



Technical Description

Genset

JGS 320 GS-N.L

with Island Operation

Colusa Indian Casino - JGS320 C86 480VAC

Electrical output

1059 kW el.

Emission values

NOx < 0.6 g/bhp.hr (NO₂)

NOTE:

The ratings in this specification are valid for full load operation at a site elevation of 52 ft (15 m) and air intake temperature up to < 94°F (34° C). Thereafter a derate of 0.83%/°F (1.2%/°C) will occur up to < 104 F (40° C), followed by a derate of 1.1%/°F (2.0%/°C).



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0.01 Technical Data (at genset)

Data at:

			Full load	Part Load	
			100%	75%	50%
Fuel gas LHV	BTU/scft		868		
Energy input	MBTU	[2]	9,482	7,367	5,248
Gas volume	scfhr	*)	10,924	8,487	6,046
Mechanical output	bhp	[1]	1,468	1,101	735
Electrical output	kW el.	[4]	1,059	791	524
Heat to be dissipated		[5]			
~ Intercooler 1st stage (Engine jacket water cooling circuit)	MBTU		619		
~ Intercooler 2nd stage (Low Temperature circuit)	MBTU		224		
~ Lube oil (Engine jacket water cooling circuit)	MBTU		430		
~ Jacket water	MBTU		1,215		
~ Surface heat	ca. MBTU	[7]	331		
Spec. fuel consumption of engine	BTU/bhp.hr	[2]	6,458	6,691	7,141
Lube oil consumption	ca. gal/hr	[3]	0.10	~	~
Electrical efficiency	%		38.1%	36.7%	34.1%

*) approximate value for pipework dimensioning
 [] Explanations: see 0.10 - Technical parameters

All heat data is based on standard conditions according to attachment 0.10. Deviations from the standard conditions can result in a change of values within the heat balance, and must be taken into consideration in the layout of the cooling circuit/equipment (intercooler; emergency cooling; ...). In the specifications in addition to the general tolerance of +/- 8% on the thermal output a further reserve of 10% is recommended for the dimensioning of the cooling requirements.



Main dimensions and weights (at genset)

Length	in	~ 230
Width	in	~ 70
Height	in	~ 90
Weight empty	lbs	~ 33,540
Weight filled	lbs	~ 34,640

Connections

Jacket water inlet and outlet	in/lbs	3"/145
Exhaust gas outlet	in/lbs	10"/145
Fuel gas (at gas train)	in/lbs	3"/232
Fuel Gas (at genset)	in/lbs	4"/145
Water drain ISO 228	G	½"
Condensate drain	in	0.7
Safety valve - jacket water ISO 228	in/lbs	2x1½"/2.5
Lube oil replenishing (pipe)	in	1.1
Lube oil drain (pipe)	in	1.1
Jacket water - filling (flex pipe)	in	0.5
Intercooler water-Inlet/Outlet 1st stage	in/lbs	3"/145
Intercooler water-Inlet/Outlet 2nd stage	in/lbs	2½"/145

Output / fuel consumption

ISO standard fuel stop power ICFN	bhp	1,468
Mean effe. press. at stand. power and nom. speed	psi	218
Fuel gas type		Natural gas
Based on methane number Min. methane number	MN d)	94 75
Compression ratio	Epsilon	12.50
Min./Max. fuel gas pressure at inlet to gas train	psi	1.2 - 2.9 c)
Allowed Fluctuation of fuel gas pressure	%	± 10
Max. rate of gas pressure fluctuation	psi/sec	0.145
Maximum Intercooler 2nd stage inlet water temperature	°F	122
Spec. fuel consumption of engine	BTU/bhp.hr	6,458
Specific lube oil consumption	g/bhp.hr	0.22
Max. Oil temperature	°F	189
Jacket-water temperature max.	°F	203
Filling capacity lube oil (refill)	gal	~ 90

c) Lower gas pressures upon inquiry

d) based on methane number calculation software AVL 3.1 (calculated without N2 and CO2)



0.02 Technical data of engine

Manufacturer		GE Jenbacher
Engine type		J 320 GS-C86
Working principle		4-Stroke
Configuration		V 70°
No. of cylinders		20
Bore	in	5.31
Stroke	in	6.69
Piston displacement	cu.in	2,970
Nominal speed	rpm	1,800
Mean piston speed	in/s	402
Length	in	131
Width	in	53
Height	in	81
Weight dry	lbs	11,464
Weight filled	lbs	12,566
Moment of inertia	lbs-ft ²	204.35
Direction of rotation (from flywheel view)		left
Radio interference level to VDE 0875		N
Starter motor output	kW	7
Starter motor voltage	V	24

Thermal energy balance

Energy input	MBTU	9,482
Intercooler	MBTU	843
Lube oil	MBTU	430
Jacket water	MBTU	1,215
Exhaust gas total	MBTU	3,006
Exhaust gas cooled to 356 °F	MBTU	2,040
Exhaust gas cooled to 212 °F	MBTU	2,542
Surface heat	MBTU	174

Exhaust gas data

Exhaust gas temperature at full load	°F [8]	916
Exhaust gas temperature at bmep= 163.2 [psi]	°F	~ 969.8
Exhaust gas temperature at bmep= 108.8 [psi]	°F	~ 982.4
Exhaust gas mass flow rate, wet	lbs/hr	13,431
Exhaust gas mass flow rate, dry	lbs/hr	12,441
Exhaust gas volume, wet	scfhr	170,069
Exhaust gas volume, dry	scfhr	151,035
Max.admissible exhaust back pressure after engine	psi	0.870

Combustion air data

Combustion air mass flow rate	lbs/hr	12,990
Combustion air volume	SCFM	2,683
Max. admissible pressure drop at air-intake filter	psi	0.145



Sound pressure level

Aggregate b)		dB(A) re 20 μ Pa	96
31,5	Hz	dB	78
63	Hz	dB	90
125	Hz	dB	92
250	Hz	dB	89
500	Hz	dB	92
1000	Hz	dB	90
2000	Hz	dB	89
4000	Hz	dB	87
8000	Hz	dB	90
Exhaust gas a)		dB(A) re 20 μ Pa	122
31,5	Hz	dB	97
63	Hz	dB	108
125	Hz	dB	118
250	Hz	dB	110
500	Hz	dB	113
1000	Hz	dB	114
2000	Hz	dB	117
4000	Hz	dB	115
8000	Hz	dB	114

Sound power level

Aggregate		dB(A) re 1pW	117
Measurement surface		ft ²	1,173
Exhaust gas		dB(A) re 1pW	130
Measurement surface		ft ²	67.60

a) average sound pressure level on measurement surface in a distance of 3.28ft according to DIN 45635, precision class 2.

b) average sound pressure level on measurement surface in a distance of 3.28ft (converted to free field) according to DIN 45635, precision class 3.

The spectra are valid for aggregates up to bmep=261.067932 psi. (for higher bmep add safety margin of 1dB to all values per increase of 15 PSI pressure).

For operation with 1200 rpm see above values, for operation with 1800 rpm add 3 dB to the above values.

Engine tolerance \pm 3 dB



0.03 Technical data of generator

Manufacturer		STAMFORD e)
Type		PE 734 B e)
Type rating	kVA	1,418
Driving power	bhp	1,468
Ratings at p.f.= 1.0	kW	1,059
Ratings at p.f. = 0.8	kW	1,049
Rated output at p.f. = 0.8	kVA	1,311
Rated reactive power at p.f. = 0.8	kVAr	787
Rated current at p.f. = 0.8	A	1,577
Frequency	Hz	60
Voltage	V	480
Speed	rpm	1,800
Permissible overspeed	rpm	2,160
Power factor (lagging - leading)		0,8 - 1,0
Efficiency at p.f.= 1.0	%	96.7%
Efficiency at p.f. = 0.8	%	95.8%
Moment of inertia	lbs-ft ²	753.55
Mass	lbs	5,975
Radio interference level to VDE 0875		N
Construction		B3/B14
Protection Class		IP 23
Insulation class		H
Temperature rise (at driving power)		F
Maximum ambient temperature	°F	104
Total harmonic distortion	%	1.5

Reactance and time constants (saturated)

xd direct axis synchronous reactance	p.u.	2.74
xd' direct axis transient reactance	p.u.	0.17
xd'' direct axis sub transient reactance	p.u.	0.12
Td'' sub transient reactance time constant	ms	10
Ta Time constant direct-current	ms	20
Tdo' open circuit field time constant	s	2.14

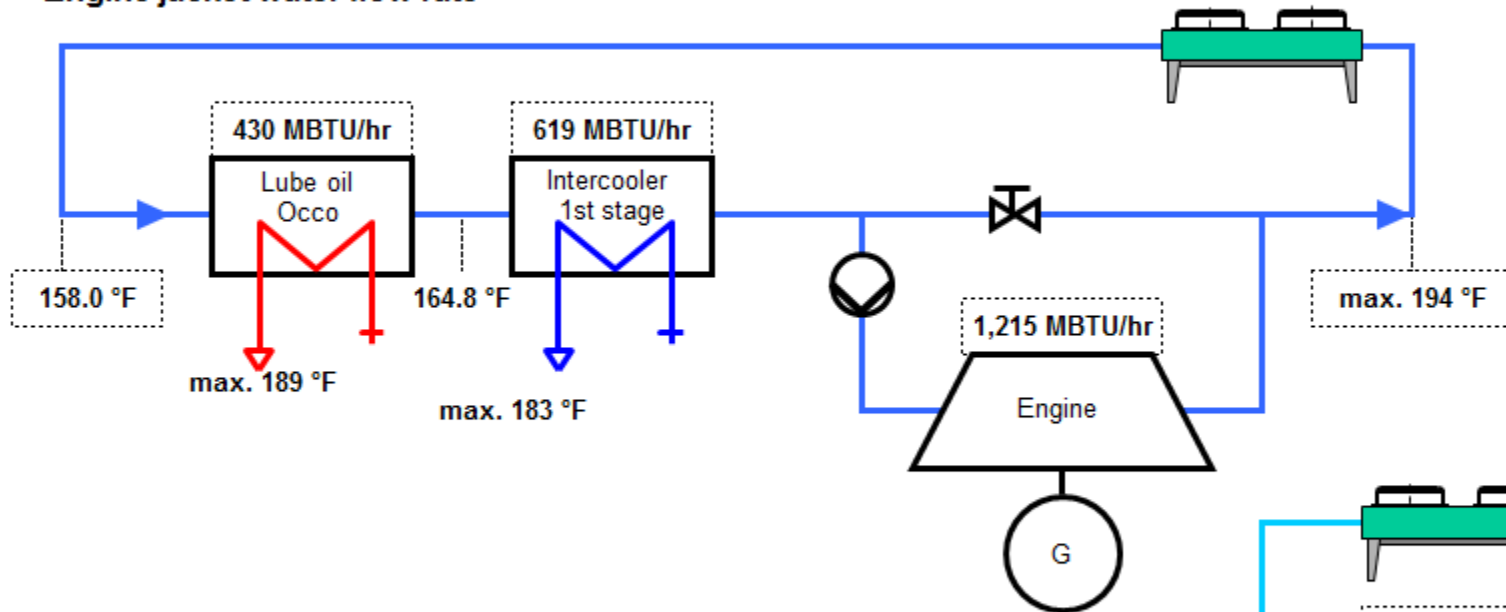
e) GE Jenbacher reserves the right to change the generator supplier and the generator type. The contractual data of the generator may thereby change slightly. The contractual produced electrical power will not change.

Engine jacket water cooling circuit (calculated with Glykol 37%)

Heat to be dissipated = 2,264 MBTU/hr

(±8% tolerance +10% reserve for cooling requirements)

Engine jacket water flow rate = 141.0 GPM

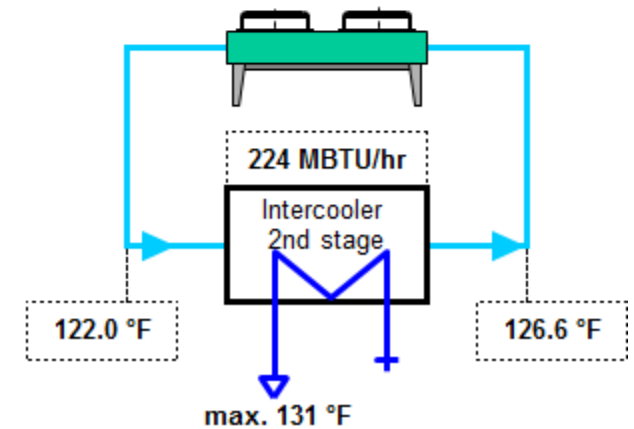


Low Temperature circuit (calculated with Glykol 37%)

Heat to be dissipated = 224 MBTU/hr

(±8% tolerance +10% reserve for cooling requirements)

Cooling water flow rate = 110.1 GPM





0.05 Cooling water circuit

Oil - heat (Engine jacket water cooling circuit)

Nominal output	MBTU	430
Max. Oil temperature	°F	189
Design pressure of engine jacket water / (operating pressure)	lbs / (psi)	145 / (87)
Loss of nominal pressure of engine jacket water	psi	2.90
Safety valve - max press. set point	psi	36.26

Engine jacket water - heat (Engine jacket water cooling circuit)

Nominal output	MBTU	1,215
Max. engine jacket water temperature (outlet engine)	°F	194
Engine jacket water flow rate	GPM	141.0
Safety valve - max press. set point	psi	36.26

Mixture Intercooler (1st stage) (Engine jacket water cooling circuit)

Nominal output	MBTU	619
Max. inlet cooling water temp. (intercooler)	°F	164.8
Design pressure of cooling water / (operating pressure)	lbs / (psi)	145 / (87)
Loss of nominal pressure of engine jacket water	psi	5.80
Safety valve - max press. set point	psi	36.26

Mixture Intercooler (2nd stage) (Low Temperature circuit)

Nominal output	MBTU	224
Max. inlet cooling water temp. (intercooler)	°F	122
Aftercooler water flow rate	GPM	110.1
Design pressure of cooling water / (operating pressure)	lbs / (psi)	145 / (87)
Intercooler water pressure drop	psi	2.90
Safety valve - max press. set point	psi	36.26



0.10 Technical parameters

All data in the technical specification are based on engine full load (unless stated otherwise) at specified temperatures as well as the methane number and subject to technical development and modifications. For isolated operation an output reduction may apply according to the block load diagram. Before being able to provide exact output numbers, a detailed site load profile needs to be provided (motor starting curves, etc.).

All pressure indications are to be measured and read with pressure gauges (psi.g.).

- (1) At nominal speed and standard reference conditions ICFN according to DIN-ISO 3046 and DIN 6271, respectively
- (2) According to DIN-ISO 3046 and DIN 6271, respectively, with a tolerance of + 5 %.
Efficiency performance is based on a new unit (immediately upon commissioning). Effects of degradation during normal operation can be mitigated through regular service and maintenance work.
- (3) Average value between oil change intervals according to maintenance schedule, without oil change amount
- (4) At p. f. = 1.0 according to VDE 0530 REM / IEC 34.1 with relative tolerances
- (5) Total output with a tolerance of +/- 8 %
- (6) According to above parameters (1) through (5)
- (7) Only valid for engine and generator; module and peripheral equipment not considered (at p. f. = 0,8)
- (8) Exhaust temperature with a tolerance of +/- 8 %

Radio interference level

The ignition system of the gas engines complies the radio interference levels of CISPR 12 and EN 55011 class B, (30-75 MHz, 75-400 MHz, 400-1000 MHz) and (30-230 MHz, 230-1000 MHz), respectively.

Definition of output

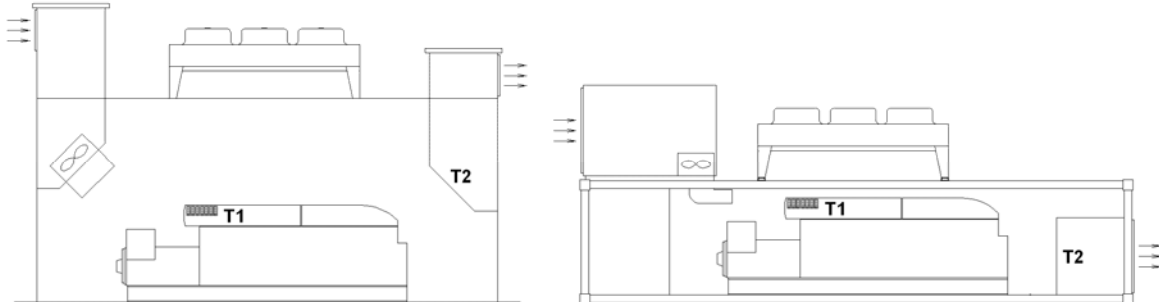
- ISO-ICFN continuous rated power:
Net break power that the engine manufacturer declares an engine is capable of delivering continuously, at stated speed, between the normal maintenance intervals and overhauls as required by the manufacturer. Power determined under the operating conditions of the manufacturer's test bench and adjusted to the standard reference conditions.
- Standard reference conditions:
Barometric pressure: 14.5 psi (1000 mbar) or 328 ft (100 m) above sea level
Air temperature: 77°F (25°C) or 298 K
Relative humidity: 30 %
- Volume values at standard conditions (fuel gas, combustion air, exhaust gas)
Pressure: 1 atmosphere (1013.25 mbar)
Temperature: 32°F (0°C)

Output adjustment for turbo charged engines

The ratings in this specification are valid for full load operation at a site elevation of 52 ft (15 m) and air intake temperature up to < 94°F (34° C). Thereafter a derate of 0.83%/°F (1.2%/°C) will occur up to < 104 F (40° C), followed by a derate of 1.1%/°F (2.0%/°C).



Maximum room temperature: **122°F** (T2) -> engine stop



If the actual methane number is lower than the specified, the knock control responds. First the ignition timing is changed at full rated power. Secondly the rated power is reduced. These functions are done by the engine management.

Exceedance of the voltage and frequency limits for generators according to IEC 60034-1 Zone A will lead to a derate in output.

Parameters for the operation of GE Jenbacher gas engines

The genset fulfills the limits for mechanical vibrations according to ISO 8528-9.

If possible, railway trucks must not be used for transport (**TI 1000-0046**).

The following "Technical Instruction of GE JENBACHER" forms an integral part of a contract and must be strictly observed: **TI 1100-0110, TI 1100-0111 and TI 1100-0112.**

Parameters for the operation of control unit and the electrical equipment

Relative humidity 50% by maximum temperature of 104°F.

Altitude up to 2000m above the sea level.

1.00 Scope of supply - Genset

Design:

The genset is built as a compact package.

Engine and generator are mounted to the base frame. To provide the best possible isolation from the transmission of vibrations the engine is mounted to the frame by means of anti-vibrational mounts. The remaining vibrations are eliminated by mounting the module on isolating pads (e.g. Sylomer). This, in principle, allows for placing of the genset to be directly on any floor capable of carrying the static load. No special foundation is required. Prevention of sound conducted through solids has to be provided locally.



1.01 Spark ignited gas engine

Four-stroke, air/gas mixture turbocharged, aftercooled, with high performance ignition system and electronically controlled air/gas mixture system.
The engine is equipped with the most advanced

LEANOX® LEAN-BURN COMBUSTION SYSTEM

developed by GE JENBACHER.

1.01.01 Engine design

Engine block

Single-piece crankcase and cylinder block made of special casting, crank case covers for engine inspection, welded steel oil pan.

Crankshaft and main bearings

Drop-forged, precision ground, surface hardened, statically and dynamically balanced; main bearings (upper bearing shell: 3-material bearing / lower bearing shell: sputter bearing) arranged between crank pins, drilled oil passages for forced-feed lubrication of connecting rods.

Vibration damper

Maintenance free viscous damper

Flywheel

With ring gear for starter motor

Pistons

Single-piece, made of light metal alloy, with piston ring carrier and oil passages for cooling; piston rings made of high quality material, main combustion chamber specially designed for lean burn operation.

Connecting rods

Drop-forged, heat-treated, big end diagonally split and toothed. Big end bearings (upper bearing shell: sputter bearing / lower bearing shell: grooved bearing) and connecting rod bushing for piston pin.

Cylinder liner

Chromium alloy gray cast iron, wet, individually replaceable.

Cylinder head

Specially designed and developed for GE JENBACHER-lean burn engines with optimized fuel consumption and emissions; water cooled, made of special casting, individually replaceable; Valve seats and valve guides and spark plug sleeves individually replaceable; exhaust and inlet valve made of high quality material.

Crankcase breather

Connected to combustion air intake system

Valve train



Camshaft, with replaceable bushings, driven by crankshaft through intermediate gears, valve lubrication by splash oil through rocker arms.

Combustion air/fuel gas system

Motorized carburetor for automatic adjustment according fuel gas characteristic. Exhaust driven turbocharger, mixture manifold with bellows, water-cooled intercooler, throttle valve and distribution manifolds to cylinders.

Ignition system

Most advanced, fully electronic high performance ignition system, external ignition control.

Lubricating system

Gear-type lube oil pump to supply all moving parts with filtered lube oil, pressure control valve, pressure relief valve and full-flow filter cartridges. Cooling of the lube oil is arranged by a heat exchanger.

Engine cooling system

Jacket water pump complete with distribution pipework and manifolds.

Exhaust system

Turbocharger and exhaust manifold

Exhaust gas temperature measuring

Thermocouple for each cylinder

Electric actuator

For electronic speed and output control

Electronic speed monitoring for speed and output control

By magnetic inductive pick up over ring gear on flywheel

Starter motor

Engine mounted electric starter motor

1.01.02 Engine accessories

Insulation of exhaust manifold:

Insulation of exhaust manifold is easily installed and removed

Sensors at the engine:

- Jacket water temperature sensor
- Jacket water pressure sensor
- Lube oil temperature sensor
- Lube oil pressure sensor
- Mixture temperature sensor
- Charge pressure sensor
- Minimum and maximum lube oil level switch
- Exhaust gas thermocouple for each cylinder
- Knock sensors



- Gas mixer / gas dosing valve position reporting.

Actuator at the engine:

- Actuator - throttle valve
- Bypass-valve for turbocharger
- Control of the gas mixer / gas dosing valve

1.02 Self-excited self-regulated three phase generator

The generator consists of the main generator (built as rotating field machine), the exciter machine (built as rotating armature machine) and the voltage regulator with cos. phi-regulator, which is powered by a permanent magnet pilot exciter.

Main components

- Main stator with frame
- Main stator with 2/3 pitch winding to eliminate neutral currents of 3rd order
- Terminal box includes main terminals plus auxiliary terminals for thermistor connection and control of regulator
- Main rotor with sufficiently sized shaft dynamically balanced as per VDI 2060, Grade Q1
- Drive end bracket with bearing
- Non-drive end bracket with bearing
- Exciter unit with permanent pilot exciter
- Power factor controller
- Voltage regulator
- Anti-condensation heater (**option**)

Electrical data and features

- Voltage adjustment: $\pm 10\%$ rated voltage Static voltage accuracy: $\pm 1\%$ at no load to full load and power factor 0.8-1
- speed variation $\pm 3\%$, cold and hot machine
- Maximum deviation of wave form according to VDE is 5% phase to phase at open circuit
- Generator suitable for parallel operating with mains and other generators
- Sustained short circuit current at 3-pole terminal short circuit: minimum 3 times rated current for 5 seconds.
- Overload capacity according. to IEC 34 - I/VDE 0530
- According to VDE 0530 the overspeed test ensues with 1.2 times of rated speed for 2 minutes.

Additional components:

- Electronic voltage regulator
- Electronic power factor regulator
- 3 thermistors for winding temperature monitoring

1.03 Module accessories

Base frame

Welded of structural steel to accommodate engine, generator and heat exchangers.



Flexible coupling

With torque limiter to couple engine with generator. The coupling isolates the major subharmonics of engine firing impulses from the generator.

Bell housing

To connect engine with generator housing. With two ventilation and control windows.

Anti-vibration mounts

Arranged between engine/generator assembly and base frame. Insulating pads (SYLOMER) for placement between base frame and foundation, delivered loose.

Exhaust gas connection

Connection of exhaust gas turbocharger; including flexible connection to compensate for expansions and vibrations.

Combustion air filter

Dry type air filter with replaceable filter cartridges, including flexible connection to carburetor and service indicator.

Interface panel

Totally enclosed sheet steel cubicle with front door, wired to terminals, ready to operate. Cable entry at bottom.

Painting: RAL 7035

Protection: IP 54 external IP 20 internal (protection against direct contact with alive parts)

Design according to IEC 439-1 (EN 60 439-1/1990) and DIN VDE 0660 part 500, respectively.
Ambient temperature 41 - 104 °F (5 - 40 °C), Relative humidity 70 %

Dimensions:

- Height: 39 in (1000 mm)
- Width: 32 in (800 mm)
- Depth: 12 in (300 mm)

Power supply from the starter battery charger.

Power distribution to the engine mounted auxiliaries (power input from the supplier of the auxiliaries power supply):

3 x 480/277 V, 60 Hz, 16 A

Essential components installed in interface panel:

- Terminal strip
- Decentralized input and output cards, connected by a data bus interface to the central engine control of the module control panel.
- Speed monitoring
- Relays, contacts, fuses, engine contact switch to control valves and auxiliaries
- Measuring transducer for excitation voltage



1.03.01 Engine jacket water system

Engine cooling jacket system

Closed cooling circuit, consisting of:

- Expansion tank
- Filling device (check and pressure reducing valves, pressure gauge)
- Safety valve(s)
- Thermostatic valve
- Required pipework on module
- Vents and drains
- Jacket water pump, including check valve
- Jacket water preheat device

1.05 Gas train

Pre-assembled, delivered loose, for installation into gas pipework to the engine.

Consisting of:

- Manual shut off valve
- Gas filter, filter fineness $<3 \mu\text{m}$
- Gas admission pressure regulator
- Pressure gauge with push button valve
- Solenoid valves
- Leakage detector
- Gas pressure switch (min.)
- Gas pressure regulator
- Gas flow meter (option)
- p/t compensation (option)

The gas train complies with DIN - DVGW regulations.

Maximum distance from gas train outlet to gas entry on engine, including flexible connections, is 78 in (2 m).

1.07 Painting

- Quality: Oil resistant prime layer
Synthetic resin varnish finishing coat
- Color: Engine: RAL 6018 (green)
Base frame: RAL 6018 (green)
Generator: RAL 6018 (green)
Module interface
panel: RAL 7035 (light gray)
Control panel: RAL 7035 (light gray)



1.11 Engine generator control panel – DIA.NE XT

Dimensions:

- Height: 87 in (2200 mm) [including 8 in (200 mm) pedestal]
- Width: 40 in (1000 mm)
- Depth: 24 in (600 mm)

Control supply voltage from starter and control panel batteries: 24V DC

Supply of power for auxiliaries from auxiliary power panel:
3 x 480/277 V, 60 Hz, xx A

Consisting of:

DIA.NE XT 3 (Dialog Network new generation) **motor management system**

System elements visualization with central engine and module control

1) Visualization:

Industrial control with 10,4" QVGA TFT color graphics display and 8 function keys.

10-key numeric keyboard for parameter input.

Keys for START, STOP, Generator circuit breaker OPEN, Generator circuit breaker CLOSED/SELECTED, display selection keys and special functions.

Interfaces:

- Ethernet (twisted pair) for connection to DIA.NE WIN server
 - CAN-Bus: bus connection to the intelligent sensors and actuators
 - Data bus connection to the control in- and outputs
- OPTION:** Interfacing with the customer's plant management according to GE JENBACHER list of options

Protection class: IP 65 (front)

Dimensions: W x H x D = approx. 8,4 x 10 x 3,75 in (212 x 255 x 95 mm)

A clear and functional graphic compilation of measured values is displayed on the screen. User prompts are by means of direct-acting display selection keys and function keys.

Main displays:

- Electrical schematic
- Oil and hydraulic schematic
- Gas data
- Engine controllers
- Cylinder data
- Exhaust gas data
- Auxiliaries controllers
- Spare screen for customer specific purposes
- System display screens
- Parameter manager
- User setting
- Alarm management

**Recipe handling:**

Setting, display and storage of all module parameters

Alarm management:

Efficient diagnostic instrumentation listing all active fault messages both tabular and chronologically, with the recorded time.

2) Central engine and module control:

A real-time, modular industrial control system which handles all jobs for module and engine-side sequencing control (start preparation, start, stop, synchronizing, after-cooling, control of auxiliaries), as well as all control functions.

Control functions:

- Speed control in no-load and isolated operation
 - Power output control in parallel operation system; job-specific with respect to internal and external set point values.
 - LEANOX control system for control of boost pressure; dependent upon the generator terminal power and the mixture temperature via the engine-driven air-gas mixer
 - Knocking control: adjustment of the ignition point, power output and (insofar as is locally possible) the mixture temperature in the event of detection of knocking.
 - Load sharing between several modules in isolated operation
 - Linear reduction of power output in the event of excessive mixture temperature and ignition failures
-
- Interface relays as per the interface list
 - Multi-transducer, to record the following electrically measured variables of the generator:
 - Phase current (with slave pointer)
 - Neutral conductor current
 - Voltages Ph/Ph and Ph/N
 - Active power (with slave pointer)
 - Reactive power
 - Apparent power
 - Power factor
 - Frequency

An additional 0 - 20 mA output is produced for active power, as well as a pulse output for active power demand.

The following alternator supervisions are integrated with the multi-transducer (max. 8 functions simultaneous):

- Overload/short-circuit [51], [50]
- Over voltage [59]
- Undervoltage [27]
- Asymmetric voltage [64], [59N]
- Unbalance current [46]
- Failure Excitation [40]
- Overfrequency [81>]
- Underfrequency [81<]
- Lockable operation mode selector switch positions:
 - "OFF"No operation is possible, running set will shut down;



- "MANUAL"
Manual operation using (start, stop) is possible, unit is not available for fully automatic operation.
- "AUTOMATIC"
Fully automatic operation, according to remote demand signal:
 - Automatic start
Fully automatic operation at full load
 - Stop with cooling down run for 1 minute
Continuous operation of auxiliaries for 5 minutes after engine shutdown
- Demand switch with the positions:
 - Demand OFF
 - Demand ON
 - Remote demand
- Supply disconnecting device for auxiliaries with lockable circuit breaker

Shut-down functions with display:

- Low lube oil pressure
- Low lube oil level
- High lube oil level
- High lube oil temperature
- Low jacket water pressure
- High jacket water pressure
- High jacket water temperature
- Overspeed
- Emergency stop/safety loop
- Gas train failure
- Start failure
- Stop failure
- Engine start blocked
- Engine operation blocked
- Misfiring
- High mixture temperature
- Measuring signal failure
- Overload/output signal failure
- Generator overload/short circuit
- Generator over/undervoltage
- Generator over/underfrequency
- Generator asymmetric voltage
- Generator unbalanced load
- Generator reverse power
- High generator winding temperature
- Synchronising failure
- Knocking failure

Warning functions with display:

- Low jacket water temperature
- CPU battery failure

Operational functions with display:



- Ready to start
- Operation (engine running)
- Generator circuit breaker "CLOSED"

Remote signals:

(volt free contacts)

1NO = 1 normally open
1NC = 1 normally closed
1 COC = 1 change over contact

- | | |
|---|-----|
| • Ready for automatic start (to Master control) | 1NO |
| • Operation (engine runs) | 1NO |
| • Collective signal "shut down" | 1NC |
| • Collective signal "warning" | 1NC |

External (by others) provided command/status signals:

- | | |
|---------------------------------------|-----|
| • Engine demand (from Master control) | 1NO |
|---------------------------------------|-----|

**Single synchronizing Automatic
With voltage balance**

For automatic synchronizing of the module with the generator circuit breaker to the grid by PLC- technology, integrated within the module control panel.

Consisting of:

- Lockable synchronizing mode selector switch, with positions "MANUAL - OFF - AUTOMATIC"
 - AUTOMATIC:
Automatic module synchronization, after synchronizing release from the control panel
 - MANUAL:
Manual initiation of synchronizing by push button. Speed adjustment and closing of the circuit breaker is automatically controlled via microprocessor
 - OFF:
Synchronization is disabled
- Additional PLC hardware for the fully automatic synchronizing of each module, and monitoring of the "CIRCUIT BREAKER CLOSED" signal.
Logic for monitoring of:
 - Non-logic breaker positions
 - Switch "ON" trouble
 - Switch "OFF" trouble
- Automatic synchronizing device to control the electronic speed governor adjustment, double voltmeter, double frequency meter and synchro-scope
- Automatic voltage balancing
- Luminous push button "GENERATOR CIRCUIT BREAKER OPEN / SELECT"
 - To indicate synchronizing mode
 - To indicate "Generator circuit breaker closed"
 - For manual synchronizing selection with the synchronizing mode selector switch in the MANUAL position



- For manual closing of the generator circuit breaker to the voltage free bus bar (first connection) with synchronizing mode selector switch in the MANUAL position
- Luminous push button “GENERATOR CIRCUIT BREAKER OPEN”
 - To indicate “Generator circuit breaker open”
 - To manually open the generator circuit breaker
- Control switch
- Required relays for control and monitoring
- Voltage relay for monitoring of busbar voltage (only for island operation)

Operational indications for:

- Generator circuit breaker CLOSED
- Generator circuit breaker OPEN

Fault indications for:

- Generator circuit breaker return signal fault
- Generator circuit breaker closing fault
- Generator circuit breaker opening fault

Remote signals

(Volt free contacts)

- Generator circuit breaker CLOSED 1 NO

The following reference and status signals must be provided by the switchgear supplier:

Generator circuit breaker CLOSED	1 NO
Generator circuit breaker OPEN	1 NO
Generator circuit breaker READY TO CLOSE	1 NO
Mains circuit breaker CLOSED	1 NO
Mains circuit breaker OPEN	1 NO

- Mains voltage 3 x 480/277 V or 3x 110V/v3 – other measurement voltages available on request
- Bus bar voltage 3 x 480/277 V or 3x 110V/v3 – other measurement voltages available on request
- Generator voltage 3 x **480 V** or 3x 110V/v3 – other measurement voltages available on request

Voltage transformers in star point with minimum 50VA, Class 1

The following volt free interface-signals will be provided by GE Jenbacher to be incorporated in switchgear:

- CLOSING/OPENING command for generator circuit breaker (permanent contact) 1 NO + 1 NC
- Signal for circuit breaker undervoltage trip 1 NO

1.11.02 Remote information – MODBUS RTU

Data transfer from Jenbacher-engine control to customer's plant management system by MODBUS-RTU-network (RS 485).



The Jenbacher module control panel works as a SLAVE.
The data transmission by the customer's MASTER shall be cyclical.

Transmitted data:

Individual failure information, plant operating information, measuring values for generator power, oil pressure, oil temperature, jacket water pressure, jacket water temperature, cylinder and average exhaust gas temperatures.

GE Jenbacher limit of delivery:

Interface connector at the PLC in the engine control panel.

1.11.03 Remote Data-Transfer with DIA.NE XT - HERMES

General

HERMES is the remote data transfer solution for DIA.NE XT. HERMES is available via three connection methods and two applications.

Connections methods

1.) Modem

Site - Customer connection via a Modem (analogue, ISDN, GSM).

Scope of supply

- DIA.NE WIN – Server (Industrial PC without display, keyboard or mouse, built into the control panel, including operating system)
- Modem (analogue, ISDN, GSM)

Customer Requirements

- Modem (analogue, ISDN, GSM) in the customers PC
- Public telephone connection with connection port for the DIA.NE WIN – Server (in the control panel) including over-voltage protection corresponding to the local telecommunication regulations.
- Public telephone connection with connection port for the customer's PC corresponding to the local telecommunication regulations.

2.) LAN

Site - Customer connection via a local network.

Scope of supply

- DIA.NE WIN – Server (Industrial PC without display, keyboard or mouse, built into the control panel, including operating system)
- Ethernet – Network card (10/100 BASE T)

Customer Requirements

- Ethernet – Network card (10/100 BASE T)
- Ethernet – Cabling between the DIA.NE WIN – Server the customers PC.



3.) Internet

Site – Customer connection via secure Internet access

See comments under Technical instruction **TI 2300 - 0006**

Scope of Supply

- DIA.NE WIN – Server (Industrial PC without display, keyboard or mouse, built into the control panel, including operating system)
- Ethernet–Network card (10/100 BASE T)
- Firewall–Appliance with connection feasibility to a customer network with a maximum of 10 Hosts (Installation and service by GE Jenbacher; during warranty period included, afterwards as a service package with costs) (built into the control panel)
- Feature – service package (access monitoring, clock synchronization for server)

Customer Requirements

- Broad band Internet access with at least two official IP addresses.
Connection feasibility for the Firewall–Appliance to the Internet–Router via Ethernet (RJ45 Connector, Network Address Translation (NAT) is not permitted)

Applications

1.) DIA.NE WIN

DIA.NE WIN is the Windows based „man-machine interface“ for GE Jenbacher gas engines. The system offers extensive facilities for commissioning, monitoring, servicing and analysis of the site. The option DIA.NE WIN extends the visualization of DIA.NE XT with respect to user friendliness, historical analysis and remote use. Several service stations can be independently operated in parallel. The system consists of a central PC (DIA.NE WIN – Server) which is built in to the control panel and one or more service stations (DIA.NE WIN – Clients). The system runs on a Microsoft Internet Explorer platform.

Function

Service and monitoring, trend analysis, alarm management, parameter management, long-term data analysis, multi-user system, remote control, OPC (OLE for process control), print and export functions, operating data protocols, available in several languages.

Scope of supply

- Software package DIA.NE WIN on the DIA.NE WIN – Server
- DIA.NE WIN – Client License (Right to access of the user to the server on site)

Customer requirements

- Standard PC with keyboard, mouse and monitor (min. resolution 1024*768)
- V supply for the customers' PC
- Operating system Windows 98, Windows NT, Windows 2000 or Windows XP
- Microsoft Internet Explorer (min. Version 6.0) including Java support

2.) DIA.NE RMC

DIA.NE RMC (Remote Message Control) is the automatic alarm system for DIA.NE XT. DIA.NE RMC can fully automatically transmit essential operational information from the DIA.NE XT Alarm Management to a remote station. The messages can be forwarded to an e-mail address, fax machine or mobile phone (SMS).



Furthermore the stored messages can be visualized at the remote station. The system consists of a central PC (DIA.NE WIN – Server) which is built into the control panel and one or more customer remote stations.

Function

Automatically transfer of messages to the customer via email, fax or SMS. Display and printing of the messages (also distributed via LAN). Automatically and manually transfer of messages, trend data and operating data protocols.

Scope of supply

- Software package DIA.NE message on the DIA.NE WIN – Server
- Software package DIA.NE control and DIA.NE report on the remote station

Only for connection method “Internet”:

- Firewall–Appliance for customer computer with connection feasibility to a customer network with a maximum of 10 Hosts (Installation and service by GE Jenbacher; during warranty period included, afterwards as a service package with costs)

Customer requirements

- Standard PC with keyboard, mouse and monitor (min. resolution 1024*768)
- V supply for the customers' computer.
- Operating system Windows 2000 (Professional and Server), Windows XP Professional or Windows Server 2003.
- Internet connection (provider account) for the case that messages from the RMC should be forwarded to an email receiver (incl. SMS for mobiles and pagers). (Mobiles and pagers to be provided by the customer).
- Customer fax software for message forwarding via fax

Only for connection method “Internet”:

- Broad band Internet access with at least two official IP addresses.
Connection feasibility for the Firewall–Appliance to the Internet–Router via Ethernet (RJ45 Connector, Network Address Translation (NAT) is not permitted)

1.20.01 Starting system

Starter battery:

2 piece 12 V Pb battery, 200 Ah (according to DIN 72311), complete with cover plate, terminals and acid tester.

Battery voltage monitoring:

Monitoring by an under voltage relay.

Battery charging equipment:

Capable for charging the starter battery with I/U characteristic and for the supply of all connected D.C. consumers.

Charging device is mounted inside of the module interface panel or module control panel.

• General data:

- | | |
|--------------------------|------------------------------------|
| • Power supply | 3 x 320 - 550 V, 47 - 63 Hz |
| • max. power consumption | 1060 W |
| • Nominal D.C. voltage | 24 V(+/-1%) |



- Voltage setting range 24V to 28,8V (adjustable)
- Nominal current (max.) 40 A
- Dimensions ca. 10 x 5 x 5 inch (240 x 125 x 125 mm)
- Degree of protection IP20 to IEC 529
- Operating temperature 32 °F – 140 °F (0 °C - 60 °C)
- Protection class 1
- Humidity class 3K3, no condensation.
- Natural air convection
- Standards EN60950,EN50178
UL/cUL (UL508/CSA 22.2)

Signalling:

- Green Led: Output voltage > 20,5V
- Yellow Led: Overload, Output Voltage < 20,5V
- Red Led: shutdown

Control accumulator:

- Pb battery 24 VDC/18 Ah

1.20.03 Electric jacket water preheating

Installed in the jacket water cooling circuit, consisting of:

- Heating elements
- Water circulating pump

The jacket water temperature of a stopped engine is maintained between 133 °F (56°C) and 140°F (60°C), to allow for immediate loading after engine start.

1.20.04 Flexible connections

Following flexible connections per module are included in the GE Jenbacher -scope of supply:

No.Connection	Unit	Dimension	Material
2 Warm water in-/outlet	in/lbs	3"/145	Stainless steel
1 Exhaust gas outlet	in/lbs	10"/145	Stainless steel
1 Fuel gas inlet	in/lbs	3"/232	Stainless steel
2 Intercooler in-/outlet	in/lbs	3"/145	Stainless steel
2 Lube oil connection	in	1.1	Hose

Seals and flanges for all flexible connections are included.



2.00 Electrical equipment

Totally enclosed floor mounted sheet steel cubicle with front door wired to terminals. Ready to operate, with cable entry at bottom. Naturally ventilated.

Protection: IP 42 external, NEMA 12
IP 20 internal (protection against direct contact with live parts)

Design according to EN 60439-1 / IEC 60439-1 and ISO 8528-4.
Ambient temperature 41 - 104 °F (5 - 40 °C), 70 % Relative humidity

Standard painting: Panel: RAL 7035
Pedestal: RAL 7020

2.04 Generator switchgear (Low Voltage)

Enclosure & Mounting

Single freestanding Nema 1 enclosure 79.5" H x 36"W x 48"D painted ASA61 Grey
Silver plated copper bus
Full length copper ground bus
Fully rated solid neutral
Provision for front and LHS access only c/w top entry and bottom exit
Internal DC Panel light

Circuit Breaker

Merlin Gerin Masterpact 2500A, 3P, 480V Drawout Type Air Circuit Breaker c/w
UL489 listed
Safety shutters
65KAIC at 480VAC
24VDC motor operator
24VDC shunt trip and close coil
24VDC undervoltage release
Cradle switch
Auxiliary contacts (2 N/O, 2 N/C)
Line and Load Lugs

Measurement

480:120VAC, 500VA thermal, line side potential transformer, accuracy 0.3 W, X, M and 0.6Y(Qty. 3)
480:120VAC, 500VA thermal, load side potential transformer, accuracy 0.3 W, X, M and 0.6Y(Qty. 3)
Current Transformer, Relay Class C50 (Qty. 6)
PT test block (Qty. 2) and CT shorting type terminals
Miscellaneous wire, terminal blocks and fuses etc. as required



3.70 Control Strategy and Options

Unit to operate full time in Island Mode. The unit will have its load controlled by an existing GE Jenbacher Master Controller. Reference Master Control requirements from Project Colusa JA579.

SCR Signals – 2 additional discrete inputs and 1 analog will be required:

Discrete In 1 - Unit Operation/Engine Running (SSL20) to start the unit

Discrete In 2 - SCR Alarm (SS69) for display on the alarm Diane XT screen.

Analog Out 1 – Generator Power (0-100% = 4-20mA) for control of the SCR spray mechanism.

3.71 Vibration Sensor

A structural Vibration Sensor will be installed on the package base frame to detect excessive vibrations. A signal will be sent to the control panel to indicate an alarm condition.

4.00 Delivery, installation and commissioning

4.01 Carriage

Ex works GE JENBACHER (Container unit ex works Jenbach or ex works Hungary) **or** carriage of the complete scope of supply to the installation site.

4.02 Unloading

Unloading, moving of equipment to point of installation, mounting and adjustment of delivered equipment on intended foundations **is / is not** included in GE Jenbacher scope of supply.

4.03 Assembly and installation

Assembly and installation of all GE Jenbacher -components **is not** included in GE Jenbacher scope of supply.

4.04 Storage

The customer is responsible for secure and appropriate storage of all delivered equipment.

4.05 Start-up and commissioning

Start-up and commissioning with the GE Jenbacher start-up and commissioning checklist **is not** included.

4.06 Trial run

After start-up and commissioning, the plant will be tested in an 8-hour trial run. The operating personnel will be introduced simultaneously to basic operating procedures.

4.07 Emission measurement (exhaust gas analyser)

Emission measurement by GE Jenbacher personnel, to verify that the guaranteed toxic agent emissions have been achieved (costs for measurement by an independent agency will be an extra charge).



5.01 Limits of delivery - Genset

Electrical:

- Genset:
 - At terminals of genset interface panel
 - At terminals of generator terminal box
(screwed glands to be provided locally)
- Genset control panel:
At terminal strips
- Auxiliaries:
At terminals of equipment which is supplied separately

Cooling water

At inlet and outlet flanges on genset

Exhaust gas

At outlet flange of the genset

Combustion air

The air filters are set mounted

Fuel gas

At inlet and outlet flange of gas train
At inlet flange of gas pipework on genset

Lube oil

At lube oil connections on genset

Draining connections and pressure relief

At genset

Insulation

Insulation of heat exchangers and pipework is not included in our scope of supply and must be provided locally.

First filling

The first filling of genset, (lube oil, engine jacket water, anti freeze-, anti corrosive agent, battery acid) is not included in our scope of supply.

The composition and quality of the used consumables are to be strictly monitored in accordance with the "Technical Instructions" of GE JENBACHER.

Suitable bellows and flexible connections **must be provided locally** for all connections.
Cables from the genset must be flexible.



5.02 Factory tests and inspections

The individual module components shall undergo the following tests and inspections:

5.02.01 Engine tests

Carried out as combined Engine- and Module test according to DIN ISO 3046 at GE Jenbacher test bench. The following tests are made at 100%, 75% and 50% load, and the results are reported in a test certificate:

- Engine output
- Fuel consumption
- Jacket water temperatures
- Lube oil pressure
- Lube oil temperatures
- Boost pressure
- Exhaust gas temperatures, for each cylinder

5.02.02 Generator tests

Carried out on the premises of the generator supplier.

5.02.03 Module tests

The engine will be tested with natural gas (Russian Natural gas with methane number 94). The technical data according to the specification can only be demonstrated to a certain extent with the available natural gas.

Carried out as combined Engine- and Module test commonly with module control panel at GE Jenbacher test bench, according to ISO 8528, DIN 6280. The following tests are made and the results are reported in a test certificate:

Visual inspection of scope of supply per specifications.

- Functional tests per technical specification of control system.
 - Starting in manual and automatic mode of operation
 - Power control in manual and automatic mode of operation
 - Function of all safety systems on module
- Measurements at 100%, 75% and 50% load:
 - Frequency
 - Voltage
 - Current
 - Generator output
 - Power factor
 - Fuel consumption
 - Lube oil pressure
 - Jacket water temperature
 - Boost pressure
 - Mixture temperature
 - Exhaust emission (NO_x)

The module test will be carried out with the original generator, except it is not possible because of the delivery date. Then a test generator will be used for the module test.

To prove characteristics of the above components, which are not tested on the test bench by GE JENBACHER, the manufacturers' certificate will be provided.



5.03 Documentation

Preliminary documentation 60 days after receipt of a technically and commercially clarified order:

- Module drawing 1)
- Technical diagram 1)
- Drawing of control panel 3)
- List of electrical interfaces 2)
- Technical specification of control system 2)
- Technical drawing auxiliaries (if included in GE Jenbacher-limit of delivery) 1)

At delivery:

- Wiring diagrams 3)
- Cable list 3)

At start-up and commissioning (or on clients request):

- Operating and maintenance manual 4)
- Spare parts manual 4)
- Operation report log 4)