



PROPOSAL WITH DETAILED SCOPE OF
SUPPLY

OF

BIOGAS CHP PACKAGES

FOR

ANGLESEY ECOPARC

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Section: 1 Covering Letter



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2nd October 2015

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Our Reference: WP/IF/237383/F

For the attention of Max Schubert
c.c. Reynier Funke

CHP UNIT PACKAGES FOR ANGLESEY ECOPARC

Dear Max

Following our recent emails please see attached the updated proposal for this project. This should be the final scope of supply.

The price is in Sterling only.

We trust the attached meets your requirements, should you require any further information please don't hesitate to contact us.

I will call you soon.

Yours sincerely

Ian Farr

Ian Farr





Section: 2 Price Schedule



Price Schedule

The following firm prices are offered for the equipment detailed below and in the enclosed scope of supply, data sheet and specification and subject to the attached Commercial Conditions.

ONE 2000KWe TCG2020V20 CONTAINERISED BIOGAS CHP UNIT

Item		Qty.	Unit Price	Total Price
1	Edina 2000kWe, containerised biogas CHP system c/w TCG 2020V20 generating set, ex-works.	1	£ 678700	£ 678,700
2	The inclusion of exhaust gas heat recovery system within the CHP unit.	1	£ 33,400	£ 33,400
3	Delivery, offloading and installation of the above items.	1	£ 52,000	£ 52,000
4	Commissioning and operator familiarisation of the above items.	1	£ 20 100	£ 20 100
Total Price				£ 784,200

All Prices are in pounds fixed for the validity period given, excluding VAT.



Section: 3 Scope of Supply

Scope of Supply – CHP Package Unit

For the design, manufacture, delivery, offloading, positioning, installation and commissioning of One (1) off biogas gas fuelled Packaged Generating Set and ancillary equipment, all as detailed in the enclosed technical specification and in this scope of supply:

1. Generating set

- ◆ A MWM generating set, as described in the attached specification, 'TCG2020(LV) Genset Technical Specification (021-SQ-001)' and comprised of:
 - MWM gas engine, spark ignition, 1500rpm
 - A.C. Generator (Marelli or equal), 400V, 50Hz, synchronous, IP23, Class H insulation, Class F temperature rises.
 - Bedplate to accommodate flexibly coupled engine/generator complete with anti vibration mountings.
- ◆ Engine lube oil system including:
 - Lube oil cooler
 - Filters
 - Lube oil circulating pump (engine driven)
 - Priming pump (electric motor driven) (also used as the lube drain pump)
 - Automatic lube oil replenishment system
 - Lube oil sump
- ◆ Engine starting system, including:
 - 24V DC starter motor
 - Lead acid batteries (mounted off engine)
 - Battery isolator
 - Interconnecting cabling/lugs etc, to provide a complete working system.
- ◆ Engine fuel gas train comprising:
 - Isolating valve
 - Pressure indicator
 - Gas strainer
 - Solenoid shut off valves with valve proving check
 - Zero pressure regulator
 - Flexible connector to engine

- Flame arrestor unit
- Complete with interconnecting pipework, etc., to provide a complete working system complying with the Institution of Gas Engineers Utilisation procedure IGE/UP/3.

2. Enclosure

- ◆ Outdoor weatherproof acoustic enclosure with separate engine and control room and including:
 - ISO style container enclosure with internal acoustic treatment.
 - Bunded floor, sized for containing an internal lube oil / water leak, for environmental protection purposes
 - Internal personnel lighting (main and emergency).
 - Power outlet for hand tools
 - Lifting beams above engine
 - Fire and gas detection systems.
 - Two personnel access doors into the enclosure, with emergency releases
 - One personnel access door into the control room, with emergency release
 - Removable end wall for genset removal
 - Rails as necessary around roof mounted equipment.
 - Hooped access ladder to roof
 - Ventilation intake attenuators with louvres and bird screen
 - Ventilation outlet attenuators with louvres and bird screen
 - Ventilation fans, inverter controlled.

3. Auxiliary Systems

- ◆ Engine gas supply system comprising:
 - External Safety Shut Off Valve, electrically opened, spring close
Note: the external manual isolation valve is by others.
- ◆ Engine exhaust system comprising:
 - Engine mounted expansion bellows
 - Exhaust duct to silencer inlet
 - Roof mounted exhaust silencer(s) lagged with bursting disc.
 - Exhaust discharge stack terminating at 8.20 m above ground level.



- ◆ Engine cooling and heat recovery system to provide a complete working system including:
 - Water circulating pumps
 - Isolating valves
 - Expansion system(s). Sized for enclosure roof mounted radiators.
 - Three way motorised valves (dump radiator and intercooler circuits).
 - Engine pre heater
 - Enclosure roof mounted horizontal type dump radiator with motor driven fans (inverter controlled).
 - Enclosure roof mounted horizontal type intercooler radiator with motor driven fans (inverter controlled).
 - Engine heat recovery system, comprising:
 - Plate heat exchanger, rated 10barg with AISI316 stainless steel plates in the jacket water circuit
 - Shell and tube type exhaust gas heat exchanger, rated 10barg with AISI316 stainless steel tubes and tube plates (lagged/insulated)
 - Any significant heat radiating part of the CHP, that will be accessible by maintenance personnel, will be insulated
 - Piping to flow and return flanged connections on the side of the enclosure.
 - The heat exchangers are sized for flow and return temperatures as defined in the “Design & Site Conditions” section below (other temperatures can be considered on request).
 - Lube oil make up system including
 - 1200 litre clean oil tank with automatic level make up valves and interconnecting pipework to engine top up system
 - A 1200 litre dirty oil tank is also provided
 - Tanks are integrally bunded and mounted alongside enclosure
 - Lube oil transfer pump – electric motor driven
- ◆ Control Panel Suite comprised of the following:
 - Genset control panel positioned inside the control room of the enclosure equipped with:



- Control Screen for MWM TEM EVO Engine Management System
- Comap Genset Controller *InteliSys NT*
 - ~ Automatic sequence control
 - ~ Automatic synchronising
 - ~ Standard generator protections
 - ~ Local control interface (Inteli Vision5)
 - ~ ModBus slave communications port for monitoring
 - ~ Terminal strip for hard wired control and shut down signals
- “G59/3” mains protection
- Battery charger
- Standard instrumentation
- “CHPQA / Ofgem” grade kWh generator metering (gross at generator terminals)
- “CHPQA / Ofgem” grade kWh auxiliaries metering
- Generating set auxiliaries panel, positioned inside the control room of the enclosure, housing MCCB’s and direct on line motor starters, with a door interlocked main isolator, conforming to UK standards and practice, .
- Remote Telemetry Unit (RTU), to enable remote monitoring of the unit from the EDINA central monitoring station. (Provided only where an applicable O&M Contract is entered into with EDINA)
- Generator circuit breaker panel, positioned inside the engine room of the enclosure allowing isolation for safety during maintenance, conforming to UK standards and practice. Complete with 3 pole withdrawable breaker.
- MWM TEM EVO panel, to provide control and supervision of gas engine functions. This panel is wall mounted in the engine room.

4. Site equipment

The following equipment is also included:

- N/A

5. Delivery, positioning and erection

- ◆ We will supply and install all the necessary materials, labour and craneage to undertake the following installation works:
 - Delivery of complete scope of supply to the installation site, during normal working hours. Special delivery arrangements or weekend working may be subject to additional charges.
 - Offloading & positioning direct onto the client's prepared foundation (assuming a single continuous operation, a maximum 14 metres crane radius and the use of standard 1.5m x 1.5m crane mats. Deviations to the above are chargeable.
 - Lifting operations will be performed in compliance with BS7121, "Code of Practice for Safe Use of Crane".
 - The Purchaser shall provide ground condition information for the crane set up as required by BS7121. For tendering purposes we have assumed the use of standard 1.5m x 1.5m crane mats.
 - Positioning of the equipment onto customer's prepared foundations.
 - Mounting of ventilation attenuators
 - Reconnecting of the pipework between the lube tanks and the enclosure.
 - Reconnecting the roof mounted radiator and silencer and exhaust gas heat exchanger.
 - Pipework between CHP unit and lube oil tank positioned adjacent to CHP unit.
 - Subject to satisfactory site access survey.

6. Commissioning

- ◆ The following commissioning works are included:
 - Commissioning of the equipment included in this scope of supply in accordance with EDINA standard procedures
 - G59/3 proving test to a local DNO representative, limited to testing of Edina supplied equipment only.
 - Testing of the unit at site:
 - 4 hour performance test using the as installed metering instrumentation.
 - The following commissioning consumables are included comprising of first fills of:



- Antifreeze/ inhibitor for MWM jacket and intercooler water systems only.
- Lubricating oil (sump only) bulk tanks first fill included if an “All Inclusive” O&M contract is taken out
- Battery electrolyte.

7. Options

The following items are offered as extra to our above standard scope of supply, prices are detailed in the Schedule of Prices.

- N/A

8. General

- ◆ The following general services are included:
 - External finish painting [of the enclosure] to EDINA standard specification and colour (Olive green – RAL6003).
 - Packing for inland transport, as considered necessary by EDINA.
 - Design and Project Management of all the works included in this Scope of Supply.
 - Health and Safety in accordance with relevant UK legislation and in particular in accordance with the provisions of the Construction (Design & Management) Regulations 2015 (CDM 2015). For the avoidance of doubt, the Client will act / appoint the Principal Contractor and will appoint the Principal Designer as defined under the terms of the CDM regulations. i.e. Edina are not the Principal Contractor and / or Principal Designer.
 - One electronic (CD) copy of the Genset and Package Documentation, in Edina standard format, including instruction manuals, drawings and engine test certificates. Plus two printed copies of as built manuals.
 - Factory test of engine to MWM standard procedure
 - Factory test of generator to manufacturer’s standard procedure.
 - Client visit to packaging factory (Lisburn Northern Ireland) to review container prior to dispatch.
 - Operator familiarisation (carried out during commissioning).

9. Exclusions

- ◆ The following items/ services are excluded from our offer.
 - Installation at site other than that detailed above.
 - Civil works, foundations, builders works, site preliminaries etc
 - Cabling and associated containment to the site BMS / SCADA monitoring system(s).
 - Power Systems Study, and relay co-ordination.
 - Island mode operation.
 - Black start capability.
 - Import/ export load control
 - Lightning protection
 - HAZOP study
 - Tools [Included within Edina's "all inclusive" O&M contract]
 - Spares [Included within Edina's "all inclusive" O&M contract]
 - Gas filtration or treatment.
 - Gas installation upstream of this Scope of Supply.
 - Gas flow metering.
 - Gas flare
 - Gas dewatering / gas drying/ booster package.
 - Gas Analyser .
 - Interconnecting gas pipework, pipe supports and pipe system accessories.
 - Condensate pipework to drain.
 - External manual gas isolation valve
 - Heat metering.
 - Engine exhaust gas emissions testing
 - Permanent access to emissions points
 - Load bank hire for site testing (if required).
 - Provision of a suitable CH₄ Methane signal into the enclosure.
 - Site noise survey
 - Witness testing at MWM during manufacture
 - Reliability run / extended running
 - Provision of telephone lines for remote monitoring purposes.

- O&M / service / spares provision, following completion of commissioning or commencement of “beneficial use”, whichever occurs first.
- Obtaining planning, building regulations and other governmental permits
- Dispersion study
- Any item not specifically included or itemised in this Tender.

10. Termination points

- ◆ The following are the major termination points between the package supply and the customer. Refer to enclosed P&ID and Single Line Diagram as applicable.

Electrical power :	LV - Load cable connection to generator breaker in enclosure (cable entry from bottom of enclosure).
Earthing:	Earth bar within enclosure
LPHW Water Circuit	Flow and return flanges on side of enclosure.
Lube Oil	Fill and drain connections on clean and dirty lube oil tanks external to enclosure
Fuel Gas :	Flange on side of enclosure.
Instrumentation :	Terminal strip in control panel in control room.
Exhaust:	Exhaust gas stack outlet, terminating at 8,20m above the ground level
Condensate drains	Terminations on side of enclosure
Lube tank	Flange on inlet and outlet Electrical terminals

11. Works to be carried out by others

We have assumed in our offer that the following works will be carried out by others and are consequently excluded from our offer.

- ◆ Supply and installation of the LV feed to each unit.
- ◆ Supply and installation of the customer's BMS monitoring signal cabling.
- ◆ Origination of a 4-20mA site load for electrical modulation.
- ◆ Noise test

- ◆ Gas sampling and analysis at commencement of commissioning (gas to be analysed for gross / net Caloric Value (CV) and the contaminants listed in MWM Technical Circular 01299-99-3017en Rev 5).
- ◆ Provision of a One Ohm earth connection (station earth).
- ◆ Earth cable from earth bar in enclosure to station earth.
- ◆ Provision of a suitable 4 – 20mA CH₄ Methane & H₂S Hydrogen Sulphide signal.
- ◆ Provision of a suitable gas supply to the edge of the enclosure.
- ◆ Provision of an external manual gas shut off valve.
- ◆ Supply and installation of gas pipework, and condensate pipework and associated pipe system accessories, external to the enclosure.
- ◆ Provision of concrete foundations, site buildings, site drainage, and connection to potable and foul water systems.
- ◆ Provision of all builders work.
- ◆ Provision of site security, site fencing, site office, and water/electricity services during construction.
- ◆ Obtaining of all necessary permits, planning permission, noise limit, stack height etc.
- ◆ Provision of two telephone lines (a PSTN & and ADSL) for remote monitoring of the set(s) if an “All Inclusive” O&M contract is taken out.
- ◆ A site single DSL line shared with the plant control system can be accommodated, but a dedicated separate line to the CHP would be preferred.

12. Design and site conditions

- ◆ Minimum Requirements of Gaseous Fuel for Gas Engines.
 - The gas fuel supplied to the generating equipment at the contract interface point must comply with the MWM Technical Circular 0199 – 99 - 3017en Rev 5, a copy of which is enclosed.
- ◆ G59/3 Protection.
 - The G59/3 protection included in our offer is based upon our interpretation of the G59/3 protection regulations. Any protection required in addition to that currently included will be chargeable as an extra.

◆ Design Conditions

Genset Reference Conditions		
Altitude above sea level	m	< 100
Ambient temperature range (external)	°C	- 10 / + 30
Humidity	%	60
Fuel		Biogas
Gas CH ₄ Content	%	55
Gas CO ₂ Content	%	40
Gas Methane number		131
Engine		TCG2020V20
Generator	Marelli	400V, 50Hz
Engine Air Inlet Reference Temperature (ISO3046)	°C	≤ 25
Exhaust Emissions (at 5% O₂) Subject to EA guidance LFTGN08 2010 uncertainty limits		
NO _x	mg/Nm ³	500
CO	mg/Nm ³	1400
VOC's	mg/Nm ³	1000
Fuel Gas Interface Conditions at Inlet Flange to CHP Unit		
Gas supply pressure setting:	mbar	100
Gas supply pressure fluctuation period:	/h	< 10
Gas supply pressure fluctuation, related to setting:		< ± 10%
Gas temperature:	°C	10 - 50
Plant Reference Conditions		
Radiator "air on" design temperature	°C	30
Return temperature into CHP Set	°C	70
Flow temperature from CHP Set (at full operating load)	°C	90
Noise Design Parameters		
Unless otherwise stated, noise levels measured 10.0m from the plant item and at 1.2m above ground level, in free field conditions.		
CHP unit	dB(A)	65
Intercooler and dump radiator(s). Radiator noise assessment to be in accordance with BS13487:2003.	dB(A)	65



Section: 4 Commercial Conditions

Commercial conditions are undertaken as a separate negotiation directly with the client.



Section: 5 CHP Performance Data

CHP Performance Data

Technical data of the unit

Electrical output:	2000 kW at a cos φ 1
Heat Output (without exhaust heat recovery)**:	1043 kW
Heat Output (with exhaust recovery)**:	1953 kW, at an exhaust heat exchanger of 180 °C
NOx emissions:	500 mg/Nm ³ (@5% O ₂)
CO emissions:	≤ 1400 mg/Nm ³ (@5% O ₂)

Design conditions		
Suction temperature / air humidity	°C / %	25 / 60
Site altitude:	m	100
Fuel data		
Fuel gas		Biogas
Methane number / lower heating value	- /	141/5.56
Gas density	kg/m ³ NC	1.25
Unit		
Engine	TCG 2020 V20	
Alternator	Marelli MJB 560 LB4	
Voltage / voltage range	V / %	400 / ± 10
Frequency	Hz	50
Energy balance		
Electrical Output at cos φ = 1	kW	2000
HT mixture cooling water heat (± 8%)	kW	1043
LT mixture cooling water heat (± 8%)	kW	132
Exhaust gas temperature after heat exchanger	°C	180
Exhaust heat (± 8%)*	kW	910
Fuel consumption (+ 5%)*{LCV}	kW	4684
Electrical efficiency*	%	42.7
Thermal efficiency*	%	41.7
Total efficiency*	%	84.4

*Subject to ISO 3046 tolerances, at 1,000 mbar of air pressure, air temperature 25° C, relative humidity 60% and cos φ =1.

**+/-8% tolerances

Auxiliary (Parasitic) Loads

The parasitic load on the container will vary during running and when the engine is stopped due to the operating conditions. Apart from the jacket and intercooler water pumps, and the intercooler radiator fans, electric motors will, where applicable, be variable speed and therefore will not be drawing their full rating very often. A list (not exhaustive) of electrical power consumers within the container is given below. Estimated power consumption, actual ratings can be detailed after order acceptance and agreed design.

Auxiliary Loads		Jacket Only Heat Recovery	Including Exhaust Heat Recovery
Fixed Load			
Jacket Water Pump	kWe	11	11
Intercooler Pump	kWe	7.5	7.5
Control Panel	kWe	1.0	1.0
Variable Load			
Ventilation Fans	kWe	15.2	15.2
Intercooler Radiator	kWe	3	3
Dump Radiator	kWe	5.5	7.2
Dump Circulating Pump	kWe		4.0
Standing Auxiliary Loads			
Pre-Lube Pump	kWe	1.1	1.1
Fresh Oil Pump	kWe	1.5	1.5
Jacket Water Heater	kWe	9	9

Other parasitic loads outside of CHP unit operation would be:-

- Gas blower.
- Gas dryer.
- LTHW pump.
- Electrical transformer / cable losses.



Section: 6 Generating Set Technical Specification

TCG 2020 TECHNICAL DESCRIPTION



Picture may differ from actual engine

1. Unit

1.1 ENGINE TCG2020

Modern, highly efficient stationary Otto four-stroke engine with a lean-burning V engine: water-cooled with mixture exhaust turbo charging and mixture cooling; anti-clockwise rotation direction in accordance with DIN 6265 (seen from flywheel side).

Engine components:

- One-piece, rigid, ventilated crankcase.
- Gear-driven propulsion unit with low level of wear and tear.
- Single cylinder heads with four valves and seat rings, optimised turbulence swirl, spark plugs positioned centrally in the combustion chamber, intensive cooling for the spark plug bases which enables optimum combustion characteristics.
- Gear-driven camshaft in the V-chamber for both rows of cylinders, controlling two inlet and outlet valves per cylinder, O-rings provide oil seals on the valve shanks.
- Wear-free, microprocessor-controlled high-voltage ignition system with low voltage distribution, one ignition coil per cylinder and battery-buffered voltage supply.
- Anti-knock system with knocking sensor to monitor every cylinder, enabling knock-free operation with the best possible output at the highest level of efficiency, all whilst keeping within emissions limits.
- The volume ratio of gas and air in the multi-gas mixer is measured by means of air extraction via a dry air filter (with optical maintenance indicator) and is supplied with gas from the DVGW proofed safety gas train.
- Exhaust turbocharger condenses the gas mixture, final return cooling takes place in a 2 stage mixture cooler (low temperature setting in a separate cooling circuit).
- Fast-reacting throttle to regulate the power.

- Electronic regulation and monitoring of the power/speed and of the air/gas mixture at the mixer/actuator via the combustion chamber temperature (1 temperature sensor per cylinder), by the MWM TEM-system.
- Mean combustion temperature of each individual cylinder is measured to regulate the exhaust emissions.
- Highly efficient electric starter; flange-mounted to the crankcase.
- Forced lubrication by means of a gear pump, lubricant heat exchanger is integrated into the engine cooling circuit; oil filter present in the main stream.
- Connection to the cooling water pipes and vibration decoupling via rubber compensators with counter flanges.
- Exhaust outlet with stainless steel compensator and counter flange for connection to the exhaust pipe.
- Knock sensors, sensors to check the position of the gas mixers, sensors to check the following: cooling water temperature, suction air, oil temperature, combustion chamber temperature, exhaust gas temperature, oil level, oil pressure, crankcase pressure and speed. Actuator for the throttle, gas mixer, control for pre-heating the cooling water. Ignition coil is completely cabled onto two central connection members (1 connection member per row of cylinders), cables can be removed.

Unit test runs:

The engine itself is subjected to a test run in the manufacturer's facility. The test runs take place on calibrated test stands. The test records are supplied with the documentation.

Corrosion protection:

Standard protection of the engine respectively the genset to guard against corrosion during transport and extended storage at the place of destination; maximum length of protection is 24 months after delivery, assuming the genset is stored in a closed dry environment

1.2 THREE-PHASE INTERNAL POLE SYNCHRONOUS ALTERNATOR

Three phase synchronous alternator, brushless, self-inducing, self-regulating, with damper cage for 30% asymmetric load and parallel operation. Soluble neutral point, protection type IP23, with Protection against tropical and humid conditions (max. 70% humidity), "N" radio interference suppression grade, for a maximum 1000 m installation height and 40°C ambient temperature.

General assembly

The alternator is composed of the main alternator as an internal pole alternator, an exciter alternator as an outer pole alternator and a voltage regulator with a power output stage, and is supplied via auxiliary winding or via the alternator output terminal, the supply being regulated according to output.

The exciter stator is supplied according to output via the voltage regulator. The three phase alternating current is aligned over the rotating diode disc and is then directed to the cogwheel of the alternator. The voltage of the main alternator is held constant when the load changes by changing the exciting current using the thyristor actuator in the voltage regulator.



Construction type

Construction B20 in accordance with DIN 42950, IM 1101 in accordance with IEC 60034-7, according to this construction type, the generator feet are installed underneath the bearings.

Protection type and ventilation

The protection type IP23 in accordance with IEC 60034-5 is made possible due to the ventilation type IC 01 in accordance with IEC 60034-6 with internal cooling and self-ventilation.

Stator

The stator winding corresponds to insulation class H / Utilization according to data sheet in accordance with VDE 0530/IEC 60034.

Rotor

The stator winding corresponds to insulation class H / Utilization according to data sheet in accordance with VDE 0530/IEC 60034.

The rotor is balanced as standard using a half feather key of the precision class G 2.5 in accordance with VDE 0530/IEC 60034, part 14. The absolute maximum rotational speed is 2250 rpm for 4-pole alternators and 1.25 x nominal speed for 6- and 8-pole alternators.

Winding

The alternator is equipped with a 2/3-step winding in order to suppress the harmonic content in the neutral point in the case of non-linear loads. The winding is insulated with high quality cast resin that is applied with latest procedure (VPI).

Shaft bearing

The alternator is built as a 2 bearing machine with regreasable anti-friction bearings. The drive-end side is designed as fixed bearing and the non- drive-end-side as loose bearing

Regulation system

Analog Voltage Regulator MARK I, mounted in auxiliary terminal box with a nominal voltage setting $\pm 10\%$ UN.

Standards and regulations

IEC 60034-1, EN 60034-1, BS 4999-5000, VDE 0530, DIN 6280-3, VDE 0530, NF 51-100, OVE M-10, NEMA MG 1.22, ISO 8528-3

Standard components / assembly groups

- Central terminal box with main terminal and grounded neutral point, auxiliary terminal boxes for the voltage regulator and terminal strip for accessories
- Cos-phi and reactive power controller with voltage tracking
- Static converter for alternators and parallel network operation
- Temperature monitors (6 pcs.) PT 100 – sensor in the winding (3x active, 3x replacement)
- Temperature monitors (1 pc each.) PT 100 – sensor per bearing
- Heating when stationary: 230 V $\pm 5\%$, 2 pieces 200 W

- By standard there are no Current transformers for measuring purposes or protection included.
- By standard with anti-magnetic plate without cable flange and without glands.

Electrical data and characteristics

- Voltage precision, static $\pm 0.5 \dots 1 \%$
- rotational speed changing $\pm 2\%$, cold and warm engine
- Voltage curve Ph Ph tick-over, deviation $< 5\%$ (voltage harmonic content)
- THD distortion factor (Total Harmonic Distortion) $\leq 2\%$
- Radio interference suppression grade THF (Telephonic Harmonic Factor) $< 2\%$, in accordance with IEC 60034-1 / VDE 0530
- Sustained short circuit current for a three pin terminal short circuit: $> 3 \times$ nominal current for 5s
- Overload capacity 10% for 1 hour within 6 hours, in accordance with IEC 60034-1 / VDE 0530
- In accordance with VDE 0530, the maximum rotational speed is determined by means of a centrifuge test with 1.2 times the nominal speed for 2 minutes

1.3 UNIT COMPONENTS

Base frame

Steel construction is bend resistant and torsionally stiff to support the engine and alternator. Steel spring elements are installed underneath the base frame, which will be delivered loose.

Coupling

Highly elastic, axially pluggable flange coupling that allows for the torsionally elastic connection of the engine and alternator. The disc-shaped rubber portion lessens torsional oscillation to a high degree. The rubber portion can be radially dismounted.

Regulating the oil level

Automatic oil level regulation. Regulation by an immersion probe connected to the oil level monitoring (min/max.) and control of the solenoid valves and clean oil pump that tops up the lubricant.

Pre-lubricating pump

An electrical pump on the unit performs the pre-lubrication; this can be emptied via the same type of pump after the three-way stopcock has been configured.

Air filter

Microfiber dry air filter with optical maintenance indicator.

Additional parts for the unit

The following additional components form part of the packaged unit.

- 1 set of maintenance-free steel spring elements, the height of which can be adjusted to enable the unit to be aligned onto the on-site foundation. These bearing elements enable a vibration isolation level of 88-94% to be reached. Mechanical vibration is reduced by means of a rubber moulded frame on the underside of the bearing

- 2 solenoid valves with connecting parts to enable the flow of lubricant.
- 1 set of flexible hoses for the lubricant inflow and outflow connections
- 1 insulating mat for the exhaust compensator
- 1 oil separator for crankcase ventilation with integrated filtration of oil mist, directing it back towards the engine.
- 1 vacuum regulator to be installed onto the oil separator.
- 1 set of parts to install the oil separator.`
- 1 can of retouch paint RAL 5010, gentian violet

1.4 GENSET ASSEMBLY

Assembly

The gas engine and alternator are elastically coupled and built onto a shared base frame, enabling a sprung vibration-insulated installation on a suitable on-site foundation.

Paint

Robust paint composed of:

- Undercoating present for otherwise non-coated components that are made from stainless steel, non-ferrous metals, galvanised and chromed parts, dry layer thickness $10^{+5} \mu\text{m}$
- Primer for complete unit, dry layer thickness $40^{+30} \mu\text{m}$
- Coating in hue RAL 5010, gentian violet for the complete unit, dry layer thickness $90^{+40} \mu\text{m}$

Wiring

Clustering of all cables on a clamping rail for easy connection with TEM-system via plug-in connectors

1.5 ZERO-PRESSURE GAS CONTROLLED SYSTEM AND ACCESSORIES FOR CONNECTION

Zero-pressure gas controlled system

Safety gas controlled system as a compact unit in accordance with the German Technical and Scientific Association for Gas and Water (DVGW)

Operating side in gas flow direction right, composed of:

- 1 ballcock
- 1 gas filter
- 1 pressure gauge
- 1 pressure monitor
- 1 double solenoid valve
- 1 flame arrester (only on biogas applications)
- 1 temperature sensor (only on biogas applications)
- 1 zero pressure regulator
- 2 counter flanges to install the gas controlled system into the gas piping
- 1 seal monitoring unit

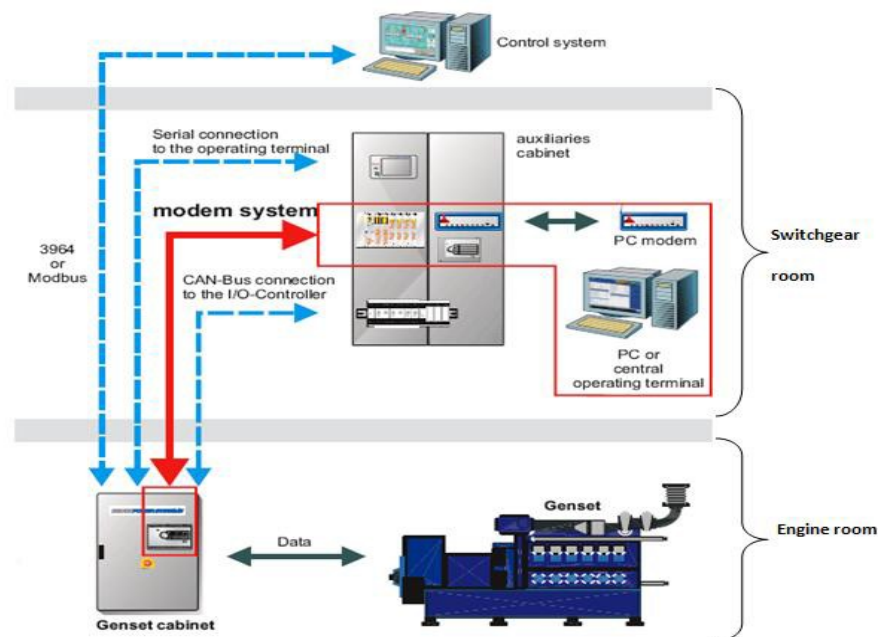
The equipment present on the gas controlled system may vary slightly depending on the type of gas and operation.

1.6 MOTOR CONTROL UNIT “TEM-EVO”-SYSTEM (mounted local to unit within enclosure)

The MWM Total Electronic Management (TEM)-system can control and monitor all the functions of a gas engine and the engine auxiliary drive in one unit. The monitoring functions protect the engine from breaching permitted limits and guarantees high running times. The TEM-EVO system regulates and optimises the gas combustion in the cylinders. Integrated regulatory functions enable optimised and reproducible engine values in all modes of operation. It is possible to adapt the TEM-EVO system to best match certain applications using a wide range of options.

Only a protection device, a synchronisation device, alternator/ network protection and an effective power measurement device are to be located in the auxiliary unit switch cabinet in addition to the TEM-EVO system.

Structure



The TEM-EVO system is composed of 3 components:

Genset switch cabinet (“AGS”)

Completely wired to the genset; contains the genset controls and the safety chain, which has been tested by the TÜV ([German Association for Technical Inspection](#)). A maximum of 8m (resp. 15 m) of wiring may be positioned between the cabinet and the connection to the engine.

I/O controller

To be built into the auxiliary unit switch cabinet (“HAS”, maximum of 250m distance from the unit switch cabinet, to be connected with three-way shielded bus lines).

Operating computer

Max. 100 m distance from the genset switch cabinet; to be connected with three-way shielded wiring.

The system is flexible, and can be easily adapted to the local conditions. Both the tendency to develop faults and the wiring time on the system are minimised.

The unit switch cabinet is to be installed in close proximity to the unit. Together with the engine wiring (tested in the factory), the ready-connected, fully tested wiring that links the unit switch cabinet to the unit (connected to the unit using plug-in connectors) guarantees a high level of operational safety and a problem-free activation.

The signals valid for the power unit are exchanged with the TEM-EVO system in the auxiliary unit switch cabinet. The data is then transferred to the unit control system via a CAN bus connection.

Basic functions

- Start and stop programmes run automatically for the gas unit
- Exhaust emissions can be reliably set to a low value
- Integrated digital regulation of speed and output
- TÜV ([German Association for Technical Inspection](#)) tested safety chain
- Actuators and sensors are connected to the *I/O controller* in the auxiliary unit cabinet. The data transfer takes place via CAN bus or direct to the TEM-EVO unit cabinet.
- Monitors all the sensors on the unit
- Monitors the engine cooling water
- Controls and monitors the lubricant circuit, including pre- and post- lubrication as well as oil changing
- Test mode to test the actuators, sensors and auxiliary units that are connected to the system
- Electronic curve plotter to generate measured values for testing and diagnosis purposes over 40 h/6 min time periods as well in sync with the operating cycle
- Electronic operational log to record warning, fault and operation messages with the date and time at which they occurred, enabling system operation to be monitored in detail.
- Electronic counting of operating hours with a breakdown in 5 load ranges
- An operating computer can be connected
- [MK] Engine cooling water regulation: the cooling water circuit regulation ensures that the cooling water remains at the optimum temperature by activating a three-way valve. If a partial load is present, then the cooling water inlet temperature is increased
- [GK] Mixture cooling circuit: the mixture cooling water inlet temperature is regulated by activating a regulatory valve in the mixture cooling water circuit; monitors the receiver temperature
- [IOC] I/O controller: the auxiliary units, pumps valves, etc. are controlled by the I/O controller and the associated measured values are recorded. The I/O controller is supplied loose and is to be installed into the auxiliary unit switch cabinet
- [16M] 16 parameterisable messages: digital inputs with extensive parametry options to enable systems-specific faults, warnings or messages to be sent directly to the TEM-EVO system. This makes monitoring a unit much simpler and is made much more transparent due to the protocol function in the

operating log. The parameterisable messages are stored as potential-free contacts on the *I/O controller* in the auxiliary unit switch cabinet.

- [SER] Serial coupling for data exchange: data exchange such as nominal values, measured values, messages, warnings and fault notifications take place via the serial coupling and the overriding control system by means of protocol 3964R with RK512 via TTY or CS 20mA. The wiring between the TEM-EVO and the overriding control system must not exceed 100 m.
- [AKRK] Anti-knock regulation: highly dynamic anti-knock regulation, individual for every cylinder, this ensures safe operation of the engine even if a low methane number is present. Highest possible output with the highest levels of efficiency, whilst keeping within permitted emissions values
- [BSX], [BSXK] Preliminary equipment for an eService system [BSX] with wiring set [BSXK]: preliminary equipment to set up remote control for the TEM-EVO (BSX): every TEM-EVO system must have either a mechanical changeover switch or an intelligent selection unit (IEA) connected to the eService modem system
- [SPC] Connection for service PC: robust service plug socket on the TEM-EVO unit switch cabinet. Connecting the service PC interrupts the connection to the operating computer through a control unit (or to the modem, if one is present). The TEM-EVO system can be operated via the service PC

Extended functions (Depending on Application)

- [HK] Heat recovery with the heating circuit: safety extended to monitor the heating circuit and regulate the engine cooling water inlet temperature as well as the heating circuit lead temperature by activating the three-way valve in the heating circuit. Measurement of the lead and return temperatures, the temperature of the heating water before the cooling water heat exchanger, monitoring of the exhaust temperature after the exhaust heat exchanger. The heating circuit regulation ensures that the heating water lead temperature remains constant even when the engine is under only partial load, and ensures that the engine's demands regarding the cooling water temperature are catered for.
- [AWT/MK1] Bypassing the minimum pressure limiter and measuring temperature: additional safety time-delay relay to bypass the "minimum pressure limiter" signal in the safety chain. Measurement of the temperature after AWT and of the hot water temperature before the emergency cooling circuit.
- [NK/BY] Dump cooling circuit and exhaust bypass control
- [CH₄/CH₄K] (only on biogas applications) CH₄ application incl. upgrade: The purpose of the CH₄ application option is to adapt the operating performance optimally to the changing ratios in the case of systems with varying CH₄ contents in the fuel gas, for example, at landfill gas sites. Automatic de-selection and restart of the unit if a set CH₄ value is undercut or exceeded. Calibration of the CH₄ sensor when system is running. Automatic acknowledgement of the "gas pressure low" fault and restart of the unit as soon as the gas pressure returns to an acceptable level. This option is not necessary if the range of fluctuation between the highest and lowest CH₄ value is less than 5%
- [CON] Converter from TTY in accordance with RS232: Converter from TTY in accordance with RS232 for system control without a TTY interface. The TTY external converter (top-hat rail model) in accordance with RS232 is to be positioned within 3 m of the overriding control

- [2MW] Parameterisable counter values: analogue inputs that can be parameterised in various ways to show system-specific measured values and to monitor limit values. For each measured value, two limit values can be parameterised. Should these be exceeded or undercut, a fault notification, a warning or a message will be displayed. This makes monitoring a unit much simpler and is made much more unambiguous due to both the protocol function in the operating log and the history function
- [BRT] Operating computer: to enable simple operation of the unit with TEM-EVO using a touch monitor with 15" TFT colour display and USB ports for printers, key dongles or USB sticks

Operation

An intelligent operating computer ensures easy interaction with the TEM-EVO system, through which all function can be accessed. The operation computer is equipped with a 15" TFT touch monitor. The touch function of the operating computer enables easy and intuitive operation of the unit.

With the navigation bar, the user can quickly and directly change between interfaces to operate the unit. Each operating computer interface informs the operator of the current status of the connected unit. All the regulatory, service, control and monitoring functions can be operated conveniently without the need for lengthy training.

The operating unit is positioned in the CHP control Panel. Communication with the user can take place in one of the many languages that are provided in the TEM-EVO. The language can be changed at any time at the press of a button. For maintenance purposes, a different language to the one normally used by system personnel can be temporarily assigned. All the important information and operational options relevant for normal operation are clearly summarised in the "Operation" interface (see fig. 1; following illustration contains options).

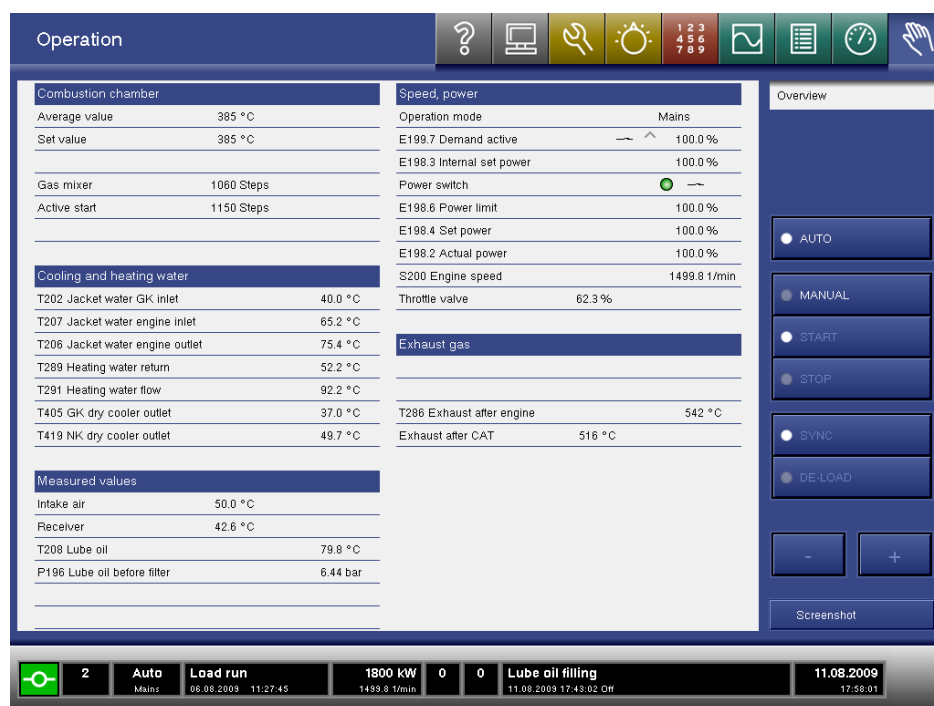


Fig. 1. All the most important information and operational function at a glance

Operation Log

The electronic operation log (fig.2) of the TEM-EVO system makes operating the gas unit and its peripheral equipment clear due to its logging functions. All operating messages, switching operations that are relevant to operation and every parameter change are logged with an exact time stamp (date/time).

In total, the TEM-EVO system can monitor and distinguish over 600 different events. This enables a fast and detailed analysis of the operating method of the unit including the auxiliary functions that are controlled by the TEM-EVO.

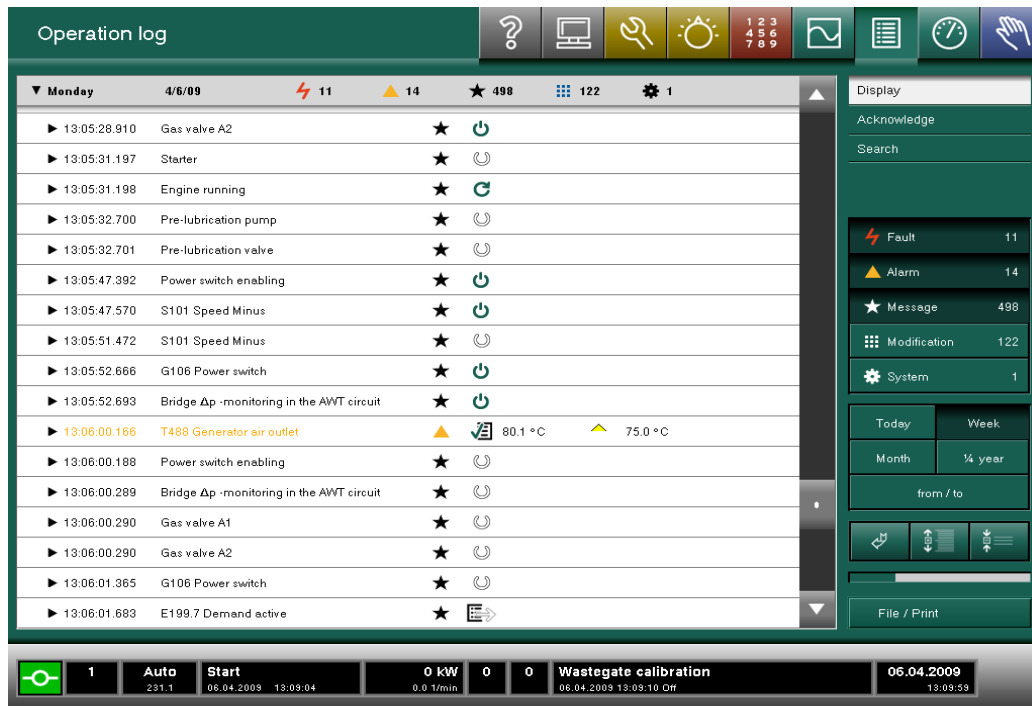


Fig.2. Logging functions of the operation log

History function

The history function records up to 84 measured values. Up to 18 measured value curves can be depicted together in one diagram. The user can individually compile the measured value curves. The TEM-EVO system records the history in three speed levels:

- Working cycle history: the current value is recorded in every working cycle (1 working cycle corresponds to 2 rotations of the crankshaft)
- 6 min. history: current values recorded every second
- 40 hr. history: mean values recorded every 6 minutes



The curves can be retracted using the cursor, and the relevant measured value is displayed as a numerical value with an exact time stamp. Should a fault occur, recording stops after 40 seconds to make diagnosing the fault easier to find. The “Real time scope” function enables continuous observation of measured values and regulatory functions.

Diagnosis/service functions

In addition to the history and operating log functions, the TEM-EVO system contains other diagnosis and service functions that play a large part in ensuring a higher level of availability of the gas engine module. Putting the machine into service is also made considerably easier and faster by these functions. This plays a large part in ensuring the total cost-effectiveness of the gas engine module.

There are interfaces for servicing and diagnosing:

- Auxiliary unit test mode
- Digital speed counter
- Electronic ignition system
- Parameterisation
- Oil change
- Electronic operating hours counter
- Language and printer selection
- System setup (software versions, serial number, colour settings, screensaver, etc.)
- As options, there are sometimes other diagnosis and service interfaces (e.g. anti-knock regulation, dual gas operation, etc.)



Remote diagnosis

The service, diagnosis and all other interfaces can be accessed via the normal telephone network using a modem to transfer data. With this function, remote diagnosis and remote maintenance can be carried out with exceptionally short reaction times by Edina customer service or customer's own customer stand-by staff.

Modem system

The TEM-EVO modem system enables the units to be operated easily by remote. Any of the functions that can be performed at the operating computer on site can also be performed over the modem system.

The TEM-EVO modem system makes accessing the system via the analogue telephone network or a GSM-Modem or an IP-Modem possible. Using this method, a head office (service or call-out service) that is equipped with the TEM-EVO PC package can access, view and operate the unit connected to the modem system.

The two-level security system (password request and automatic call-back function) of the TEM-EVO system protects the unit from unauthorised access. The TEM-EVO can be physically separated from the modem by using a mode selector switch that manually switches system access on and off. With this, the unit cannot be viewed or operated externally via a modem, e.g. if repairs need to be carried out.

The following items are included with the TEM-EVO: the preliminary equipment for the modem (BSX) including the mode selector switch, the cable needed to attach the modem system (BSXK), as well as the analogue modem (eServ).

Delivery specifications and technical data

1 TEM-EVO switch cabinet:

Type of protection:	IP 54
Operating temperatures:	5 – 45°C

1 x I/O-Controller:

Measurements:	99 x 114 (W x H) mm
Length (dependent on the number of optional parts):	120 – 700 mm
Type of protection:	IP 20
Operating temperature:	5 – 50°C

1 x operating computer with colour display:

Measurements:	310 x 483 x 115 (H x W x D) mm
Type of protection on the front:	IP 65
Operating temperature:	5 – 50°C

The unit wiring set is tested and is ready-installed onto the unit switch cabinet and is composed of 6 pre-assembled wiring harnesses with robust plug connections that are easy to tell apart from one another. It is to be used to connect the unit and the TEM-EVO switch cabinet together (length: 8 metres).



2. OPERATING AND CONSUMABLE SUBSTANCES

The following points apply to characteristics of the operating and auxiliary substances such as lubricant oil, combustion air, engine cooling fluid and combustion gas.

The engine unit properties, the maintenance schedule and the emission values are only applicable if the “minimum qualities of combustion gas” and the required minimum water qualities are observed and adhered to. This also applies to the lubricant, which must be kept in accordance with the recommendations made by the manufacturer.

When using lubricants, the replacement Technical Bulletin 0199-99-2105, 13, dated 4.08.2012 is to be observed.

The replacement Technical Bulletin 0199-99-02091, 9, dated 12.08.2011 is authoritative when ensuring the water quality for engine coolant fluid and water quality in the heating circuits.

The replacement Technical Bulletin 0199-99-3017, 4, dated 01.11.2008 is authoritative in ensuring the approved combustion gas quality needed to operate MWM engines.

The requirements for the combustion air and suction air in the replacement Technical Bulletin 0199-99-2132, 3, dated 20.08.2012 is to be observed.

Technical data
2000 kWel; 400 V, 50 Hz; Bio gas

Design conditions

Comb. air temperature / rel. Humidity:	[°C] / [%]	25 / 60
Altitude:	[m]	100
Exhaust temp. after heat exchanger:	[°C]	180
NO _x Emission (tolerance - 8%):	[mg/Nm ³ @5%O ₂]	500

Genset:

Engine:	TCG2020V20	
Speed:	[1/min]	1500
Configuration / number of cylinders:	[-]	V / 20
Bore / Stroke / Displacement:	[mm]/[mm]/[dm ³]	170 / 195 / 89
Compression ratio:	[-]	13,5
Mean piston speed:	[m/s]	9,8
Mean lube oil consumption at full load:	[g/kWh]	0,2
Engine-management-system:	[-]	TEM EVO
Generator:	Marelli MJB 560 LB4	
Voltage / voltage range / cos Phi:	[V] / [%] / [-]	400 / ±10 / 1
Speed / frequency:	[1/min] / [Hz]	1500 / 50

Fuel gas data: 2)

Methane number:	[-]	141
Lower calorific value:	[kWh/Nm ³]	5,56
Gas density:	[kg/Nm ³]	1,25
Standard gas:	Bio gas	
Analysis: CO ₂	[Vol%]	40,00
N ₂	[Vol%]	4,70
O ₂	[Vol%]	0,30
H ₂	[Vol%]	0,00
CO	[Vol%]	0,00
CH ₄	[Vol%]	55,00
C ₂ H ₄	[Vol%]	0,00
C ₂ H ₆	[Vol%]	0,00
C ₃ H ₆	[Vol%]	0,00
C ₃ H ₈	[Vol%]	0,00
C ₄ H ₈	[Vol%]	0,00
C ₄ H ₁₀	[Vol%]	0,00
C ₅ H ₁₂	[Vol%]	0,00
C _x H _y	[Vol%]	0,00
H ₂ S	[Vol%]	0,00

Energy balance

Load:	[%]	100	75	50
Electrical power COP acc. ISO 8528-1:	[kW]	2000	1500	1000
Engine jacket water heat:	[kW ±8%]	1043	806	584
Intercooler LT heat:	[kW ±8%]	132	88	53
Lube oil heat:	[kW ±8%]			
Exhaust heat with temp. after heat exchanger:	[kW ±8%]	910	752	567
Exhaust temperature:	[°C]	459	482	507
Exhaust mass flow, wet:	[kg/h]	10509	7998	5557
Combustion mass air flow:	[kg/h]	9443	7174	4975
Radiation heat engine / generator:	[kW ±8%]	72 / 54	68 / 45	61 / 39
Fuel consumption:	[kW+5%]	4684	3619	2554
Electrical / thermal efficiency:	[%]	42,7 / 41,7	41,4 / 43,0	39,1 / 45,1
Total efficiency:	[%]	84,4	84,4	84,2

System parameters 1)

Ventilation air flow (comb. air incl.) with ΔT = 15K	[kg/h]	50300
Combustion air temperature minimum / design:	[°C]	5 / 25
Exhaust back pressure from / to:	[mbar]	30 / 50
Maximum pressure loss in front of air cleaner:	[mbar]	5
Zero-pressure gas control unit selectable from / to: 2)	[mbar]	20 / 200
Pre-pressure gas control unit selectable from / to: 2)	[bar]	0,5 / 10
Starter battery 24V, capacity required:	[Ah]	430
Starter motor:	[kWel.] / [VDC]	15 / 24
Lube oil content engine / base frame:	[dm ³]	300 / -
Dry weight engine / genset:	[kg]	8070 / 17900

Cooling system

Glycol content engine jacket water / intercooler:	[% Vol.]	35 / 35
Water volume engine jacket / intercooler:	[dm ³]	210 / 25
KVS / Cv value engine jacket water / intercooler:	[m ³ /h]	58 / 52
Jacket water coolant temperature in / out:	[°C]	80 / 93
Intercooler coolant temperature in / out:	[°C]	50 / 53
Engine jacket water flow rate from / to:	[m ³ /h]	60 / 85
Water flow rate engine jacket water / intercooler:	[m ³ /h]	74 / 40
Water pressure loss engine jacket water / intercooler:	[bar]	1,6 / 0,6

1) See also "Layout of power plants":

2) See also Techn. Circular 0199-99-3017

1) See also "Layout of power plants"		2) See also Techn. Circular 0199-99-3017																																													
Frequency band f [Hz]	25	31,5	40	50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.25k	1.6k	2k	2.5k	3.15k	4k	5k	6.3k	8k	10k	12.5k	16k	L _{WA} [dB(A)]	S [m ²]																
Air-borne noise ³⁾ L _{W, Terz} [dB(1in)]	95	97	98	100	106	111	112	119	114	116	117	112	112	114	112	111	112	110	111	111	109	107	106	106	109	120	105	99	99	124	140																
Exhaust noise ⁴⁾ L _{W, Octave} [dB(1/3)]	7383f			132			141			134			131			130			129			126			120			36			136	15,5															
OCTOBER 2018																																															
3) DIN EN ISO 3746																4) DIN 45635-11 Appendix A (+3 dB)											L _W : Sound power level											S: Area of measurement surface (S _m =1m ²)									

3) DIN EN ISO 3746

4) DIN 45635-11 Appendix A (±3 dB)

L_W: Sound power level

S: Area of measurement surface (S₀=1m²)

MJB 560 LB 4

50 Hz 1500 rpm

Wickelschema	Winding Code	80
Wickelschritt	Winding Pitch	2/3
Übertemperatur	Temperature Rise	F
Isolationsklasse	Insulation	H
Schutzart	Protection Degree	IP 23
Leistungsfaktor	Power Factor	0,8
Schleuderdrehzahl	Overspeed	2250 rpm
Klemmenzahl	Number of Terminals	6
Kühllufttemperatur	Cooling Temperature	40 °C
Kühlart	Method of Cooling	IC 01
Kühlluftmenge	Cooling Air Volume	3,00 m³/s
Aufstellhöhe	Altitude at Site	1000 m
Gewicht	Weight	7250 kg
Trägheitsmoment	Inertia	98,00 kgm²
Gesamtverluste	Total losses	69,4 kW
Strahlungswärme	Radiated Heat	3,5 kW

FREQUENZ	FREQUENCY					Hz	50
SPANNUNG	VOLTAGE (± 10%)					V	400
STROM	CURRENT					A	3581
NENNLEISTUNG	RATED POWER @ 0,8 p.f.					kVA	2481
LEISTUNG - RATING	kVA	2481	2101	2000	2103		
LEISTUNGSFAKTOR – POWER FACTOR	p.f.	0,8	0,95	1,0	0,95		
WIRKUNGSGRAD - EFFICIENCY - (%)	110%	96,61	97,20	97,40	97,25		
	100%	96,62	97,16	97,35	97,23		
	90%	96,60	97,10	97,27	97,14		
	75%	96,48	96,91	97,07	96,98		
	50%	95,82	96,14	96,28	96,23		
	25%	93,19	93,39	93,52	93,55		
		übererregt overexcited		untererregt underexcited			

			unsat	sat	
Reaktanzen - Reactances (%)	Synchron, d-Achse	Synchronous, d-axis	Xd	230	211
	Synchron, q-Achse	Synchronous, q-axis	Xq	129	123
	Transient, d-Achse	Transient, d-axis	Xd'	25,7	24,6
	Transient, q-Achse	Transient, q-axis	Xq'	129	123
	Subtransient, d-Achse	Subtransient, d-axis	Xd''	14,3	12,4
	Subtransient, q-Achse	Subtransient, q-axis	Xq''	14,9	12,9
	Invers-System	Invers-sequence	X2	14,6	12,7
	Null-System	Zero-Sequence	X0	4,8	4,2
Widerstände - Resistances (%)	Null-System	Zero-Sequence	R0	0,80	
	Mit-System	Positive-Sequence	R1	0,74	
	Invers-System	Negative-Sequence	R2	1,07	
	Stator (@ 20°C)	Armature (@ 20°)	Ra	0,53	
Zeitkonstanten - Time constants (s)	Transient, d-Achse	Transient, d-axis (1)	T'd0	4,900	
	Transient, d-Achse	Transient, d-axis (2)	Td'	0,550	
	Subtransient, d-Achse	Subtransient, d-axis (2)	Td''	0,025	
	Gleichstrom	Armature	Ta	0,056	
Kurzschlussdaten - Short circuit data					
Anfangskurzschlusswechselstrom 3~ (kA)	Initial short circuit current 3~ (kA)		Ik''	37,1	
Stosskurzschlussstrom 3~ (kA)	Max. peak current 3~ (kA)		Is	76,2	
Dauerkurzschlussstrom 3~ (kA)	Sustained short circuit current 3~ (kA)		Ik	13,4	
Leerlauf-Kurzschluss-Verhältnis	Short circuit ratio		Kc	0,47	
Stosskurzschlussmoment 2~ (kNm)	Initial short circuit torque 2~ (kNm)		Mk2	189,3	
TVD bei Aufschaltung der Nennlast (%)	TVD at rated load step (%)		ΔU	22,0	
Max. Laststoss für ΔU = 15 %	Max. load step at low PF for TVD = 15 %		ΔSmax	1505 kVA	

Vorschriften - Standards : VDE 0530 ; IEC 60034-1 ; BS 4999-5000

Wenn der Generator nach UL gebaut und zertifiziert wird, gilt das selbe Datenblatt.

If alternator is manufactured and certified acc. to UL, the same datasheet is valid.

2054 kWmech



Section 7: Ancillary Equipment

NOT USED



Section: 8 Project Programme

- No project programme is detailed.
- The standard delivery schedule for a containerised 2000kWe generation set is eight months from acceptance of order:
Assuming the order is confirmed by September 15th 2015
this would be May 15th
- For proper installation and preparation the delivery on site shall be at least 2 month before scheduled G.59 acceptance test.
- Quicker delivery may be available on request.
- Further to receipt of an order, Edina will confirm the delivery time, and a full preliminary project plan will be prepared.



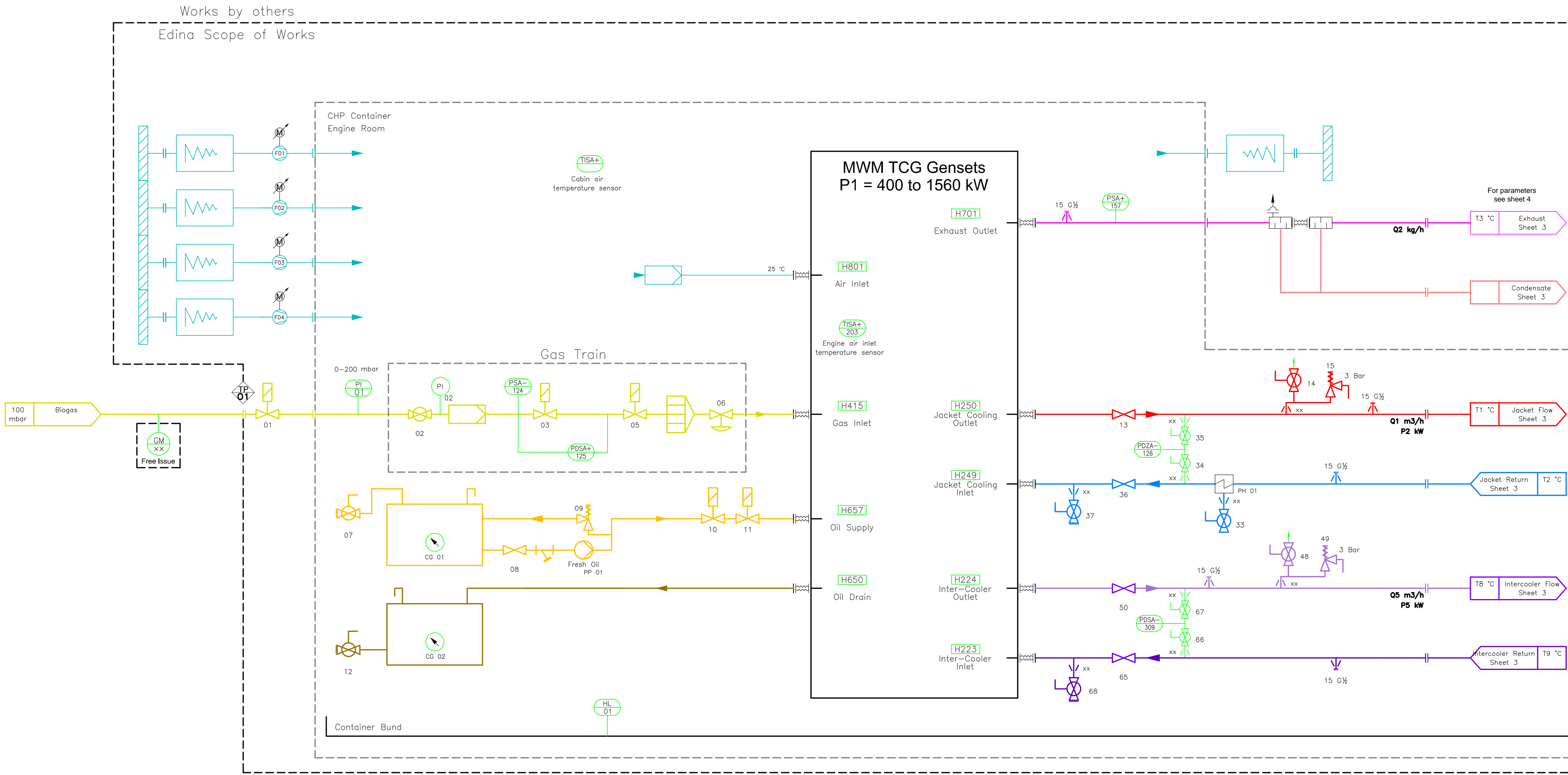
Section: 9 Drawings

The following drawings are submitted to support our offer. They are preliminary and are not to be used for construction. Formal drawings will be submitted at the contract stage:

- CHP Unit General Arrangement Drawing 2MWe with exhaust gas heat recovery
- Typical P&I diagram for Engine Package.
- Single Line Diagram

Notes:

1. THIS DRAWING IS PRELIMINARY ONLY, AND MUST NOT BE USED FOR DETAILED DESIGN.
2. Design ambient temperature of -10 to +30 °C
3. Noise specifications as shown: To meet max. 65 dBA @ 1m in free field conditions for the exhaust silencers, enclosure ventilation and dry coolers operating together



P01 Jacket dry cooler return temp corrected DM PA TL 05/01/15

Rev Description By Ckd App Date

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Units 12-13 Rugby Park
Bletchley Road, Stockport
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T: +44 (0) 161 432 8833 F: +44 (0) 161 975 1499
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Drawn: DM Checked: WJP Client Drawing No.

Date: 10/07/14 Approved: TL

Client:

Project: Generic

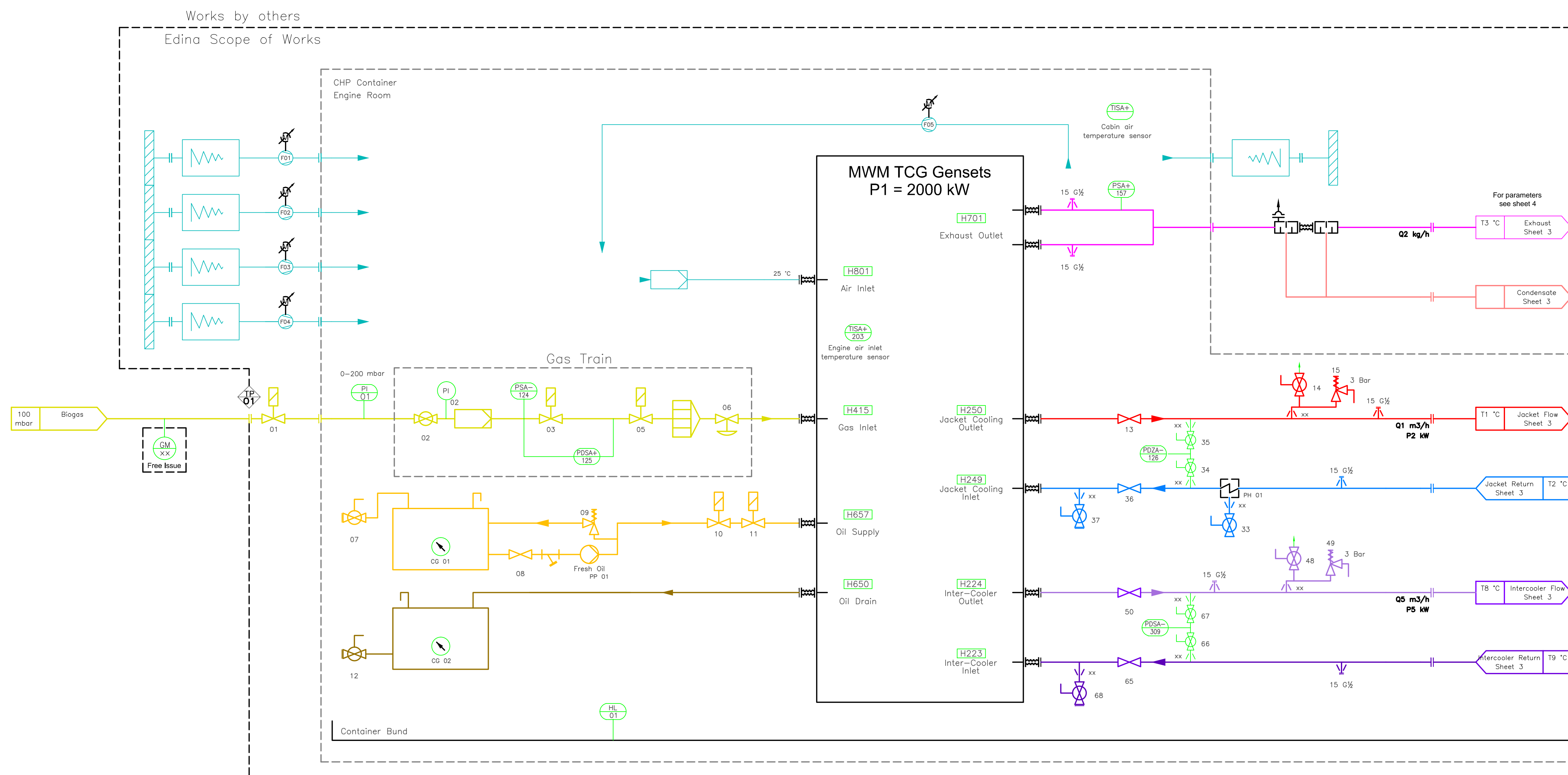
Title: Biogas P & ID - 400-2000 kW

Sheet 1 of 4 Sheet Title: CHP Engine Room - 400-1560 kW

Status: Preliminary

Scale: N.T.S. Drawing No. Standard P & ID Biogas Rev. no. P01

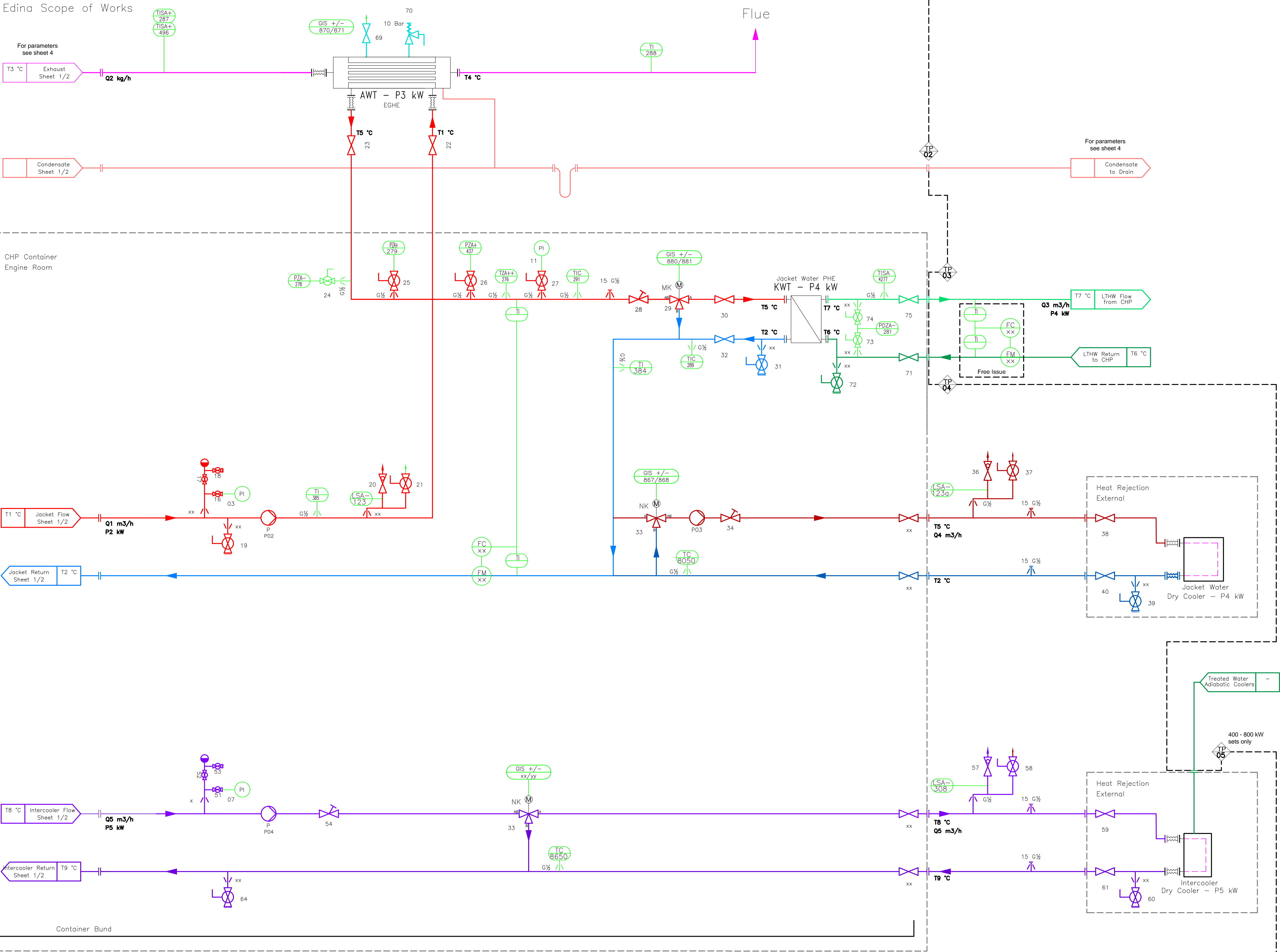
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Scale: N.T.S.	Drawing No. Standard P & ID Biogas	Rev. no. P01
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Works by others

Edina Scope of Works



Edina UK Ltd 2012

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Certificate no HS1442

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P01 Jacket dry cooler return temp corrected DM PA TL 05/01/15
Rev Description By Ckd App Date

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Drawn: DM	Checked: WJP	Client Drawing No.										
Date: 10/07/14	Approved: TL											
Client:												
Project:												
Title:												
Sheet 3 of 4												
Sheet Title												
CHP Heat Recovery												
Status												
Preliminary												
Scale: N.T.S.		Drawing No. Standard P & ID Biogas			Rev. no. P01							

Report all errors, omissions and modifications to the Design Department.

Dimensions in millimeters unless otherwise stated

If in doubt, ask

Do not scale

CHP System Parameters at 100% Output

Parameter	Ref	Units	TCG 2016 V8	TCG 2016 V12	TCG 2016 V16	TCG 2020 V12	TCG 2020 V16	TCG 2020 V20
Power								
Electrical power generated	P1	kWe	400	600	800	1200	1560	2000
Jacket heat available	P2	kWth	200	301	404	627	826	1048
Exhaust heat available	P3	kWth	175	265	347	565	742	1048
Total heat available/recovered/rejected	P4	kWth	375	566	751	1192	1568	1926
Intercooler heat rejected	P5	kWth	30	49	67	93	128	132
Flow rates								
Jacket/EGHE flow rate	Q1	m3/h	18.6	28.0	37.6	44.8	59.1	75.0
Exhaust flow rate	Q2	kg/h	2161	3246	4316	6544	8575	10658
LTHW flow rate	Q3	kg/h	16.6	25.1	33.3	52.8	69.5	85.4
Jacket heat rejection flow rate	Q4	kg/h	18.6	28.0	37.6	44.8	59.1	75.0
Intercooler heat rejection flow rate	Q5	kg/h	7.0	9.1	8.9	28.8	29.8	40.9
Temperatures								
Jacket flow temperature	T1	°C	88.0	88.0	88.0	93.0	93.0	93.0
Jacket return temperature	T2	°C	78.0	78.0	78.0	80.0	80.0	80.0
Exhaust temperature	T3	°C	442.0	444.0	440.0	459.0	460.0	447.0
Exhaust cooled to	T4	°C	180.0	180.0	180.0	180.0	180.0	180.0
EGHE water flow temperature	T5	°C	96.8	96.8	96.6	104.7	104.7	103.9
LTHW return temperature	T6	°C	70.0	70.0	70.0	70.0	70.0	70.0
LTHW flow temperature	T7	°C	90.0	90.0	90.0	90.0	90.0	90.0
Intercooler flow temperature	T8	°C	44.0	45.0	47.0	53.0	54.0	53.0
Intercooler return temperature	T9	°C	40.0	40.0	40.0	50.0	50.0	50.0

KEY



Termination point



Exhaust silencer



Bursting disk



Explosion relief vent



Expansion bellows



Instrumentation



Indication



Meter



Pump



Fan



Damper



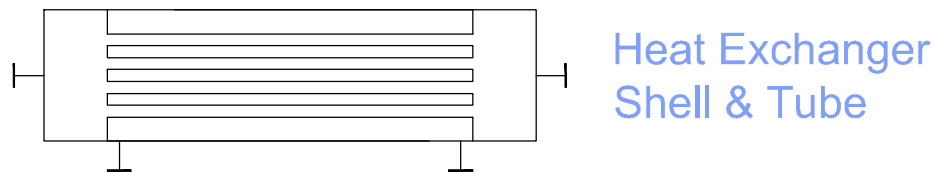
Flow conditioner



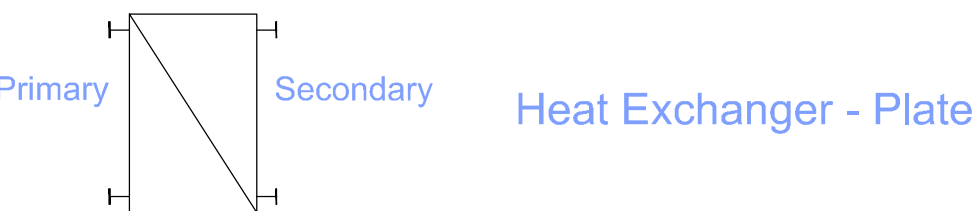
In-line water heater



Cooling radiator



Heat Exchanger
Shell & Tube



Heat Exchanger - Plate



Automatic air vent



Purge Valve



3-port valve



knockout Pot



Ball valve



Butterfly valve



Gate valve



Globe valve



Needle valve



Non-return valve



Parallel slide valve



Plug & seat valve



Pressure relief valve



Pressurisation valve



Regulating valve



Double regulating valve



Screw-down non-return valve



Zero pressure regulator



Pressure regulating valve



Orifice plate



Reducer



Expansion vessel



Sample point



Motorised actuator



Solenoid actuator



Variable speed drive



Pneumatic actuator



Catalytic Converter



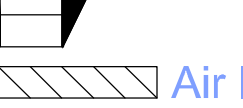
Deflagration arrestor



Detonation arrestor



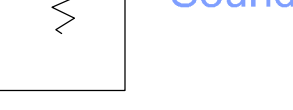
Air louver



Filter



Sound attenuator



Strainer



Dirt Separator

Stream Legend

	Biogas		Exhaust
	Lube oil fresh		Instrumentation
	Lube oil waste		Packages
	Jacket water flow		Plant
	Jacket water return		Air duct
	Intercooler flow		Terminations
	Intercooler return		Compressed air
	Heat recovery secondary		Steam
	Condensate		Condenser Circuit

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Notes:

- THIS DRAWING IS PRELIMINARY ONLY, AND MUST NOT BE USED FOR DETAILED DESIGN.
- Design ambient temperature of -10 to +30 °C
- Noise specifications as shown: To meet max. 65 dBA @ 1m in free field conditions for the exhaust silencers, enclosure ventilation and dry coolers operating together

P01 Jacket dry cooler return temp corrected DM PA TL 05/01/15

Rev Description By Ckd App Date

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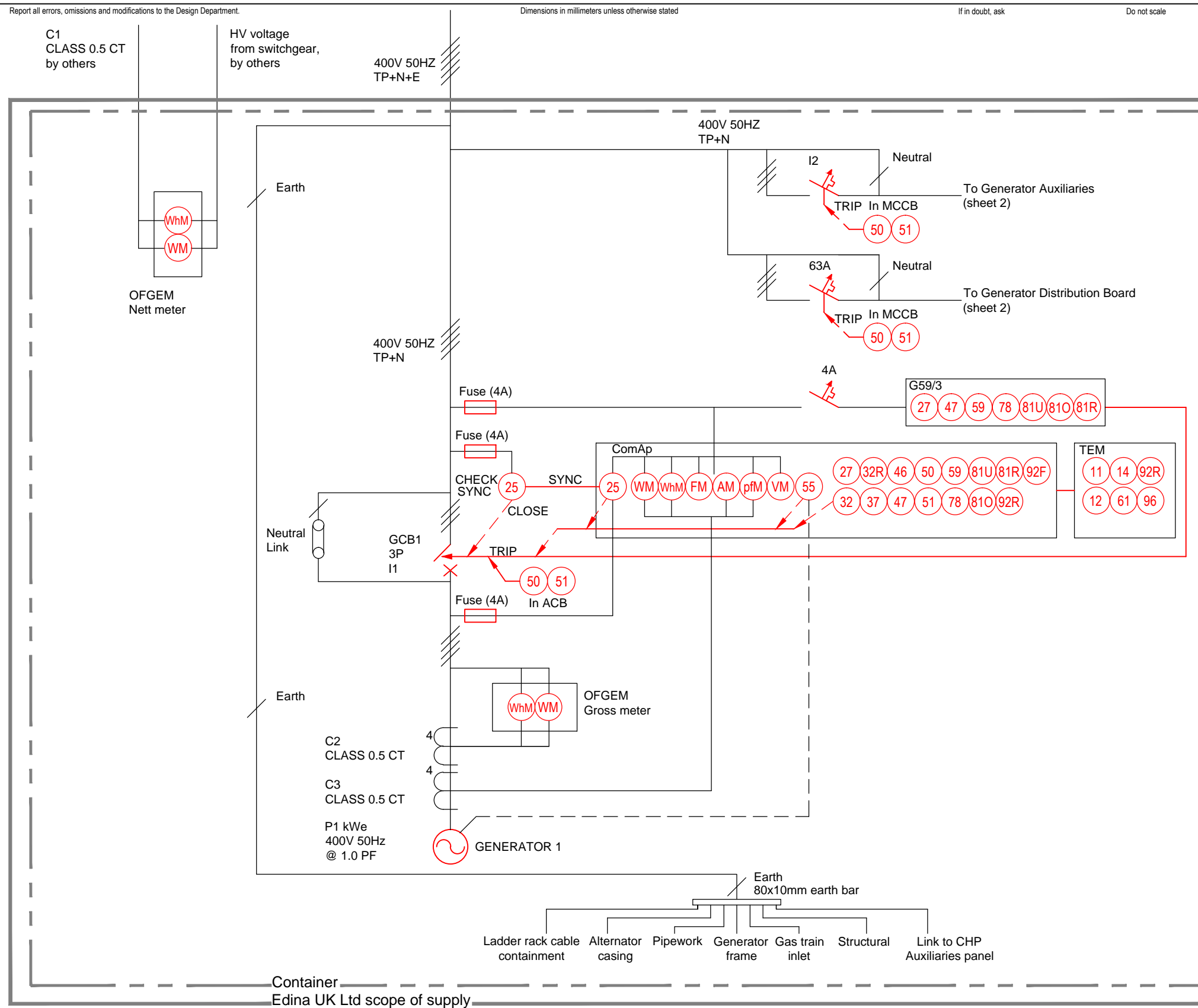
Rev Description By Ckd App Date

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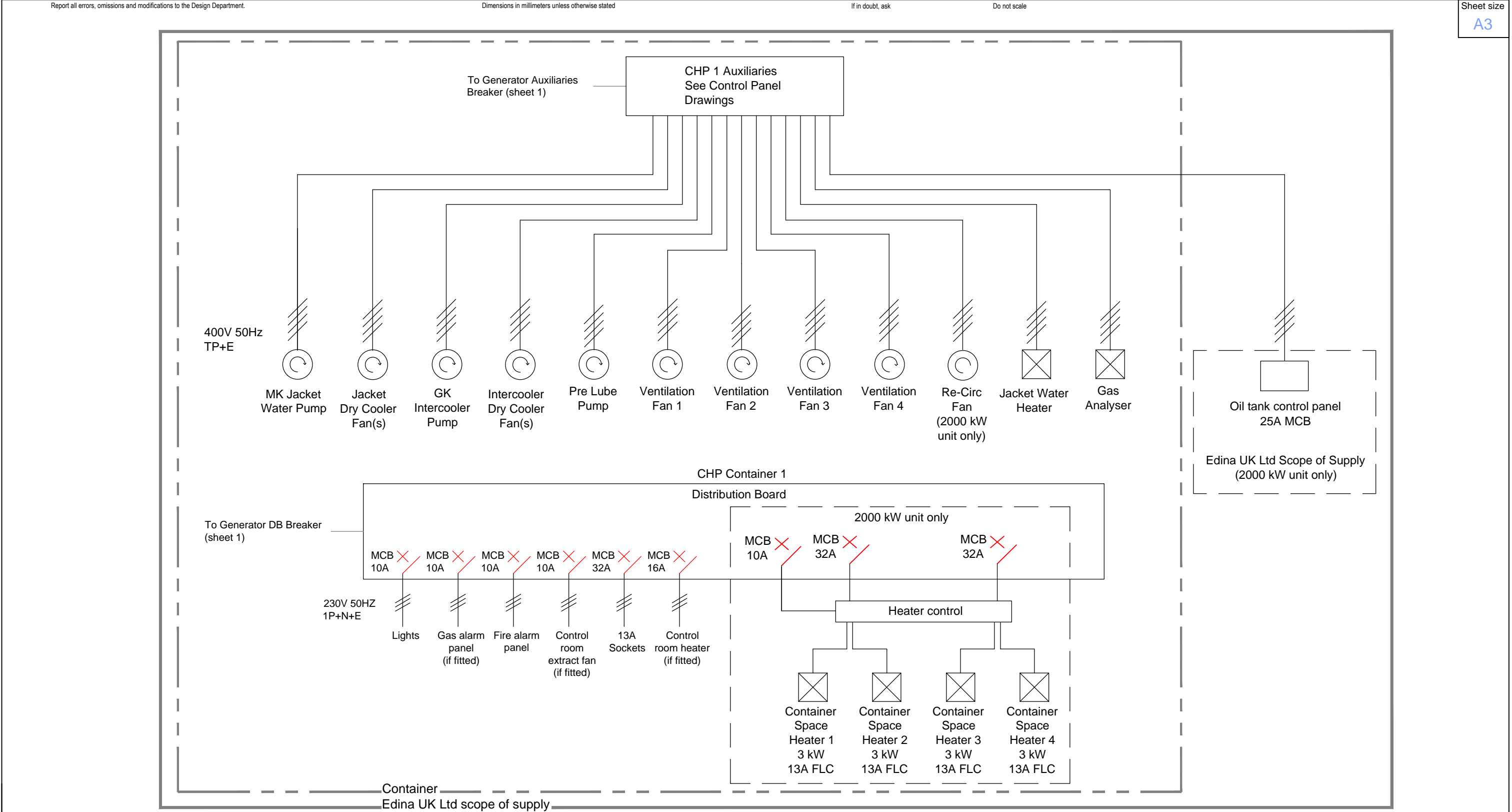
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Mnemonic	Description	Function
11	Mains failure	Protection
12	Overspeed	Protection
14	Underspeed	Protection
25	Synchronizing device	Control
27	Undervoltage	Protection
32R	Reverse power with time delay	Protection
37	Under Current	Protection
46	Current Unbalance	Protection
47	Phase Sequence (0,+,-)	Protection
50	Instantaneous Overcurrent	Protection
51	Timed Overcurrent	Protection
55	Voltage Matching and Power Factor	Control
59	Over Voltage	Protection
61	Engine Overload	Protection
78	ROCOF Vector shift	Protection
81U	Under Frequency	Protection
81O	Over Frequency	Protection
81R	Rate of change of frequency	Protection
92F	Forward Power (generator overload)	Protection
92R	Reverse Power	Protection
96	Engine Fault	Protection
AM	Ammeter	Monitor
ComAP	Generator Control System	Control & Protection
CT	Current Transformer	Monitor & Protection
FM	Frequency Meter	Monitor
G59	G59 Protection	Protection
pFM	Power Factor Meter	Monitor
TEM	MWM Engine Control	Control
VM	Volt Meter	Monitor
WhM	Watt Hour Meter	Monitor
WM	Watt Meter	Monitor

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<div>QAS INTERNATIONAL ISO 9001:2008 REGISTERED FIRM Certificate no CA13188</div>				<div>QAS INTERNATIONAL ISO 14001:2004 REGISTERED FIRM Certificate no EN1369</div>				<div>QAS INTERNATIONAL BS OHSAS 18001:2007 REGISTERED FIRM Certificate no HS1442</div>				<div>Sheet 1</div> <div>of 3</div>		<div>Sheet Title SLD</div>		<div>Title: LV SLD 400-2000 kW</div>		<div>Scale: NTS @ A3</div>		<div>Drawing No. SLDTypical LV</div>		<div>Rev. no. P00</div>	
Rev	Description						By	Ckd	App	Date													



										Status		Preliminary											
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										Date: 11/11/14		App: TL											
										Sheet 2		of 3		Sheet Title SLD		Title: LV SLD 400-2000 kW							
Rev	Description					By	Ckd	App	Date														

Report all errors, omissions and modifications to the Design Department.

Dimensions in millimeters unless otherwise stated

If in doubt, ask

Do not scale

Sheet size
A3

CHP Electrical Parameters								
Parameter	Ref	Units	TCG 2016 V8	TCG 2016 V12	TCG 2016 V16	TCG 2020 V12	TCG 2020 V16	TCG 2020 V20
Power								
Electrical power generated	P1	kWe	400	600	800	1200	1560	2000
Breaker Ratings								
Generator breaker	I1	A	800	1250	1600	2500	3200	4000
Auxiliaries breaker	I2	A	160	250	250	250	250	250
CT Ratings								
Nett power metering CT	C1	A						
Gross metering CT	C2	A	800/1	1250/5	1600/5	2500/5	3200/5	4000/5
Generator protections CT	C3	A	800/1	1250/5	1600/5	2500/5	3200/5	4000/5

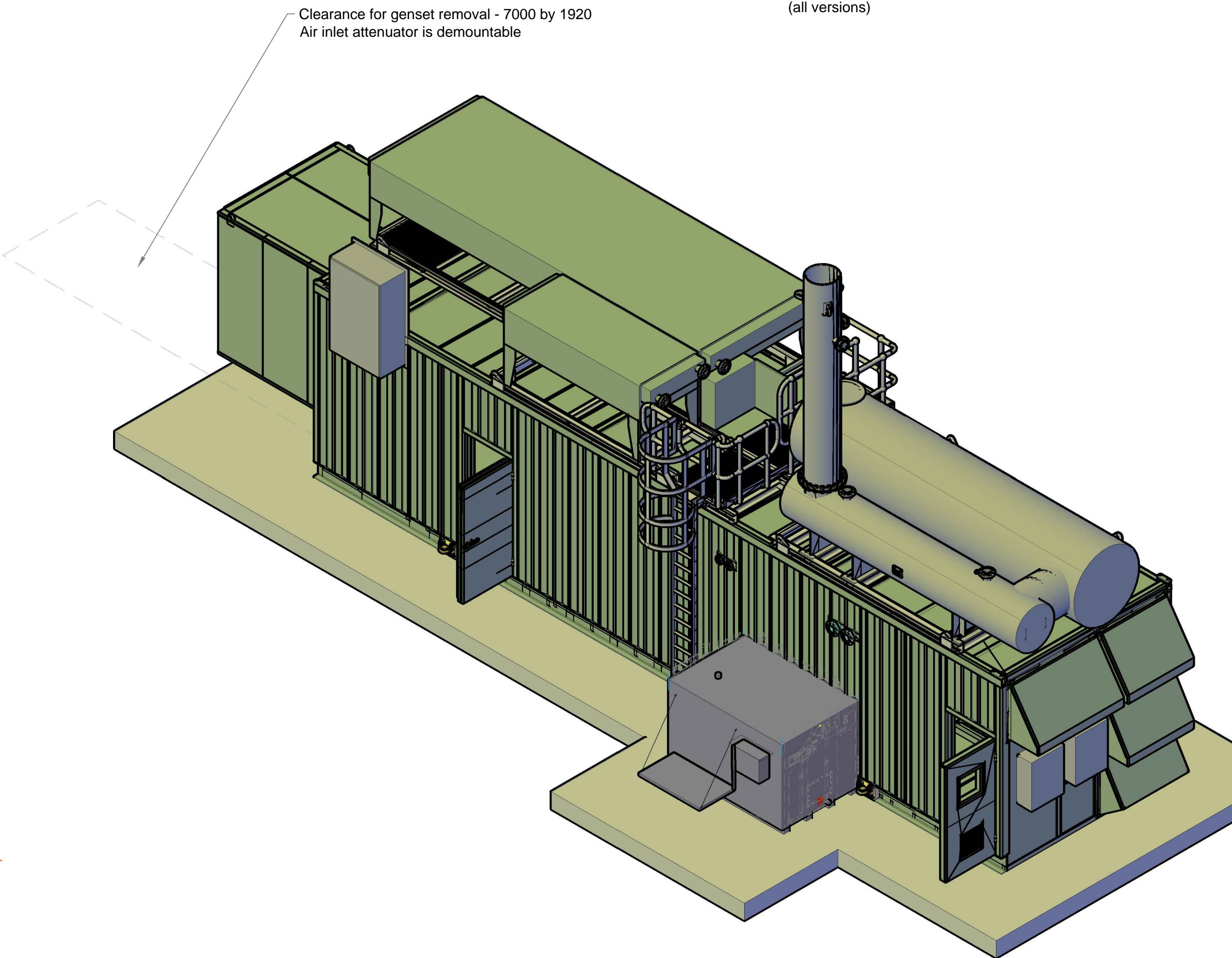
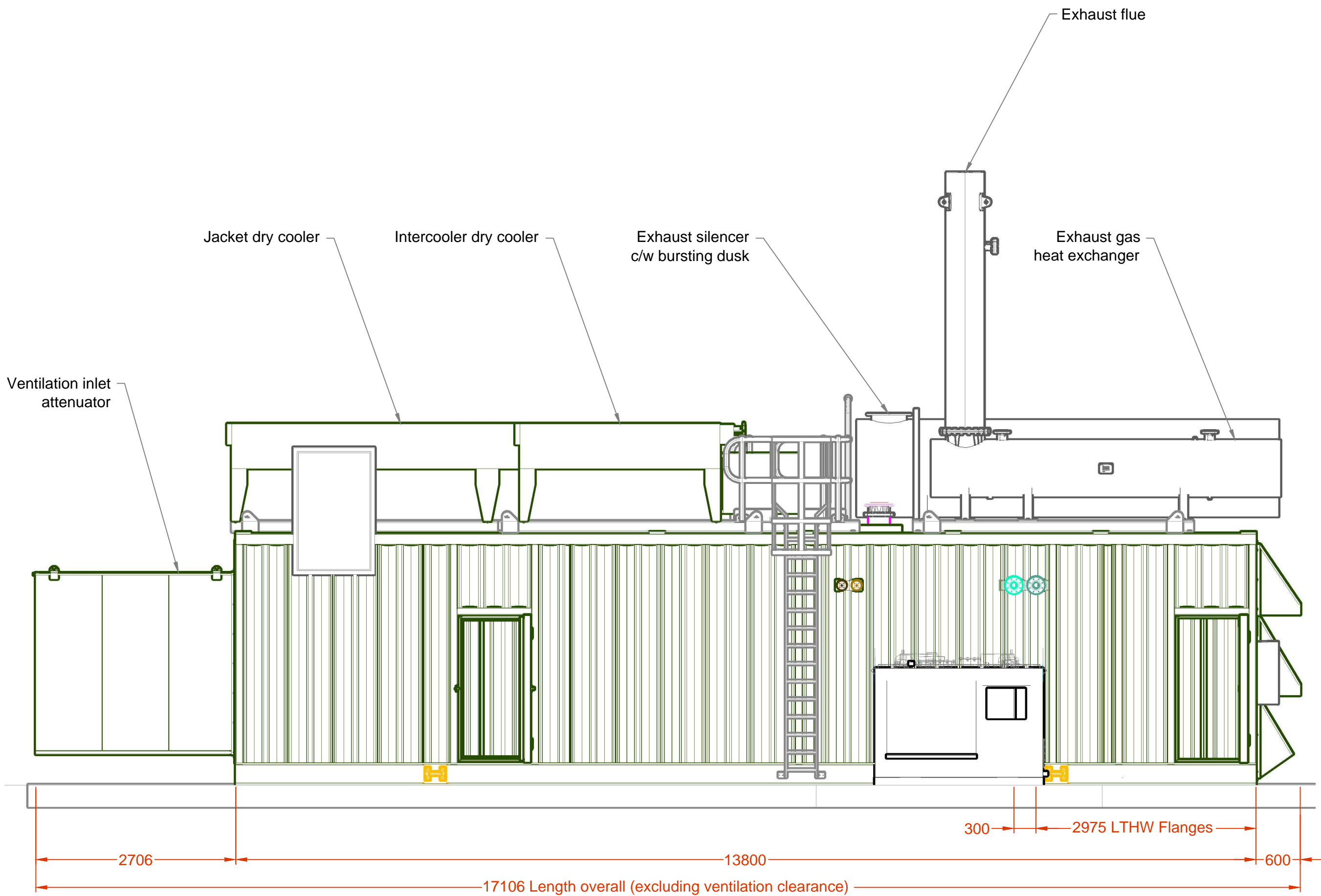
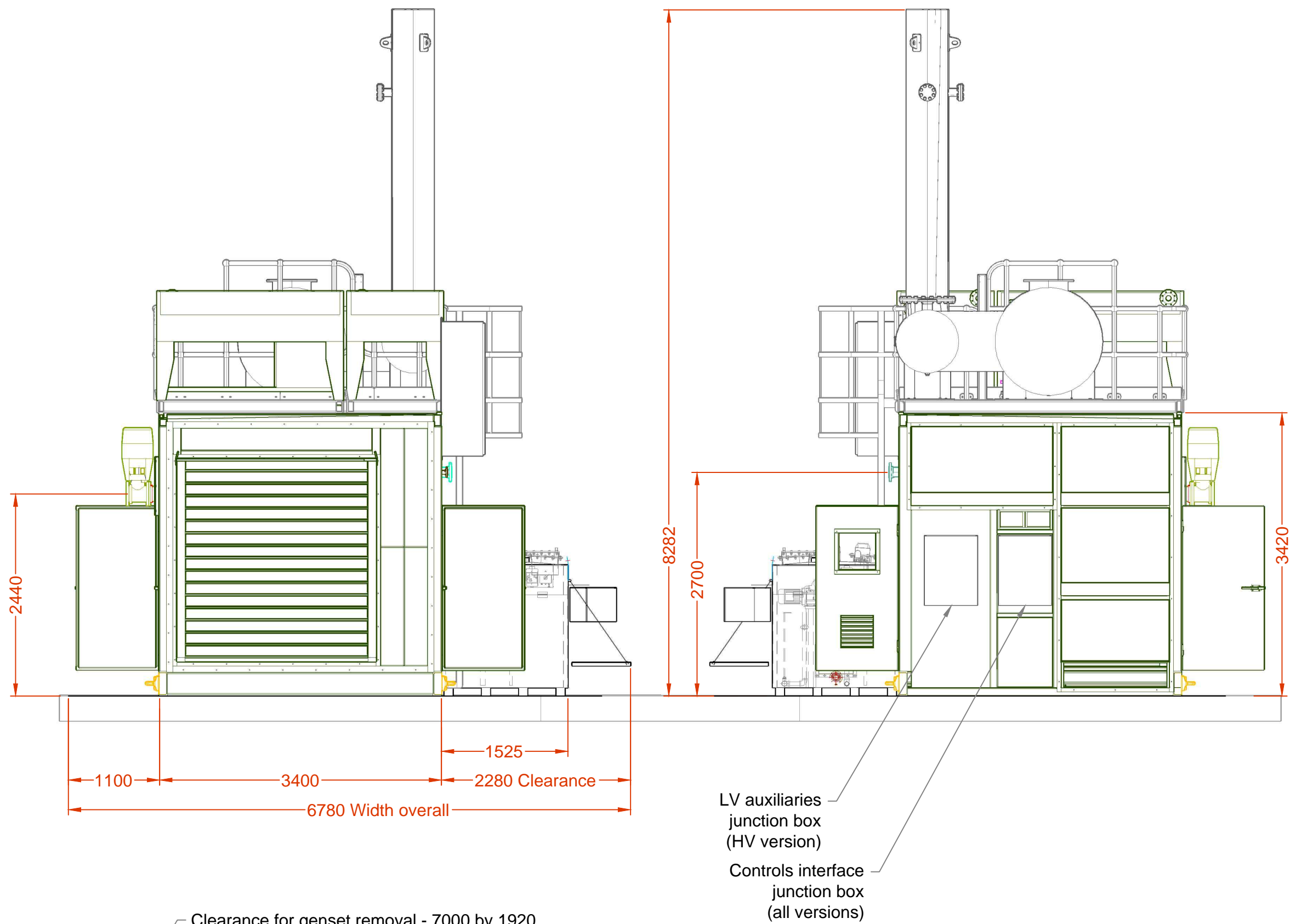
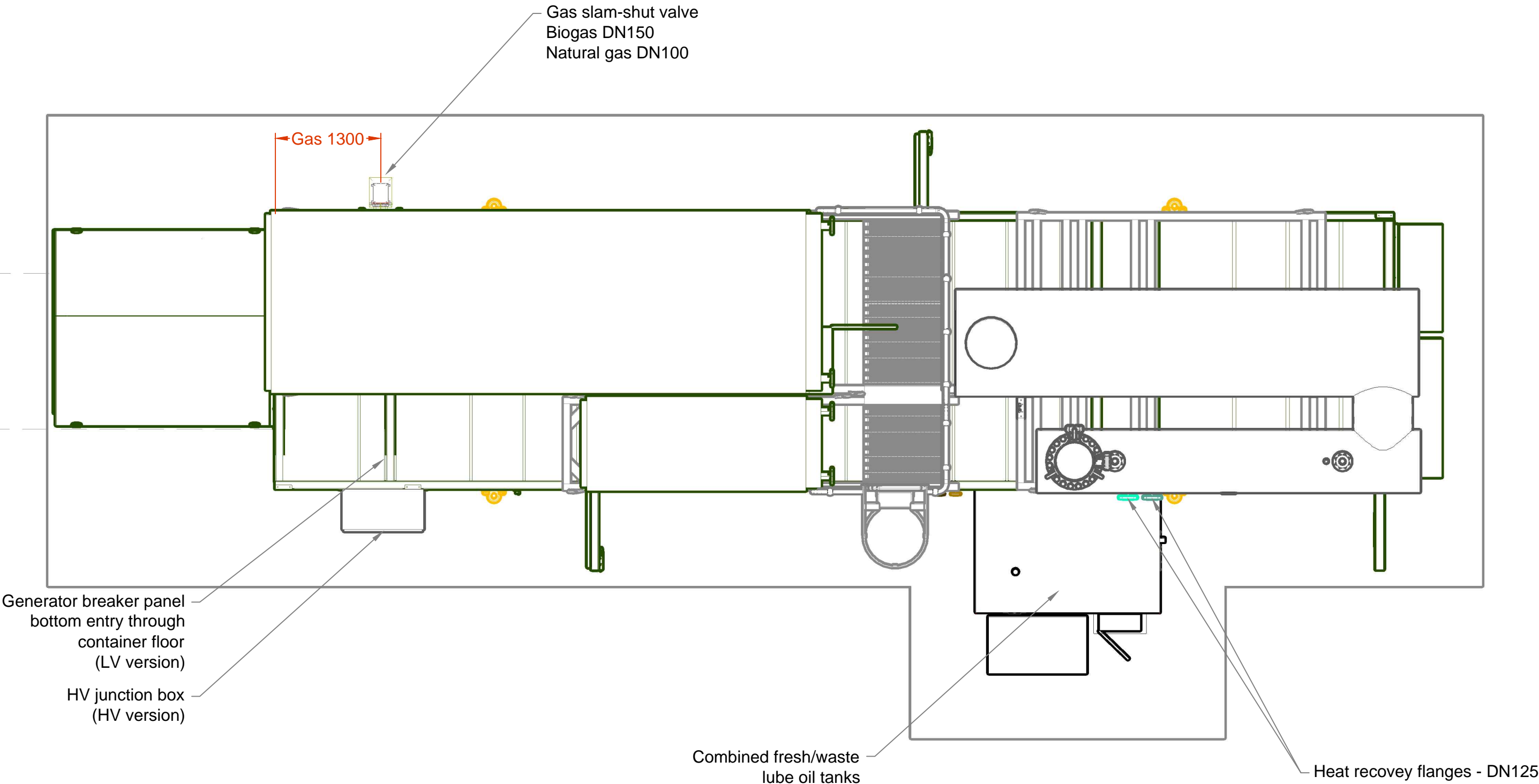
Status Preliminary


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						<div>QAS INTERNATIONAL ISO 9001:2008 REGISTERED FIRM Certificate no CA13188</div>	<div>QAS INTERNATIONAL ISO 14001:2004 REGISTERED FIRM Certificate no EN1369</div>	<div>QAS INTERNATIONAL BS OHSAS 18001:2007 REGISTERED FIRM Certificate no HS1442</div>	<div>Sheet 3</div> <div>of 3</div>	<div>Sheet Title SLD</div>			<div>Title: LV SLD 400-2000 kW</div>	<div>Scale: NTS @ A3</div>	<div>Drawing No. SLDTypical LV</div>
						Rev	Description					By	Ckd	App	Date

Notes:

1. THIS DRAWING IS PRELIMINARY ONLY, AND MUST NOT BE USED FOR DETAILED DESIGN.
2. Design ambient temperature of -10 to +30 °C. Other ambient temperature conditions can be met.
3. Container noise specification 75 dBA @ 1m in free field conditions
4. Container ventilation noise specification 75 dBA @ 1m in free field conditions. Other noise specifications can be met if required.
5. For this set the oil tanks must be installed external to the container
6. Some terminations and door positions can be adjusted to suit a specific application.

Please contact Edina Sales to discuss your requirements



Rev	Description		By	Ckd	App	Date
<div><div><div><div>Specialists in Power Generation</div></div><div><div>Edina</div><div>UK Ltd</div></div></div><div>Units 12-13 Rugby Park Bletchley Road, Stockport Cheshire SK4 3EJ T: +44 (0) 161 432 8833 F: +44 (0) 161 975 1499 e mail: sales@edinauk.com Internet: www.edinauk.com</div></div>						
Drawn: DM		Checked:	Client Drawing No.			
Date: 08/11/13		Approved:				
Client:						
Project: 2MW TCG 2020 V20						
Title: Standard Container (75 dBA/30 DegC)						
Sheet 1 of 2		Sheet Title		CHP Layout		
Status		PRELIMINARY				Sheet size A1
Scale: 1:50 @ A1		Drawing No. Example				Rev. no. P00

