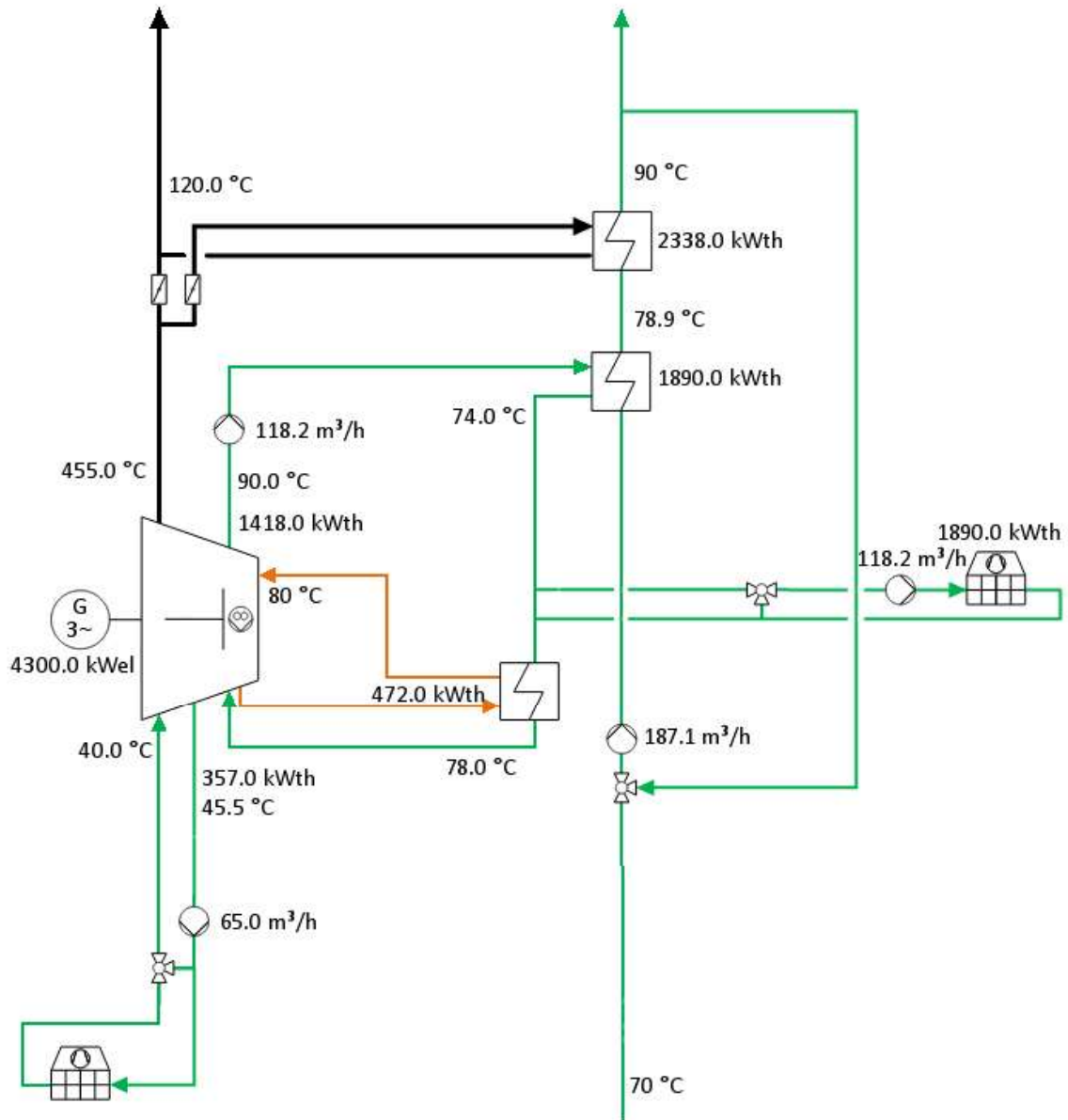


4 Schematic Process Flow Chart



Note: The P&I diagram is simply showing the hydraulic embedding of the generator set. The definition of the Scope is described in the technical specification.

5 Scope of supply

5.1 Overview

Number	Title
Genset	
Engine Parts	
1	Engine configuration
1	Basic parts
1	Exhaust gas system
1	Exhaust expansion joint
1	Exhaust turbo charger
1	Cooling system
1	Torsional vibration damper
1	Fly wheel
1	Starter equipment
1	Engine Mounting
1	Speed and load regulation
1	Ignition device
1	Gas mixer
1	TEM Engine monitoring and control
1	Primer and Topcoat Engine - Primer
1	Conservation
1	without spare parts for commissioning
Mixtrure Piping	
1	Gas mixture pipe without compressor cooling
Lubrication System	
1	Lube oil system
Standard Tool Set	
1	Tool Kit base scope incl. barring motor
Genset Parts	
1	Genset defintion
1	Generator - TDPS - TD 145
1	Base frame without integrated oil tank
1	Elastic genset mounting
1	Elastic coupling
1	Fasteners
1	Crankcase ventilation
1	Piping (roller bearing)
1	Coolant preheat V
1	Coolant expansion joints water / oil
1	Pre Lubrication Genset - 400 / 690 / 460 V
1	Additional parts for lubrication system 230 V
1	Air filter, lateral air supply, with console
1	Conformity label

1	Locking Parts for Genset Connection
1	Compressed air control train
Primer and Topcoat for Genset	
1	Primer and Topcoat for Genset - RAL 5010, gentian blue
Spare Paint	
1	Repair Paint - RAL 5010, gentian blue
Name Plates for Complete Engine	
1	Labeling of the genset - English (US)
Genset Test	
1	Genset acceptance test without customer participation
Packing for Complete Genset	
1	Packing suitable for overland transport for genset: foil cover
Fuel System	
Zero-Pressure Gas Control Train	
Gas Train	
1	Gas train DN 125/125 - with seal monitoring unit / flow direction left-right
1	Gas train option - EAC certification
Connecting Accessories for Zero Pressure Train	
1	Compensator for gasconnection
Heating System	
Engine Cooling Circuit	
Lube Oil Heat Exchanger	
1	Lube oil heat exchanger
1	Counter flange DN 100 - steel/stainless steel
Sensors and Accessories	
1	Gas and dirt separator DN 125
1	Counter Flange Set DN 125 - Set of 2
Exhaust Gas System	
Sensors	
1	Exhaust back pressure sensor
Electrical System	
Genset Management (TEM)	
Base System	
1	TEM - Basic System (ST32-F)
1	TEM packaging in wooden crate (VER)
Power Plant Control System	
1	Heat utilization with heating circuit (HK2)
1	Radiator controller (TKS1)
1	Handling of mains failure (NA)
1	Acknowledgment of external monitoring (QEÜ)
1	Cabin air regulation (RL1)
1	Demand of external starting preparations (AES)
1	Dump cooling and exhaust bypass control (NK/BY)
Parameterizable Input/Output	
1	2 parameterizable measurements (2MW)
1	1 parameterizable control circuit (1PR)
Interface	

1	Modbus TCP (MTCP)
1	Analog speed setting (ASD)
1	Remote Engine Management
Hardware	
1	I/O Controller (IOC) (included in Base system)
1	Operating terminal (BRT)
1	wall switch cabinet, Height 1200mm door hinge right (AE0R)
1	TEM connecting cable set 8m (K32ARM)
Services	
Packing	
Plant Components	
1	Packing plant components
Transport	
1	Transport FCA (Free Carrier)
Service Packages	
Engineering Package	
1	Engineering Package DTO
PM Package	
1	PM Package DTO TEM
Documentation	
Documentation First language	
1	Documentation digital - First language
Documentation second language	
1	Documentation digital - Second language
Documentation	
1	Standard documentation incl. TEM documentation
Certificates and Labels	
1	TR 020 declaration and EAC label for the Eurasian Customs Union

6 Technical Description

6.1 Option Blackstart

The function Blackstart is not included. The power supply of the auxiliaries must always be provided by the customer.

6.2 Genset

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.

6.2.1 Engine

Industrial engine for stationary application.

Four-stroke Otto engine with lean-mixture charging, cylinders in V arrangement with water cooling for cylinders and mixture.

Counterclockwise rotation direction according to DIN 6265 (seen on flywheel end).

Main engine components

Crankcase

One-piece crankcase made of gray cast iron with screwed-on oil tray with crankcase ventilation.

Driving gear

Forged crankshaft stored suspended in housing, bearing seats under cross tension, flywheel flanged and with gear ring for the starter, spur gear unit to drive the camshafts.

Forged con-rod

Forged piston with piston rings

Water-cooled cylinder liners, can be replaced individually, with specialized honing for low lube oil consumption and low wear rates.

Cylinder head

Individual cylinder heads with four valves and seat rings for optimized spin, spark plug positioned in center of combustion chamber, O-ring oil seal at the valve shafts

Valve drive using roller tappets and push rods.

Cylinder units

Cylinder head, valve train, cylinder coat, liner, and piston with con-rod are premounted as a complete unit and are installed in the crankcase as a complete unit. This means that quick replacement of the individual cylinder units can be illustrated on the plant.

Oil lubrication

Pressure lubrication via a gear pump, lube oil heat exchanger in the engine cooling circuit supplied as loose part, oil filter in the main stream. Fine filter in sub-stream.

Charging

Exhaust turbocharger for compressing the gas-air mixture, with 2-stage mixture cooler for recooling (low temperature level in a separate cooling circuit).

Integrated Front End (IFE)

Housing, arranged on the end opposite the flywheel, into which the following functions are integrated:

- Mixture cooler
- Throttle organ
- Discharge of the crankcase gases
- Console for the exhaust turbocharger and gas mixer
- Attachment of the lube oil pump and distribution of the lube oil to the crankcase
- all connections for cooling water, oil and fuel gas.

Starter

Compressed air starter with inlet pressure 20 – 30 bar.

Fuel supply / Mixture treatment

Multi-gas mixer for dosage of the gas-air mixture for each cylinder bank.
Throttle organ (rotary valve) with electric actuator for the speed and power control.
Electronic control and monitoring of the air-gas mixture at the mixer-actuator via combustion chamber temperature (1 temperature sensor per cylinder) with the TEM system.

Air filter

Dry air filter packages for each cylinder series, in cassette design, supplied as loose parts.

Sensors

Sensors for:

- Temperatures
 - Cooling water
 - Intake air
 - Mixture
 - Oil
 - Combustion chamber
- Pressure sensor
 - Oil
 - Crankcase
- Speed

- Gas mixer position recording
- Knock sensors
- Oil level
- Control for cooling water preheating

Most sensors, sometimes installed multiple times, are wired to a central TEM rail per cylinder bank.

Ignition system

Non-wearing, high-voltage ignition system controlled by microprocessors with low-voltage distribution, one ignition coil per cylinder.

Knock monitoring and control

Anti-knock control with knock sensor monitoring for each cylinder for operation free from knocking with best possible performance and efficiency under observance of the emission limit values.

Connections

Connection to the plant's lines for vibration decoupling

Cooling water: Rubber expansion joints with counterflange

Lube oil: Rubber expansion joints with counterflange

Exhaust outlet: Stainless steel expansion joints with counterflange

Fuel gas outlet: Stainless steel expansion joints with counterflange

Boost pressure control

Boost pressure control and adjustment to various ambient conditions via a bypass valve (exhaust wastegate) in the exhaust flow

Corrosion protection

Corrosion protection of the engine or genset for protection during transportation and any subsequent storage at the place of destination; maximum length of protection of 24 months after delivery, when stored in closed dry room.

Mixture cooler

2-stage mixture cooler with a highly efficient heat transfer with low pressure loss and low probability of dirt accumulation.

6.2.2 Three-phase Internal-pole Synchronous Generator

Type: TDPS TD 145 or similar (*)

Voltage: 10500 V

Frequency: 50 Hz

Three-phase synchronous generator, salient-pole machine, brushless, self-excited, with damper cage, star point dissolvable, with insulation suitable for tropical and humid ambient conditions (max. 90 % humidity).

General structure

The generator comprises the main generator as internal-pole machine, an exciter as external-pole machine and a voltage controller with a power output stage, the power unit of which is supplied by a permanent magnet generator (PMG).

The power of the exciter stator is supplied by the voltage controller. The three-phase alternating voltage which is induced in the exciter rotor is rectified by the rotating diode bridge and is then supplied to the field winding of the main generator. The voltage stabilization of the main generator under variable load in island mode and the setting of a specified power factor or the specified reactive power in mains parallel mode is performed by changing the field current via the power actuator in the voltage controller.

Protection type and ventilation

Type of ventilation IC 01 acc. to IEC 60034-6 open cooling circuit with self-ventilation and protection class IP23 acc. to IEC 60034-5.

Stator

The insulation of the stator winding corresponds to insulation class F/ Temperature rise according to generator data sheet according to IEC 60034-1.

Rotor

The insulation of the rotor and field winding corresponds to insulation class F/ Temperature rise according to generator data sheet according to IEC 60034-1.

The rotor is balanced with half key in compliance with quality G 2.5 according to ISO 21940-1. Max. overspeed (spin speed) according to IEC 60034-1.

Winding

To reduce the harmonics, the generator is equipped with a 5/6 pitch winding. The windings are insulated with a high-quality cast resin by using vacuum-pressure impregnation (VPI) which protects the windings from moisture, dust, ash, and abrasive particles.

Shaft bearings

By default the generator is designed as a double-bearing machine. Self-lubricated plain bearings; oil cooling via heat exchanger on the generator (Aero-Therm)

Voltage controller

Digital voltage controller with diode failure monitoring, mounted in the auxiliary terminal box.

Voltage nominal value setting $\pm 10.00\% U_N$.

Standards and specifications

IEC 60034-1, ISO 8528-3, NEMA MG 1-32

Standard components / assembly groups

- Central terminal box with main terminals and star point, auxiliary terminal box with terminal strip and accessories
- Generator controller with functions for regulating the voltage, the reactive power or the shift factor, incl. the voltage and current transformers required for regulation
- Temperature monitoring with 6 PT 100 – sensors in the winding (3 x active, 3 x spare)
- a permanent magnet generator (PMG)
- Anti-condensation heating: 240 V \pm 5%, 4 x 150 W
- Current transformer: 350/1/1/1 A
 - Core 1: 30 VA, 1FS5 (measurement, not calibrated)
 - Core 2: 15 VA, 10P10 (general protection)
 - Core 3: 15 VA, 10P10 (differential protection)
-

Electrical data and properties

- Voltage accuracy, static \pm 0.5 to 1 % of the rated voltage
- Speed change + 3% / - 5 % of the rated speed, cold and warm machine
- Total harmonic distortion factor THDU (Total Harmonic Distortion) of the voltage (Ph-Ph) at no-load \leq 3 %
- Unbalanced load $I_{\text{Inverse}} / I_N \leq 8$ % according to IEC 60034-1
- Radio interference suppression level Class B, Group 1 according to DIN EN 55011; VDE 0875-11
- Sustained short-circuit current with a 3-pole terminal short-circuit: minimum threefold rated current for 5 s
- Generator overload capacity 10 % of rated power for 1 h within 6 h

*CES reserves the right to change the alternator supplier and type during offer period. The genset data may thereby change slightly. The power output will not change. CES will confirm the alternator type, brand and alternator data sheet with the order confirmation.

6.2.3 Genset Parts

Base frame

Non-flexing, torsion-resistant steel construction for supporting the engine and generator. Elastic steel spring elements supplied as loose parts for mounting below the base frame on the plant.

Coupling

Torsion-elastic, axial plug-in flange coupling for connection of engine and generator.
The rubber element can be radially removed.

Oil level control

Automatic lube oil refilling, control using an immersion probe for oil level monitoring (min./max.) and for controlling the solenoid valves and the fresh oil pump.

Cooling water preheating

Electric cooling water preheating and oil preheating (heating output approx. 20 kW) with circulation pump, mounted on the genset and completely encased, including oil fine filter.

Prelubrication pump

Electrical prelubrication pump on genset; the engine can be emptied for oil change by switching a three-way valve.

Genset additional parts

Additional components are delivered "loose" and are not mounted on the genset.
The following components are delivered with the aggregate:

- 1 set of maintenance-free steel spring elements with height adjustment for easy alignment of the genset on the on-site foundation.
- 2 solenoid valves with connection parts for lube oil inlet
- 1 set of flexible hoses for lube oil inlet and outlet connections
- 1 insulation mat for exhaust expansion joint
- 1 oil separator for ventilation of the crankcase with integrated filtering of the oil mist vapors and recirculation to the engine
- 1 vacuum regulator for mounting on the oil separator
- 1 set of assembly parts for installing the oil separator

Cooling water preheating

Electric cooling water preheating and oil preheating (heating output approx. 20 kW) with circulation pump, mounted on the genset and completely encased, including oil microfilter.

Air filter

2 units delivered loose.

Microfiber dry air filter with a visual service indicator, integrated into a housing, installed laterally onto the plant (or before the engine), connected to the gas-air mixer with the supplied flexible hose on the corresponding air inlet of the gas mixer.

- 2 air filter housings with 4 filter cassettes
- 2 special hoses with accessories for connection between gas-air mixer and air filter

- 2 sets of consoles with fastening material

Paintwork

According to industrial standards, paintwork of the assembled genset consists of:

- Primer, dry film thickness 40^{+30} μm
- Topcoat in the shade RAL 5010, gentian blue dry film layer 90^{+40} μm
- 1 can refinishing paint, loose in the shade of the topcoat.

Labeling

Language on the labeling of the genset: English (US)

Genset Test without Customer Participation

During the genset test, the entire genset (engine and generator mounted on their base frame) is tested at our test benches and the measurements are recorded. All test bench equipment for recording of measurements is calibrated.

A control system that belongs to the test bench is used for the test. A genset test with customer's control system is not possible.

The measurements are carried out in a standardized testing procedure at 100% standard testing power.

The recorded measurement data are summarized in the genset performance report, that is part of our documentation.

Conditions for 50Hz operation: Mains parallel mode, power factor 1, no island mode, no load steps.

For 60Hz operation, a load bank is used, power factor <1 .

The following measured values are provided:

Power, speed, lubricating oil pressure, gas consumption at methane number 80, efficiency, intake air temperature, exhaust gas temperature after turbine, receiver pressure, O₂ dry, exhaust gas emission NO_x (Reference: 5% O₂ in dry exhaust gas), frequency, voltage, power factor.

Standard genset packaging with film

Packaging, suitable for truck transportation. Loose parts in transport boxes.

6.3 System components

The components stated in the following chapters are included in the scope of supply and are delivered "loose". Assembly and any cabling is performed on site by the client, as long as no installation for these components is listed.

The stated technical data may change at order.

6.3.1 Fuel system

Zero pressure gas control line

Gas type: Natural gas MN80
Nominal width (outlet side): DN 125
Manufacturer: Dungs

Gas control line as a tested functional assembly made from individual components with EC prototype test certificates in accordance with the EC pressure equipment directive and the EC gas equipment directive, suitable for gases of the gas families 1, 2 and 3 (in the gaseous phase) in accordance with DVGW G 260.

Provided it complies with the regulations of the applicable manufacturer's declaration, the gas control line is deemed to be "permanently technically sealed" in accordance with TRBS 2152 Part 2, Section 2.4.3, and can thus be excluded as the cause of an explosive atmosphere.

- 1 ball valve
- 1 gas filter
- 1 manometer
- 1 pressure monitor for minimum gas pressure
- 2 automatic shut-off valves, valve class A, group 2
- 1 thermal monitoring with trigger isolated switch amplifier
- 1 zero pressure controller
- 1 outlet molding in the case of external measuring point of the zero pressure controller
- 2 counterflanges for installation of the gas control line in the gas line
- 1 valve proving system

The gas control line is designed for an inlet pressure of **100 mbar** with a permissible accuracy of AC 10 with a pressure fluctuation frequency < 10/ h. To secure the control accuracy of the outlet pressure, the maximum permissible inlet pressure is 200 mbar. The outlet pressure (OPd) is 0 mbar +/-3 mbar.

The equipment of the gas train may vary depending on the gas or operation type. The bill of materials separately created at order is binding.
If applicable, a secure ventilation and outlet line that leads to outdoors is to be provided on-site.

Steel expansion joint

Steel expansion joint for flexible connection of the gas line to the gas-air mixer, incl. counterflange
Nominal width: DN 125

6.3.2 Engine cooling circuit

Lube oil heat exchanger

With the help of a plate heat exchanger, the lube oil heat is transmitted to a cooling circuit. Plate heat exchanger in screwed construction with flow-optimized plate design, connections with flanges.

Heat output	kW	472	
		<u>Lube oil</u>	<u>Cooling water</u>
Inlet temperature	°C	89	74
Outlet temperature	°C	80	78
Flow rate	m ³ /h	125 m ³ /h	118

Gas and dirt separator

The gas and dirt separator removes the smallest of micro-bubbles and dirt particles from the cooling system. This improves the coolant quality, meaning that plant components have a longer service life and engine problems are avoided.

Connection:	Flange connection DN 125
max. volumetric flow rate:	166.30 m ³ /h
Pressure loss at max. volumetric flow rate:	0.1 bar

6.3.3 Exhaust system

Exhaust back-pressure monitor

Pressure sensor for monitoring the maximum permissible exhaust gas back pressure downstream of the engine, for installation in the exhaust line downstream of the engine (turbocharger) and upstream of the catalytic converter or exhaust silencer. Diaphragm pressure monitor with microswitch, scope of supply including approx. 400 mm protective tube.

Switching range	mbar	5 to 500
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6.4 Electrical system

6.4.1 Engine control TEM EVO system

The Total Electronic Management (TEM) system involves controlling and monitoring all functions of a gas engine, as well as the engine auxiliary drives in one unit. Its monitoring functions protect the engine against impermissible boundary conditions and guarantee a long service life. The TEM EVO system regulates and optimizes gas combustion in the cylinders. Integrated regulatory functions ensure optimum,

reproducible engine status values in all operating conditions. Thanks to a wide range of options, the TEM EVO system can be optimally adapted to specific application cases.

The TEM EVO system comprises 3 components:

- I/O Controller
- Operating computer
- Genset switch cabinet ("AGS")

Basic functions

- Automatic program flow for starting and stopping the gas engine genset
- Reliable control of exhaust emissions at low NOx values
- Integrated digital engine speed and power control
- TÜV-approved security chain
- Connection of actuators and sensors to the *I/O Controller* in the auxiliary genset cabinet and data transmission via CAN bus or directly to the TEM EVO genset cabinet
- Monitoring of all sensors in the genset
- Monitoring of the engine cooling water
- Control and monitoring of the lube oil circuit, including pre- and relubrication as well as oil change
- Test mode for verification of connected actuators, sensors and auxiliary gensets
- Electronic line recorder for measured values for control and diagnostic purposes over time periods of 40 h / 6 min as well as work cycle-synchronously
- Electronic operating log to record warning, fault and operating messages with their dates and times of occurrence for detailed observation of operations
- Electronic operating hour meter with breakdown into 5 load ranges
- Option to connect an operating computer
- [MK] Engine cooling water control: the cooling water circulation control actuates a three-way valve to ensure an optimum cooling water temperature. At partial load, the cooling water inlet temperature is increased.
- [GK] Mixture cooling circuit: controls the mixture cooling water outlet temperature by actuating a control valve in the mixture cooling water circuit; monitors the receiver temperature
- [IOC] I/O Controller: the auxiliary gensets, pumps, valves, etc. are controlled and the associated measured values are recorded via the I/O Controller. The I/O Controller will be delivered loose for installation in the auxiliary genset switch cabinet
- [16M] 16 parameterizable messages: digital inputs with comprehensive options for parameterization to allow the connection of plant-specific faults, warnings or messages directly to the TEM EVO system. This greatly simplifies genset monitoring and makes it transparent due to the logging function in the operating log. The parameterizable messages are issued as potential-free contacts in the TEM auxiliary genset switch cabinet on the *I/O Controller*.

- [SER] Serial coupling for data exchange: exchange of data such as e.g. set values, measured values, messages, warnings and faults with the superior control via serial coupling by means of protocol 3964R with RK512 via TTY or CS 20 mA. The maximum cable length between the TEM EVO and the superior control is 100 m.
- [AKRK] Anti-knock control: individual highly dynamic anti-knock control for each cylinder – for safe operation of the engine even at a low methane number. Best possible performance and efficiency and observance of the emission limit values
- [GL] Monitoring of the generator bearing temperatures: display (mask, history, serial coupling) and monitoring of the two generator bearing temperatures. A fault or warning is triggered when a parameterizable limit value is exceeded.
- [GLT] The basic bearing temperature (main engine bearing temperature) is recorded and monitored in the TEM EVO to protect the engine. If the threshold value is exceeded, depending on the magnitude of the exceedance, a warning is triggered first and then a fault
- [SATL2] Measurement and restriction of the exhaust gas turbocharger rotational speeds: display (mask, history, serial coupling) and restriction of the exhaust gas turbocharger rotational speeds
- [NATL2] Rolling monitoring of the exhaust gas temperature after turbocharger A and B: display (mask, history, serial coupling) and rolling monitoring of the exhaust gas temperature after the turbocharger. A fault is triggered when a parameterizable limit value is exceeded
- [BSX], [BSXK] Pre-fitment for eService system [BSX] with cable harness [BSXK]: Pre-fitment for remote control of the TEM EVO (BSX): required for each TEM EVO that is to be connected to an eService modem system, a mechanical switch or an intelligent selection unit (IAE)
- [VAWT/VSWT] Measurement of heating water temperature before the exhaust heat exchanger and before the lube oil heat exchanger
- [SPC] Connection for service PC: robust service socket in the TEM EVO genset switch cabinet. Upon connection of the service PC, a control unit interrupts the connection to the operating computer or any modem that may be present. The TEM EVO system can then be operated via the service PC
- [2xNKAT] To protect the catalytic converter, in the TEM EVO the exhaust gas temperature is measured after the catalytic converter and the operating point is dependently monitored. A fault is triggered if the parameterizable threshold value is exceeded
- [AWG32] Activation of the exhaust gas wastegate, measurement of the position of the control device and operation of the actuator

Extended functions

- [HK2] Heat utilization with a heating circuit: enhanced security chain to monitor the heating circuit and regulation of the engine cooling water inlet temperature and the heating circuit flow temperature by actuating a three-way valve in the heating circuit. Measurement of the flow and return temperature, heating water upstream of the cooling water heat exchanger, monitoring of the exhaust gas

temperature downstream of the exhaust heat exchanger. Even at a partial load of the engine, the heating circuit control ensures a constant heating water flow temperature while meeting the requirements of the engine in terms of the cooling water temperature. 2x safety time relay for delaying signals from the flow monitor and pressure monitor in the safety chain (delay time is permanently set to 3 seconds).

- [TKS] Table cooler control for mixture cooling and engine cooling circuit or emergency cooling circuit with one cooler per circuit, parameterizable as a fan level switch (maximum 17 levels) for frequency-controlled fans
- [NA] Network failure handling: with the network failure handling option, network failures can be extensively managed without problem in that any subsequent failures are automatically acknowledged and thus the readiness to start is re-established where possible
- [QEÜ] 'Acknowledgement of external monitoring: it is possible to acknowledge external devices via a digital output on the *I/O Controller*. An acknowledgment signal is issued when acknowledging via an operating log, while for remote acknowledgment it is via a serial coupling
- [RL1] Ambient air regulation: regulation of the ambient air temperature with addition or frequency-regulated fans. Control of inlet and outlet flaps, continuous regulation with parameterizable set value. Display (mask, history, serial coupling) and monitoring of the ambient air temperature (genset room). A fault or warning is triggered when a parameterizable limit value is exceeded.
- [AES] Demand for external starting preparation: demand for additional starting preparations. Using this, e.g. compressor blowers can be started or exhaust flaps can be opened.
- [NK/BY] Emergency cooling circuit and exhaust gas bypass control
- [2MW] Parameterizable measured values: analog inputs with comprehensive parameterization options to display plant-specific measured values and to monitor threshold values. For each measured value, two threshold values can be parameterized wherein a fault, a warning or a message is triggered if they are exceeded or not attained. This greatly simplifies genset monitoring and makes it transparent due to the logging function in the operating log and the history function.
- [1PR] Parameterizable control circuits: additional plant-specific controls (e.g. for additional heat exchangers, gas compressors, etc.) with extensive parameterization options. Easy commissioning with the help of the history function "Realtime Scope". For each parameterizable control circuit, a parameterizable measured value (option 2MW or 4MW) is required to record the control variable (actual value). Two or three point control can be parameterized for the output of the controller. This permits easy connection of control valves, frequency converters, heating registers, etc.
- [MTCP] Ethernet TCP/IP: field bus interface Ethernet TCP/IP for communication with protocol Modbus/TCP. Via the interface, status information, measured values, messages, warnings, faults from TEM EVO are available for retrieval and set values or commands can be sent to the TEM EVO (MTCP is installed instead of the SER option contained in the basic system).

REM (general):

Remote Engine Management (REM): remote access to the TEM plant control.

Replacement for the TEM IP and GSM modem.

REM consists of:

- Remote Plant Gateway
- Remote Access Client software
- IAE or FAE cable

The Remote Plant Gateway (RPG) is a preconfigured router that is installed at the plant in the switch cabinet. The RPG autonomously establishes an outgoing VPN connection via the existing Internet connection to the "Rendezvous Server" in the Caterpillar Energy Solutions data center located in Mannheim. This requires a standard Internet connection to the plant on site. Optionally, the RPG also lets you set up a mobile wireless data connection.

A secure VPN connection to the Rendezvous Server in Mannheim and then further to the plant / genset can be established via the Internet using the special Remote Access Client software that is installed on a PC or laptop. Authentication on the Rendezvous Server takes place via user name / password. Following this, JView software can be used to access the TEM plant control.

A prerequisite for use of the REM is JView software including authentication dongle.

Remote diagnosis

Like all other masks, the service and diagnostic masks can also be made accessible via model for data transmission via the normal telephone network. In this way, remote diagnoses and remote maintenance can be provided with very short response times via Customer Service or the operator's own on-call staff.

Modem system

The TEM EVO modem system allows convenient remote control of the gensets. All functions that can be performed on site on the operating computer can also be executed via the modem system.

I/O Controller

For installation in the auxiliary genset switch cabinet (cabling with shielded three-core bus cable).

Operating computer

The operating computer BRT is used to operate the TEM EVO system. It is intended to be installed in the closed switch cabinet. The touch functionality of the 15" TFT monitor and the graphic user interface allow easy and intuitive operation.

The genset switch cabinet is situated in the direct vicinity of the genset. Together with the factory-tested engine cabling, the cables fitted and tested on the genset switch

cabinet and connected to the genset (with plug connections on the genset) ensure smooth commissioning and a high level of operational reliability.

Signals relating to the power part are exchanged directly with the TEM EVO system in the auxiliary genset switch cabinet via the I/O Controller. Data is transmitted to the genset control via an extremely fail-safe CAN bus connection.

Operation

Easy operation of the TEM EVO system is ensured by an intelligent operating computer that can be used to access all functions. The operating computer is equipped with a 15" TFT touch monitor. The touch function of the operating computer allows easy and intuitive operation of the genset. The operator can use the navigation bar to quickly and directly change a screen to operate the genset. Each operating computer screen informs the operator about the status of the connected genset. All regulation, service, control and monitoring functions can be operated conveniently without a lengthy training period.

Communication with the user can take place in one of the many languages that can be stored in the TEM EVO. The language can be changed quickly at any time by pressing a button. Service work may be temporarily performed in a different language to that used by the site staff.

Operating log

Operation of the genset is seamlessly logged via defined fault, warning and text messages in the electronic operation log of the TEM EVO system. By means of filters, groups of information can be presented in a well-directed way.

All operating messages and operationally-relevant switching actions are recorded with a precise time stamp (date/time), as are all parameter changes.

As a whole, the TEM EVO system can monitor and distinguish between over 600 different events. This makes it possible to provide fast and detailed analyses of genset operating modes, including TEM EVO-controlled auxiliary functions.

History

The history function records up to 84 measured values. Up to 18 measured value curves can be displayed together in a single diagram. The user can compile the measured value curves themselves. The TEM EVO system records the history in three speed levels:

- Working cycle history: records actual values in each working cycle (1 working cycle corresponds to 2 crankshaft revolutions)
- 6 min. history: records current values at one second intervals
- 40 h history: records 6 min. average values

The graphs can be traced with the cursor, wherein each measurement value is indicated as a number with a precise time stamp. If a fault occurs, logging stops automatically after 40 s in order to facilitate fault diagnosis. The function "Real time scope" allows continuous observation of measured values and regulatory functions. Optionally, measurements can be saved and retrieved later for further analysis.

Diagnosis / service functions

In addition to the history and operating log, the TEM EVO system contains additional diagnosis and service functions which contribute significantly to the high availability of the gas-engine module. Commissioning also becomes easier and faster using these functions. This contributes decisively towards the overall economic efficiency of the gas engine module.

Genset switch cabinet ("AGS")

The genset switch cabinet is intended for the control of CES gas engines. It contains the genset control and the TÜV-approved security chain.

Genset cables

Genset cable set, connected to the genset switch cabinet and tested, consisting of 6 pre-confectioned cable harnesses with robust, non-interchangeable plug connections for connection between the genset and the TEM EVO switch cabinet.

Length: 8 m

6.5 General Services

Transport FCA

Delivery: FCA Max-Joseph-Street 55, 68167 Mannheim / Germany (Free Carrier) according to Incoterms® 2020

For containers or larger plant parts, the loading location is the manufacturing location in Sulzbrunnenstrasse 18, 74564 Crailsheim / Germany.

Engineering Package DTO

The engineering package includes an order-specific design and documentation for the scope of delivery of the Caterpillar Energy Solutions GmbH. Customer-specific features (special documentation requirements, customer P&ID) are checked for feasibility and evaluated against the Caterpillar Energy Solutions design guidelines. All required documentation is provided on a project-specific basis, with delivery depending on the progress of the project, but at the latest with the final documentation.

PM Package DTO TEM

- Fixed contact person in Project Management
- Handover Meeting with Project Management, Sales, Commercial Order Processing
- Design Order placement/processing/tracking by Project Management
- Staggered Design Freeze Process regarding TEM, led by Project Management.

Documentation digital – First language

The documentation is supplied in the agreed language as download in the Service Library. The documentation must comply at a minimum with the valid legal requirements, such as the EC Machinery Directive, for example.

The following items are included as digital download:

- General
 - Safety regulations
 - Maintenance information
 - Operating manual for the gas genset
 - Operating manual for TEM system /TPEM system
 - Installation directives
 - P&I diagram
 - Genset drawing
 - Engine test report
 - Certificates
- Switchgear
 - Electrical terminal diagrams
 - Wiring diagrams
- Installation notes
 - Container (if applicable)
 - Other installation notes or component-specific installation notes
- Work instructions
- Spare parts catalog
- Supplier documentation

Further documents that are of importance to the operator will be supplied depending on the scope of supply. The complete documentation is provided as download. A table of contents provides access to the files.

Documentation digital – Second language

The documentation is supplied in the agreed language as download in the Service Library. The documentation must comply at a minimum with the valid legal requirements, such as the EC Machinery Directive, for example.

The following items are included as digital download:

- General
 - Safety regulations
 - Maintenance information
 - Operating manual for the gas genset
 - Operating manual for TEM system /TPEM system
 - Installation directives
 - P&I diagram
 - Genset drawing
 - Engine test report
 - Certificates
- Switchgear
 - Electrical terminal diagrams
 - Wiring diagrams
- Installation notes
 - Container (if applicable)
 - Other installation notes or component-specific installation notes
- Work instructions
- Spare parts catalog

- Supplier documentation

Further documents that are of importance to the operator will be supplied depending on the scope of supply. The complete documentation is provided as download.

A table of contents provides access to the files.

Standard documentation

The documentation is supplied 1 times as a single copy in the agreed language on a data carrier (e.g. CD, DVD or flash drive). The documentation must comply at a minimum with the valid legal requirements, such as the EC Machinery Directive, for example.

The following items are included as standard:

- Maintenance information
- Safety regulations
- Operating manual for the gas genset
- Operating manual for TEM system /TPEM system
- Installation directives
- Electrical terminal diagrams
- P&I diagram
- Genset drawing
- Engine test bench log

Further documents that are of importance to the operator will be supplied depending on the scope of supply. The complete documentation is on the data carrier. A table of contents provides access to the files. The documentation in paper form contains excerpts of the complete documentation, such as the legally prescribed paper copies, as well as circuit diagrams and drawings, for example.

6.5.1 TR declaration and EAC label for the Eurasian Customs Union

The gensets are declared according to TR 020 for electromagnetic compatibility of the Eurasian Customs Union (EAEU). The TR declaration verifies the compliance with the relevant product requirements. Together with the EAC label that is attached to the product, permission is given for the importation and installation to/from the regions of the member states of the Customs Union (Russia, Belarus, Kazakhstan, Armenia and Kyrgyzstan).

7 Closing remarks

Operational materials and consumables

The genset characteristics, maintenance intervals and emissions that apply to our products can be guaranteed only if the binding Technical Bulletins of Caterpillar Energy Solutions GmbH as listed below are observed in their respectively applicable version.