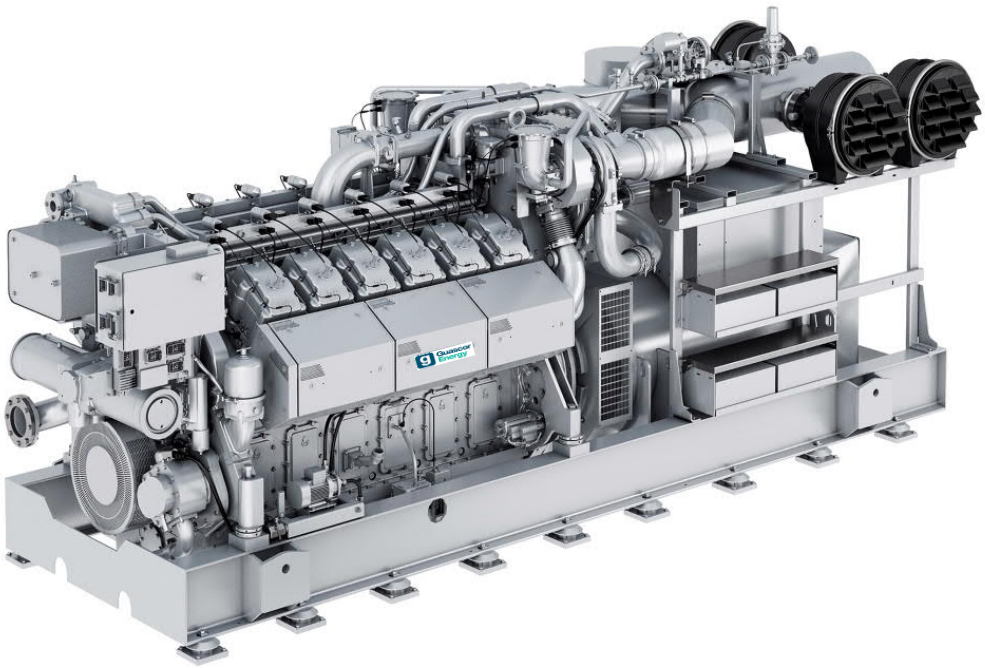
G-100EM GUASCOR ENERGY GAS ENGINE
Technical Scope of Supply



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✔ **Natural gas, 1200 rpm, 60 Hz**

G-100EM engine is the highest efficiency state-of the art stationary gas engine, key features include:

- Spark-ignited lean-burn engine based on the 4-stroke Miller cycle technology.
- 12 V cylinder design, part of the EM family. Highest displacement with less maintenance and smallest footprint.
- Dry exhaust manifold with a high-efficiency exhaust turbocharger configuration.
- Cast iron cylinder head design with high volumetric efficiency.
- Crankshaft - press forge hardened and tempered alloy steel for durability.
- Innovative pre-combustion chambers provide efficient and stable combustion.
- Two water circuits to optimize electrical and thermal performance
- On engine digital engine control system– type GCS-E.
- G-EM engines design focus is on high efficiency electrical power generation and CHP (combined heat-power) in continuous duty applications.

GUASCOR ENERGY can provide scope of supplies to meet customer's demands:

- ✓ Bare engine and accessories.
- ✓ Generator set, peripherals and controls.
- ✓ Containerized solutions for generation and CHP applications.

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General Specifications:

Engine model	**G-100EM**
Rated rpm	**1200**
ISO COP, kWb (bhp)	
Cylinder arrangement	V – 12
Displacement,	6,102 cu.in (100 L)
Bore x stroke,	7.68x11.02in (195x280 mm)
Compression ratio	13.5:1
Mean piston speed, in/s (m/s)	265 (6.72)
Exhaust manifold type	Dry
Engine noise, LpA,∑ dB(A)	90.2

Sound pressure levels measured at 1m / 3.3 ft of the engine.
For further information see IC-G-D-00-318e

Ambient temperature	32°F to 77 °F (0°C to 25°C)
Altitude	0 - 1640 famsl (500 mamsl)

Remark: Higher altitudes will require a power derating. Higher temperatures (up to 113°F/45°C) may produce an efficiency loss without power derating. For further information IC-G-B-00-029e.

Engine performance data is provided within the Specific Engine Power Rating

Fuel

Fuel type	Natural Gas
Engine inlet pressure range	2.2 - 3.99 psi (150-275 mbar)
Engine pre-combustion chamber	65-72.5 psi (4.5-5 Bar)

Electronic carburation & flow control valve

Engine Control System GCS-E



Integrated control system that handles all critical engine control functions in a Plug&Play ECU:

- Speed / load control. Carburation.
- Ignition and timing control; emissions control.
- Autonomous engine protection and control.
- Knocking detection system
- Engine ancillaries control panel (starter, water & oil preheating, pre-lubrication pump, etc.)
- Interface protocols: Modbus TCP/IP, CAN J1939, CANopen
- Exhaust temperature sensors by cylinder.

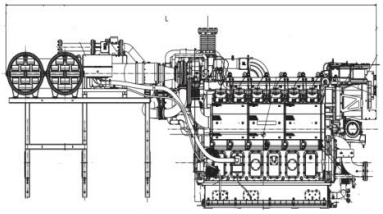
Lubrication System

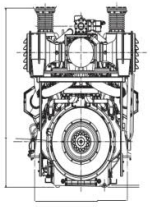
Lube oil pump	Gear mechanical pump
Lube oil capacity	204.47 gal (774 L)
Filters	3 Full flown type filters

Approx. oil consumption, 0.00066 lb/bHP.hr (0.40 g/kWh)
Oil level maintainer with float and sight glass
Oil crankcase gases recirculation system

Dimensions and Weights:

Engine overall size LxWxH	**255 x 79.17 x 105.24 in**
	6477 x 2011 x 2673 mm
Weight, dry,	35494 lb (16100 kg)
Standard color	Grey - RAL 9007





Engine Starting System

Starting system	Electrical starter, 24 Vdc

Cooling System

Cooling system	**2 circuits (HT & LT)**
Oil cooler	In HT
Intercooler stages	Two stage IC (1st LT & 2nd HT)

Jacket (HT) Water circuit

Outlet Temperature	**194°F /90 °C**
Capacity,	102 gal (385L)
Flow rate min, m³/hr (gpm)	423 (96)
Flow rate max, m³/hr (gpm)	660 (150)

Intercooler (LT) Water circuit

Inlet Temperature	**104°F / 40°C (variable temp)** Acc/4 in IC-G-B-00-029e
Capacity	17 gal (65L)
Flow rate min m³/hr, (gpm)	66 (15)
Flow rate max, m³/hr, (gpm)	119 (27)

Included in scope of supply

- Pre-lube electric oil pump.
- Oil & water preheating system.
- Dry type high efficiency air filter.
- Flexible water, gas, oil and exhaust connections
- Basic spare parts & maintenance tool kit for start-up.
- Documentation: Installation, O&M manuals.

SPECIAL ACCESSORIES / COMMENTS:

G-100EM GUASCOR GAS ENGINE
Technical Scope of Supply

GENSET MODULE ☐

Genset Module

Electrical power,kWe

Voltage, kV	☐	☑	☐
	0.48	4.16	13.2
Frequency, Hz	**60**		
Coupling:	Flexible coupling. Alignment at GE facilities		
Bedframe	Welded rigid steel bedframe Battery rack and wiring to starter Lifting lugs Elastic suspensions: 18		

Alternator

Type:	Synchronous brushless
Duty:	Continuous duty
Isolation/Temperature rise:	Class H / Class F
Protection	IP23
Excitation type:	AREP (PMG as optional)
AVR:	Electronic
Bearings / Poles:	2 / 4
Winding pitch:	2/3 – Low Voltage 5/6 – Medium Voltage
Voltage regulation/ accuracy:	± 5 % / ± 0.5 %
Short circuit current withstand:	3 x In for 10Sec
Norms:	IEC 60034, NEMA MG-1-32-33 ISO 8528/3 CSA-22.2-100
Heating resistance:	Included
Protections:	6xPT-100 at stator and 2xPT-100 at bearing

☐ Cost adder alternator with CTs for 87 Differential protection and protection relay. (Second set of CT's excluded from scope)

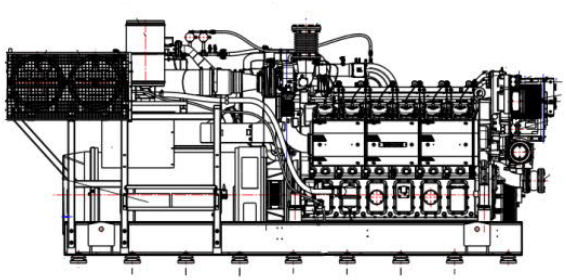
☐ Cost adder alternator with PMG excitation

☐ Cost adder - UL 1004 alternator certificate

Dimensions and Weights:

Genset Overall Size LxWxH	**258.39 x 95.67 x 112.87 in** **6563 x 2430 x 2867 mm**
Weight dry,	50481 lb (22898 kg)
Standard color:	Grey - RAL 9007

Remark: These dimensions are valid for 1200 4.16kV model. For other voltage model please contact Guascor Energy.



CE Marked

Batteries - Options

☑ Batteries: 6x12Vdc high duty lead acid type, 220 Ah, Supplied loose.

Gas Supply System - Options

☑ **Gas train**, includes:
Manual shut off valve, gas filter, pressure regulator, double solenoid valve, low and high level pressure switches, electronic leak detection, inlet and outlet pressure gauges.

- ☐ Inlet pressure range 2.9-7.25 psi (200-500 mbar)
- ☑ Inlet pressure range 14.5-72.5 psi (1 – 5 bar)

☑ **Prechamber gas train**, includes:
Manual shut off valve, gas filter, pressure regulator, double solenoid valve, low and high level pressure switches, inlet and outlet pressure gauges.
Inlet pressure range 65-72 psi (4.5-5 bar)

☐ Gas trains according NFPA37

☐ **Gas booster and 105.67 gal (400L) gas buffer tank with safety valve.** UL approval. Necessary in case gas inlet pressure is below 65 psi/ 4.5bar (1 booster to feed max. 6 gensets).

OTHER SPECIAL ACCESSORIES / COMMENTS

G-100EM GUASCOR GAS ENGINE
Technical Scope of Supply

ACCESSORIES

Lubrication System - Options

- [x] Lube Oil– first fill supply

Exhaust System - Options

- [x] Y-Pipe
- [x] Industrial silencer - 40dB
- [ ] Oxidative catalyzer
  - [ ] High efficiency in NMHC – cost adder
- [ ] Exhaust motorized diverter for CHP
  - [ ] Electrical motors according UL
  - [ ] Cost adder for stainless steel in exhaust line.

Cooling System / CHP Equipment - Options

- [x] 3-ways electrically driven thermostatic valves for HT & LT circuits
- [x] Electric water circuits circulating pumps for HT &LT circuits
- [x] Dry Air Coolers (LT & HT separate air coolers)
  - [ ] Electrical motors according UL
- [x] Plate heat exchanger HT circuit – hot water recovery
- [ ] 3-Ways Electrical control valve HT circuit.Acc/thermal diagram
- [ ] Skid mounted with piping for HT & LT
- [ ] Expansion tanks for the HT & LT circuits
  - [ ] Expansion tanks and safety valves under ASME rules
- [ ] Pyrotubular exhaust heat exchanger for hot water recovery. Instrumentation included.Acc/thermal diagram.
- [ ] 3-Ways Electrical control valve process circuit – see thermal diagram (Loose item supply always)

OTHER SPECIAL ACCESSORIES / COMMENTS

G-100EM GUASCOR GAS ENGINE
Technical Scope of Supply

CONTROLS

GCS-G CONTROL & POWER CABINET

GCS-G Control Cabinet: A multi-function genset and ancillary control system. A PLC based flexible control system configurable to a range of generators in model, frequency (50/60) Hz and voltage. Selectable for island and/or parallel operation, with black start, import/export control, economode options available.

GCS-G Power Cabinet: Switchgear panel rated for generator at 400-600 Volt.

Several GCS-G (up to 6 units) can work together in a group island mode, to share kW/KVAr; control of a master grid switch can also be incorporated.

The GCS-G control system Key features:

- PLC based, with touch HMI interface.
- Flexible configuration options to meet application needs.
- Integration with Guascor Energy switchgear panel. Synchronization and main circuit breaker operation.
- Full integration with engine ECU (GCS-E), for control, monitoring and setup.
- Alternator protections and regulation.
- Gas train control.
- Battery charger.
- Control for ancillary system:
    - Cooling system – pumps.
    - Cooling system – Emergency coolers.
    - Thermal recovery-
    - Ancillary equipment status.

Detailed description according IC-G-D-AM-006e

GCS-G Supply Options

- [x] GCS-G control cabinet
- [x] GCS-G power cabinet (Only low Voltage)
    - [x] GCS cabinets according UL508

GCS-P PLANT CABINET & SCADA SYSTEM

GCS-P governs a power plant.

GCS-P is a PLC based hub cabinet that provides a single control and data collection point for the whole power plant.

GCS-P system controls the GCS-G gensets when >6 gensets operate in island mode or a complex installation is required.

The GCS-P governs:

- GCS-G units as the master.
- The operation of the grid switch(s).
- Co-generation machines. (absorption machines, for example)
- Additional special ancillary operations.

GCS-P detailed description according IC-C-D-AI-001e.

Guascor Energy has developed an ad-hoc Scada Application for Guascor Energy Genset Power Plants including the ancillaries (cooling & CHP) and other peripherals.

The SCADA establishes communications with GCS-G and GCS-P PLC's providing a user friendly HMI to interact with the whole plant control systems and allowing the collecting and analyzing of the provide data.

SCADA detailed description according IC-C-D-SC-001e.

Consult Guascor Energy for additional information

Plant Control - Supply Options

- [ ] GCS-P Plant cabinet
- [x] SCADA System

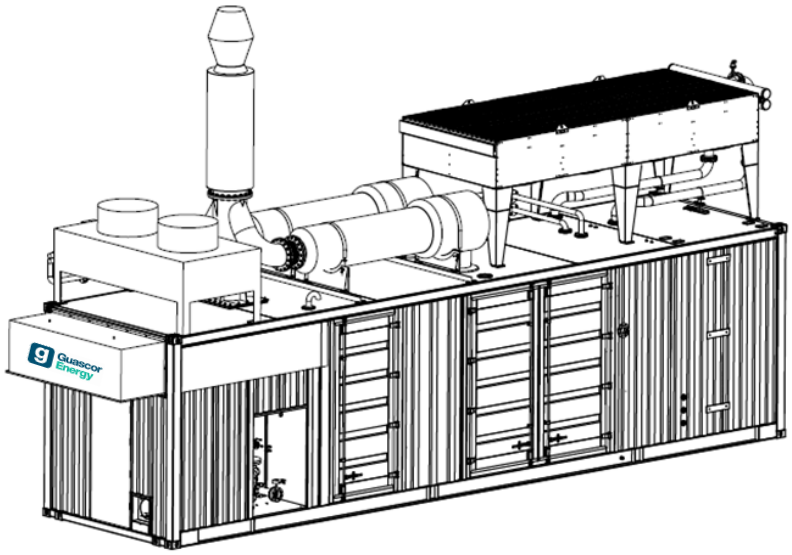
Remote Diagnostic System (RDS)

- [ ] **myConnect** data collector solution for RDS. myConnect collects time series and event data from control system. Solution includes cyber-secure DMZ architecture based on two firewalls.

OTHER SPECIAL EQUIPMENT / COMMENTS

G-100EM GUASCOR GAS ENGINE
Technical Scope of Supply

CONTAINERIZED UNIT ☐



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CHARACTERISTICS

Core design is a bespoke 40 feet container. Dimensions (40' x 9.84' x 10.83' (12192 x 3000 x 3300 mm). (LxWxH). Not considered dimensions of equipment on top.

Weatherproof for outdoors installation.

Standard average perimeter noise pressure level: 75dB(A) @10m / 33 ft. See IC-G-D-00-406e. Other levels by request.

Enclosure ventilation included, positive pressure axial fans.

Gas leakage and fire detectors included: alarm signaling and safety automatic genset & gas supply shutdown.

Containerized unit is supplied assembled and tested – based on the scope defined in this document. (Containerized version not possible for CHP scope, only for power generation)

Standard operation temperature range: 32°F to 95°F (0°C to 35°C)

Wide doors on both side of the container to provide for ease of maintenance.

Internal lighting, emergency lighting and available power sockets included.

Equipment on the roof of container is pre-assembled and pre-wired at factory and must be assembled at site

Factory assembly and testing and pre-configured external skids minimize site installation and commissioning works.

Detailed description according IC-G-D-00-391e

OPTIONAL

☐ CE marked container.

☐ Manufacture of container under NFPA70, UL508, NFPA72

☐ Noise pressure level 75dB(A)@1m / 3.3 ft.(@Tamb ≤35°C/95°F)

Minimum ambient temperature: ☐ 25°F/-4°C ☐ 3°F/-16°C

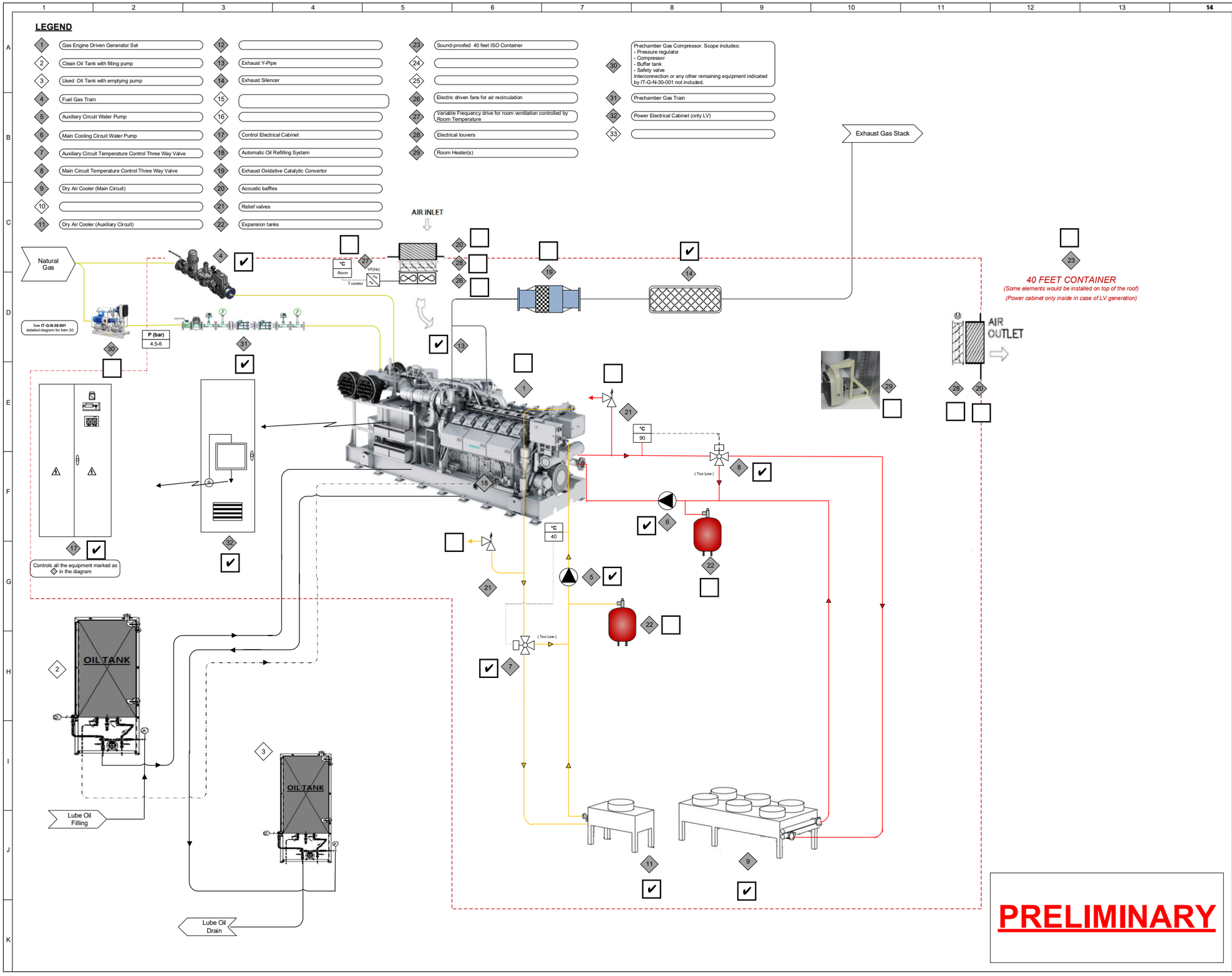
Maximum ambient temperature: ☐ 113°F/45°C

OTHER SPECIAL EQUIPMENT / COMMENTS

LEGEND

1	Gas Engine Driven Generator Set	12	
2	Clean Oil Tank with filling pump	13	Exhaust Y-Pipe
3	Used Oil Tank with emptying pump	14	Exhaust Silencer
4	Fuel Gas Train	15	
5	Auxiliary Circuit Water Pump	16	
6	Main Cooling Circuit Water Pump	17	Control Electrical Cabinet
7	Auxiliary Circuit Temperature Control Three Way Valve	18	Automatic Oil Refilling System
8	Main Circuit Temperature Control Three Way Valve	19	Exhaust Oxidative Catalytic Convertor
9	Dry Air Cooler (Main Circuit)	20	Acoustic baffles
10		21	Relief valves
11	Dry Air Cooler (Auxiliary Circuit)	22	Expansion tanks

23	Sound-proofed 40 feet ISO Container	30	Prechamber Gas Compressor. Scope includes: - Pressure regulator - Compressor - Buffer tank - Safety valve Interconnection or any other remaining equipment indicated by IT-G-N-30-001 not included.
24		31	Prechamber Gas Train
25		32	Power Electrical Cabinet (only LV)
26	Electric driven fans for air recirculation	33	
27	Variable Frequency drive for room ventilation controlled by Room Temperature		
28	Electrical louvers		
29	Room Heater(s)		



PRELIMINARY

Key

- NATURAL GAS
- EXHAUST
- MAIN CIRCUIT WATER
- AUXILIARY CIRCUIT WATER
- RECOVERY HOT WATER
- LUBRICATING OIL

Notes:

1. INTERFACE CONNECTIONS
   - Others
   - GUASCOR
2. PFD Illustrates one genset CHP System
3. SCOPE OF SUPPLY
   - Guascor (only if marked)
   - Others

Tolerance values as specificied in the engine data sheet according to ISO 3046

Rev.	Initials	Date	Remark
4	IBU	14/2/23	Engine model name change (SGE- > G)
3	IBU	30/9/22	Company name change. (Guascor Energy).
2	IBU	1/12/20	Company name change. Rearrangement of item positions. Safety valves depiction changed. Louvers, VFD and heaters added. Compressor accessories and IT-G-N-30-001.
1	IBU	01/06/18	Skid removed

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Proposal:

G-100 EM GENERATION Natural Gas

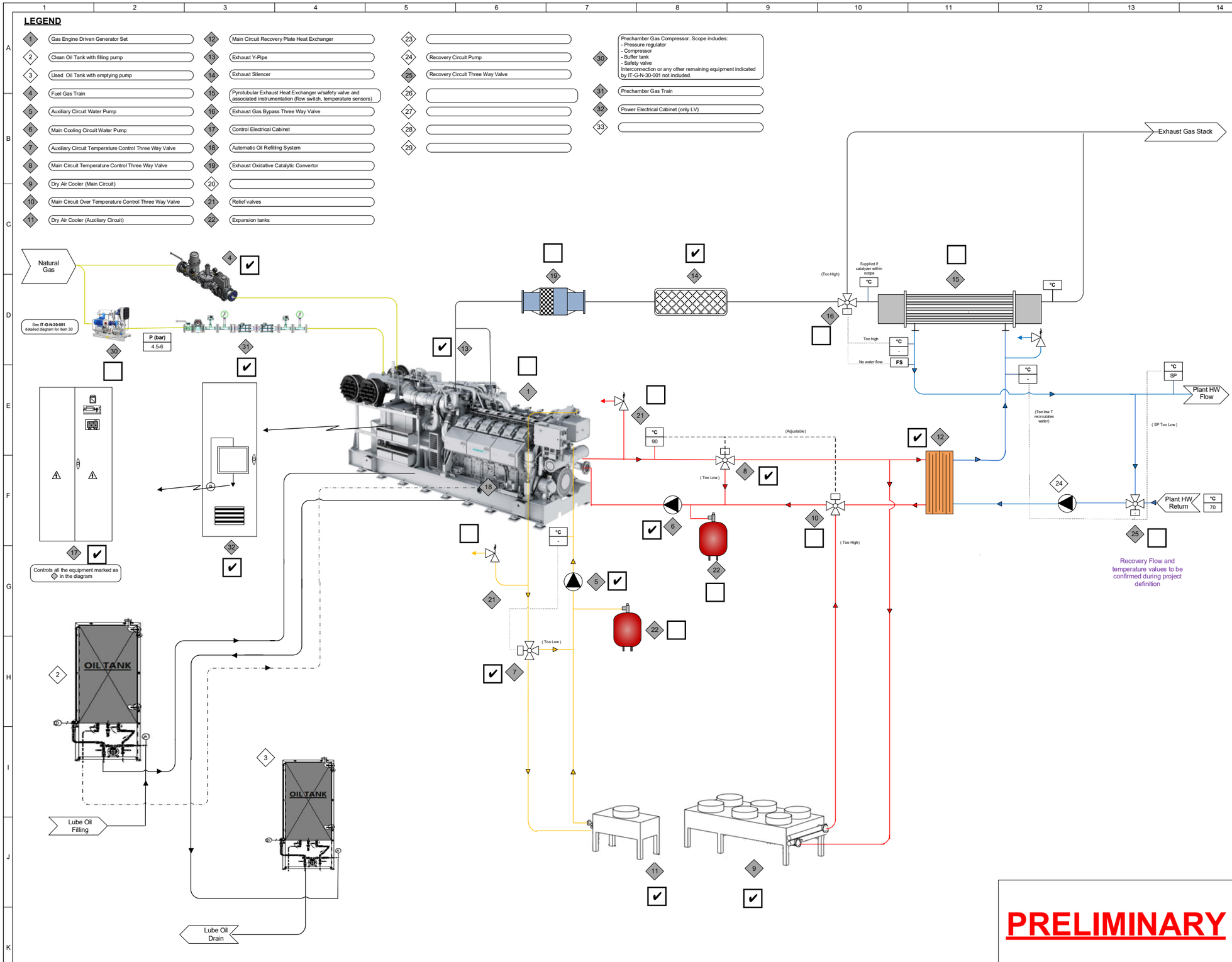
Drawing Title:

PROCESS FLOW DIAGRAM (D18 GDC)

Drawn By: XB	Scale: n/a
Checked By: IG	Date: 03/05/18
Drawing Number: **0106218 – G-100EM GEN GN (D18 GDC)**	Rev: 4

LEGEND

1	Gas Engine Driven Generator Set	12	Main Circuit Recovery Plate Heat Exchanger	23		30	Prechamber Gas Compressor. Scope includes: - Pressure regulator - Compressor - Buffer tank - Safety valve Interconnection or any other remaining equipment indicated by IT-G-N-30-001 not included.
2	Clean Oil Tank with filling pump	13	Exhaust Y-Pipe	24	Recovery Circuit Pump	31	Prechamber Gas Train
3	Used Oil Tank with emptying pump	14	Exhaust Silencer	25	Recovery Circuit Three Way Valve	32	Power Electrical Cabinet (only LV)
4	Fuel Gas Train	15	Pyrotubular Exhaust Heat Exchanger w/safety valve and associated instrumentation (flow switch, temperature sensors)	26		33	
5	Auxiliary Circuit Water Pump	16	Exhaust Gas Bypass Three Way Valve	27			
6	Main Cooling Circuit Water Pump	17	Control Electrical Cabinet	28			
7	Auxiliary Circuit Temperature Control Three Way Valve	18	Automatic Oil Refilling System	29			
8	Main Circuit Temperature Control Three Way Valve	19	Exhaust Oxidative Catalytic Convertor				
9	Dry Air Cooler (Main Circuit)	20					
10	Main Circuit Over Temperature Control Three Way Valve	21	Relief valves				
11	Dry Air Cooler (Auxiliary Circuit)	22	Expansion tanks				



Key

- NATURAL GAS
- EXHAUST
- MAIN CIRCUIT WATER
- AUXILIARY CIRCUIT WATER
- RECOVERY HOT WATER
- LUBRICATING OIL

Notes:

1. INTERFACE CONNECTIONS

   ◆ Others GUASCOR ◆

2. PFD Illustrates one genset CHP System

3. SCOPE OF SUPPLY

   ◆ **Guascor (only if marked)** ◇ **Others**

Tolerance values as specified in the engine data sheet according to ISO 3046

Rev.	Initials	Date	Remark
5	IBU	14/2/23	Engine model name change (SGE- > G)
4	IBU	30/9/22	Company name change. (Guascor Energy).
3	IBU	01/12/20	Company name change. Rearrangement of item positions. Safety valves depiction changed. Instrumentation associated with exhaust heat exchanger. POS 25 mixing valve. Compressor accessories and IT-G-N-30-001
2	IBU	30/09/19	Recirculation pump removal, 3W valve position

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Proposal:

G-100 EM CHP Natural Gas

Drawing Title:

PROCESS FLOW DIAGRAM

Drawn By: XB	Scale: n/a
Checked By: IG	Date: 03/05/18
Drawing Number: **0305218 – G-100EM GN**	Rev: **5**

PRELIMINARY