



DRAGON[®]

Make it happen.

PowerGen GT 43

Mobile Power Unit

Project Proposal



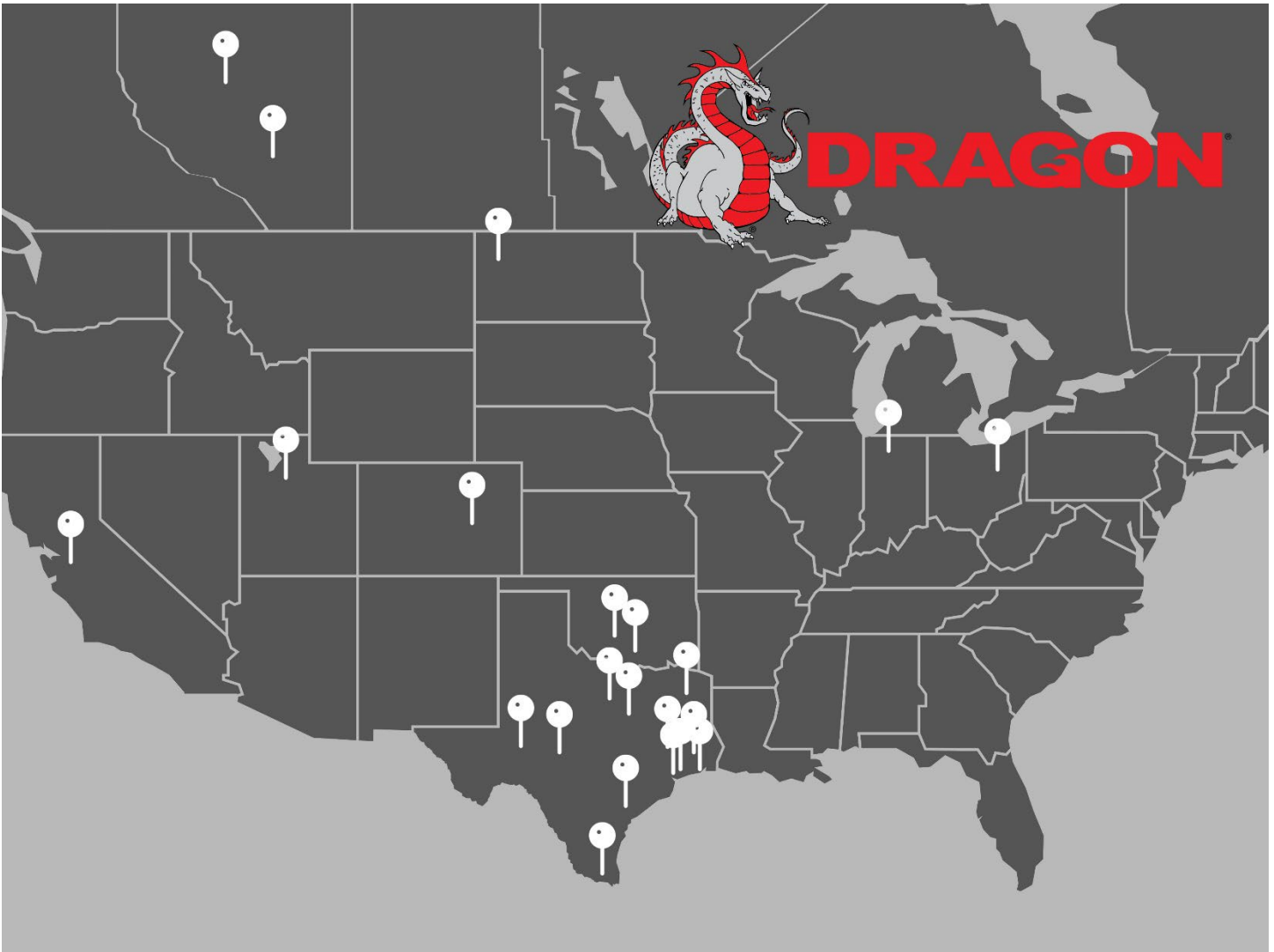


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Section 1: The Modern Group

U.S. owned and operated since 1947, the Modern Group is a strong family of leading industrial equipment companies. These companies serve a broad variety of industries, including oil and gas, agriculture, power generation, storage, and transportation.

Organizational Footprint





Dragon Products: Our Story

The highest quality equipment, advanced in-house engineering, state-of-the-art manufacturing, high-volume capacity, expansive infrastructure, extensive industry experience, competitive pricing, and a rock-solid commitment to get the job done for our customers.

Dragon Products is a leading manufacturer of mission critical products serving the energy and industrial industries. U.S. and family owned and operated for more than 75 years the Dragon name is synonymous with “severe duty engineered” equipment for a broad range of applications including well servicing, bulk storage, mobile power generation, liquid and solids hauling and a variety of pumping and mud solutions. Our inventory and product lineup includes tanks and trailers; roll off equipment; pumps and stimulation equipment; mobile workover rigs; and surface production equipment.

The Dragon network includes a vast support infrastructure that covers all major hydrocarbon producing regions. We continually expand our footprint to grow with our customer’s needs to ensure that we are accessible and responsive. Our equipment and parts inventory is immense and ready to ship anywhere at a moment’s notice. We engineer and build our products in-house, so we can control the quality and respond quickly to customer needs.

Maintain reliability and performance with genuine Dragon Parts and Service. Dragon pumps, spare parts, and pumping expendables are engineered and manufactured to maximize uptime and minimize total cost of ownership. We keep one of the most extensive inventories of parts in the oilfield equipment industry and have expert service teams that can help provide the maintenance and repairs you need to keep your equipment performing.

At Dragon, we know that when it comes to truly helping customers, equipment is just the beginning of that commitment.

We understand the bigger picture – that each customer is trying to meet a specific business goal on every project.

Our goal is to help you *Make It Happen*.

Dragon Power, Pumps, and Stimulation - Sales and Service Locations

2609 Wespine Rd.
Beaumont, TX 77713
(409) 861-6700

3310 Columbus Rd
Wooster, Ohio 44691
(330) 345-3968

2394 W. Catlin St.
Odessa, TX 79766
432-333-8177

1201 E. Hwy 67
Alvarado, TX 76009
(817) 783-3026

3300 Burlison Blvd
Alvarado, TX 76009
817-783-5530

3174 State Hwy 7 West
Center, TX 75935
409-504-9557

213 Spruce Street
Red Deer, Alberta T4E 1B4
(330) 345-3968

4400 Post Oak Parkway
Houston, TX 77024
(713) 623-7520

10701 NW 2nd Street
Yukon, OK 73099
(405) 324-2193

10103 US Hwy 59N
Victoria, TX 77905
(361) 572-8080

5042 141st Ave NW
Williston, ND 58801
(701) 774-5930

3777 Puritan Way
Frederick, CO 80516

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Section 2: General Overview

Executive Summary

Dragon Products is pleased to submit the enclosed proposal regarding the supply of our PowerGen GT43 Mobile Gas Turbine Generator Packages for your mobile power needs.

We have the required experience and capabilities to successfully execute this important project, having a strong specialization in both the energy industry, as well as designing, building and commissioning over the road US DOT and international transit compliant heavy equipment. We welcome the opportunity to meet with you to discuss the scope of this proposal in further detail to ensure that the best solution is ultimately selected for your project.

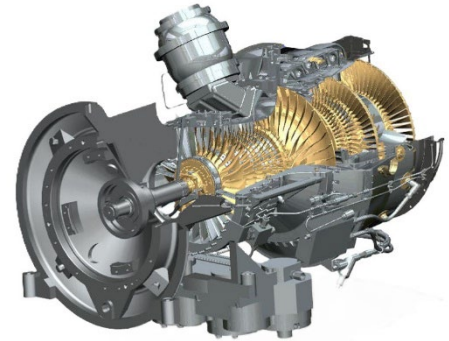
Key Features of the PowerGen GT43

- Single trailer design with the drive train and systems fully integrated onto the trailer.
- Low emissions Gas Turbine engine,
- 60Hz, 13.8KV generator
- Hydraulic leveling system with built-in legs levels the package to within tolerance.
- Low speed coupling able to be left in place during transit.
- All package ventilation, as well as turbine inlet and exhaust are integral to the unit. No onsite installation required.
- Hydraulic starter system.
- Reduced envelope size minimizes permit and eliminates escort requirements mandated by the Department of Transportation (DOT) in most states.
- Setup takes four hours.
- Only four connections
 - Auxiliary Power Unit
 - Fuel Gas Supply
 - Output Power
 - Grounding Connections
- Simply PARK, PLUG & POWER

Vericor ASE50B Turbine Highlights

Compact, rugged power unit designed stationary, portable, mobile, industrial and oilfield applications. The core is a well proven design, Having accrued over 15 million operating hours in harsh military and commercial service.

Vericors aero-derivative gas turbine solutions have high over density, and light-weight footprint delivering high reliability.



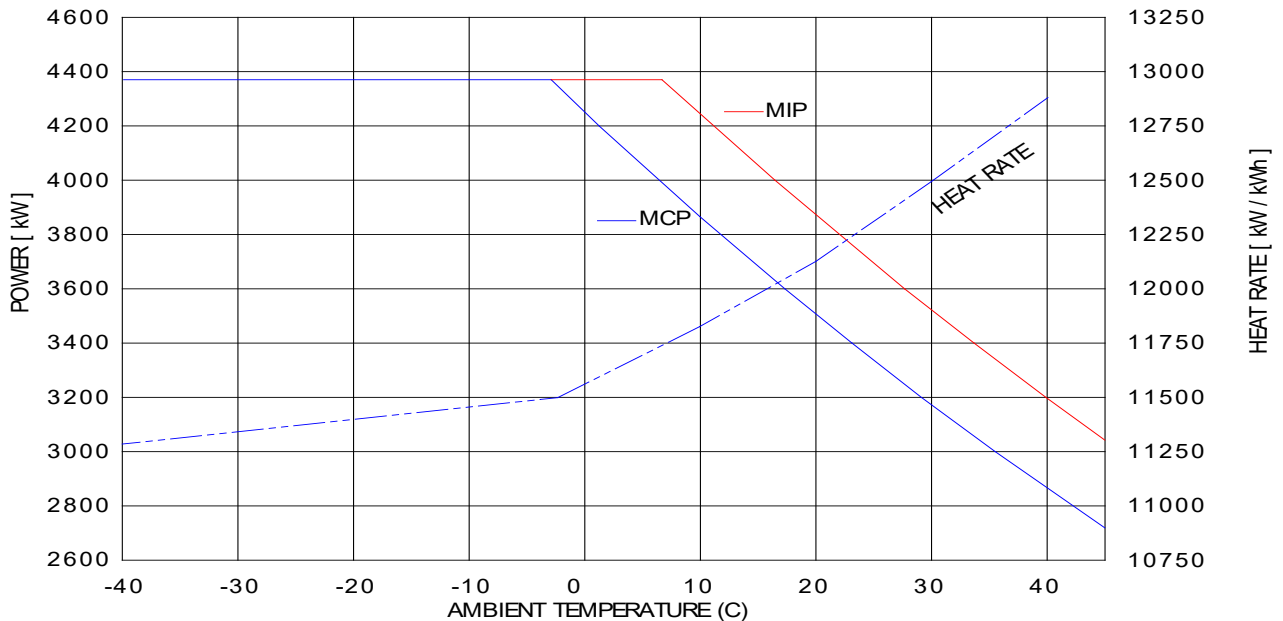
HIGH RELIABILITY, COST-EFFECTIVE MAINTENANCE

- Rugged design with cold end drive and military heritage with over 15 million hours in harsh environment for maximum reliability
- Aero-derivative design is highly reliable and well proven
- High power density
- Direct mount to driven equipment eliminates alignment issues
- Fast start and load capability with no impact on life

FUEL FLEXIBILITY, ECO-FRIENDLY, ECONOMICAL

- Utilizes clean, economical natural gas, wide range of methane numbers, including wellhead gas
- 60,000 hours between major overhauls
- High part load efficiency from twin shaft design

Power and Heat Rate VS Ambient Temperature



Typical Emissions, MCP conditions of 4938shp / 3679 kW shown in Bold

Fuel Type	Uninstalled Power at 15C/59F Sea Level 60%RH		Expected Emissions [unmargined] [ppmvd@15%O2]	
	[SHP]	[kW]	NOx	CO
Natural Gas	4444	3311	45	16.5
	4938	3679	50	15
	5336	3975	57	13
	5850	4358	65	12.5

Section 3: Scope of Supply

Overview

PowerGen GT43 is a high-efficiency, trailer mounted, gas turbine generator designed for power generation applications requiring maximum reliability and availability. It has been developed leveraging the latest proven technology to respond to the demand of power generation in the 4 MW range with high efficiency, reliability and availability with low environmental impact.

PowerGen GT43 Package has been designed focusing on the requirement of fast installation and compact design while being easy to operate, with an emphasis on standardization, optimization of factory assembly and the elimination of costly field assembly methodologies, making GT43 ideal for operations with challenging footprint and height restrictions. It consists of a main single frame design on which the Gas Turbine, Generator, Gearbox and all main auxiliary systems are installed, including an on-trailer electrical house, an integrated lube oil system, and starting system, along with all required filtering and ventilation systems.

Major Components include:

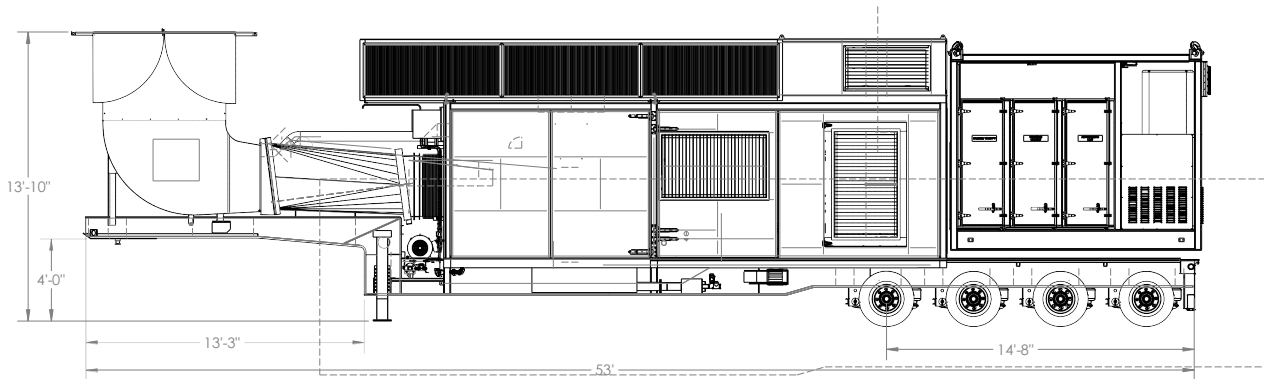
- Step deck design, two main beam frame trailer with 4 air ride suspension axles and hydraulic leveling jacks
- Aeroderivative Gas Turbine
- Planetary Gearbox
- 13.8kV Generator
- On-Unit control system
- Support Systems (fuel, lube, safety etc.)
- Weather resistant, acoustic enclosure

On-highway weights and dimensions (without tractor):

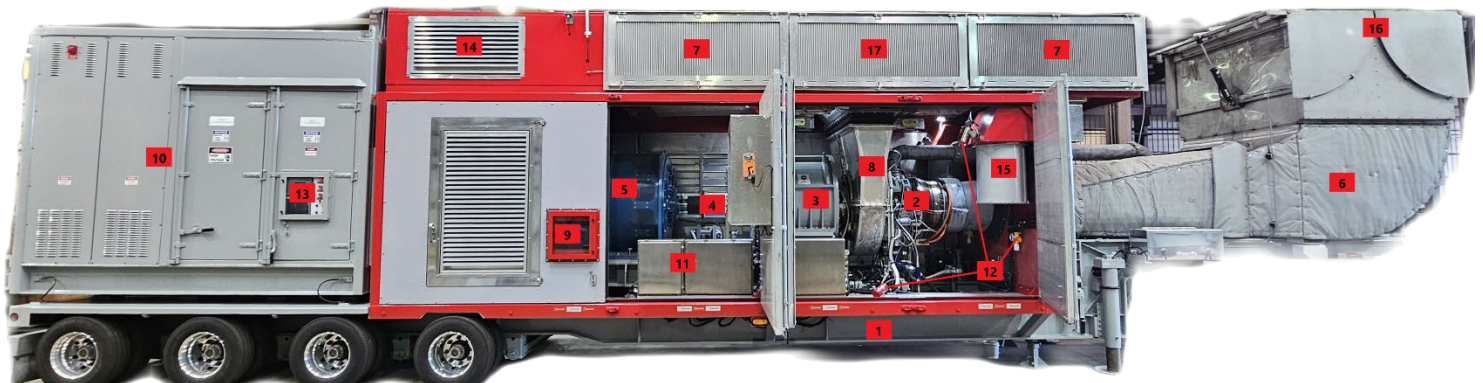
- Gross Weight: 125,000lbs
- Trailer Length 53' 0"
- Width 8' 6"
- Overall transport height: 13' 6"

Four main connections required for operation:

- Auxiliary Power Unit (APU)
- Fuel Gas Supply
- Output Power
- Grounding Connections



Subassembly Legend



1. Semi-Trailer, 59'
2. Gas Turbine
3. Gear
4. Coupling
5. Generator (AVR included)
6. Gas Turbine Exhaust
7. Gas Turbine Filtration
8. Gas Turbine Inlet Duct
9. Main HMI
10. Electrical House
11. Control Cabinets
12. Fire and Gas System
13. Electrical Control HMI
14. Oil coolers
15. GT Ventilation fans
16. Exhaust Rain Guards
17. House Ventilation Filtration



Gas Turbine with Integral Gear Reduction

The power plant of the GT43 is a modularly constructed turbine engine manufactured by Vericor. This engine consists of an inlet housing module, gas producer module, and power turbine module fitted with an accessory gear box. It is fueled with natural gas in the annular combustor through multiple nozzles fitted in an external fuel manifold. The engine includes an interstage surge bleed valve to improve acceleration from low-power and prevent surging, along with adjustable angle compressor inlet guide vanes which are hydraulically controlled.

The turbine engine is fitted with an accessory gear box to drive the lube oil supply and scavenging pumps, and the compressor guide vane hydraulic pump. This accessory gear box also acts as the input starter gear assembly and connects the starter motor to the turbine engine.

The gas turbine is cantilever mounted and direct coupled to a planetary gear reduction unit. The highspeed direct coupling is enclosed within the coupled engine/gear reduction unit assembly. The connection is made by a bolted flange arraignment. The gear reduction ratio is 8.83:1, turbine power shaft speed is 15,890 rpm, gear reduction output speed is 1800 rpm. The gear reduction unit includes a mechanical pto to drive an externally mounted lube oil pump.

Typical gas turbine performance (at conditions listed):

Conditions

Gas fuel: Typical pipeline natural gas
 Altitude: Sea level
 Temperature: Ambient, 59 deg F
 Inlet loss: 4 in H₂O
 Exhaust loss: 4 in H₂O
 Output shaft speed: 16,000 rpm (15,890 rpm)
 Fuel LHV: 20,548 btu/lbm

Performance

Power: 3684 kW (uninstalled ISO), 3540 kW max continuous power, installed @ conditions
 Heat rate: 11,239 btu/kWh (uninstalled ISO), 11,583 btu/kWh max continuous power, installed @ conditions
 Exhaust gas temperature: 1,064 deg F max continuous power, installed @ conditions
 Exhaust gas flow: 30.15 lb/s max continuous power, installed @ conditions

Efficiency

30% based on thermal equivalent, output power only, no CHP, (btu input / (kW/h equivalent to 3412 btu) output.

Typical emissions, natural gas fuel, new engines

NO _x :	50 ppmvd @ 15% O ₂
CO:	15 ppmvd @ 15% O ₂
VOC (non-methane)	2 ppmvc @ 15% O ₂

Starting System

The main function of the starting system is to accelerate the gas turbine up to self-sustaining speed at which stage the energy available in the combustion chamber is at least equal to the sum of the energy required by compression and mechanical losses in the gas turbine.

The starting system is also required to drive the axial compressor to purge the gas turbine and exhaust duct of any volatile gases prior to initiating the ignition cycle. Other purposes include engine turning during shutdown to facilitate cooling.

The GT43 starting system is a hydraulic system including a 30 hp electric motor, piston hydraulic pump with electronic flow control, and hydraulic motor. The hydraulic motor is equipped with a completely automatic clutch system coupled to the gearbox. The clutch releases automatically when the gas turbine reaches the number of revolutions necessary to be self-sustaining.

Electric Generator

The Electric Generator transforms the Gas Turbine mechanical power, transferred by the gearbox, into electric power available at generator terminals. The electrical generator designed for the GT43 is a 4 Pole Synchronous generator manufactured by WEG Electric Corporation. It is designed for safe area (ODP enclosure) installation. During start up, as the Gas Turbine accelerates to rated speed, the generator voltage output is controlled by the generator field, controlled by the brushless exciter and Automatic Voltage Regulator (AVR). As rated speed is reached, the synchronization module in the Unit Control Panel (UCP) senses both generator voltage through a set of Potential Transformers on the generator side of the medium voltage switch gear, and bus bar voltage through a set of Potential Transformers on the plant side medium voltage switchgear, providing inputs to AVR to regulate voltage at generator terminals to ensure synchronization with bus bar and provide enable signal to the Generator Main Circuit breaker into the Medium Voltage switchgear.

Generator Specifications:

Output:	4,834 kVA
Rated Voltage:	13,800 VAC, 3 phase
Rated Current:	202.2 A
Frequency:	60 Hz
Poles:	4
Rated Speed:	1,800 rpm, Counterclockwise Rotation

Control System

The GT43 is equipped with a Vericor Turbine Engine Control panel, an Electrical House and control system, and a Unit Control Panel (master control) with HMI touch screen and laptop remote system. This provides for the control and protection of the gas turbine engine - generator unit and auxiliaries. The control system includes the following primary equipment and features:

- Multi process controller system with TCP/IP communication protocol. Turbine engine / system SCADA
- Touch Screen / Cabled Remote Laptop operation, no E-house entry required to operate
- All gas turbine control & protections, total unit operational / safety logic, Emergency stop / shutdown
- Automated circuit breaker operation, power control / distribution, all system auxiliaries
- Integrated generator control, distribution synchronization, energize / shed load functions
- All system instrumentation, sensors, and actuators
- Fire & Gas detection, fire suppression systems

System Architecture

The Unit Control System controls and monitors the gas turbine, gearbox and electric generator equipment and all other unit sub systems. The system architecture is based a master control / secondary control, hardware and software platform. The overarching design principle of the Unit Control System is a split architecture in which the gas turbine and gearbox primary control, signal acquisition, and processing equipment is housed in a dedicated enclosure housed in the generator enclosure section of the trailer. The E-house system control includes generator control, signal acquisition, system switch gear actuation, fire system and emergency controls. This secondary control system is located in the E-house at the rear of the trailer. The Unit Control System is located in a dedicated enclosure located in the generator enclosure. This master control receives inputs from the user HMI or laptop and the secondary controls. It processes these inputs and send output commands to the secondary controls, which in turn drive their respective systems. All data is transmitted by Ethernet cable with feedback and heartbeats to ensure continuous communication.

System Operation, User Interface

The HMI user interface screen is located on the curb side of the unit, midway, in the generator enclosure side wall. all system functionality is duplicated on the cable connected laptop using a 200 ft cable. The system features a series of operating step through functions. Each linked by a system permissive required to be fulfilled before preceding to the next step. In each step the required actions are automatically performed by the control system. There are some system override functions included as appropriate.

Operational Sequence / Mode

- Power on, prestart conditioning
- System standby, ready to start conditions met
- Purge, purges engine and exhaust system
- Start, starts engine
- Engine Idle, engine at speed, generator powers system bus, unit self-sustaining
- Energize load, connects generator system bus to off trailer supply connection and closes main breaker
- Shead load, opens main breaker and returns unit to engine idle mode
- Shut down / cool down, stops engine and performs engine / exhaust cool down

Black Start System / Self Sustaining Operation

The GT43 is design for island or grid operation. The unit requires 480 VAC power to start. In island operation this power can be supplied by two methods. A diesel generator (125 kW nominal) can be connected to the unit using the shore power at the rear of the E-house, or the unit can be powered by an onboard battery and power inverter system. This DC battery system is housed in the E-house and include an inverter and charging system. It is sized to power the typical system shut down requirements and have enough to power the prestart and unit starting requirements in moderate conditions (above 40 deg F nominal) for a period of about 30 min. This allows the unit to start and become self-sustaining. The batteries will recharge during normal operation allowing for the next shutdown – start cycle.

In typical operation, after starting, when the engine is in the idle or breaker load mode, power from the generator bus is used to power all operating and control systems in a self-sustaining manor. This allows the battery system to recharge or the diesel generator power to be turned off.

In grid operation, the grid power is connected to the shore power connection, grid voltage is used to provide the pre-start and starting power requirements. Grid voltage and frequency are monitored, and the generator speed / output is matched to these parameters before the load breaker is closed to connect the generator output to the grid.

Ventilation System

During all gas turbine working conditions (startup, normal run, and shutdown), the ventilation system provides a continuous source of cool air which serves the following main purposes:

- Remove heat from the enclosure
- Dilute possible hazardous gas leaks to the point where the leak is no longer hazardous
- Maintain the expected and appropriate temperature field, to allow the correct working and certification conditions for all the equipment placed inside the enclosure
- Allow appropriate working condition of the gas detection system

GT43 comes with a negative pressure ventilation system (enclosure depressurized below the atmospheric) and dual ventilation fans.

Gas Turbine Inlet Air System

The primary function of the inlet duct system is to direct airflow from the inlet filter house to the inlet plenum and then to the axial compressor bell mouth with uniform flow and minimum pressure drop. The secondary function of the inlet duct system is to attenuate the noise emanating from the compressor bell mouth during gas turbine operation. Gas turbine engine combustion air is completely separated from the enclosure ventilation air by the design of the air intake unit on the top of the unit enclosure. The trailer mounted inlet duct system consists of the following main components:

- Intake filtration water shedding first layer louvers and fine particulate pleated filters, no prefilters are required
- Silencer duct
- Transition piece to the Gas Turbine inlet plenum
- Plenum side expansion joint to isolate in transit vibration and movement

Gas Turbine Exhaust Air System

GT43 features an axial discharge exhaust. The exhaust system includes a thermal expansion cone interface, expansion joints, exhaust transition, and vertical discharge silencer contained in the trailer package with no field installed components required. The general function of an exhaust system is to direct the exhaust flow from the discharge of the gas turbine diffuser to the atmosphere with the minimal practical pressure drop, while performing a variety of functions, including, but not limited to, noise reduction and thermal insulation of the flow from external surfaces. The exhaust system is fitted with power actuated weather covers to minimize the ingress of moisture (rain / snow) when the unit is not in use.

Lube Oil System

The lube oil system provides continuous, reliable, and adequate filtered oil flow at proper temperature and pressure to the gas turbine and gearbox for lubrication and heat removal. All operating conditions are covered: startup, normal operation, normal and emergency shutdown, and cool down. The system is equipped with devices that allow protection of the equipment against low lubricating oil pressure, high lubricating oil temperature, and low lubricating oil level.

The GT43 package utilizes MIL-PRF-23699 synthetic hindered ester lube oil. Main components of the lube oil system are:

- Lube oil tank, 100-gal working
- Lube oil piping
- Lube oil pumps:
 - Reduction gear box mechanical pump, for primary running operation
 - AC starting and shut down pump – 5 hp electric, 460 V
- Lube oil filters, first stage primary filter duplex, second stage filters on turbine engine and guided vane system
- Lube oil heater inside oil tank
- Regulating valves, temperature, and pressure controls on each branch circuit
- Oil cooler, two each with two fans each
- Oil mist extractor installed in lube oil tank lid, vented to the outside

Fuel System

Natural gas is the most commonly used fuel for gas turbines due to its good combustion properties and low emissions.

GT43 Main components of the fuel gas system:

- High pressure slam shut over pressure safety valve
- Manual shut off valve, gas globe valve
- Electrically operated fuel gas operating control valve
- Primary engine fuel gas flow control operating valve
- Fuel gas piping, wye strainer, gas filtration

Fuel gas pressure is 250 psi, min pressure 200 psi, max pressure 275 psi. Fuel gas temperature range is 185 deg F max, 10 deg F above dewpoint.

Fire Suppression System

The firefighting system functions as the machine's equipment protection by discharging the extinguishing agent to create an inert atmosphere in the environment where the fire is detected, cooling the zone, and extinguishing the fire. It also prevents re-ignition until the temperature of the metallic surfaces decrease below the ignition temperature of the combustible materials.

GT43 is equipped with a standard aerosol firefighting system. CO2 and water mist systems optional.

Condensed aerosol fire suppression is a particle-based form of fire extinction similar to gaseous fire suppression or dry chemical fire extinction. The aerosol employs a fire extinguishing agent consisting of fine solid particles and gaseous matter to extinguish fires. The condensed aerosol microparticles and effluent gases are generated by the exothermic reaction; until discharged from the device, the particles remain in vapor state. They are cooled and "condensed" within the device and discharged as solid particles.

GT43 is equipped with three aerosol generators installed on enclosure roof to protect the gas turbine package. The aerosol devices are self-contained and function as both a storage container and as a nozzle that propels the gas, therefore no distribution network is required to transport or distribute the fire-extinguishing agent from a remote storage location. The system is configured with two combustible gas detectors, two heat detectors and 2 IR flame detectors.

Noise

GT43 package is designed with best engineering practices order to reduce operating sound levels as much as practical.

The typical acoustic profile target during running operation is:

- Logarithmic average sound pressure level at 25 ft from the trailer unit perimeter, at 6 ft elevation from ground level, around the whole trailer; less than 90 dBA

The average 90 dBA @ 25ft sound pressure level is based on free-field condition over reflecting plane and with only one GT43 in operation.

Enclosure

The enclosure is a completely enclosed, weatherproof, and sound-attenuated system that provides protection for the gas turbine and its auxiliaries. The enclosure is mounted on the trailer and supported by the trailer frame. The enclosure sides include removable panels and/or doors to allow access to major components for inspection and maintenance and to permit removal of components by forklift or overhead crane.

The engine area is furnished with hinged doors to facilitate engine removal from the side of the package. There is a removable partition between the turbine engine area and the generator area for temperature control and operating zone safety. The generator area is accessible through side doors on each side. The entire engine / generator enclosure is removable along with the air intake section to enable major overhaul service. The E-house is separate and removable at the rear of the unit.

Miscellaneous

- A fuel conditioning skid may be required depending on the composition and condition of the fuel gas being used. Dragon Products can provide guidance; however, fuel conditioning is not included in this offer.

Testing

Factory testing is in accordance with Dragon Products test specifications and as outlined below.

The customer or customer's designated representative can observe factory production tests listed in the production and testing schedules. However, production tests will not be delayed due to the unavailability of the customer or customer's representative. The production test facilities provide a comprehensive test program using simulators to perform static testing of package systems to verify control, system operation, and component calibration. Engine test cells feature a computerized real-time data acquisition system that collects digital and analog data from the engine during acceptance testing to facilitate a comprehensive test report.