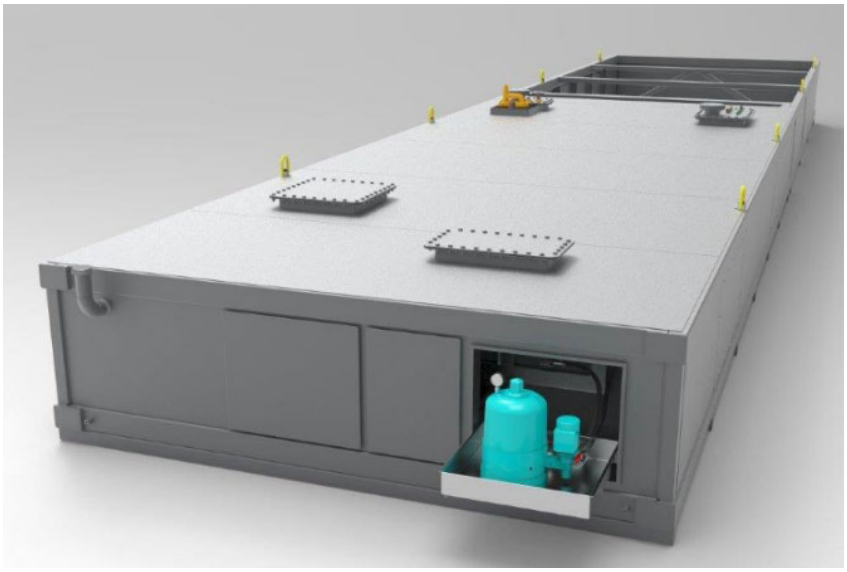
Electric Motor Specifications:	EC FAN + FLOWGRID
Power consumption per electric motor	0,66 Kw
Power consumption per radiator	9,24 Kw
Installed Electric Motor Power	1,95 Kw
Voltage	380/.../480 V
Frequency	50/60 Hz.
Phaze	3
Insulation Class	F
Protection Class	IP55
Anti Condensation Heater	no
Thermal Overload Protection	Yes

Sound Power and Pressure Level:	
Sound Power Level per Radiator	85 LwA (dBA)
Sound Pressure Level@1m.	64 LpA (dBA)
Sound Pressure Level@7m..	56 LpA (dBA)
Sound Pressure Level@10m..	53 LpA (dBA)

SCOOPE OF SUPPLY:

- ✓ LT AND HT HEAT EXCHANGE COILS
- ✓ LT AND HT STAINLESS STEEL 304L EXPANSION TANKS
- ✓ MURPHY EL150K1 COOLANT LEVEL SWITCH PER TANK
- ✓ VISUAL SIGHT GLASSES FOR EXPANSION TANKS
- ✓ FAN AND ELECTRIC MOTORS
- ✓ FAN PROTECTION GUARDS
- ✓ JUNCTION BOX
- ✓ STAND LEGS

V. Fuel tank



1. CONSTRUCTION PRINCIPLE

Steel tanks are UK manufactured in general accordance with BS799: Part 5 2010.
In accordance with Control of Pollution Regulations - "with 20-year design life expectancy" Environment Agency Guidleline PPG2
Steel Plate: 5mm thick S275 JR
Integrated steel (UB) support frame - subject to design and structural calculations.
6No x 17,817L Useable tank packs supporting STATIC 50T load (design)
Overall dimensions of pair of tanks bolted together: 16600mm (L) x 2800mm (W) x 1250mm (H).
The O/A length includes allowance for 1000mm integrated cabinets at either end.
Additional tank compartment added for 2,500L UREA, tank constructed from 316 3mm stainless steel Dimensions to be confirmed.
Paint Finish: Shot blast to SA2.5, Paint System to C3-M, tank base and bearers finished with bitumen paint.

2. TANK FITTINGS

- Foot valve, 50mm (2in) from tank base.
- Engine fuel via 50mm roof socket
- 25mm "flow and return" fuel filtration pipe work designed to provide "swirl" across tank floor to enable entire tank contents to be passed through integrated fuel filtration system noted below, pick up pipe work to be cross-drilled with multiple points of pick-up.
- Fill Point 50mm (barrel Nipple, cap/chain) fill c/w motorised fill valve controlled by fuel fill panel, c/w mechanical overfill prevention valve.
- Manual Fill Point 50mm via shared overfill prevention valve.
- Bund Drain 25mm drain port from the tank bund section.
- Access Manway 600mm manway access to bund and tank c/w full nitrile/cork gasket seal suitable for a diesel application (min. 3mm (0.1in) thick) Top access on tank only above full level
- OLE T5020 automatic tank contents gauge c/w with relay board and bund sensor
- Tank Vent to be provided to meet tank design requirements
- Spare Connections 2 no. 50mm spare connections.
- Integrated Fill and Fuel Filtration Cabinet (end mounted into tank pack)

- Mounted on sliding rails 1 x CJC fine filter HDU 27/27 pvm 3 phase 415v 50hz pvm30-4 pump (200lph) magnetic coupling, nitrile seals 27/27 insert air vent screw, pressure gauge, sampling point test port
- 1x Gemin PRO control panel.
- 2 x 25mm SS braided flexible pipes for direct connection to fixed tank rood sockets.

3. FUEL TRANSFER PUMPS

- 6 x PE D/S pump transfer set 0.6kW 230/1/50 CKm80 self-priming liquid ring pumps, mounted on common base plate fixed to cabinet floor, c/w suction and discharge manifolds, NR valve and isolation valves
- 6 x Pump Control Duty/Standby with alarms and automatic rotation 230V / 1ph / 50Hz with 4 - 6 Amp overloads and 1 x 230V Belimo valve output.

VI. Load bank connection panel

1. APPLICABLE STANDARDS

Equipment meets the requirements of the following standards:

- IEC 61439-1 Low-voltage switchgear and controlgear assemblies
- IEC 61439-2 Low-voltage switchgear and controlgear assemblies < 1000VAC et 1500V DC
- IEC 60364 Electrical Installations for Buildings
  Compliance with the latest edition of Regulations for electrical installation applicable:
  - Ireland ET101,
  - UK BS 7671,
  - Netherlands NEN1010,
  - Germany DIN VDE 0100,
  - France NF C 15-100
  - …
- 2006/95-EC European Low Voltage Directive (LVD)
- IEC 60529 Degrees of protection provided by enclosures (IP Code)

2. CAMLOCK CONNECTORS

Our offer includes CAMLOCK connectors on switchboards for load bank with standardized high-quality solutions.

Offer is based on:

LV SWITCHBOARD LOAD BANK OUTPUT	CAMLOCK POWERSAFE PHASE 3 PLUGS
5000 Amps	10 plugs per phase = 30 plugs Neutre = 10 plugs 1 plug for EARTH

3. ILLUSTRATION

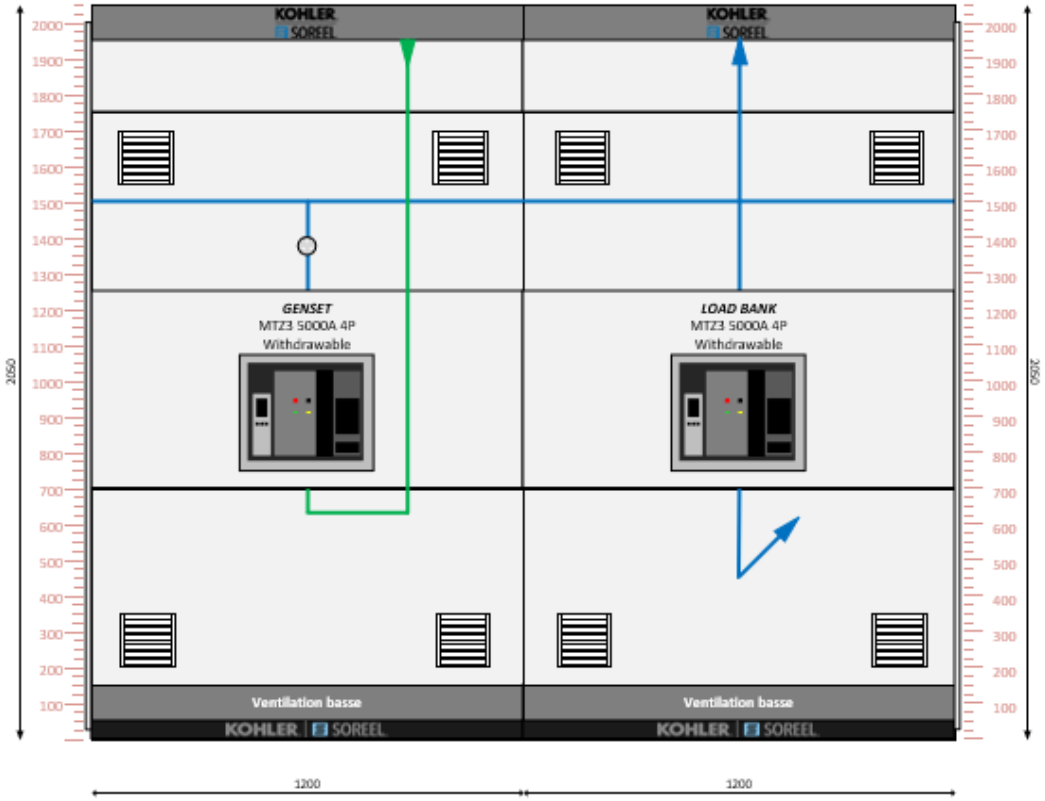
SWITCHBOARD BLUE PRINT

5000 Amps

H (en mm) : 2050

L (en mm) : 2420

P (en mm) : 1280



4. SPECIFICATION

	LV Switchboard KD3100
Climate conditions	
Indoor air temperature	41°C
IP (door closed)	31
IP (door opened)	xxb
IK	10
Altitude	< 2000m
Atmosphere	Neutral
Electrical characteristics	
Earthing arrangement (scheme)	TNS: 3PH + N + PE
Surge arrestor	Yes, Type 1 + 2 + Protection
Circuit breakers & busbar current rating	5000 Amps Main busbar copper is >= 99,90% pure Cu.
Circuit breakers	Principal: 1 x SCHNEIDER MTZ3, 5000 Amps, 4P, H1 Motorized, withdrawable, disconnected position lockable 2xNO/NC, 1xSD, M-XF-MX -230VAC + LSIG, Micrologic 5.0 Load bank: 1 x SCHNEIDER MTZ2, 5000 Amps, 4P, H1, Micrologic 5.0 Manual, withdrawable, disconnected position lockable 2xNO/NC, 1xSD, MX -230VAC

Icw	65kA
Auxiliary circuit	
Visual control indicators	3 x front facia voltage presence indicator tri-LED.
Circuit breaker monitoring	Auxiliaries for each circuit breaker: 2 x position contacts: open / close 1 x contact: circuit breaker fault warning
Mechanical characteristics	
Dimension (Height x Length x Depth) mm	2050 x 2420 x 1280
Complementary base with slots for lifting forks	Included (100mm)
Form	4b
Access/Connections	Front
Genset Incomings	Top by cables
Outcomings	Installation: Top by cables Load bank: Camlock Bottom Rear
Wiring & others characteristics	
Identification / Type / Section / Voltage / Colors	Kohler Standard
Mimic Bus	Yes

VII. Emissions treatment system

1. GENERAL DATA & ENGINE DATA

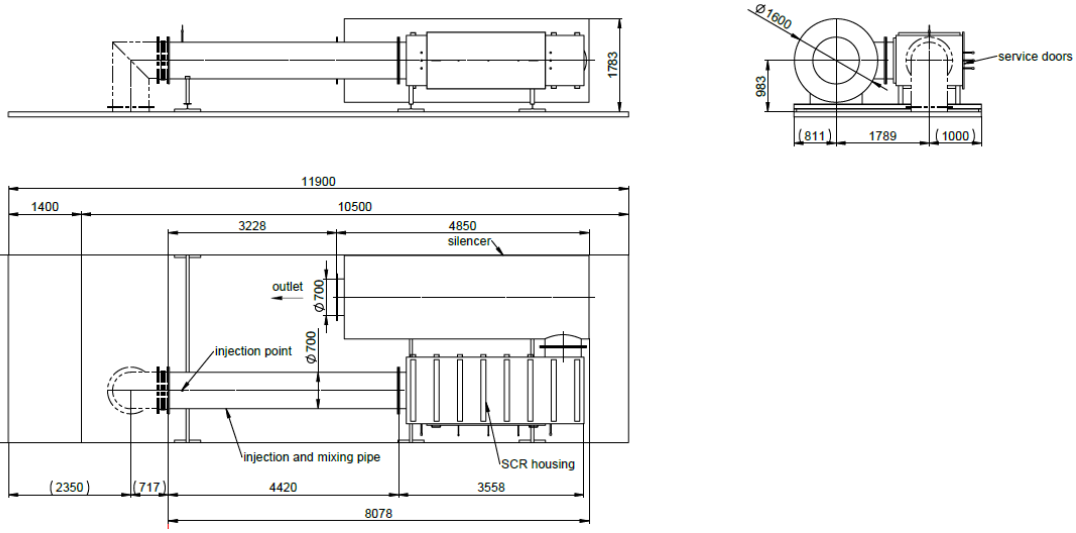
Engine	KD83V16
Engine power	3’007 kWm
Numbers of gensets	3 pcs.
Application	Emergency
Running hours per year	≤ 500 h/Y
Fuel	Diesel EN590 quality
Exhaust gas volume flow	≤ 36’958 m3/h (10’266 l/s, operating flow rate)
Exhaust gas temperature	≤ 510 °C*
Max Exhaust gas temperature	≤ 520 °C* (max. physical limit of catalyst)
Max Exhaust gas temperature	≤ 490°C* (max. temperature to achieve reduction at full load)
Min Exhaust gas temperature	≤ 390°C* (min. temperature to achieve reduction at full load)
Min Exhaust gas temperature	≤ 340°C* (min. temperature to achieve reduction at below 75% engine load)
Backpressure for SCR	≤ 40 mbar (32mbar in delivered state, +8mbar if spare row filled)
Backpressure for Silencer after SCR	≤ 10 mbar
Backpressure for piping inbetween	≤ 10 mbar (confined space option only)
NOx after engine	< 3’174 mg/mn3 @ 5 % O2
NOx limit to be reached (MCPD)	< 507 mg/mn3 @ 5 % O2 (equals: 190 mg/Nm3 @ 5 % O2)

***Note on temperature**: The temperature for the selected catalyst must be between 390 -490°C at full load, any deviation from that may result in lower reduction rate achieved. Some will still be achieved, but the catalyst has been selected for this operation point.

2. TECHNICAL DATA

Dimensions

Space availability 11.6 x 3.6 x 2.8 m (LxWxH)



Consumables

Urea (AdBlue) 32.5 w/w solution	~62 l/h (temp. compensated)

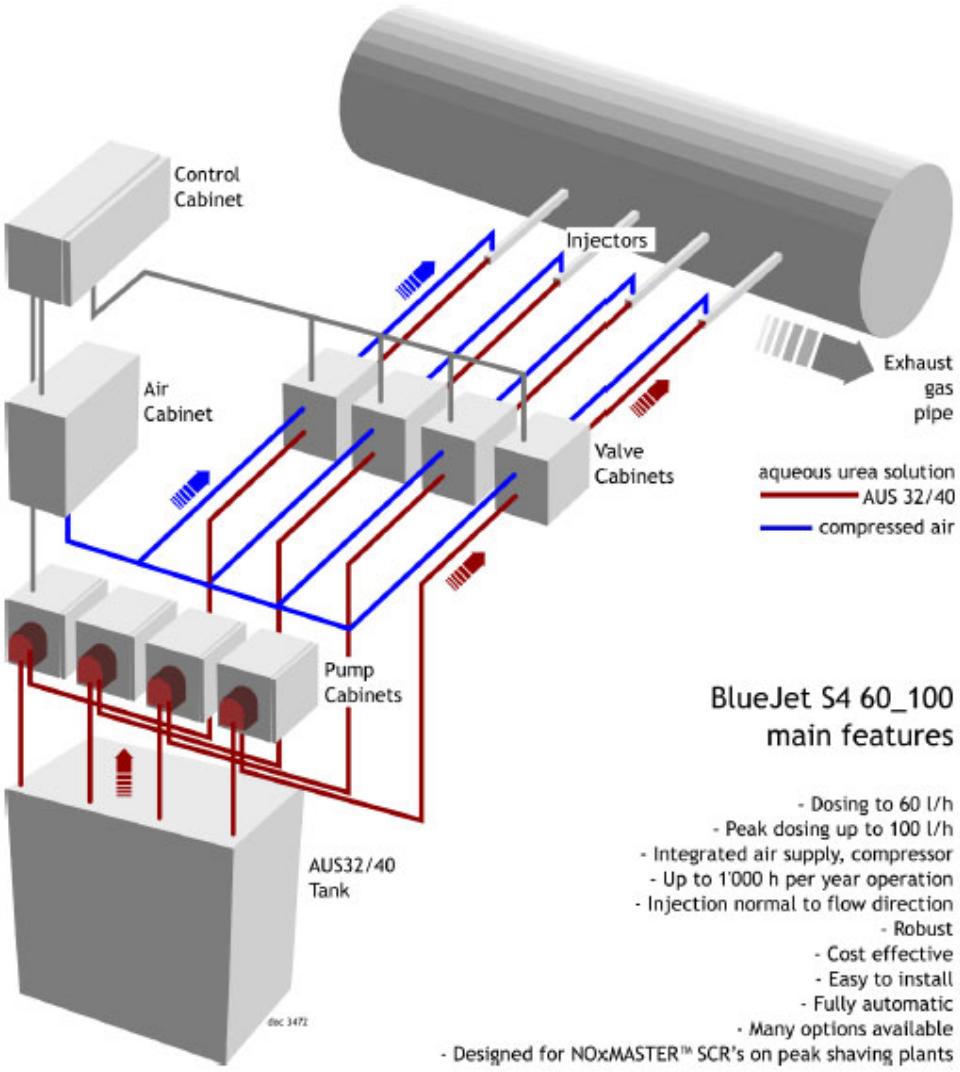
Backpressure

SCR System, flange to flange, calculated value	≤ 40 mbar
Primary silencer	≤ 10 mbar
+ piping in confined space	≤ 10 mbar
Total	≤ 60 mbar

Warranty values

Nitrogen oxide NOx	MCPD ≤ 190 mg/Nm3 @ 15 % O2 Equals ≤ 507 mg/Nm3 @ 5 % O2

3. DOSING SYSTEM



VIII. Services

1. DOCUMENTATION

1.1. English documentation(s) delivered in paper (#1 set)

The documentation supplied with the generating sets specifies the operations for use and maintenance of the generating set or the power plant.
This documentation provides information on the equipment, guides the user in operating and maintaining the equipment on a daily basis or periodically. The documentation relating to motors and alternators installed in the generating sets includes operating and maintenance instructions for the motors (from the manufacturer) and for the alternators (from the manufacturer).
The documentation consists of:

- **operating and maintenance instructions**, containing the following information:
  - general recommendations and safety requirements
  - general rules relating to the installation of generating sets
  - general instructions relating to the preparation of generating sets prior to commissioning
  - charts listing capacities (lubricants and coolants) and fuel tanks for the various motors installed in the generating sets, depending on their configuration
  - special maintenance instructions
  - maintenance specifications and/or instructions for certain optional pieces of equipment
- **user manual for the control panel** (if applicable)
- **wiring diagrams** (these diagrams are supplied with the documentation or delivered with the generating set)
- **CE certification** (if the equipment was sold under this application)
- **test reports with load impacts**
- **operating and maintenance instructions for the engine** forming part of the generating set
- **maintenance instructions for the alternator** forming part of the generating set

2. SPARE PARTS

"SERVICE PLUS" package enables to reach the second maintenance level and includes the first maintenance level package and according to the assembling:

- Belt(s)
- Rocker cover gasket(s)
- Injector gasket(s)

3. FACTORY WITNESS TESTING

3.1. FWT program for generating sets in UK

Tests performed in the presence of the customer, or their representative are aimed at approval of the technical capacities of generating sets. Participants are under the supervision of a KOHLER representative for the day, starting from 8:00 am to 5:00 pm (as per our internal instruction IN-00 63).

3.1.1. Basic program

- Static test to check the conformity of installed elements:
  - general appearance (paintwork, finish, welds, fastenings, etc.)
  - dimensions
  - information on manufacturer’s plates
  - protection against direct contact

- dimensions of connection points (copper rods, fuel inlet/outlet,…)
- circuit breaker check (number of poles, tripping value,…)

- Test off load (without load)
  - tests on motor safety devices
  - check of information displayed by generating set control console
  - visual checks for the sealing of the following systems: cooling, oil and diesel.
  - checks for the absence of vibrations and unusual noises
  - start and stop cycle check
- Test on load:
  - power measurements are performed on a reactive load bank PF=0,8 (in one unit)

    - No load test for 5 min.
    - On load test 5 min 25% ESP PF=1
    - On load test 5 min 50% ESP PF=1
    - On load test 5 min 75% ESP PF=1
    - On load test 30min 100% ESP PF=1

  - For each stage, the following information will be recorded at a given time: electrical parameters (voltage, frequency, amperage and power).
  - Measurements for engine oil pressure and coolant temperature will be recorded for the 100% stage
- Load impacts and graphic records
  - Load impact measurements are performed at different stages of the rated power using a flatbed plotter. Frequency and voltage transients will be recorded graphically at each load impact with a test at maximum power according to the acceptance criteria. The results will be recorded in our test report.

- Tests approval
  - At the end of the tests, a factory acceptance report will be drawn up and signed by KOHLER representative and the customer or their representative.

IX. Scope of works

The following sections describes the supply and responsibility and interface arrangements for the generator system

1.1. Kohler scope of works

- supply of previously specified equipment and accessories
- execution of project documents and drawings as previously agreed during KOM
- project management.
- Factory first of the kind witness test
- Transport CPT London, UK
- Commissioning
- Training

1.2. By others

- Offloading, positioning, and crane hire
- Site installation
- Temporary load bank for testing
- Fuel for onsite and commissioning test
- Urea for onsite and commissioning test
- Import duties and taxes
- Civil works
- Structural calculations
- Primary steel supports
- Primary containments
- Access steelwork into acoustic enclosures
- Access steelwork onto enclosure roof including handrailing and kick strips
- Support frame for combined generator enclosure and fuel tank to mediate the sloped floor
- Cable link boxes
- Fusible link fire wire systems inside the enclosures
- Motorised or fire dampers (this would increase the canopy length if required)
- False floor systems
- Interconnecting coolant pipework for all remote coolers (remote and roof mounted)
- Coolant booster pump set
- Vent fan power and control cables inside the canopy
- Power cabling for the remote coolers
- Interconnecting fuel pipework from the belly tanks to the gantry canopies
- Supply or installation of any cables, containment, or bracketing outside the generator container
- Exhaust flues and pipework for the exhaust drains
- Smoke or leakage testing on exhaust system
- Fire alarm and suppression systems
- SCR or DPF systems
- All control, communication, and power cabling outside generator container
- Containment for the power or signal cabling outside of container premises
- Canopy earthing system and any earthing system outside of the canopy
- Lightening protection
- Load shedding control
- Everything not described or not included in KOHLER offer

X. Annexes

1. GENERATING SETS STANDARDS AND DIRECTIVES

Directives

Machinery Directive	2006/42/EC
Low Voltage Directive	2014/35/UE
EMC Directive	2014/30/UE
Outdoor Directive	2000/14/EC

Standards

General data on Generating sets

Engine power	ISO 3046-1
Performances, genset classes of application, methods of application, etc.	ISO 8528-1 to 10 EN ISO 8528-13
Generating set safety	ISO 12100
General safety principles	IEC / EN 60204-1
Electrical equipment of machines	

Engine

Exhaust emissions measurement	ISO 8178
Engine safety	EN 1679-1

Alternator

Electric rotating machinery	IEC 60034

Electrical equipment

Electrical protection	
Switchgear and controlgear	IEC 60364-4-41
Low-voltage switchgear and controlgear	ISO 8528-4
Low-voltage switchgear and controlgear assemblies	IEC 60947-1 à 3 EN 61439-1
Degrees of protection provided by enclosures (IP code)	IEC 60529

Regulation

EC Regulation concerning the recording, the evaluation and the authorization of chemical substances, as well as the limitations applicable to these substances (REACH)	1907/2006/EC

2. CHARACTERISTICS OF FLUIDS

To guarantee the good working order of the generating set, the characteristics of fluids specified below must be adhered to.

2.1. DISTILLATE FUEL

Fuels	Designation	Details	Restrictions
ASTM D975	ASTM D975 1D (Road) ASTM D975 2D	0,0015 % Sulphur	Max HFRR 460 µm
		0,05 % Sulphur	Max HFRR 460 µm Without AEG
		0,5 % Sulphur	
EN590	EN590	Road diesel CSR 4.0.05	Biodiesel blend < 10%
		Non road diesel CSR 4.1.03	
BS2869 2010	BS2869 2010 class A2	Non Road use Diesel 0.001% sulphur content	Biodiesel blend < 10%
DFO	DFO available in France*	CSR 4.4.06 DIN51603	Without EATS Improve fuel pre-filtration with a water separator type pre-filter between the main storage tank and the day tank.
Bio diesel	On consulting		
Military grade fuels	On consulting		

- 0.5% sulphur = 5000 ppm and 1% sulphur = 10000 ppm.
- EATS = Exhaust After Treatment System.
- HFRR (High Frequency Reciprocating Rig) : testing method used to evaluate the lubricating properties of diesel fuels.
- DFO: Domestic fuel oil

**The engines performances will not be guaranteed, a power loss and a consumption increase can occur with an impact on the emissions.* For regions with cold weather conditions, it is necessary to make sure that the fuel chosen with the supplier is compatible to avoid congeal and starting issues.

2.2. OIL

GENLUB EVOLUTION 15W-40 or similar*

Oil category	Minimum Standards	Recommended viscosity class
Oil category 2	ACEA E4 or ACEA E7 API CI-4 Plus	SAE 5W-40 SAE 10W-40 SAE 15W-40**
Oil category 3	ACEA E4-12	SAE 5W-40 SAE 10W-40

**For any other product, an approval of the manufacturer is necessary*
*** To use the 15W-40 oil, it is necessary to plan an engine water preheating for the series K175.*

Without engine preheating, it is possible to use the SAE 10W-40 or 5W-40.

2.3. COOLANT

GENCOOL PC-26 or similar:

- ready for use
- high protection
- with Glysantin G48 antifreeze and inhibitors
- nitrite, amine and phosphate free
- clear fluorescent orange liquid
- conforms to the standard NF R 15.601

**For any other product, an approval of the manufacturer is necessary*